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Innovation in ultra-peripheral regions: The case of Finnmark and rural areas in Norway

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Preface

This report is prepared as a chapter in Bjørn T. Asheim and Keith Smith (eds.): *Regional innovation systems, regional networks and regional policy*. (Edward Elgar, forthcoming.) An earlier version of the paper was presented at the European Urban and Regional Research Network (EURRN) Conference on 'Regional Frontiers' in Frankfurt (Oder), September 20-23, 1997.

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Abstract

This paper explores geographical variations in innovation activity in Norwegian manufacturing industry, and examines in particular the characteristics of innovation activity in the most peripheral parts of the country. This is an important topic when innovation is regarded as a territorial phenomenon: The innovation process is in part based on resources that are location-specific - resources which are tied to particular places and cannot easily be transferred or reproduced elsewhere. Thus, innovation is generated differently in different regions, depending on the firm and industry structure, the composition of the regional innovation system, as well as on varying social and cultural conditions.

It is essential to understand the way in which innovations occur in different regions, in order to develop a regional innovation policy tailored to suit varying local conditions. In the Norwegian context it is a special challenge to develop innovation policy for *ultra-peripheral* regions. This paper uses Finnmark, the most northern county in Norway, as an example of this kind of region. The paper explores strong and weak parts of the innovation system in Finnmark, and suggests innovation policy initiatives suited for ultra-peripheral regions. As an introduction to the Finnmark study, we first expose some key features of the pattern of geographical variation in innovation activity in Norway as a whole.

Keywords: Innovation; system; network; region; policy; Finnmark; Norway.

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Innovation in ultra-peripheral regions: The case of Finnmark and rural areas in Norway

1. Innovation theory and the regional dimension

1.1. Innovation theory

The empirical studies reported in this paper are based on data from a national survey and data from a specially designed innovation survey for Finnmark. Before detailing some of the main results from these surveys, we give a brief sketch of the theoretical foundation underlying these kinds of regional innovation analyses. We regard innovation as a *non-linear process*, involving activities other than formal R&D. These activities include product design, trial production and production start-up, the purchase of patents and licenses, market research and investments - in new machinery, for instance (Nås et. al. 1994). With the increasing complexity of innovation processes, it is not only the internal innovation activities of firms that are manifold and interlinked. The complexity of the innovation process has given rise to the idea of systems or network models for understanding the process of innovation (see for example Lundvall 1992). Innovation (and the spread of new technology) is a complex interactive and collective process in which communication, cooperation and coordination of different actors involved are necessary for generating and spreading new products and processes (Kline and Rosenberg 1986).

Innovation often happens in cooperation between firms and different actors, and the term *innovation system* is used to describe those actors that decide a firm's, a region's or a nation's innovative capability. The innovation system consists of both a production structure (a techno-economic structure), an institutional infrastructure (a political-institutional structure) and the interaction between the two. The actors in the innovation system differ between industries and countries. There are various components and linkages within such systems, including other firms (customers, suppliers, etc.), educational institutions and research laboratories (sources of skilled labour and knowledge), government agencies (sources of financing, regulatory

constraints and support for innovation), financial institutions (such as banks or venture capitalists), and other providers of business services. Systems models of innovation are becoming increasingly influential in innovation studies (see for example Lundvall 1992, Tötling 1994).

The central point deriving from the systems approach is that innovation is a process of *interactive learning*. The process of learning is highly dependent on interaction between a multitude of persons and milieus. This multitude is also related to differences in work experiences and access to knowledge. Innovation presupposes that such diversities are bridged: Knowledge is created in a collective and cumulative process (Lazonick and O'Sullivan 1998.) The uncertainty of the innovation process and the importance of learning mean that complex communication must take place between the parties involved. Innovation demands coordination of both technological and economic activities in firms.

The innovation process is understood not only as a technical but also a *social* process. Innovation can only take place in extended and close cooperation between people, both within firms and other institutions, and between them. This kind of cooperation is likely to require mutual trust and understanding. Further, innovation and technological change are created from already existing knowledge and skills, and develop along specific paths. Knowledge and skills are found partly in local institutions and business environments, which can lead to the development of regional paths for innovation development (Tödtling 1994). "This implies that technological innovation...is increasingly a product of social innovation, a process happening both at the intra-regional level in the form of collective learning processes, and through inter-regional linkages facilitating the firm's access to different, though localised, innovation capabilities" (Camagni 1991).

1.2. The regional aspect of innovation

Innovative activity is presumed to be widespread, and regional conditions are seen as having greater bearing on the innovation process. Regional conditions are viewed as "contributor[s] to the creation of technology" (Courlet and Soulage, 1995: 293).

Innovation is encouraged when firms are located close to each other. Prolonged, direct and close cooperation between different actors is necessary for the successful development of complex and specialised products or processes, and this is achieved most easily when there are short distances between firms. These relationships can further be seen to provide external economies that can be exploited in the provision of innovation services and support. Regional innovation systems should therefore be seen as possible instruments for promoting innovative activity and - thereby - firms' competitiveness. This is especially the case for small and medium sized firms.

Proximity ensures that people are able to meet frequently and quickly, and that actors have similar cultural backgrounds. Extensive cooperation between firms requires a degree of loyalty, as well as mutual respect and trust, which develop over time (Lundvall and Johnson 1995). Mutual trust is encouraged and uncertainties diminished when actors are familiar with the same informal rules and practices of cooperation. These informal rules and institutions are often the result of long historical processes in specific areas, and can therefore be specific to certain geographical areas. These are *untraded interdependencies* between actors (Storper 1995). This refers to the fact that mutual trust cannot be purchased, but is essential for cooperation that leads to technological and organisational learning. The concept *untraded interdependencies* is equivalent to Maillat's (1995) term *atmospheric externalities*, which originate in a common technological culture where there is a highly mobile labour market. This facilitates the exchange of knowledge and makes it easier also to establish contacts and exchange information between persons and firms in an area.

When smaller and incremental innovations are accorded greater importance, knowledge and learning become important factors in the innovation process. Lundvall and Johnson (1995) thus see knowledge as the fundamental resource of the economy and learning as the most important process. "The economy as a whole... is 'learning by doing' and 'learning by using'" (Lundvall and Johnson 1995: 26).

To a significant extent knowledge is embodied in machines and components, or can be sold in the form of patents. However, much important knowledge remains *tacit*, that is, it is not communicated directly - in codified form - through speech or writing.

People possess this knowledge, and pass it on through informal teaching at the workplace and in the local community. "Important elements of tacit knowledge are collective rather than individual" (Lundvall and Johnson 1995: 30). Often these skills have been built up through many years of experience with a particular production process in an area. These skills include the ability to introduce frequent, small changes to products and processes to solve production problems as well as to develop efficient ways of producing new products. Engineers, technicians and skilled workers usually develop these kinds of incremental innovation within the production process (Freeman 1995).

In those cases where incremental innovations are considered decisive to firms' competitiveness and survival, the significance of tacit and local knowledge increases. Autonomous R&D is considered to be less important than in the linear innovation model, where it is thought that innovations are largely developed in the R&D departments of large companies. However, R&D capabilities and systematic research and development remain decisive to radical innovation, although in these cases too, contact with clients and suppliers remains vitally important.

The specific regional conditions that can spur and support innovative activity are thus:

1. The presence of collective tacit knowledge, often developed through long-term experience with a production process, but also local R&D capabilities.
2. The presence of mutual trust, which encourages cooperation on innovation, both within and between firms and institutions.

The innovation survey in Finnmark collected information about specific regional factors both encouraging and restraining innovation activity in manufacturing firms in the county. As indicated, these factors may relate to the firms themselves, to the operating of the regional innovation system (or lack of such a system), as well as to 'soft' factors such as degree and possibility of cooperation, and the existence of formal and informal knowledge-bases.

2. Geographical variations in innovation

To what extent does innovation activity differ between Norwegian regions, and what can explain the differences? What are the most and least innovative parts of the

country? These questions are answered by the use of a national survey (the Community Innovation Survey in Norway), where we focus on two indicators: (1) the total innovation costs of firms in 1992, and (2) the share of sales accounted for by products that are new or were significantly altered during the three-year period 1990-92. The first indicator gives a measure of the innovation *inputs* of firms, measuring the degree to which firms invest in innovation. The second indicator provides us with a measure of the *results* of innovative activity.

The national innovation survey incorporates responses from nearly 1000 firms. Almost 60% of the firms that responded to the question on innovation costs reported no such costs for 1992. The share of innovative firms is further reduced when we measure the results of innovative activity; the share of turnover accounted for by new or significantly altered products. In 1992, 23% of the firms that responded had products that had been developed or significantly altered during the three-year period 1990-92. Thus, the overwhelming majority of firms were non-innovative according to this indicator.

2.1. The share of innovative firms

The percentage of innovative firms varies greatly between different parts of the country. With some exceptions, table 1 shows a basic centre-periphery pattern. Looking first at the share of firms recording innovation costs, this is largest in Trøndelag, the Oslo region and in the south-east part of the country. The north-west and Northern Norway clearly have the smallest shares. The picture changes somewhat when we look at firms with high innovation costs (where innovation costs account for 10% or more of turnover). There were only 73 such firms in the survey. The south-east and south-west had the largest number of such firms, with Northern Norway having the least.

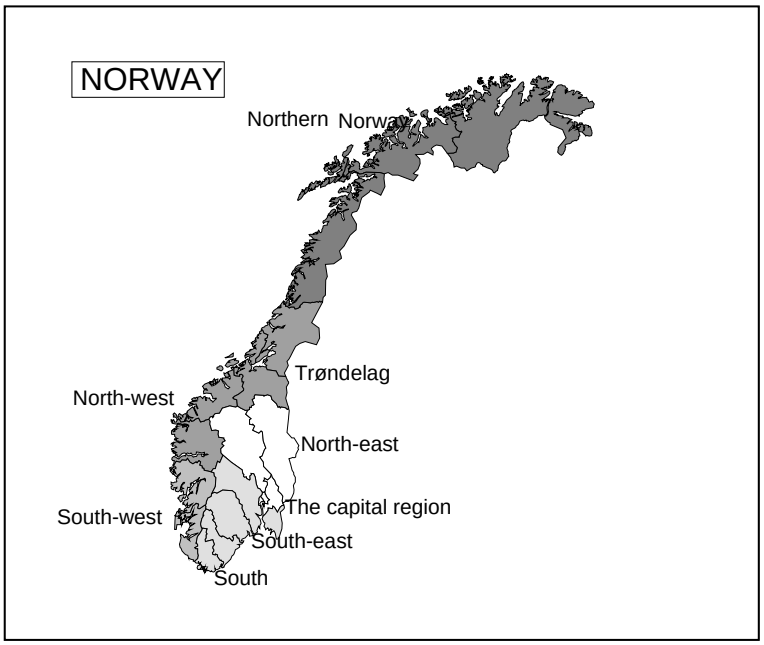
Table 1: Share of innovative firms in different parts of the country in 1992

Part of the country	Number of firms*	Share of firms with innovation costs	Share of firms with large innovation costs**	Share of firms with new/altered products ***
The Oslo region	151	49,7	7,3	27,2
North-east	66	37,8	6,1	23,2
South-east	210	46,2	9,5	23,0
South	77	39,0	5,2	17,3
South-west	175	41,1	9,7	22,3
North-west	96	34,4	6,3	24,5
Trøndelag	58	50,0	5,2	19,4
Northern Norway	84	34,5	3,4	18,9
Norway	926	42,4	7,9	22,9

* Refers to number of firms with innovation costs.
** Firms where innovation costs amount to at least 10% of turnover.
*** Share of firms with new or significantly altered products during the period 1990-92 in sale.

Figure 1 (below) shows the share of firms recording innovation costs for each of the counties. The figure confirms the impression given by table 1 of a basic centre-periphery pattern with some exceptions. The counties near the Oslo fjord (Østfold, Oslo, Akershus and Buskerud) have high levels of innovative firms. Further, Rogaland has a greater share of innovative firms than the national average, whilst more peripheral counties such as Hedmark, Sogn og Fjordane, Troms and *Finnmark* have the smallest share of firms with innovation costs. The main exception to the centre-periphery pattern is Nord-Trøndelag, which has a large share of innovative firms. The large share displayed for the Trøndelag region as a whole is thus due to the figures for the more rural Nord-Trøndelag, not Sør-Trøndelag with the large city of Trondheim.

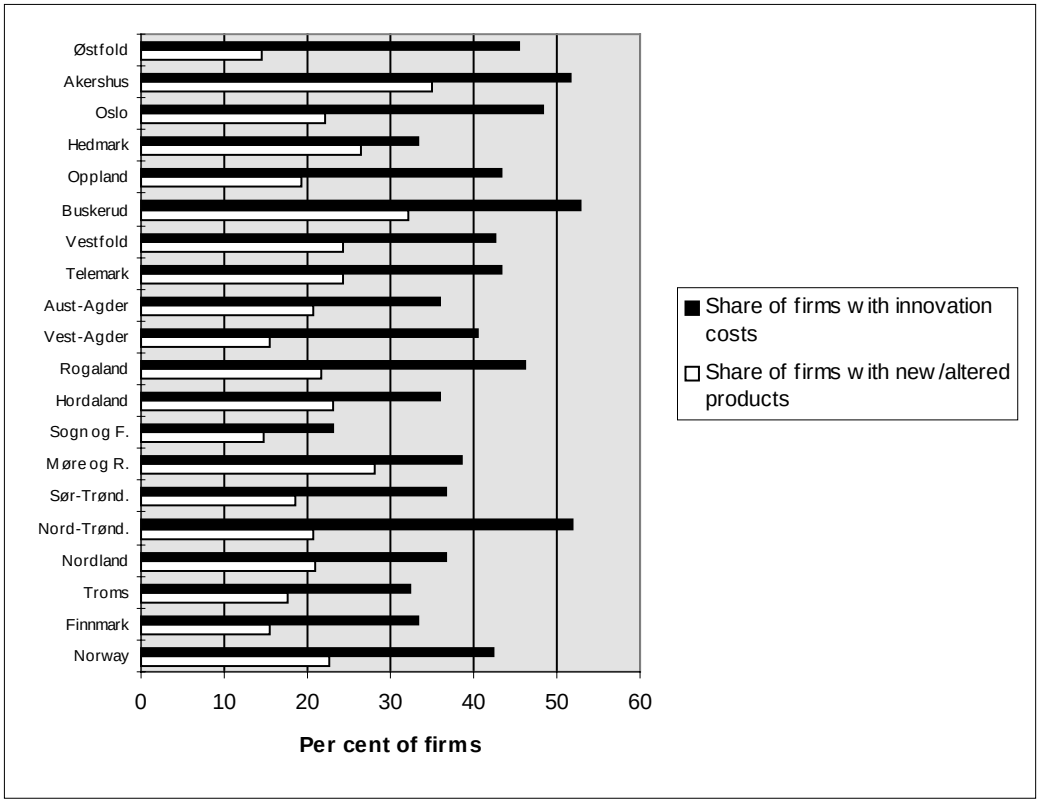
Map 1: The location of parts of the country in Norway



When we examine the rates for the second indicator, that is, the share of firms selling new or significantly altered products; the capital region has the highest rate of innovative firms (table 1). The north-west ranks second amongst the parts of the country. Figure 1 displays that the relatively high rates in these two areas are due to high figures in the counties Akershus, surrounding the capital, and Møre og Romsdal, with a relatively large number of manufacturing jobs. Oslo has a rate equal to the average for the country as a whole, while Sogn og Fjordane in the north-west has a clearly lower rate. Møre og Romsdal thus has a lower rate of firms with innovation costs than the country average, but a higher share of firms with new or significantly altered products.

Many of the other counties in Eastern Norway, as well as Rogaland and Hordaland in the south-west have above average or average shares of firms with new or significantly altered products. Østfold, Vest-Agder, Sogn og Fjordane and Finnmark, with traditional manufacturing industries or peripheral location, display the lowest values according to this indicator.

Figure 1. Share of innovative firms in the counties in 1992



2.2 Innovative firms according to area-types

Parts of the country and counties are heterogeneous entities, incorporating both urban and rural areas. We have therefore examined geographical variations by use of other area categorisations that emphasise urban-rural differences. Table 2 shows the situation in five different types of areas. *City-centres* and *city surroundings* have the highest shares of firms with innovation costs. However, the rural areas alone are distinguished for having a particularly low share. Communes of this type dominate the region of Finnmark. Out of 19 communes in Finnmark 16 are found in rural areas and 3 are found in smaller towns. Smaller towns have high levels of firms with innovation costs compared to the average for the country as a whole, and this area type also has the highest level of firms with large innovation costs compared to all other area types. Thus we find that there is an even spread of innovative firms throughout all area types, with the exception of the most peripheral areas. However, we must underline that firms with innovation costs are also to be found in the most peripheral parts of Norway.

The same centre-periphery pattern emerges when we chart the share of firms with new or significantly altered products according to area type (table 2). City surroundings have the highest share, with city centres in second place. Rural areas have the lowest score according to this indicator also.

Table 2: Share of innovative manufacturing firms in five area-types, 1992.

Area-types	Number of firms*	Number of firms with innovation costs	Number of firms with large innovation costs**	Number of firms with new/altered products***
City centres	213	45,5	9,4	23,0
City surroundings	242	46,7	9,1	27,1
Medium sized towns	251	43,4	6,7	21,8
Smaller towns	67	43,3	11,9	21,9
Rural areas	148	27,0	4,7	17,9
Norway	926	42,4	7,9	22,9

* Refers to number of firms with innovation costs.
** Firms where innovation costs amount to at least 10% of turn over .
*** Share of firms with new or significantly altered products during the period 1990-92 in sale.

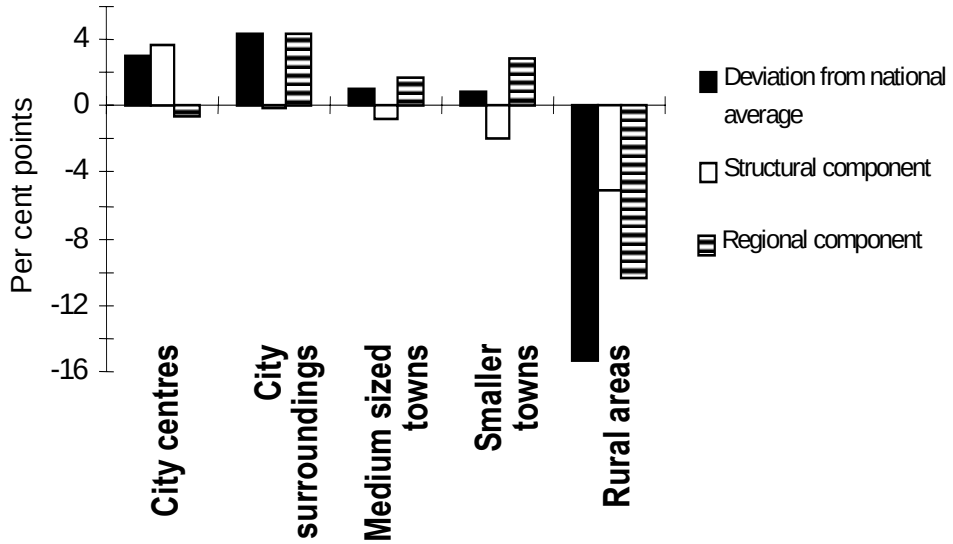
2.3 Causes of regional variation; shift-share analysis

The geographical variations in the shares of innovative firms can in principle be explained by structural and regional factors. The *structural component* refers to the different industrial and firm structures of the areas. The share of innovative firms varies widely between different manufacturing sectors, and there is a higher share of innovative firms among large firms than among small ones (Nås et. al. 1994). A given area may have a high share of innovative firms because of a favourable "structure"; the area then has a relatively high number of firms in innovative industries (industries with a large share of innovative firms) and/or the area has a high number of large firms. In contrast, a low level of innovative firms may reflect the fact that the area has few firms in innovative sectors and/or many small firms.

What we call the *regional component* is a residual factor, which shows that aspect of geographical variation that cannot be attributed to differing industrial and firm structure. The regional component thus measures the geographical variations in the shares of innovative firms *within* different industries and size-categories of firms.

The starting point for calculating structural and regional components is the difference between the share of innovative firms in an area and the national average. Figure 2 shows the difference between the share of firms with innovation costs in the five area types, and the country as a whole (black columns). As already demonstrated (table 2), the rural areas have significantly lower shares of innovative firms than the national average, whilst the four remaining area types have slightly above average shares. Using a shift-share analysis we can establish to what extent the difference can be explained by the structural component (as defined above), and how much of it is to be explained by the regional component. Industrial structure alone is taken into account when calculating the structural component in figure 2.

Figure 2: Share of firms with innovation costs 1992. Shift-share analysis by industrial structure



Rural areas have an approximately 15 percent point smaller share of firms with innovation costs than the national average. The structural component can "explain" a third (5 percent point) of this difference (figure 2). The rural areas have a negative structural component, as there is a relatively large number of firms in many industries with low levels of innovation nation-wide. This is particularly true in certain industries, such as the food products, wood products, furniture, and transport equipment industries. Further, rural areas have a significant negative regional

component, which shows that the individual industrial sectors generally have fewer innovative firms in these areas than is the case for the nation as a whole. Thus the rural areas face a double problem: These areas have much of their manufacturing firms in sectors that are less innovative, and they have relatively few innovative firms within the various sectors.

The smaller towns also display a negative structural component, as they have a relatively large number of firms in the same sectors as rural areas. However this negative component is outweighed by a positive regional component. On the whole, smaller towns have relatively higher numbers of innovative firms within the various sectors than the national average. Smaller towns, thus, have a somewhat greater share of innovative firms than the national average despite an unfavourable business structure.

The only area type that displays a positive structural component is *city centres*. This reflects the fact that city centres in Norway have a relatively large number of firms in innovative sectors such as oil extraction, chemicals, and machinery. City centres have a small, negative regional component, which reflects that firms in the six city-communes are not particularly innovative compared to the national average. The high shares of innovative firms found in city centres reflect that these areas contain many firms in innovative sectors and *not* that firms are particularly innovative, when we adjust for industry structure. However, city surroundings have a positive regional component, reflecting the relatively high number of innovative firms found within the individual sectors in these areas.

3. The specificities of the innovation system in Finnmark

3.1. The regional survey of Finnmark

The most rural area-type reveals the lowest innovation activity according to the national survey. To get a deeper understanding of innovation processes in this kind of regions, we now focus on innovation activity in one selected county, namely Finnmark, which is the most peripheral county in Norway. Since the national survey on Norwegian manufacturing innovation contains information on only 12 firms from

this county, supplementary surveys are necessary. The present paper therefore includes results from a regional innovation study of Finnmark, based on empirical evidence from a questionnaire based regional survey and from in-depth interviews with firms and institutions in the region (cf. the appendix). The regional study of Finnmark explores and exemplifies findings from the national survey. The rationale for focusing on such an ultra-peripheral region, operating in traditional resource-based manufacturing industries, is to get a better understanding of how innovation activity is undertaken in scarcely populated, economically and technologically less-developed regions. This in contrast to most of the innovation literature, where emphasis tend to be on core growth regions that have had great success as innovation systems.

The greatest proportion of the workforce in Finnmark is employed in the public sector and the social and private service sector. The number of people employed in the primary sector has decreased drastically during recent decades, and now accounts for only 8% of the workforce. Manufacturing industry in the region is dominated by traditional resource based industries, which are now in a period of revitalisation after major crisis in the 1980s. The region's unemployment rate - traditionally one of the highest in Norway - is at the end of the 1990s more or less on the level of the national average. Finnmark had the lowest gross value added in Norway in the period from 1986 until 1990. Few patents are registered in Finnmark. (During 1992 only one new patent was registered.)

The share of employees with higher education in Finnmark is only slightly below the national average, but the traditional industries find it difficult to recruit young graduates. Most of the students finishing the regional college find positions in the public sector, apparently seeking job security.

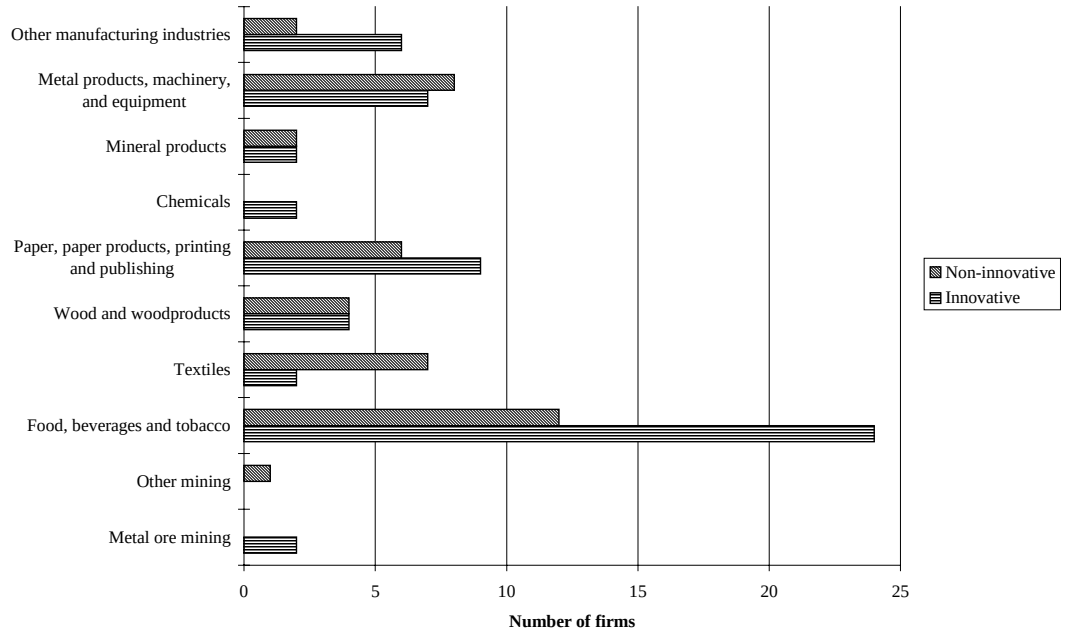
The Finnmark county council faces great challenges in its effort to stimulate development and foster growth in the regional economy. The county of Finnmark can not be called a successful region in Norway, but there are sub-regions and industries that are very successful.

We showed in part 3 that innovative activity varies between regions, even when adjustments are made for industry and firm structure. Peripheral, rural areas such as

Finnmark have low shares of innovative manufacturing firms. Regional policy in a particular area requires detailed information about local industry and innovative activity, and we will in the following analyse factors related to innovative activity in manufacturing firms in Finnmark.

In the Finnmark survey, 58% of the firms responded that they had been engaged in product- or process development the last three years. The number of innovative firms is greater than the number of non-innovative firms in three industries, namely in *food, beverages and tobacco* (which is dominated by the fish industry), in *paper, paper products etc.*, and in *other manufacturing industries* (figure 3). Another industry with a high proportion of innovative firms is *metal products, machinery and equipment*. While the next section focuses on innovative firms, one must bear in mind the kind of industries that actually dominate in the data.

Figure 3. Number of innovative and non-innovative firms in the sample (N=100)



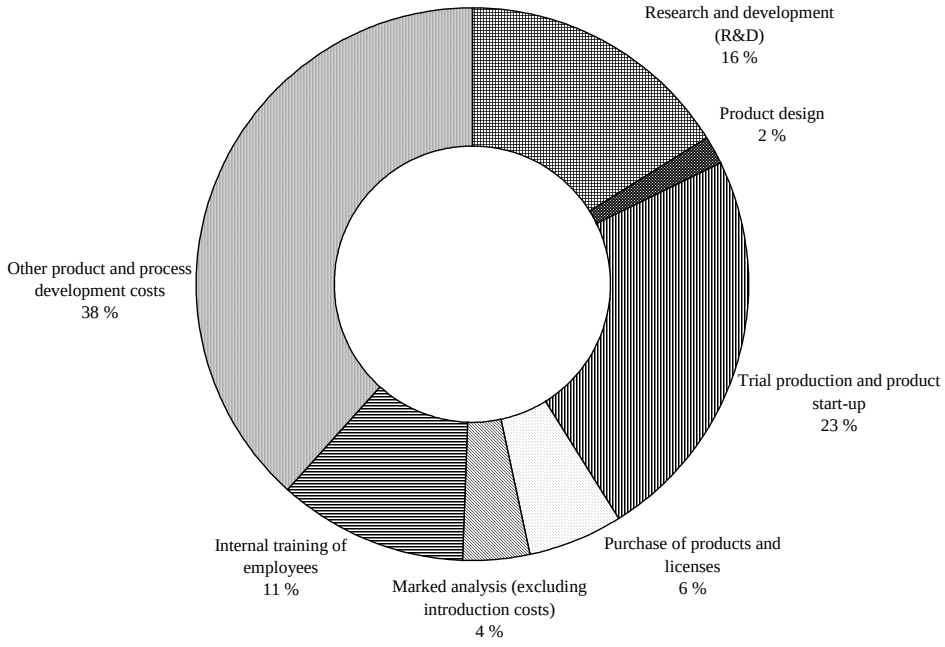
3.2. Innovation costs and innovation inputs

Innovation is a highly differentiated and heterogeneous activity, taking different forms and involving different activities. This section will look at firms' innovation costs, how it is distributed over different innovation activities and how the innovation activity differs between firms.

The average innovation cost intensity for the sample is 11,5%. When looking at size categories we find that the innovation cost intensity varies between firm size, actually being higher for firms with less then 49 employees, than for larger firms. Smaller firms have higher input (as share of turnover) in the innovation process than larger firms, however the proportion of smaller firms with innovation cost is much smaller.

Trial production and production start-up is the most important cost component in the Finnmark survey (besides *other costs*, cf. figure 4).

Figure 4: Distribution of total innovation costs (N=56)



The share of R&D is 16%, which is a much lower share than the average in the national innovation survey (34,4%). This is explained by the fact that the national survey covers mostly large firms (only 12% of the firms have fewer than 20 employees), and generally larger firms have larger R&D activity than smaller firms. In the Finnmark survey 56% of the firms have less then 10 employees. The national survey also reveals that R&D-costs differ between area types. In the Oslo region almost half of total innovation costs are related to R&D; the highest share in the country. In less central parts of the country R&D costs are far below the national average.

Firms in Finnmark use 11% of their innovation costs on internal training of employees. Because of constant development and increasing use of information technology in different production processes (especially within the fishing industry where there has been a remarkable development over the last years) firms must engage in internal training of employees. This is especially important in times of rapid technological change when skills tend to become obsolete (Lee and Has 1995). Training of employees is an important factor for the employees' own development and is a motivation factor, especially within industries dominated by repetitive routines.

Only 4% of the innovation costs are used on market analysis. Interviews with firms revealed problems with market contacts due to large distance to major markets, and lack of internal strategies towards new markets. Firms tend to be more occupied with resources and production constraints than the market side of the chain. There seems to be a lack of emphasis on marketing, even though studies show that greater contact with the market stimulates internal development processes in enterprises, as well as demand for external assistance to build up competence (Onsager and Eikeland 1992).

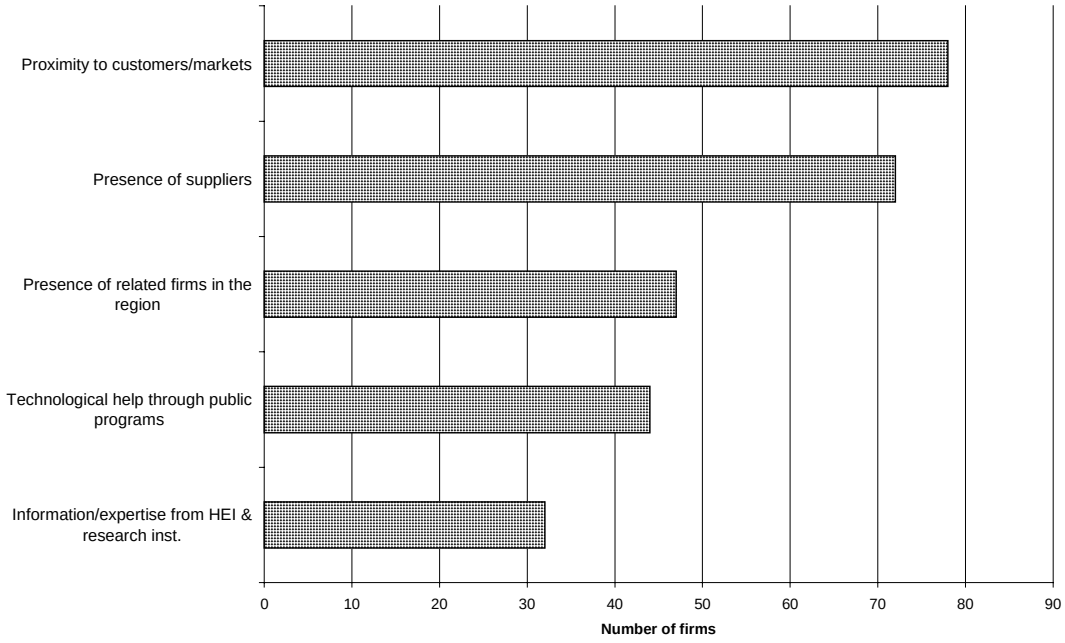
The fact that 38% of the innovation costs is categorised as *other product and process development costs* surely indicates that we still have more to learn about what kinds of activities are important in firms' innovation process. However, this also indicates that the innovation may be a result of an evolutionary learning process (learning by doing). Interviews with firms in Finnmark confirm that many innovations are incremental, with a high degree of adaptation of machines from related industries. Much developmental effort is targeted on adjusting new machines and techniques to the firms' own needs. (A fish-processing firm, for example, had adapted and implemented machines found in the chicken industry in Denmark and in the local dairy.)

3.3 Sources of information and expertise

Firms employ a variety of external sources of information and expertise to sustain the innovation process and the learning process that is an integral part of innovation. This section puts particular emphasis on the region as a source of information and

expertise for innovative activity in firms. Focusing on these external regional factors can help us to understand the dynamics of a region, and what makes it a locational option for firms.

Figure 5. Number of firms perceiving factors as important for own competitiveness (N=99)



As much as 78 (out of 99) firms in the survey consider proximity to markets to be an important (medium important and very important) regional factor for their ability to compete, and therefore a very important source of information and input in their innovation processes (figure 5).

The presence of suppliers is also one of the most important factors for firms in the survey, more than 70% of the firms emphasised this. Especially innovative firms see this as an important factor, suggesting that suppliers might be a more important locational factor for innovative firms than for non-innovating ones.

Presence of related firms in the region is of less importance for firms in Finnmark. This might indicate that related (competitive) firms in the region do not have many interactions (lack of horizontal integration). This can be due to a fear of loss of new technology or ideas, or simply that related firms have different specialisations. The firms may however have contact with related firms outside the region.

Regional infrastructural resources that are commonly regarded as important for firms (such as higher education institutions and research institutions), are not generally perceived as important by firms themselves. As many as 59% of the firms see information from these institutions as *least important* for their activity, indicating little contact between most firms and higher education/research institutions. The few firms that attached importance to information/expertise from such institutions are mostly innovative firms. Through interviews with some firms and with the regional research institution in Finnmark (*Finnmarksforskning*), different aspects of the relation between firms and the research institutes interaction were investigated.

From these investigations result that firms interested in joint projects with higher education and research institutions often lack the capital needed to start projects. Funding of projects is mostly public, and often gained through initiatives launched by the research institute. The contact established between the firms and the research institution seems to last even after the end of the project. This indicates that firms need to be motivated to join research projects, both by getting public funding and by getting ideas for research projects from the research institutions. There seems to be no 'spontaneous' link between the two.

Regional research institutions seldom have the capacity to cover all research-fields needed by the industry in the region. In particular, parts of the fishing industry lack contacts to R&D institutions with relevant experience - despite the fact that this is the largest industry in the county. Interviews with managers in the fishing industry indicate that they had no contact with higher education nor research institutions in Finnmark, apparently due to the fact that these institutions do not have the expertise that is needed. According to respondents, there are actually no research institutions in the county that have the kind of technical expertise needed for technological development in the fishing industry. Nevertheless, there has been a remarkable development in the industry, in part because managers have relied on their own inventiveness in order to develop new process technology in the firms, often adapting technologies from related industries in other countries. Their sources of information were most often external linkages with foreign suppliers of machinery. *Finnmarksforskning* claims to be aware of the needs of the fishing industry, but have

decided to devote their limited resources to research on fish farming, which is also becoming an important industry in the region.

Regional innovation policy often attempts to link firms to different types of R&D institutions (Isaksen 1995). Such an approach may at first glance seem odd, considering that firms themselves see R&D institutions as least important as a source of information. Regional innovation policy until now has especially aimed at improving those parts of the innovation system made up of national and local R&D institutions and firms. Clients and suppliers, however, are far more important as sources of information in the innovation process than R&D institutions. Thus policy must include all participants in the innovation system, as "networks of relationships... are necessary for firms to innovate" (Freeman 1995: 5). It therefore seems that the interactive or system based innovation model is most in touch with how innovative activity actually takes place in Norwegian manufacturing. The linear innovation model, where R&D form the basis for innovation, hardly seems to conform to the results presented here. However, regional policy should of course be concerned with lack of important links to relevant R&D institutions. These actors may be important in innovation processes in many firms; the reason for firms not using these institutions may be related to barriers both inside firms and in R&D milieus.

3.4 Innovation obstacles

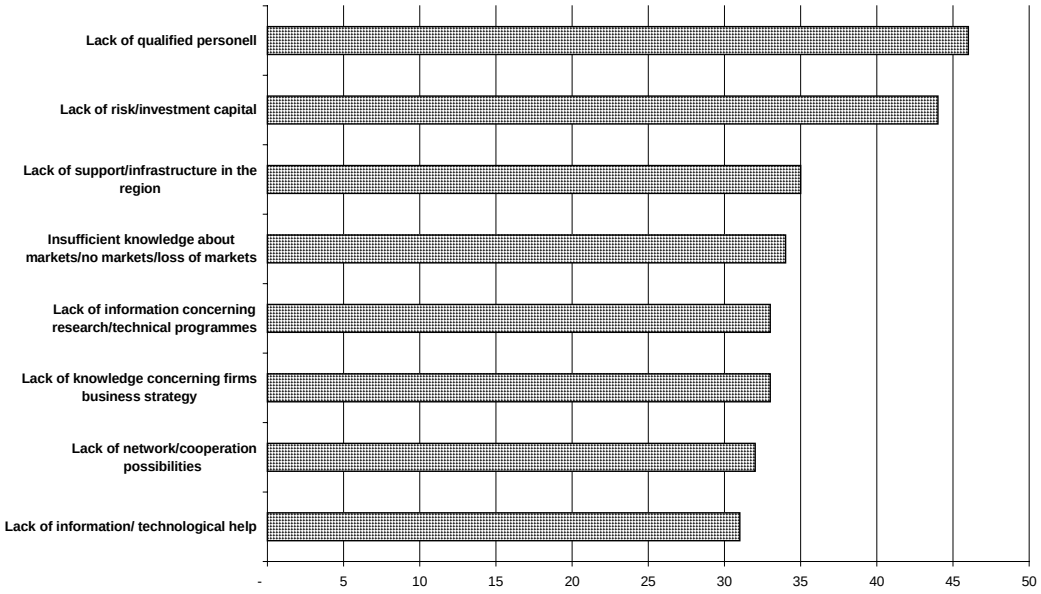
Knowledge about innovation obstacles may be important in the development of regional innovation policy, as one of the main aims of such policy is to help solving problems associated with sub-optimal innovation activity (cf. Nås et. al. 1994). We were interested in finding which factors firms in Finnmark perceived as restrictive (medium and very restrictive) to their innovation process (see figure 6).

Lack of qualified personnel is the factor that the most firms in Finnmark consider an important obstacle to innovation. Limited access to qualified personnel is especially perceived as a limitation by innovative firms. This indicates that these firms demand more know-how, probably due to a modern production process often based on high-tech machinery. There seems to be a particular demand for executives on the 'mid-level', working between the production unit and the management, in firms in the

fishing industry. Such personnel is hard to find, because it needs both practical experiences from the fishing industry, as well as economic and administrative skills. The fishing industry claims there is a need to develop education that could train such executives. Public efforts have been made to attract skilled persons to Finnmark (low taxes, reduction of students loans etc.). Efforts have also been made to forge links between educational institutions and local industry, trying to inform and tempt young people to work in traditional industries.

Lack of risk/investment capital is another significant obstacle for firms' innovation activity in Finnmark. This factor is emphasised especially by firms with less than 10 employees. Small firms dominate and these have limited financial resources, which constrains their product and process development. More than half (53%) of the innovative firms in the county receive public financial support for their innovation activity. The share of financial support varies between 10 and 75% of total innovation costs.

Figure 6: Number of firms and factors regarded as 'restrictive' and 'very restrictive' in product/process innovation (N=97-99)



The Finnmark study also displays that firms see *lack of support/infrastructure in the region* and *lack of information/technical support* as a problem. Turning to more general forms of innovation support, such as information and expertise, there are several institutions of this kind in Finnmark. These institutions may play an important role in stimulating innovativeness, and help local firms finding new technical solutions and new markets. In the survey 10 such local institutions were listed and 62% of the firms had been in contact with one or more of these. In particular small firms had contact with these institutions. A larger share of the innovative firms (65%) had been in contact with the institutions than non-innovative firms (57%). The regional institutions that provide financial support for innovation activities supply firms with information and expertise related to product- and process development as well. These institutions are the regional office of SND, Finnmark County Municipality and the Municipalities. Overall, innovative firms are to a larger extent in contact with these institutions than non-innovative firms, suggesting that the institutions do play a role in firms' innovation activity. The results in Figure 6 indicate, however, needs to further develop the kind of assistance and support supplied by these institutions. Efforts should be made to improve the existing institutions, since local firms already have contact with them.

Innovative firms consider insufficient knowledge about markets as a relatively important factor restricting their innovation potential. As said earlier, firms use only 4% of their total innovation costs on market analysis. Firms also emphasis lack of network/cooperation possibilities as a problem. The survey found that 60% of the firms had some kind of network/collaboration with other firms in Finnmark. Innovative firms collaborate more than non-innovative firms, and larger firms more than smaller firms. Generally, small, non-innovative firms need to cooperate. They often seem to be isolated (Pyke and Sengenberger 1990), and they do lack internal resources (Semlinger 1993). Cooperation may integrate firms and institution in a system, and might encourage development of firms' capabilities regarding innovative activity.

On the background of these empirical findings from the region of Finnmark and some main findings from the national innovation survey, the next section will discuss possible policy initiatives aiming at the rural areas in general, and Finnmark in particular.

4. Regional policy for innovation in Finnmark

In this section, we will sum up some of the main results of the empirical investigation of innovation in Finnmark, and point out some important policy implications. A point of departure for this paper was the need to tailor regional innovation policies to varying regional circumstances. Empirical analysis reveals regional differences in the innovation activity in Norway. However, the national innovation survey reveals a relatively even spread of innovative activity across the country. Nevertheless, there exists a centre-periphery cleavage. The share of innovative manufacturing firms is lowest in the most peripheral areas, and in those areas where the economy is dominated by primary industry. These areas face a double problem. On one side they have a relatively high number of firms in nationally less innovative sectors and a high number of small firms. On the other side these areas have low shares of innovative firms within the individual sectors and size-categories. The opposite is often the case in central areas. These areas have both a favourable industry- and firm structure as

well as a relatively high number of innovative firms within individual industrial sectors and firm size-categories.

The interactive innovation model provides a basis for the interpretation of the empirical results, as it places more emphasis on place-specific, regional factors in the innovation process. The conclusion that there is a wide spread of innovative activity also concurs with other data on regional manufacturing development.

In the regional survey in Finnmark the main findings were that as much as 58% of the firms in the sample do engage in innovation activity. Small firms have a higher innovation cost-intensity than larger firms, and half the firms receive public support for innovation, with the share of support ranging between 10-75% of total innovation costs. The large share of firms receiving public support indicates that in spite of the economic upswing over the last years there is still a need for non-material support. Firms are not able to undertake all innovation effort themselves. The major innovation costs of firms are related to trial production and product start-up, suggesting that incremental innovations are important to the innovation process in this area.

Firms, and in particular small firms, do use regional institutions that offer support for innovation. This may indicate that we are faced with actors that are active in the innovation process but who lack internal resources to draw upon, and therefore demand external assistance to build up competence. How these regional institutions will actually assist firms in their innovation process is not obvious, but we know that firms lacking internal resources look outside the firm for competence. Cooperation with other firms in the region is also looked upon as being important for firms' innovativeness.

Obstacles to innovation include lack of risk/investment capital. There are also restrictive factors related to more specific regional problems, such as lack of support/infrastructure and lack of qualified personnel. The government has made many efforts to attract skilled persons to the region, but have attained only limited results.

The findings from Finnmark reveal that there are obvious deficiencies in this particular regional innovation system, and regional resources need to be restructured before Finnmark can become a balanced regional economy. The creation of regional innovation systems (located around innovative manufacturing firms and local institutions) will often be difficult in areas such as these, because of the weak manufacturing base. Manufacturing firms in Finnmark make little use of regional factors in their innovative activity. There is little horizontal cooperation between competing manufacturing firms in the county, and little contact between firms and regional colleges and research institutions.

Norwegian regional innovation policy has, to a great extent, concentrated on transmitting R&D-competence to small and medium-sized firms in the districts. There is no doubt that this is an important aspect of regional innovation policy, but other types of efforts must supplement this policy. Policy should address current problems associated with the following needs reported by firms:

- Better contact with relevant research milieus
- Access to technical institutions for innovation support
- Closer links between the college in Alta in Finnmark and the Engineering College in Narvik (in the county of Nordland)
- The introduction of new subjects with clear business relevance at the technical colleges in the region
- Better financial support for innovation
- Recruitment of young graduates with relevant background and skills
- Help to overcome network bottlenecks

A concrete proposal put forward to increase innovation in manufacturing industry in Finnmark as a result of the innovation survey concerns the use of regional institutions as *intermediary bodies*. Research institutions and regional authorities should help firms to make contact with relevant national or international research milieus, as well as with firms in other areas. Firms lack information about which milieus they should contact in order to gain information or R&D services. Traditional tools of regional innovation policy thus continue to be relevant for firms in Finnmark.

The remaining proposals aiming at increasing the innovation capacity in Finnmark concern strengthening of the regional college and research system. There is no technical education at college level available in the county. Nor are there any R&D

institutions that are relevant to the fishing industry, which is the dominant sector in the county. However, there are important R&D-institutes (The Norwegian Institute of Fisheries and Aquaculture Ltd.), and there is the University of Tromsø, in the neighbouring county to Finnmark. Thus, it may be as relevant to strengthen the contact between these R&D institutions and local firms, as it is to strengthen the R&D system within Finnmark. The county-border is of little relevance in this context, because firms have access to important R&D competence in Northern Norway, and are likely to take part in a regional innovation system covering particularly the fishing industry in this part of the country.

Both the proposals to strengthen the education and research system in Finnmark, to strengthen the contact to nearby research institutions and to increase the role of regional institutions as intermediary bodies, is in line with traditional innovation policy. Bessant and Rush (1995) emphasise *bridging institutions* as important tools of regional innovation policy. The functions of these institutions are:

1. to assist firms in analysing their situation, i.e. to articulate and define their particular needs in relation to the innovation process;
2. to link firms with external consultants and other institutions that offer the competencies needed by the firm; and
3. to advise firms (small and medium sized in particular) in order to compensate for a lack of knowledge within the firms.

Such *bridging institutions* are similar to the technology and transfer centres in Germany and France (Callon 1995, Koschatzky 1994). These centres provide technological services to small and medium-sized firms. These are services not necessarily based on the latest research findings, but on information that is new and relevant to the specific firms. The centres are run by applied R&D institutes, technical university institutes and in particular by technical colleges. Management of the centres is handled jointly by regional authorities and companies.

Finnmark appears to lack the kind of institutions that could run this kind of technology centre. However, the Innovation and New Technology Programme for Northern Norway (the NT Programme) does act as a bridging institution to some extent. This programme gives financial support to product and process development as well as market development in Finnmark and the two other counties in Northern

Norway (Isaksen et. al. 1996). The programme helps to strengthen cooperation between firms and R&D institutions, both in Northern Norway and outside this region, as well as with other centres of competence through a system of *technological advisory contracts*. Moreover, the programme aims to act as a proactive mentor for the innovation process inside firms, providing all-round support (such as assistance with project organisation, strategy development and market research), and having long-term relations with their target group of the most innovative firms in Northern Norway.

In addition to the lack of technological and market information, manufacturing firms in Finnmark have difficulties in attracting qualified personnel. We propose to address these problems using traditional regional policy tools, such as support through the Norwegian Industrial and Regional Development Fund (SND), the NT Programme, and placement arrangements for engineers and economists (Arbo 1993).

Policy suggestions for more *central* regions of Norway will in many respects differ from those suggested above. Firstly, there often exists a broader industrial base in these regions, where firms have higher levels of innovative activity. The most important input into the innovation process may be systematic R&D, and the innovation activity is often directed towards more radical innovations. Norwegian R&D institutes are to a high degree localised in central areas, and it may therefore be important to stimulate interactions between such institutions and firms. Technology parks that can increase contact between research and business and are concerned with the commercialisation of new research results, could be a viable solution for these types of areas. Encouraging spin-offs from R&D institutions may be another relevant policy initiative for this type of area.

Appendix: The two sets of data used

The Appendix briefly outlines the two sets of data material used in the national survey of manufacturing innovation in Norway and in the regional survey of Finnmark.

The national innovation survey

The starting point for the analyses of regional variation in innovative activity is the Community Innovation Survey for Norway, carried out by Statistics Norway in 1993. This survey investigated innovative activity in Norwegian manufacturing. The results have previously been analysed and presented (Nås et. al. 1994), although for Norway as a whole. In contrast we here use the data to describe aspects of the *geographical dimension* of innovative activity in Norwegian manufacturing.

The survey collected background information on Norwegian firms in addition to a series of data on the innovation process. The paper uses two main types of data from the national survey; firstly, data concerning the extent of innovative activity, secondly data on different aspects of carrying out innovative activity.

The national survey took the form of postal questionnaires to a representative selection of Norwegian manufacturing firms. Selection was made randomly from different categories based on firm size. The study had a 52% response rate, in all 986 firms. The response rate was distributed relatively evenly across the size-categories.

The original selection process did not attempt to select a geographically spread selection of firms, yet we find that firms are fairly evenly distributed across parts of the country (table A.1). The south-east is over-represented, while some - more peripheral - parts of the country have a lower share of firms in the innovation survey compared with their share of all firms in manufacturing and mining.

The regional unevenness in distribution is likely due to the fact that the survey has a greater rate of coverage for large firms than small ones. The survey includes over half of all Norwegian manufacturing and mining firms with more than 100 employees, but only 12% of firms with fewer than 20 employees (Nås et. al. 1994). This unevenness in the coverage of size-categories leads to uneven coverage of geographical areas. As there are relatively greater numbers of large firms in central areas, these areas are likely to be somewhat over-represented in the national study. In contrast, peripheral areas may be somewhat under-represented.

Proportions of employees in the different parts of the country are also unevenly distributed amongst the survey respondents. The capital region and the south-west have approximately 10 percent more employees in the response-group than the average for all firms in manufacturing and mining (Table A.1). This underlines the fact that these areas have a higher share of large companies.

In the analyses presented in this paper each firm is represented equally, irrespective of size. For example, we map the share of innovative firms for different areas. In such cases, it will not matter if a firm has 2 employees or 200. Thus the uneven distribution of number of employees will have no direct bearing on the results. We are here interested in the geographical spread of firms, and the firms in the response group are fairly "correctly" distributed between the different parts of the country.

Table A.1: Share of firms and employees in different parts of the country

Part of the country	Share of firms in manufacturing and mining in 1992	Share of employees in manufacturing and mining in 1992	Share of firms in the Innovation Survey	Share of employees in the Innovation Survey
The capital region	17,2	16,5	15,8	25,3
North-east	9,0	7,4	7,1	3,5
South- east	22,2	22,4	22,7	18,2
South	6,2	6,0	8,5	4,5
South-west	17,4	23,5	18,5	29,5
North west	11,0	10,2	10,6	5,8
Trøndelag	8,1	6,9	7,6	7,2
Northern Norway	8,9	7,0	9,2	6,0
Norway	100,0	100,0	100,0	100,0

Source: Manufacturing Statistics 1992 and the Community Innovation Survey

The regional innovation survey in Finnmark

This survey uses the same definitions and questions on innovation inputs and outputs, and questions related to a range of locational issues, as those used in a study of another region in Norway, namely Møre & Romsdal (Wiig & Wood 1995). The questionnaire used as a background to this report has been slightly modified as a result of our experiences with the Møre & Romsdal survey. These surveys are the first in a series of regional studies in Norway, and might be looked upon as pilot studies for testing out regional indicators. The indicators are taken from related studies in this field.

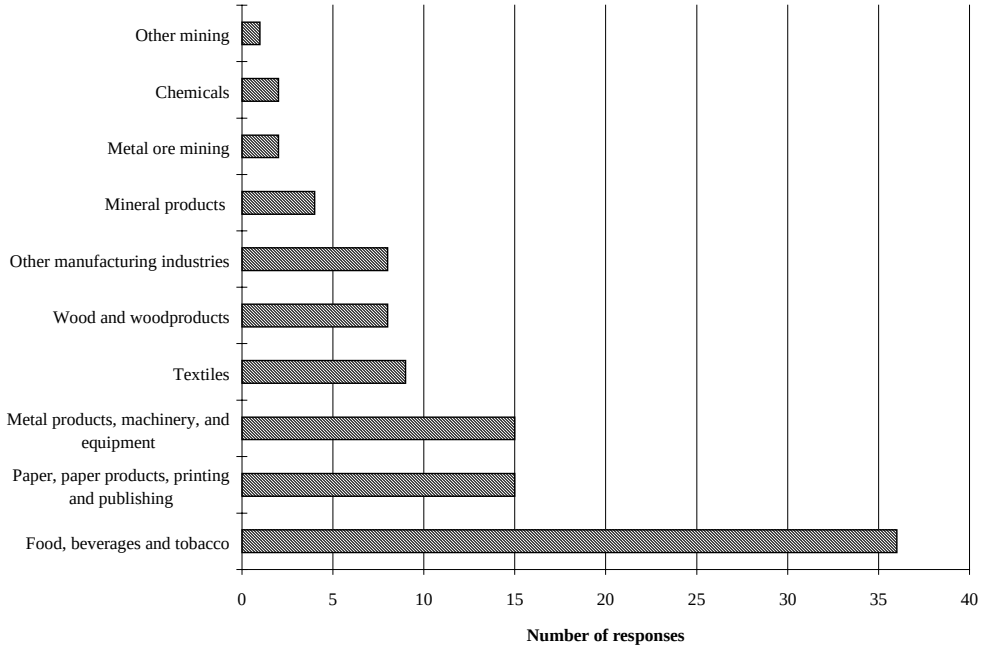
This survey uses definitions and questions on innovation inputs and outputs identical to those used by the Community Innovation Survey. We also adapted the questionnaire to reflect a range of locational issues, such as location of main suppliers and customers, roles of specific regional agencies, importance of specific regional infrastructural institutions and so on.

A postal survey was sent to the gross population of manufacturing firms in Finnmark. We started out with 407 firms. However a large number of firms (approximately 174) were either not relevant (that is, they had been erroneously classified as being involved in manufacturing production), or were impossible to contact, reducing the gross sample to 233 firms. Of this 51 firms declined to respond, and 93 firms we still

had problems with getting hold of. We received a total of 100 responses, a response rate of 43% of the population. A subsequent non-response analysis was carried out with the 51 non-respondents, which suggested that there were no significant differences between respondents and non-respondents. We also carried out interviews with 5 firms in the region; 3 from the fishing industry, 1 in mining and 1 in wood products. We also held interviews with the regional college in Alta, the regional research institution Finnmarksforskning, a consultancy firm and a representative from Finnmark County Council (department of industry). The interviews were structured around key issues related to 'innovation in firms and the importance of the region'.

The number of respondents is divided as shown in figure A.1.

Figure A.1: Number of respondents by industry (N=100)



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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.