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**What Comprises a Regional
Innovation System? An
Empirical Study**

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Preface

Acknowledgements

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Abstract

This paper is based on an empirical study of a region, both as an economic space and an innovation environment; it tests whether the concept of the 'regional innovation system' can be given a quantitative basis. The paper argues that the focus for research on regional innovation should move beyond 'successful' regions and high-technology regions, and accordingly explores innovation activity in a region of mainly 'traditional' industry and relatively peripheral location. A subsidiary aim of the paper is to explore innovation policy issues for regions of this type.

The study is based on a comprehensive survey of innovative activity amongst manufacturing firms in Møre and Romsdal, a coastal region in central Norway. The survey covered all manufacturing firms in the region, collecting data on R&D and non-R&D expenditures on innovation at firm level, and on innovation outputs (measured as proportions of sales deriving from new and improved products). It discusses factors which are perceived by firms as important their innovation activities, and identifies where problems may exist in terms of the economic and technological system in the region. The evidence indicates that although the region is important as a base for firms' commercial activities, and although firms in Møre and Romsdal are innovative, technological links between firms and with other institutions (both within and beyond the region) are limited. There is little evidence to illustrate the existence of a strong 'regional innovation system' in terms of interactions directed specifically towards innovation, and there is some evidence to suggest that strong user-producer interactions in this region do not necessarily favour innovation. The overall agenda of our research was set both in relation to existing empirical and theoretical work in the area of regional innovation systems as well as in relation to current objectives of regional policy in this region and in Norway as a whole. This paper forms part of a wider research project into regional innovation funded by the Ministry of Local Government and Labour (KAD) in Norway, and conducted by the STEP-Group in Oslo.

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1. Introduction

This paper examines the innovation activities of manufacturing firms at a regional level, focusing on the county of Møre and Romsdal in central Norway. A key basis for research into regional innovation systems, exemplified by the great amount of attention this has received, is an awareness of the implications of disparities which exist between regions in terms of economic and technological growth and development¹. By determining what distinguishes growth regions from less-dynamic regions it may be possible to address the problems of those regions with less-developed economic and technological bases, which are often geographically peripheral regions.

The importance of innovation is also reflected in a shift in focus in regional policy away from purely economic issues and toward science and technology concerns². The basic idea here has been expressed as follows by the European Commission:

Regional economic performance depends upon the progressive introduction over time of innovations in products and processes to enhance the competitiveness of the regional economic base in an increasingly competitive world.³

This perspective has also emerged as a key issue arising from regional policy objectives in Norway: as policy makers are increasingly concerned with reducing regional disparities, this focal shift towards science and technology aspects of regional industrial activity is reflected in changes in regional policy objectives⁴.

But, how should science, technology and innovation perspectives be incorporated into the analysis of regional economic performance? One of the key insights of modern innovation theory is that innovation is systemic, in the sense that firm-level innovation processes are generated and sustained by inter-firm relations, and by a wide variety of inter-institutional relationships. Innovation and the creation of technology involve systemic interactions between firms and their environments: central links include those with customers and suppliers, science and technology infrastructures, finance institutions and so on. Such ideas have been central to the 'national innovation systems' literature⁵, which can be extended to the regional case.

¹ CURDS (1987) 'RTD in the less-favoured regions of the Community' STRIDE Final Report, CEC, April 1987; Landabaso, M. (1995) 'The promotion of innovation in Regional Community Policy: lessons and proposals for a Regional Innovation Strategy' Presentation to NISTEP International Workshop on Regional Science and Technology Policy Research RESTPOR '95, Japan, Feb.13-16th 1995

² Logue (1995) 'The Role of Research and Technological Development in the Regions' Presentation to NISTEP International Workshop on Regional Science and Technology Policy Research RESTPOR '95, Japan, Feb.13-16th 1995

³ CEC (1991) 'Four Motors for Europe. An analysis of cross-regional cooperation' Fast Occasional Paper no.241 CEC, DGXII, vol.17

⁴ White Paper (1992-1993) By og land hand i hand (City and district hand in hand) White Paper no.33.

⁵ for example, Lundvall B-Å (1992) (ed.) National Systems of Innovation, Pinter, London; Nelson R. (1993) (ed.) National Innovation Systems, OUP, New York

A major problem, however, is to build an adequate empirical basis for conceptual work focusing on 'regional innovation systems' (see Section 2). Much existing work is marked by the overall lack of comparable and comprehensive empirical evidence⁶, and the absence of a developed theory that might provide a framework for further work in this area⁷. Although these problems highlight major objectives for future work, as part of our research we aim to contribute to a further theoretical and empirical understanding of 'regional innovation systems' and to establish and test a research methodology that may be used in future regional innovation studies. As yet, however, there has been limited empirical evidence concerning regional technological diversities within Norway and existing studies from other countries are often of little relevance for the Norwegian case; mainly because of the special geography (spatially extensive, with many fjords, mountains and rural areas) and industrial base (often 'traditional' sectors) that exists there. Such factors have made it difficult to find directly comparable and comprehensive empirical analysis from other European regions. Accordingly, our survey is based on a structure and approach which has already been widely used to generate harmonised innovation data at national level in Europe, the approach of the so-called *Community Innovation Survey*. Our intention is to use this approach to start mapping differences between regions within Norway and, by developing an understanding of these differences, to suggest more effective and diversified policy measures. This study of Møre and Romsdal provides an initial step in this process.

This paper is structured as follows. First, a brief background of studies of innovation at a regional level is undertaken in order to provide both empirical and conceptual bases for our research on Møre and Romsdal. Following this, an overview of the Møre and Romsdal region is provided, suggesting why it was selected for this study. This is followed by a more analytical discussion of technology-related issues associated with the 'regional innovation system', including an investigation of the region as a base for firms' innovation activities and the actual innovation activities and capabilities of firms located there. Specific regional factors which affect innovation activities of firms are examined. Lastly, a summary and conclusions are drawn from the analysis suggesting possible policy responses. An outline of the research methodology used is given in the appendix.

⁶ Alderman N. and Wood M. (1994) 'Surveys of Regional Innovation? A Feasibility Study for Europe' EIMS Publication no.09, SPRINT, CEC, DGXIII; Higgins T. (1995) 'The Spatial Allocation of S&T Assets and their Management - Measurement Indicators and Evaluation' Presentation to NISTEP International Workshop on Regional Science and Technology Policy Research RESTPOR '95, Japan, Feb.13-16th 1995

⁷ Landabaso, M. (1995) op cit; Higgins (1995) op cit.

2. Studies of innovation at a regional level

2.1 Conceptual and empirical bases

There have been longstanding efforts to understand, in theoretical terms, the economic and technological dynamics of industrial systems operating in particular regions.⁸ The role and importance of geography or locational factors in this often forms a prime focus, where spatial proximity is a key factor in determining the outcome of the activities of firms' activities. This may enable the exploitation of "dynamic relative advantages" of a given territory⁹, arising from synergetic relationships between actors in the 'innovation system' and economies of scale in the provision of innovation services and support. This is emphasised by Storper who states: "Innovation and modification of products and processes rests on an extraordinary complex variety of institutions, social habits, ideologies and expectations, and even firm and market structures are to a certain extent outcomes of these underlying social structures"¹⁰ where the social structures are seen to be bound to specific regions. Alternatively, geography is present in analyses in the sense that studies are often explicitly or implicitly 'place specific' and base their concepts on observations from particular regions or localities where the 'innovation system' is highly visible, for example, Silicon Valley in California, the 'Third Italy', Baden Württemberg in Germany¹¹ and other 'innovative milieux'.¹²

As a result of this there has arguably been an overemphasis on core regions and high-tech industries in the literature, and the sporadic nature of such studies often results in inconsistency in the use of conceptual tools across different studies. This also creates difficulties for the application of findings from such studies of core areas particularly when attempting to analyse innovation systems or innovation dynamics

⁸ see Brusco, S. (1990) 'The idea of the industrial district. Its genesis' in F.Pyke, G.Becattini and W.Senenberger (eds) (1990) Industrial districts and interfirm cooperation in Italy, International Labour Organisation, Switzerland pp10-195; A.Amin and K.Robins (1990) 'Industrial districts and regional development: Limits and possibilities' in F.Pyke, G.Becattini and W.Senenberger (eds) (1990) Industrial districts and interfirm cooperation in Italy, International Labour Organisation, Switzerland pp185-219;

Asheim B. (1992) 'Industrial Districts, Interfirm Cooperation and Endogenous Technological Development: The Experience of Developing Countries' UNCTAD Symposium on industrial districts and technology, Geneva 16-47th Nov.1992; Storper, M. (1991) 'Technology Districts and International Trade: The Limits to Globalization in an Age of Flexible Production' mimeo Grad School of Urban Planning and Lewis Centre for Regional Policy Studies, Univ. Of Calif. LA, Sept. 1991 p36;

Porter, M. (1990) The competitive Advantages of nations. Macmillan, London, p. 19-21 and 60-61.

Cooke and Morgan (1994) op cit; Castells M. and Hall P. (1994) Technopoles of the world: the making of twenty-first century industrial complexes, Routledge, London

⁹ Héraud J-A. (1994) 'Is there a Local System of Innovation in Alsace? An Analysis of the Firms Networks based on an Empirical Study' Paper presented at EUNETIC Conference, Evolutionary Economics of Technological Change : Assessment of results and new frontiers, European Parliament, Strasbourg, Oct. 6-8, 1994

¹⁰ Storper (1991) op cit.

¹¹ Cooke, P. and Morgan, K. (1994) 'The regional innovation system in Baden-Württemberg' International Journal of Technology Management, vol.9, no.s 3/4, pp394-429.

¹² Aydalot, P. and Keeble, D. (1988) High Technology Industry and Innovative Environments. The European Experience, Routledge, London; Castells and Hall (1994) op cit.

in other, less technologically-advanced regions or on 'low-technology' sectors. Thus, studies on regional innovation often cite the lessons which may be learned from successful, usually geographically core regions, without fully concentrating on endogenous capabilities of less-developed regions. This has important implications for regional policy, as Koshatzky¹³ notes: "the activation and more intensive utilisation of endogenous innovation resources for regional development constitutes an important challenge for a technology-oriented regional policy".

In addressing such issues of innovation capability, another major approach rests on the application of concepts which place less emphasis on geography and use ideas from evolutionary economics, systems theory and innovation theory, giving rise to the idea of systems or network models for mapping innovation¹⁴. These recognise that technology does not exist alone but functions as an integrated part of a socio-economic system; for example as a national innovation system¹⁵. Thus, the context within which firms conduct innovation may be highly important and may be modelled by analysing the interrelationships between social, economic and technological systems at various scales. The various components and linkages within and beyond such systems or networks form the basis for analysis, and include: other firms, such as customers and suppliers; education institutions and research laboratories as sources of skilled labour and knowledge; government agencies as sources of finance, regulatory constraints and support for innovation; financial agencies such as banks or venture capitalists; and providers of business services.

However, in placing less emphasis on geography this can create difficulties, since the role of factors arising from the particular locality or region within which the system operates is ignored or at best explained by the 'embeddedness' of firms within particular cultural environments. This criticism has been raised particularly by Krugman and it has been suggested that "recently, however, there have been certain developments within economics which may mark the beginning of a closer relationship with economic geography in general and regional development theory more particularly"¹⁶. There remain, therefore, key questions concerning the role and importance of geographic factors in the operation of the social, economic and technological systems within a specific region.

In turn, the marrying of theoretical ideas with empirical work has also been problematic¹⁷, particularly with the need to apply new and more sophisticated empirical indicators which has emerged with the recognition of the complexity of innovation¹⁸. The main existing science and technology indicators, namely R&D data, patents data and bibliometrics, are often irrelevant to regions characterised by

¹³ Koschatzky K. (1994) "Utilization of innovation resources for regional development - Empirical evidence and political conclusions", Paper prepared for NISTEP Conference, in February 1995.

¹⁴ see especially Lundvall B-Å (1992) op cit; Todtling F. (1994) 'The uneven landscape of innovation poles. Local embeddedness and global networks' in Amin and Thrift (eds) Globalization, Institutions and Regional Development in Europe, OUP, Oxford

¹⁵ Lundvall (1992) op cit; Nelson R. (1993) op cit

¹⁶ Martin, R. and Sunley, P. (1995) 'Paul Krugman's Geographical Economics and its Implications for Regional Development Theory: A Critical Assessment' Paper presented at IBG Conference, Newcastle-upon-Tyne, Jan.1995, 2

¹⁷ Higgins, (1995) op cit.

¹⁸ OECD (1992) Oslo Manual. OECD Proposed Guidelines for Collecting and Interpreting Technological Innovation Data, OECD, Paris

'traditional' industrial structures, large numbers of small firms and an absence of science-based industries and formal scientific institutions. The indicator problems following from this have also been discussed in Norway, and considerable effort has gone in to developing a wider range of official and unofficial statistics on innovation.¹⁹ In addition to this, it seems clear that the study of innovation systems in particular localities or regions should be based on an integration of suitable innovation and regional indicators, using methodologies to allow comparisons across different regions²⁰.

2.2 The statistical approach

During the 1980s a number of independent research teams attempted to develop survey approaches to innovation which would widen the scope of statistical methods in innovation analysis (for an overview of such work, see Smith, 1992). These surveys mainly attempted to collect data on new product development, and on the firm-level activities which supported such development. In the early 1990s, these approaches were synthesised by the OECD into a statistical manual which recommended a future 'standard practice' for the collection of such data. This approach was taken up by the European Commission, in a collaborative action involving DG-XIII (European Innovation Monitoring Initiative) and Eurostat, who implemented a 'Community Innovation Survey' in all Member States in 1993/4; this survey collected harmonised data on approximately 40,000 firms.

Simultaneously with this action, the European Commission sponsored a study exploring the possibilities of extending this approach to a regional level²¹. This project, known as ERIS (European Regional Innovation Surveys), was important background for the study reported here.

The Community Innovation Survey collected three broad types of data. Firstly, economic data on new product introduction and sales, R&D and non R&D inputs to innovation, sales and employment. Secondly it collected binary data on, for example, patterns of technological collaboration. Finally it collected ordinal data, asking firms to rank the importance of various information sources, obstacles to innovation, support measures, and so on.

In this study we use identical definitions and questions on innovation inputs and outputs to those of the Community Innovation Survey. However 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. The questionnaire was applied in two stages in mid-1994 to the gross population of manufacturing firms in Møre and Romsdal; it is, in effect, a census rather than a sample survey. In the first stage a

¹⁹ notably K.Smith (1992) 'Technological innovation indicators: experience and prospects' *Science and Public Policy* no.19, vol.6, Dec.1992, 383-392; K.Smith and T.Vidvei (1992) 'Innovation activity and innovation outputs in Norwegian industry' *STI Review*, OECD, no.11 December 1992 pp11-3312; S.O.Nås, T.Sandven and K.Smith (1994) 'The community innovation survey. Status and perspectives' *CEC*, DGXIII, Luxembourg

²⁰ see Alderman and Wood (1994) op cit; Nam, Ch.W., Nerb G. and Russ, H. (1990) 'An empirical assessment of factors shaping regional competitiveness in problem regions' *IFO Main Report*, CEC, Luxembourg

²¹ Alderman and Wood (1994) op cit

postal survey was sent to all firms. In the second stage, all non-respondents were contacted by telephone, and asked to complete a closely similar 'core' postal questionnaire. Only 110 firms declined to respond. However a large number of firms (approximately 570) were either not relevant (that is, they had been misclassified as being involved in manufacturing production), or were impossible to contact. Approximately 300 firms failed to respond to letters and phone calls, and there must be a strong supposition that they were out of business. We received a total of 399 responses, which represents a response rate of 78.4% of the firms who we succeeded in contacting, and 48% of the population including the 399 non-contactable firms. A subsequent non-response analysis was carried out with the 110 non-respondents, which suggested that there were no significant differences between respondents and non-respondents.

3. The Møre and Romsdal region

The focus of this study is Møre and Romsdal, which was selected because it is a recognised region for innovation activities in traditional industries²² and has a higher share of total industry employment when compared with the Norwegian average (Table 1), and had one of the countries highest numbers of patents in both 1982 and 1992²³. As such, it may be termed a 'core' region in Norway. However, there are characteristics which distinguish it from other regions in Norway and core regions in other countries. First, in terms of gross value added, it is only the 9th largest in Norway (Figure 1). Second, there are the particular structural differences of the region, where the main industrial base is not founded on high technologies such as electronics, computers and so on, but is largely comprised of three main 'traditional' industries i.e. the manufacture of furniture, fabricated metal products (including shipbuilding) and fish products (see Figure 2 below). It is therefore useful to analyse the particular characteristics of the 'innovation system', and the innovation activities of firms, in such 'traditional' industries to see how these differ from other industrial sectors which have often received more attention.

Table 1. Industry employment as share of total employment and average unemployment rate in Norway and in Møre and Romsdal. 1987-91.

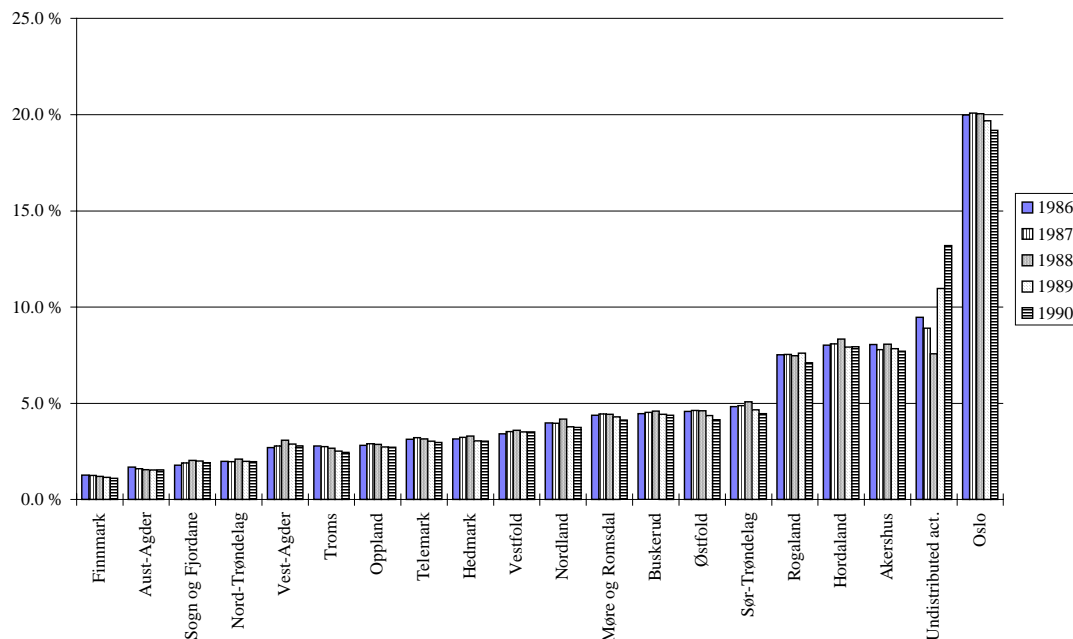
Year	Industry employment as share of total employment.		Average unemployment rate.	
	Norway	Møre and Romsdal	Norway	Møre and Romsdal
1987	26.4 %	30.4 %	1.8 %	1.8 %
1988	25.9 %	29.4 %	2.3 %	3.2 %
1989	24.6 %	28.5 %	3.8 %	4.7 %
1990	24.1 %	27.7 %	4.3 %	4.5 %
1991	23.2 %	27.3 %	4.7 %	4.6 %

Source: Statistics Norway.

²² Wicken, O. (1994). 'Entreprenørskap i Møre and Romsdal. Et historisk perspektiv.' (Entrepreneurship in More og Romsdal. A historical perspective) *STEP-report*, 21/94

²³ Haug R. and Skorge O. (1994) 'Patenter i Norge. Økonomisk utvikling, bedriftsstørrelse og lokalisering som forklaring på variasjon i antall patentsøknader i Norge', *Siviløkonomoppgave Bødo Graduate School of Business* 31.05.94.

Figure 1. Regional gross value added at market prices²⁴. Million Norwegian Kroner. (Total before deduction of imputed output of bank services, by county.) 1986-1990.



Source: Statistics Norway.

Although the raw material bases for the traditional manufacturing industries are available often in abundance in other Norwegian regions, industry in Møre and Romsdal is perceived as particularly innovative in its use of these materials²⁵. Related to this the history of the region indicates that there are diversities which exist within the region, where innovation activities and industries differ across the three fogderi²⁶ or sub-regions of Sunnmøre, Nordmøre and Romsdal which make up Møre and Romsdal. Further understanding of differences in innovation activities within the region, as discussed here, may be used to support and direct policy objectives in this area.

There is historical evidence to support the idea that Møre and Romsdal as an area has entrepreneurial skills. Historically, collective entrepreneurship through cooperation in both productive and commercial phases of economic activity gave rise to an economic vitality in the rural districts and a positive attitude towards entrepreneurship. It seems that the tradition of collective entrepreneurship paved the way for individual entrepreneurs in these regions. The local community supported new enterprises by way of family, community or municipal support in terms of technical, financial and commercial support to initiatives taken by individuals²⁷. We shall suggest below that these historical dimensions of the region may still be visible in the contemporary data.

²⁴ The methodological approach has been to allocate national accounts figures of gross value added (GVA) to regions by using distributional keys corresponding to each industry in the national accounts system.

²⁵ see evidence from Haug and Skorge (1994) op cit. and Wicken O. (1994) op cit.

²⁶ An archaic jurisdiction akin to a bailiwick.

²⁷ Wicken O. (1994) op cit.

3.1 Industrial base of the region

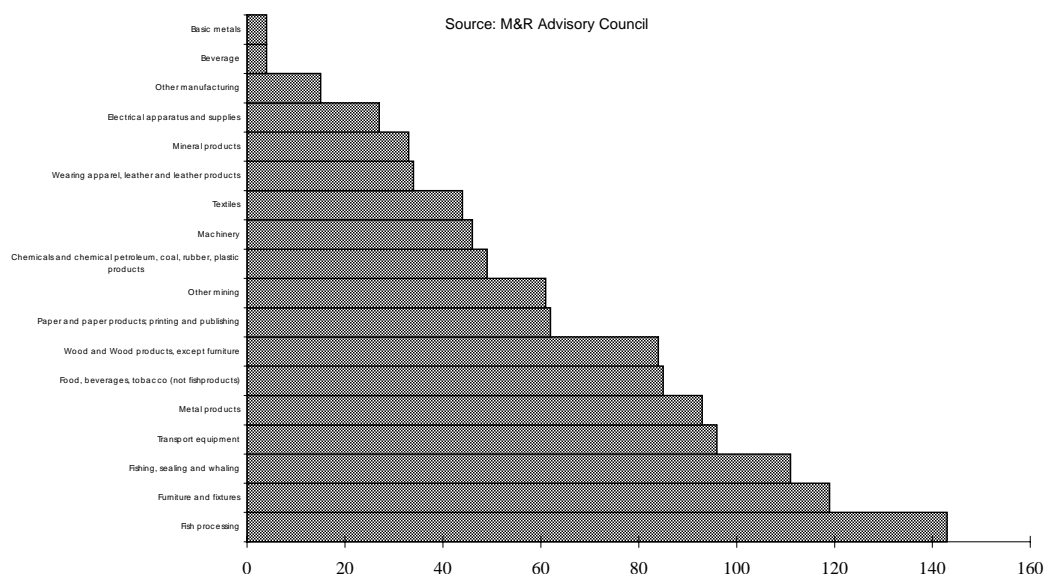
As noted above, in 1994 1128 companies were registered in Møre and Romsdal. Of these, by stripping out non-relevant firms or those no longer in business, 824 firms (representing 100% of manufacturing industry) formed the sample base for our survey of the 'regional innovation system' (see appending section for outline of methodology). Using our primary data together with information from elsewhere²⁸ the industrial structure is shown to be dominated by small, even micro companies, since only about 100 companies in Møre and Romsdal employ 50 or more whilst nearly 700 companies have less than 10 employees. However, when comparing this with the national pattern, it is noted that the average company size in Møre and Romsdal is in fact somewhat larger than in the rest of Norway. The share of companies in manufacturing, where the average company size is larger than in other economic sectors, also exceeds the national average. Thus, of all the 19 counties of Norway, Møre and Romsdal has the largest share of employees involved in manufacturing (see Table 1) and employment is to a large extent concentrated in a few industries, some of which are key to the national economy. These are:²⁹

- 1) Manufacturing of fabricated metal products, machinery and equipment (ISIC 38), of which ship and boat-building (ISIC 3841) is the dominant;
- 2) Manufacture of wood and wood products, including furniture (ISIC 33), of which manufacture of furniture and fixtures (ISIC 332) accounts for around 80%; and
- 3) Food manufacturing (ISIC 311-312), of which canning, preserving and processing of fish (ISIC 3114) accounts for 40-50%.

²⁸ Møre and Romsdal Industry Catalogue (1991/92)

²⁹ We have used "Standard Industrial Classification of all Economic Activities - ISIC" published in 1972, in grouping manufacturing industries. The classifications are given in parentheses.

Figure 2. Industry structure by sector in Møre and Romsdal, 1994. ($n=1110$)³⁰



More specifically, at present roughly 40% of those employed in manufacture in Møre and Romsdal³¹ work in manufacturing fabricated metal products, where ship and boat-building, and manufacture of components and fixtures for ships and boats dominates. This industry has meanwhile experienced thorough restructuring and rationalisation which has left waning demand for labour despite satisfactory levels both of orders and profits. The furniture manufacturing industry in Møre and Romsdal now accounts for about half the sector nationally and was developed by individual entrepreneurs as a spin-off from traditional locally-organised wood working activities. Today, the furniture industry is highly automated, and its intensive use of technology has made it competitive both nationally and internationally. Despite this, only a relatively small share of production is exported. Finally, fish processing, together with the outfitting of the fishing fleet, may be viewed as an extension of the traditional base of activities that grew up around fishing. Modernisation of the region's industries may be described as a combination of local and international processes. While the fish industry is relatively conventional in the catching and processing of fish, for example, this can involve considerable technical upgrading which improves traditional technology; there has been important progress in research institutions which provides new possibilities for the industry. However, as yet, the fish industry has been unable to use these new inventions to their full potential.³² The fishing and the fish-processing industries employ about 7% of the working population, spread amongst numerous, closely linked, small and medium-sized companies.

³⁰ This is slightly less than the total number of firms in the region as we took out some non-manufacturing firms (retail and construction firms (6)) and the remainder were not allocated an ISIC code. See appendix for fuller picture of sampling procedure.

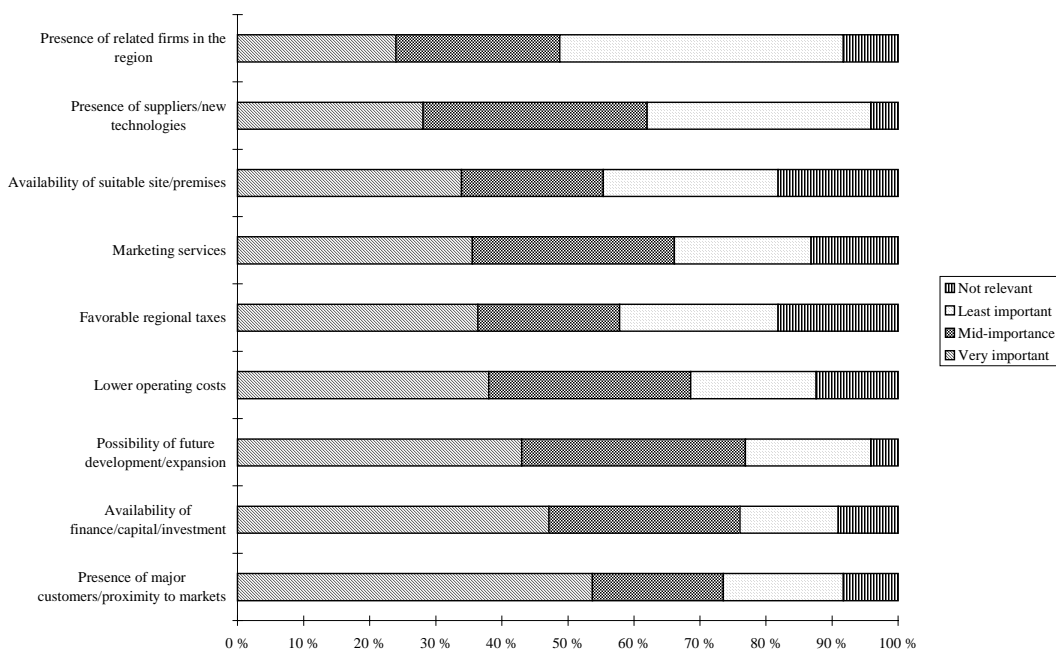
³¹ Møre and Romsdal fylkeskommune (1993) *Årsmelding 1993* (Annual report 1993). Nærings- og miljøavdeling.

³² Hernes G. og Trondsen (1986) T. 'Fast i fisken? Fiskerinæringens markedsmuligheter, styringsproblemer og innovasjonsevne' (The fish industries market opportunities, steering problems and innovation capabilities). FAFO, Oslo, June 1986.

3.2 Economic links and innovation

How important is the region as an economic environment in input-output terms? It is evident from the survey results that there is a strongly focused economic base within Møre and Romsdal in terms of its importance as a market for firms' products, firms' links with key customers and as a source of supply for other firms. Customers within the region account for 61% of total sales and over half (53%) of the firms have their main customer in the region, trading mainly with industrial customers rather than supplying to final consumer markets. In addition, 34% of firms have their main supplier in Møre and Romsdal. These links are supported by the fact that the most important general regional factor affecting firms' activities in the region is presence of major customers or presence to markets (Figure 3). This would imply a degree of local linkage formation in the form of 'clusters'³³ or 'regional production networks' particularly in the key sectors outlined above.

Figure 3. Importance of general regional factors to firms' activities (n=121), 1994.



(Source: STEP-Group survey of Møre and Romsdal)

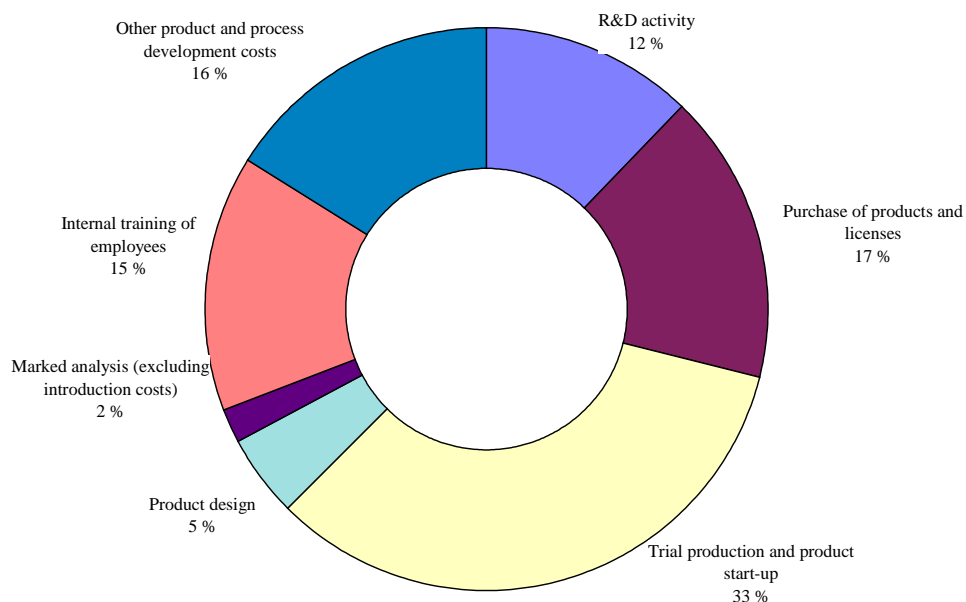
Innovation inputs and innovation-related expenditures

The survey evidence suggests that many firms are innovative in that they have expenditure on innovation activities, where 62% (n=249) of firms said they have some form of innovation cost (i.e. expenditure on innovation activities), although only 83 firms actually gave a distribution of total innovation costs (Figure 4). As shown in the figure, R&D expenditure (representing more basic or 'pure' research) accounts for only 12% of total innovation costs, whereas more applied work (the development side of R&D), such as trial production and product start up (33% of total innovation costs), account for the majority of costs. In turn, developmental work and purchasing of products and licenses are also key areas of innovation costs. This suggests that regardless of firm, R&D expenditure on the whole represents a relatively small element of the innovation process for firms in Møre and Romsdal,

³³ Porter M (1990) op cit.

indicating that incremental innovations through learning by doing and learning by using are important in manufacturing industry in Møre and Romsdal. This (probably) reflects many small entrepreneurial firms in the region.

Figure 4. Distribution of total innovation costs (n=83), 1994



(Source: STEP-Group survey of Møre and Romsdal)

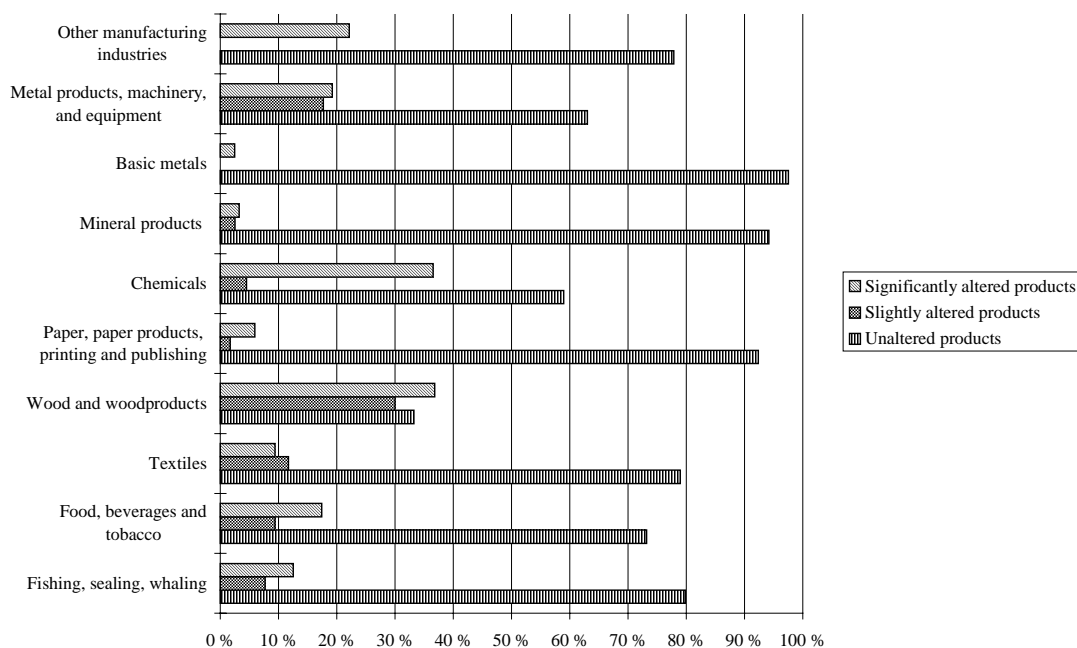
Firms also provided data regarding research employment. Of the 61 firms responding to this, only 26 registered full-time research positions indicating that overall these firms have very few employees specifically engaged in R&D. These results are not surprising given that the majority of firms are SMEs, which often have limited resources directly for R&D expenditure and employment.

Innovation outputs

The innovation activities of firms in Møre and Romsdal have significantly inter-industry variations and it should be noted that innovations are not only confined to 'high technology' industries. Given that the industrial base in Møre and Romsdal is based on more traditional industries such as wood products and food products (especially fish) illustrates the persistent importance of innovation in these sectors. There is evidence to show that many firms are innovative in that they introduce new and altered products³⁴. Wood products have a larger proportion of altered products (67%) than unaltered products in their turnover, and in these terms is far more innovative than chemicals which often is regarded as a 'high-technology' industry. 'Metal products, machinery and equipment' and 'Food, beverages and tobacco' also have a proportion of altered products in sales (Figure 5).

³⁴ The main indicator of innovation output was: the proportion of the firms's sales generated by product innovations introduced in the market within the last three years. Product innovations or 'new' products are understood here to mean either significantly altered products or slightly altered products.

Figure 5. Share of turnover accounted for by unaltered, slightly altered and significantly altered products, by industry (n=252), 1994



(Source: STEP-Group survey of Møre and Romsdal)

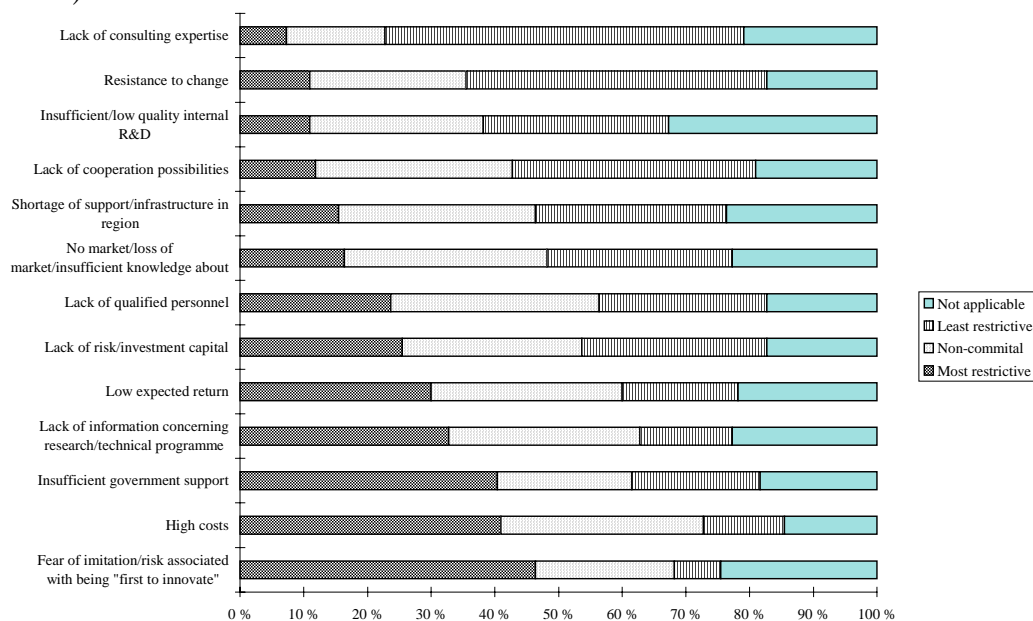
There are important geographic patterns to innovation within Møre and Romsdal. For example in terms of proportion of new products in sales, one of the three main fogderi, Sunnmøre, has the largest share; which may be largely because of the fact that lack of access to risk capital is less of a problem for firms in Sunnmøre than for the other two sub-regions of Nordmøre and Romsdal.

Obstacles to innovation

On the basis of this evidence, it is suggested that strong trade links or networking between firms based in Møre and Romsdal may be seen as a potential for interaction or cooperation for innovation activities. According to Tödtling, for example, since networks exist at various spatial levels, geographical proximity, good communication networks, a common cultural background and a well developed infrastructure act as a catalyst for the utilisation of regional innovation potentials³⁵. But when focusing on such issues in the context of Møre and Romsdal, such links between firms are not evident. In fact, the most important obstacle to firms' innovation is their fear of imitation of their products or risks associated with being the first to innovate (Figure 6), this holds especially for small firms. This is further supported by the fact that firms see the presence of related firms of little importance to their activities, (see Figure 3 above) here again especially for the small firms and the lack of cooperation possibilities is not seen as an obstacle to innovation (Figure 6).

³⁵ Tödtling (1994) op cit

Figure 6. Factors seen to restrict product/process innovation: postal survey only
(n=121)



(Source: STEP-Group survey of Møre and Romsdal)

There are differences, in terms of size of firm, as to how they perceive lack of cooperation possibilities where larger firms see it less of a problem than smaller firms. Such factors are more directly related to internal firm strategy rather than those based on regional factors, although if there are a number of similar or competing firms in the region then the fear of imitation through, for example, loss of information due to spatial proximity between competing firms has an important regional dimension. This issue is highly relevant given the predominance of small firms in the sample which are often less able to support or finance risky innovation activities, indicated by the high response to high costs as a restrictive factor for innovation (Figure 6). This also reinforces existing evidence from other studies concerning the particular constraints to innovation faced by SMEs.

In addition, although previous research emphasises the importance of user-supplier interaction for innovation³⁶ this not borne out by the evidence for Møre and Romsdal. Several firms are, in fact, dependent on one main customer (23% of firms rely on their main customer for more than 50% of sales), but the innovation potentials of such 'customer dependent' firms are lower (14% of innovation in sales) than those that are non-dependent (17%). Although the difference is not great it does suggest that strong economic links with key customers does not necessarily have a positive effect on innovation, it shows 'the weakness of strong ties'³⁷, whereby such firms undertake a subcontract role and are 'tied in' to supply customers with specific components or materials; as such they may have little requirement to innovate.

³⁶ see, for example, Lundvall B-A. (1988) 'Innovation as an interactive process: from user-producer interaction to the national system of innovation' in Dosi et al (eds) *Technical Change and Economic Theory*, 349-369

³⁷ Grabher, G. (1993). 'The weakness of strong ties. The lock-in of regional development in Ruhr area' in Grabher, G. (ed.) *The embedded firm. On the socioeconomics of industrial networks*, Routledge, London/ New York, p1-31

However, cooperation for innovation between the firm and its main customer is not evident, suggesting a dependent supplier characterised by low technical skills, producing only ordered components, which has a strong price competition because the customer has many related suppliers.³⁸

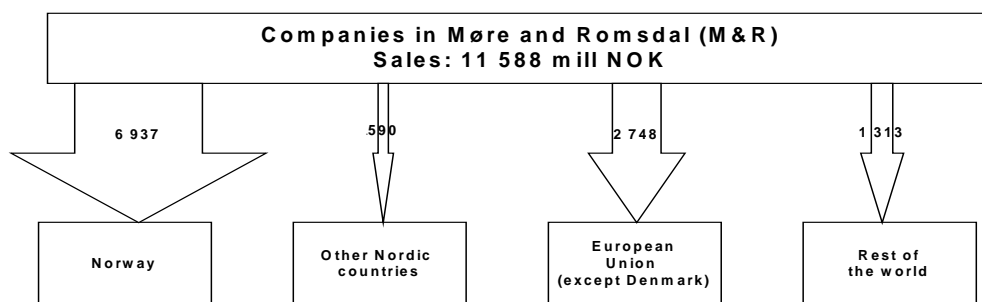
Overall, firms in Møre and Romsdal have strong trading links to the region; the goods that are sold are mostly low-technology but innovative, and most products are traded with industrial customers, rather than supplying final consumer markets. Firms are innovative and the fear of imitation suggests that there is high competition between firms in the region. There are historical evidence of entrepreneurial skills in the region, and there are spatial differences in Møre and Romsdal when it comes to innovation, where the innovative regions have less problem with finding risk capital for their innovation activity. However, the results also indicate that too strong economic dependencies between firms does not necessarily promote innovation linkages between firms.

3.3 Role of external links

Given the increasing awareness of globalisation³⁹, expansion of export markets and emphasis on external technological collaboration⁴⁰, the importance of external links to regional innovation has been emphasised. As such, firms' links both elsewhere in Norway and outside of the country were also examined in this study.

Firstly, in terms of extra-regional trade links, 40% of the total sales of Møre and Romsdal industry are outside the region (Figure 7); the smallest firms (less than 10 employees) export only 14% of their sales, and for largest firms, 58% of sales is exported (dominated by the EU market).

Figure 7. Sales from companies in Møre and Romsdal to different markets (n=350). (Figures in million of Norwegian Krone)



(Source: STEP-Group survey of Møre and Romsdal)

³⁸ Asheim, B.T. and A. Isaksen (1995), "Spesialiserte produksjonsområder mellom globalisering og lokalisering." In Olberg, D. (red), "Endringer i arbeidslivets organisering". Oslo: FAFO. Comming.

³⁹ Howells, J. and Wood, M. (1993) *The Globalisation of Production and Technology*, Belhaven, London

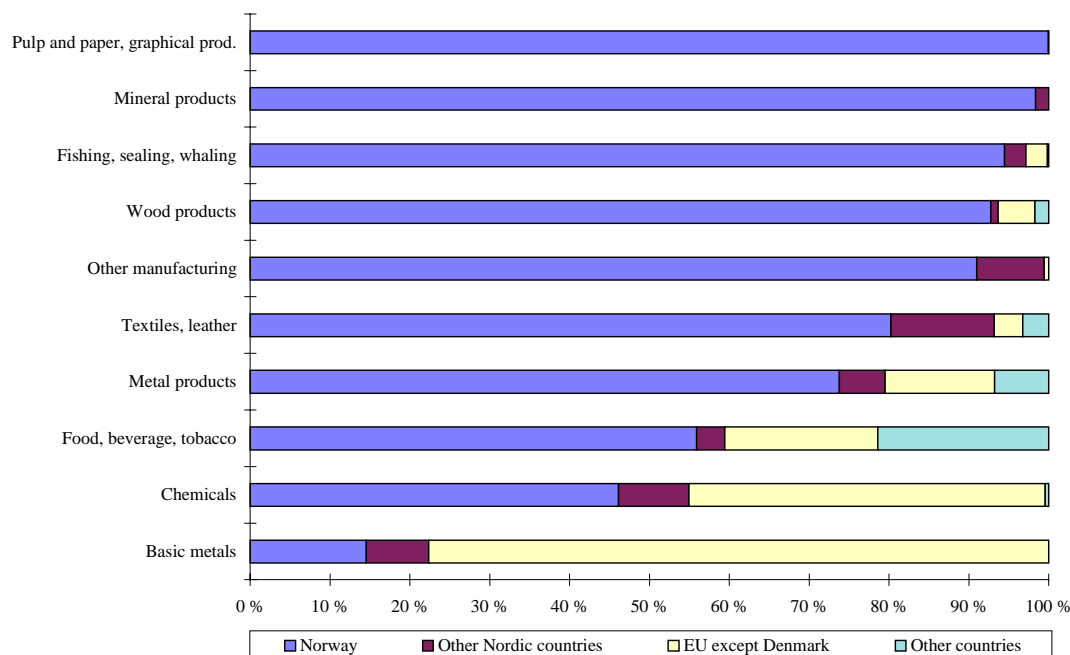
⁴⁰ Chesnais, F. (1988) 'Technical co-operation agreements between firms' *STI Review*, 4, 51-119; Pike A. and Charles D. (1995) 'The impact of international collaboration on UK university-industry links' *Industry and Higher Education* (forthcoming)

In terms of markets elsewhere in Norway, the neighbouring regions to Møre and Romsdal, Trøndelag, Sogn og Fjordane and Hordaland, all have minor importance (accounting for 10% of all sales); and there is slightly more emphasis on markets in the Oslo region (12%) and elsewhere in Norway (17%).

As well as differing in terms of size of firm, with larger firms being more outward-looking, there is variation according to industrial sector. Thus the basic metals and metal products, chemicals and food, beverage and tobacco sectors are more export-oriented than other sectors (Figure 8), although in terms of national links, textiles and wood/wood products sectors are also relatively externally-oriented, contributing to domestic consumption needs within Norway.

Second, looking more specifically at innovative products in international trade, firms were asked to estimate what proportion of their exports in 1993 was accounted for by altered and unaltered products. Of the 40 firms that reported international trade, only 20 said that their turnover included altered products. Thus, it appears that very few firms have innovative products amongst their exports. This may be because firms do not rely on export markets and are satisfied by supplying only regional and domestic needs. Conversely, there may be a lack of awareness amongst firms as to the potential openings for product innovation associated with gaining access to wider, and more competitive, export markets.

Figure 8 . Share of sales to different markets by industry (n=350)



(Source: STEP-Group survey of Møre and Romsdal)

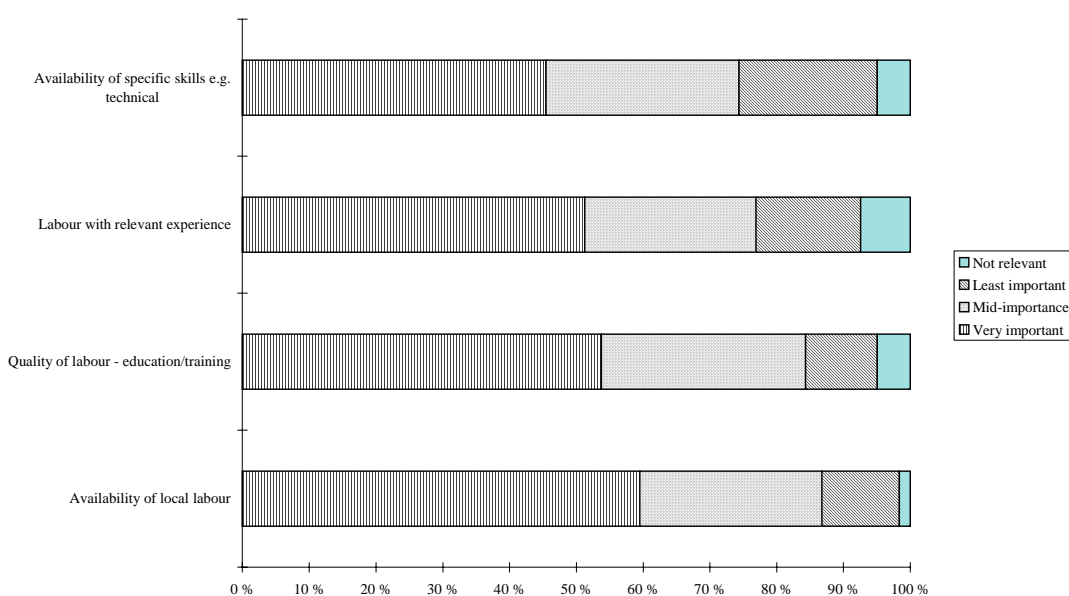
Third, investigation of external ownership of firms indicates that only 2 firms have parent companies outside of Norway. Overall, there are limited foreign direct investment links with firms in Møre and Romsdal, implying that international competitive pressures for indigenous firms to innovate, arising from proximity to foreign-owned firms, are limited. Thus, although overall firms in the region export 40% of total sales outside the region, the proportion of export differs between size and sector of firms. In addition, few firms have innovative products in their export-

market. Other external links such as ownership relationships or via inward investment contacts appear to be extremely limited within firms in Møre and Romsdal.

3.4 Availability of a skilled workforce

A key requirement of any regional economy and technological system is the availability of labour⁴¹, and particularly staff with the necessary skills and quality. The questionnaire asked firms to rank the importance of various factors affecting innovation activity, most importantly skills. In the context of Møre and Romsdal, several labour-related issues are important. These include the need to obtain labour with relevant skills, suitably qualified labour, and labour with special technical skills. This emphasis on labour issues is shown in Figure 9, where the two most important factors affecting firms' activities in the region are access to local labour and the quality of labour in terms of training (over 50% of firms); the fourth main factor is access to labour with special skills (about 49% of firms).

Figure 9. Importance of regional labour factors for firms' activities: postal responses only (n=121)



(Source: STEP-Group survey of Møre and Romsdal)

Other, more general evidence indicates that there are negative perceptions throughout industry in the region regarding the availability of skilled labour and the ability to get young people to take on apprenticeships within local industry or to take special courses set up in the region⁴². In addition, there seem to be perceptions amongst people such as school-leavers and particularly those who follow further education that there are poor opportunities for following a 'career-path' or being able to obtain

⁴¹ Nam, Ch.W., Nerb G. and Russ, H. (1990) 'An empirical assessment of factors shaping regional competitiveness in problem regions' *IFO Main Report*, CEC, Luxembourg

⁴² Newspaper article in *Aftenposten* August 1994, and interviews on the radio (16/8-94 in NRK P2) of the leader of a labour organisation for furniture producers in Møre.

jobs involving higher skills, or with possibilities for training, within industry in the region. There is some evidence that high-skilled youths leave the region to seek jobs in the bigger cities, such as Oslo, Bergen and Trondheim. These have important implications for the regional labour market suggesting that there are problems for renewing the skills base of the region.

In addition, the changing educational preferences of young people have led to a decreasing proportion of secondary level pupils going into vocational training. The share of young people taking higher education has risen dramatically the last couple of years, and the labourforce in industries is changing. The share of workers having background in mechanical- and electroengineering has decreased, and the share of workers having administration, economy, social sciences and law qualifications has risen.⁴³ Regional industrial activity which is strongly oriented toward natural resources, and thus demanding a high vocational intensity, has become less attractive for young people as increasing numbers are opting for more generally oriented education. This has been a problem for the furniture industry of Sunnmøre; an industry which has experienced great problems in recruiting youths for apprenticeships. "Today's youths want to educate themselves and 'be somebody' - if we want to attract the youth to the furniture industry it must get a higher status."⁴⁴

There are also problems associated with having insufficient apprenticeships in certain industries, for example, in Møre and Romsdal. In the 4 years plan for Møre and Romsdal⁴⁵, the focus is on the need for cooperation between industry and high schools, in order to support the needs in industry apprenticeships that should be offered in these areas. These may include offering more apprenticeships, with a greater technical basis, or more closely integrating the activities of schools, technical colleges and industry, as it has been attempted within the shipbuilding industry in Sunnmøre (initiated by the Mechanical Engineering Association in the Ulstein district) in Møre and Romsdal. Pupils visit different shipbuilders in the third and again in the sixth grade (8/9 years old and 11/12 years old). In the ninth grade (14/15 years old) pupils are allowed to choose a course at school where they both have theoretical teaching and then work at the shipyard and supplier firms. In upper secondary school (videregående) the pupils who choose shipbuilding will automatically get an apprenticeship, after this you are eligible to continue further into college. In general, the County (Fylkeskommune) wants to strengthen the vocational training in Møre and Romsdal, so that the industry in the region can raise their competence level and be able to compete on the national and international market. When it comes to vocational training it is also necessary to provide the kind of education that makes it possible to continue higher education, such as into university studies.

As the evidence indicates, labour factors (particularly skill shortages) are highly problematic to firms' activities in the region, and for many industries there are problems with getting younger people interested to work in these industries. However, there are strategies to overcome the lack of young people interested in following an apprenticeship: for example forging links between schools and industry

⁴³ Not corrected data based on administrative register

⁴⁴ Aftenposten (1994) 'Ikke fint nok å lage møbler' .24. August 1994.

⁴⁵ District Plan for Møre and Romsdal 1992-1995

at an early age (i.e. visits from schoolchildren to local industry), setting up apprenticeships for young people in firms, and fostering special links within certain sectors such as ship-building to allow young people to gain work experience.

3.5 Regional technological infrastructure

The role and importance of the technological infrastructure in the region in providing support for firms' activities was also examined. Geographical proximity, good communication networks, a common cultural background and a well developed infrastructure act as a catalyst for the utilisation and regional innovation potentials⁴⁶. Many firms in the survey indicate that more general infrastructural provisions related to the quality of telecommunications and proximity to key transport links are important. Of the firms, 38% perceived quality of telecommunication as the most important regional infrastructural factor to firms activities, and 61% looked upon frequent and reliable transportation services as most important (Figure 10). The importance of these factors to the technological infrastructure is evident from many other studies in this field and, in the case of Møre and Romsdal, this is largely due to the special geography of the region, where towns are on different sides of fjords or mountains, so transportation links are of the utmost importance for firms.

However, although basic infrastructural factors are important to firms in the region, other technology-related factors such as proximity to higher education, technical colleges and research institutions are not perceived as important to their activities; this is especially true for the small firms, where 70% look upon this as least important, but only 45% of the largest firms has the same view. There are no particular difference between the industries in how they perceive proximity to higher education, technical colleges and research institutions. Other evidence shows that 70 firms have been in contact with, for example, the research institution in the region (Møreforskning). We found only 11 of these firms among our respondents, of which 7 firms are seen to be innovative according to the criteria discussed above. In addition, the size distribution differs from our sample, in that there is a majority of large firms that have been in contact with Møreforskning, 5 of these 11 firms have more than 100 employees, only 2 firms had less than 20. Thus, even though they have been in contact with Møreforskning, most of these firms responded to our survey as seeing proximity to research institutions as least or mid-important for their activities. This emphasises the results found earlier in the paper that showed that firms R&D expenditures are only 12% of total innovation costs. This confirms that 'incremental innovations' through internal activities or in cooperation with other firms are important for the firms in the region.

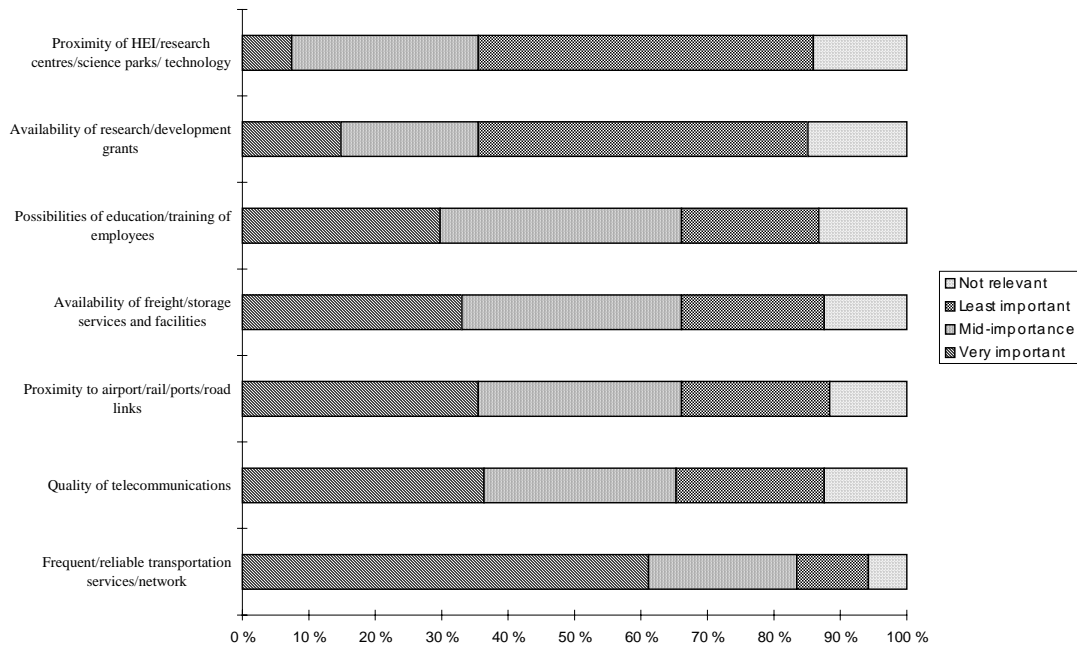
More specifically in technological terms, it is evident from elsewhere, that links between industry and the external technological infrastructure, such as universities and HEIs are beneficial for innovation activities⁴⁷. For firms in Møre and Romsdal, in terms of public support for innovation, the most important 'formal' source of support in the region is what is known as 'Møre and Romsdal firms' counselling' and the regional offices of the State Industrial and Regional Fund (SND) (Figure 11). These institutions are regionally based and are acquainted with the region,

⁴⁶ Koschatzky K. (1994) op cit, 23

⁴⁷ Charles, D. and Howells, J. (1992) *Technology Transfer in Europe: Public and private networks*, Belhaven, London

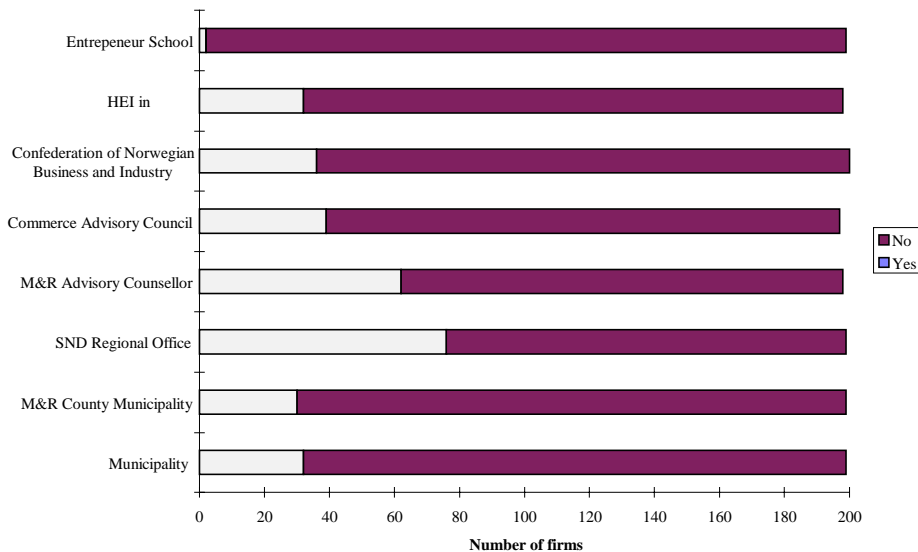
organisations and institutions located and operating there and barriers to innovation which may exist. As such, these institutions seem to have a positive effect on the establishment of links between firms and technological infrastructure. Other organisations, such as higher education institutes (HEIs), and technical colleges and schools, which could potentially offer a source of technological support and expertise for firms located in Møre and Romsdal are not perceived as strongly important by firms. This again may be due to a lack of awareness amongst firms and education institutes as to the potential benefits of collaboration.

Figure 10. Importance of regional infrastructural factors to firms' activities: postal responses only (n=121), 1994



(Source: STEP-Group survey of Møre and Romsdal)

Figure 11. Sources of information, expertise or support for innovation activities: responses to telephone survey (n=121)



(Source: STEP-Group survey of Møre and Romsdal)

Our findings suggest that firms place little emphasis on external sources for innovation support but, are more likely to rely upon internalisation of innovation processes. This is suggested by findings indicating the history of entrepreneurship amongst firms, reliance primarily upon internal funding for innovation, concentration on incremental innovation or a lack of awareness as to the possibilities of obtaining external knowledge or support through for example collaborative projects with colleges or research institutes. The 'entrepreneurial spirit' that exists in parts of Møre and Romsdal has been discussed elsewhere⁴⁸ implying that the owners of firms are conscious that they are self-sufficient in undertaking innovation. Most firms have little internal research, conducting mainly development-related preproduction or trial work, and therefore seldom see the work of HEIs (at the more basic end of R&D) of use to their activities. In addition, the data from Møreforskning shows that innovative large firms look more to external environment for support for their innovation activity.

3.6 Role of public support for innovation

Lastly, the role of national or regional government⁴⁹ in supporting innovation in firms is discussed. Overall, firms in Møre and Romsdal see lack of public support as a problem, and a key aspect of this concerns funding particularly for innovation activities. The data shows that this varies with firm size (number of employees) - the smaller the firm the more they see lack of public support as a problem. What is evident from the data is that firms rely mainly on their own sources of funds for technological activities, 63% of firms were 100% self-financed in terms of innovation. The data shows public support is mostly given to firms which have between 10-49 employees. There are also sectoral differences, where 'manufacturing of paper and paper products; printing and publishing' is the highest recipient of public support funding. There is no evidence to suggest that firms which receive public support are more innovative than those which are 100% self-financed, the firms that were self-financing had 25% of their turnover accounted for by innovations, whilst for those firms in receipt of public funding the level was 20%. Although the difference is not substantial it may suggest that self-financing firms are compelled to be more innovative with their own funds. In fact it appears that lack of finance and investment capital are seen as a restrictive factor on process or product innovation, although there are differences between the localities where the most innovative sub-regions, for example Sunnmøre, look upon lack of finances as less of a problem than the less-innovative regions.

In addition there is not a strong correlation between innovation inputs and innovation output. There are also time-lags between inputs and outputs where innovation is concerned - particularly with small firms who introduce new products only intermittently, we should not necessarily expect a statistical link between innovation costs and innovation outputs in one time-period. Despite this, lack of capital remains an important factor in firms innovation decisions, where over 20% of firms see this as highly restrictive (figure 6), over 40% of the firms sees insufficient government support as most restrictive. This may be partly due to internal lack of funds as well as

⁴⁸ Wicken O. (1994) op cit.

⁴⁹ Callon, M. (1995) 'Recent Trends in French Institutions for Regional Innovation Policies: An Appraisal' Presentation to NISTEP International Workshop on Regional Science and Technology Policy Research RESTPOR '95, Feb.13-16th 1995; Higgins (1995) op cit.

a shortage of funds from other regional agencies or institutions. There are also different types of innovations costs across different industries and these vary according to size of industries. These factors have been relevant when making public financial support available to firms.

It is recognised that there are other complex mechanisms that have positive effects on innovation besides financial expenditures. Other sources of indirect public support may include particular legislative arrangements, taxes or subsidies and other local economic development strategies. Although the main focus here is on financial support (particularly funding for innovation activities given that it is a key issue for SMEs), firms also emphasised that there is insufficient government support in general and, more specifically, a lack of information regarding research/technology programmes (Figure 6). In general, though, the main finding is that firms lack finance capital, although those that are given public support in the innovation process are not necessarily more innovative than other firms.

4. Summary and conclusions

The main aim of this paper was to discuss the possibility of there being a 'regional innovation system' operating within and beyond the Norwegian region of Møre and Romsdal. The findings are based on empirical evidence from a survey focusing on the activities and responses of manufacturing firms, including: their economic and innovation activities, and links both within and beyond the region; the availability of labour, and education and training requirements; the technological infrastructure including links with innovation support organisations; and the role of public bodies in providing support for innovation.

The results show that Møre and Romsdal is an important base for the economic activities of firms located there, where the majority of trade occurs between firms within the region. Additionally, according to our evidence, many firms actually undertake innovation in products and processes. There is a strong regional economic environment, and a specific type of innovation system; the question is, whether it is a dynamic system in terms of user-producer interactions. The existence of strong trade linkages and the presence of a number of firms particularly in the three main industrial sectors, implies some form of 'clustering'. This suggests that benefits may be achieved via collaboration between firms, together with other institutions, for innovation in products and processes, as well as in the provision of trained labour, collaboration for provision of services, and common technological expertise.

However, there is little evidence to suggest interaction between firms for innovation; in fact the presence of related firms is seen as unimportant to firms' activities, and firms do not see other institutions as valuable sources of information, expertise and support for their innovation activities. In the main, they look to particular regional agencies, such as State Industrial and Regional Fund (SND) or the regional office for industry, for support, primarily in the form of funding, and appear to rely on internal entrepreneurship for their innovation activities. In addition, firms in Møre and Romsdal appear to face particular problems related to a general lack of public support for firms' innovation activities, the availability and retention of skilled labour including training and education (marked by rising unemployment since 1987 - see Table 1) as well as the more general problems SMEs in traditional sectors face in relation to innovation activities. A further difficulty may lie with the locational peripherality of Møre and Romsdal within Norway and Europe, in terms of distance from potentially new markets and suppliers of technologies and equipment, and potential exclusion from other external sources of technological expertise, support and funding (for example, EU-funded projects).

These issues could form a key focus for public sector support and policies. Since there are mainly small firms in the region, these have particular problems related to lack of specialist capacities, 'bounded vision' (for example a lack of awareness of innovation possibilities due to low resource and knowledge bases and limited expertise) and often strong locational dependency. All of these characteristics can affect their approach toward innovation and may affect their attitude toward external sources of technological support. Thus firms may be constrained in their use of external sources of support for innovation due to a lack of awareness about

innovations developed in related companies, industries and public institutions. Equally, they are likely to experience insufficient in-house resources to enable external linkages or may view these with suspicion. In addition, the key sectors in the region are regarded as traditional industries and although there is evidence to show that some firms are actually using new technologies (and possibly 'high' technologies) whether in products or processes, there is scope to further develop these sectors. For some regions, industrial structure makes them vulnerable to the effects of geographical distance to markets, key suppliers and services, and partners and collaborators. Firms in these regions experience higher barriers to gaining access to information, technology and knowledge that are relevant for their production. These barriers make it difficult for the firm to participate fully in technological development in the relevant markets because the functionality of various networks and channels are severed.

It is important for national and, more specifically, regional governments to be familiar with the particular needs of the firms in the areas for which they are responsible. It has been argued that "the varying nature of problems facing small firms in different regions and the difficulties of addressing those needs with centralised policies"⁵⁰ therefore requires a response from regional and local government. In the case of firms in Møre and Romsdal, regional policies should take into account evidence concerning firm's innovation activities, and inadequacies, or perceived unimportance, of the existing technological infrastructure in the region. Public support must be directed to those aspects of the innovation process in which firms are actually involved i.e. product development and trial production rather than research, and therefore technical and business advice and support may be the most appropriate. This may require the creation of new institutions, such as business support offices or regional technology agencies, or new mechanisms, such as partnerships between firms and other organisations and between government agencies within the region, and out to the national and European or international levels. More importantly, public support should look to the promotion of collaboration between firms and existing, regional institutions, such as colleges and schools. Such a role may lie with local institutions, such as 'Møre and Romsdal firms' counselling' and SND's⁵¹ regional office; institutions that firms already recognise and use, albeit minimally. In addition, as different industries and different size of firms have different needs, this presents a potentially important role for sector-specific trade organisations, which work to link customers and suppliers vertically, in contrast to the more general 'horizontal' measures applicable for all industries.

More specifically, policies should address the current problems associated with attracting and retaining skilled labour and training or education of young workers. At present, there is a tendency for many young people to move to the cities and to study at the universities of Oslo, Bergen and Trondheim, for example. Since these

⁵⁰ Woodcock, C. (1993) 'A regional problem that needs to be addressed' *The Guardian*, Mon. April 5th 1993

⁵¹ SND - The Norwegian Industrial Regional Development Fund - has as its aim to establish a profitable socioeconomic environment for industrial development in Norway. SND shall help product development and establishment of new firms, and help modernising and reajust Norwegian industry. Employment in less favoured regions is of great concern to SND. SND gives loans, grants, economic subsidies.

cities have a more diversified labour market, they become an increasingly attractive location for higher educated personnel; for a large number of students, obtaining a degree increases the preferential barrier to moving back home. There is an important role for both central and regional government in this, to ensure the forging of links between schools, colleges and firms through, for example, having people from industry on the board of technical colleges. Students must see there are options after ended vocational training, something that will make it more attractive to young people today. The education system must develop a flexible system that makes it possible to combine vocational and higher education, this might attract new students. Other locational factors that might attract (or retain) a skilled workforce in the region are 'soft' locality factors such as leisure facilities and housing⁵². National government, together with public sector in the regions, may aid such a transformation by means of a wide range of initiatives related to the development of knowledge-bases and the acceleration of learning-by-doing.

A key question is raised as to whether such policy should be based on an indigenous growth strategy or alternatively, if there should be increased emphasis on improving external trade and innovation links. If a strategy of improving or strengthening external links is required then there appears to be an important role for firms and regional agencies in attracting finance and investment capital. This implies that if firms want to strengthen their export links or move to new markets (particularly in light of the decision not to join the EU) or if home-based firms want to undertake exports then it seems that there should be methods of collaboration between different types of firms in order to increase awareness as to the possibilities offered by external export markets. Conversely, however, if a strategy of endogenous growth is to be followed then awareness of the possibilities of internal markets in the region and in Norway and possibilities of innovation-led growth may be required. Thus, there are possibilities of focusing on the needs of the region in order to help firms contribute to endogenous growth and technological development.

The location of Møre and Romsdal in Norway is peripheral particularly when considering the location and role of the major cities in Norway. These both attract economic and technological activities and are sites for the main institutions in the national technological infrastructure, such as universities, higher education institutions and research institutions. This fact constrains the more even spread or regionalisation of many science-based activities in regions such as Møre and Romsdal. However, the vulnerability of firms to the effects of geographical distance can be reduced by technological and physical infrastructure in the region that is up-to-date and functioning as part of an orchestrated national infrastructure. By creating and developing physical infrastructures, for instance in terms of telecommunications and transport systems which firms rate as highly important, the public sector can reduce some of the drawbacks of being located in a particular region, and by that means augment the advantages of the location. Thus integration of regional infrastructures with national infrastructures has to be an important aspect of a policy having the objective of stimulating sustainable economic growth in the regions. Despite this, a national technology policy cannot usually take regional problem situations adequately into account, since neither its aims nor its instruments are

⁵² Koschatzky, K (1994) op cit, 23

adapted to regional particularities⁵³. In which case, further investigation of the characteristics and needs of other regions will give a more comprehensive understanding of the national system of innovation.

Lastly, in terms of the innovation system in the region the results discussed here provide only one, albeit important, perspective - that of manufacturing firms - and as the discussion indicates, in terms of analysing innovation linkages, the 'innovation system' or network in Møre and Romsdal is limited in scope and extent. This supports findings from similar studies elsewhere⁵⁴. It may be that such linkages are more highly evident amongst firms and institutions within a sub-region, such as Sunnmøre, giving rise to a 'local innovation system' or within particular industries, embodied in their particular knowledge bases or labour markets; although further evidence is needed in order to investigate this. In addition, the apparent weakness of the Møre and Romsdal innovation system may lie with conceptual difficulties and perceptions associated with models of 'regional innovation systems', resulting from studies of successful, core regions where innovation linkages are strong. In fact, the problematic of constructing a definition of an 'innovation system' which is applicable to a whole range of different localities and regions has been raised elsewhere⁵⁵, with suggestions that individual firm strategies and networks actually work against the formation of an visibly integrated regional innovation system. This paper attempts to provide an empirical basis for this, but recognises that a great deal of work remains in this area, in both conceptual and empirical terms.

⁵³ Koschatzky K (1994) op cit, 26

⁵⁴ see Héraud, (1995) op cit

⁵⁵ Higgins, T (1995) op cit, p7

Appendix: Methodology

In the regional innovation study of the Norwegian county of Møre and Romsdal, data was collected via postal questionnaires sent to business enterprises in the region. This was followed up by a telephone survey (using a slightly modified questionnaire) to all non-respondents to the initial postal questionnaire. The total number of responses was 399 representing a response rate of 49%.

Address lists covering all industrial firms in the county were supplied by the Møre and Romsdal Advisory Council. Constant cross-referencing with the Brønnøysund register together with the Council's extensive first-hand contact with industry in the area ensured that these lists were both comprehensive and up-to-date. In addition to firm names, these lists furnished the names of the managing director, which proved important when contacting the individual companies.

In all, the original list contained 1128 business enterprises. Some of the firms were not relevant to the study and were discarded, as in the case of individual companies simply constituting a division of a enterprise. The original list also consisted of firms that were not engaged in production and a number of the remaining industrial firms did not deem the study relevant to their activities, owing for example, to the fact that they were involved in closing down production. Further, some had changed their activities away from production several years back, while still others had not been involved in production for at least three years. There were another set of firms that found the study irrelevant for them and businesses that had gone bankrupt.

Table 2. Individual elements of the data collection

Total number of firms on the list	1128			
Firms out-of-business	51			
Non-relevant firms	253			
Study's sample base		=	824	
Responses to the postal survey				140
Responses to the telephone survey				259
Declined to respond				110
Unable to contact				315

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