

## **EXECUTIVE SUMMARY**

1. The objective of the TSER Thematic Network on "Networks, Collective Learning and RTD in Regionally-Clustered High-Technology Small and Medium-Sized Enterprises" has been to investigate "the role and importance of regional and European-wide research and technology development (RTD) linkages and networks in the evolution and competitiveness of regional clusters of innovative high-technology small and medium-sized enterprises (SMEs) in European Union countries", and "the significance for successful SME RTD in these clusters of 'collective learning processes' operating within the regional scientific, research and professional labour market".
2. These issues have been studied by comparative analysis of the recent evolution and internal dynamics of ten leading European regional clusters of high-technology SMEs, namely those of Cambridge, Oxford, Goteborg, Helsinki, Munich, Sophia-Antipolis, Grenoble, Barcelona, the Randstad, and Pisa/Piacenza/NE Milan.

### **Regional Evolutionary Trajectories**

3. The origins and nature of the European regional SME clusters studied by the TSER Network are very diverse and their evolutionary trajectories thus inevitably differ considerably. Recent trends however show some signs of convergence, in part reflecting radical changes in the globalisation process of large multinational firms in the 1990s compared with the 1970s, when most of the regional clusters studied began to develop.
4. The research clearly indicates that in a number of European high-technology regions there has been a marked resurgence in the creation rate and numbers of new technology-based SMEs since about 1993, following the severe impact of the early-1990s recession when creation rates fell sharply. Employment has also risen significantly.
5. This resurgence of technology-intensive SME creation reflects in part the growth of new technology-intensive sectors (biotechnology, computer software and internet

applications, telecommunication services, and R&D and technology consulting and services) in which rapid technological change, sometimes coupled with relatively low barriers to entry (as in some high-technology services), is generating new market niches and opportunities which innovative small firms can exploit.

6. These 1990s trends appear also generally to involve regional diversification of sectoral structure, rather than increasing specialisation upon only one or a few sectors, and a growth in high-technology services. At the same time, traditional divisions between sectors are rapidly becoming blurred, with a coalescing and combining of different technologies (computers, telecommunications, biotechnology, medical and health products, for example). These trends could well be enhancing the need for and benefits of both inter-SME collaboration and interaction and inter-firm transfer of different kinds of technological and professional expertise.
7. Large multinational firms appear to be showing greatly increased interest in locating R&D laboratories in Europe's SME regional clusters, reflecting a major re-orientation and redefinition of their globalisation strategies driven by the frenetic pace of technological change, the imperative of constant innovation, and the regional specificity of SME-based "knowledge communities" and research competences. The role of regional knowledge centres, notably universities, is also becoming more rather than less significant in this respect, and in enhancing cluster growth. New and innovative regional collective initiatives are emerging to promote cluster growth in particular regions.

### **Regional Institutional and Policy Frameworks**

8. Technology transfer and knowledge infrastructure are key elements of regional innovation systems. The main feature of most regions studied is the high concentration of R&D institutions as well as innovation support organisations. However, while technology and innovation centres in particular have attracted considerable attention and publicity, these in fact cater for only a minority of local firms, and their regional

economic effects (creation of new jobs, intensification of technology transfer) are generally relatively small.

9. The research and educational infrastructure in the ten regions studied represents a necessary but not sufficient determining factor for high-technology growth. The role of transfer institutions and innovation centres is relatively limited, while of greater than expected importance in particular regions (Munich, Oxford, Sophia-Antipolis) are key people. Dominant large corporations (Siemens) can also influence the creation and long-term existence of an innovative milieu through their interconnected relations.
10. Government policy has shaped high-technology processes in the study regions in a variety of direct and indirect ways. National policy is the quantitatively dominant level, but is being increasingly complemented by other institutions on the local, regional and supra-national levels. Regional authorities are becoming increasingly engaged in technology policy, in both federal (Germany, Spain) and centralised (France, Finland) states. Particularly noteworthy examples are Sophia-Antipolis and Grenoble. The studied regions include examples of all five different types of policy-related technology regions identified by Gordon (1991).
11. Networks, collective learning and knowledge development in regionally clustered high-tech SMEs in Europe can be influenced by policy measures explicitly developed at regional or local levels (“bottom-up”). But regional initiatives must be coordinated with EU and national policies, in order sensibly to build up regional competence centres that fit with supra-political levels. Policymakers must also avoid copycat behaviour, since in terms of policy effectiveness, no generally accepted “best practice” role model can be identified due to different needs in each individual region.

## University and Public Research Institute Links

12. All the regions studied except Sophia-Antipolis have a high density of universities and research institutes. Their evolving role appears to be of growing importance in fostering regional collective learning and high-technology SME development.
13. The regions exhibit a wide range of (evolving) interface mechanisms between universities/research institutes and local SMEs, with traditional notions of technology transfer management now evolving into 'technology co-development' and knowledge partnerships. Direct research collaboration between SMEs and local universities is surprisingly limited, with firms in each region claiming that their customers were a more important external source of innovation than knowledge centres. An important finding from Helsinki research is that university liaison services tailored to the specialist needs of individual SMEs are much more valued than traditional generalist approaches.
14. University spin-offs represent a particularly important process whereby regional clusters benefit from local knowledge centres, with a cumulative impact through subsequent indirect spin-offs. Most of the regions report relatively high levels of spin-off since the 1970s. Interestingly, in four separate regions approximately 17% of all local high-technology SMEs were found to be direct university spin-offs, but with lower shares being recorded by Munich and the Randstad.
15. Deliberate attempts to attract inward (often multinational) R&D investment to locate alongside universities appear to be growing in certain regions. More important for development of a regional collective learning capability is the training - and recruitment by local SMEs - of university graduates. University-related science parks have attracted considerable publicity, and have played a part in the evolution of particular regional clusters: but the Network evidence suggests that their role can be exaggerated and other mechanisms of university-SME interaction are much more important.

16. Overall, the Network's research highlights the need to build better bridges between local universities and local SMEs. This is particularly important in a period when small firms need greater complementarity between their business needs and external technology, and knowledge centres need commercial outlets for their research. Knowledge centres have an important part to play in adapting the knowledge they create and to improve its diffusion. But achieving this requires local steering agencies sensitive to both the present and future needs of SMEs.

### **SME Networking in Innovative High-Technology Milieux**

17. Theoretically and empirically, the Network's research suggests that successful high technology clusters are those which successfully combine dense internal inter-firm interactions and synergies with external, and often global, networks. Inter-SME linkages are a vital element in the existence, functioning, and survival of innovative milieux. Such relationships act as channels for spatial transfer of knowledge and as mechanisms for reducing uncertainty.
18. Comparison of findings for different successful Network regions reveals a relatively high proportion of SMEs reporting close links with other firms within the region, especially between customers and suppliers. In addition, and despite great differences in the different milieux analysed, such vertical inter-SME links are also often important for the innovative activities of local firms. Finally, the importance of vertical links does not stem only from geographical proximity, but also reflects other forms of closeness (technological, organisational, institutional, social and cultural) which facilitate innovation and decrease the risks and uncertainty surrounding the innovation process.

### **Large Firm Acquisitions, Spin-Offs and Links**

19. The different regions studied by the TSER Network have quite different large firm-small firm interaction and linkage patterns. These differences reflect differences in historical evolution, institutional framework, industrial structure, and the technological or sectoral focus of a region.

20. The Network's research provides powerful evidence of the importance of entrepreneurial spin-offs, often from large firms, in the growth of technology-based industries and regions. In those regions where large technology-based firms are historically important, such as Grenoble, Munich and Goteborg, they appear to be particularly important in training entrepreneurs, while corporate spin-offs also appear to grow faster than other SMEs, including university spin-offs.
21. In regions such as Munich, collaboration and co-operation between large firms such as Siemens and local high-technology SME suppliers is of considerable benefit to both the large and the small firms. In other 'large firm' milieux such as Göteborg and Utrecht, collaboration and cooperation between spin-offs and their parents appears to be the most important local link between large and small firms.
22. Multinational acquisitions of high-technology SMEs are quite common in several of the European regions studied. While such acquisitions can have a negative impact, the evidence does not on balance support a negative judgment. On the contrary, large firm acquisition of local technology-intensive SMEs seems often to bring new resources and help with marketing and internationalisation.
23. The TSER Network's research thus suggests that large firms are generally a positive and significant influence on the development of European regional clusters of high-technology SMEs. In some regions, this is because of the large firm's important role as a source of technology-intensive spin-offs. Such spin-offs also usually maintain beneficial links, especially research links, with their former parent. Over time, the development of new links outside the region may result in external large firm - and usually multinational - acquisition of the SME. If an innovative local SME does not lose its autonomy after such an acquisition, it may well play a key role not just in local small firm-large firm networks, but also as a link between the regional milieu and the global activities of its parent multinational.

### **Regional Collective Learning**

24. Regional collective learning can be defined as involving "the creation and development of a base of common or shared knowledge among individuals and firms making up a productive system which allows them to co-ordinate their actions in the resolution of the technological and organisational problems they confront". Key processes in the development of a regional collective learning capability include the spin-off of entrepreneurs, with their "embodied expertise", from existing firms and universities to found new local firms, formal and informal inter-firm and organisation collaboration and networking, and the movement within the regional labour market of key research, scientific, professional and managerial staff.
25. In several regions, favourable "pre-conditions for learning", in the form of common regional culturally-based rules of behaviour and collaboration, have been created or enhanced by key regional "collective agents". The most obvious of these are major universities, but public research institutes, large technology consultancies, and enlightened locally-based large firms, have also sometimes played a part in creating a regional culture of trust and collaboration which encourages innovation.
26. While regional collective learning processes are very important for successful innovation by high-technology SMEs in the European regional clusters studied, the Network's research clearly reveals that so too are national and global networks and collaborative links, with customers, universities, suppliers and even competitors. The research further suggests that successful global and regional networking by high-technology European SMEs are inter-linked and complementary, not alternatives. Successful globalisation in fact appears to be grounded or embedded in successful regional networking and research and technology collaboration.
27. Perhaps the single most important collective learning process identified by the Network's research is the spin-off of new firms and entrepreneurs into the local productive system. All the study regions except Barcelona are now characterised by a dynamic but highly localised spin-off process, from both small and large firms, universities and public research institutes. There is also a high rate of subsequent networking and collaborative activity between spin-offs and 'parents'. An intense local

spin-off process thus appears to be a hallmark of a successful European regional cluster, leading to the diffusion and further development of embodied expertise, innovative technologies, and managerial and research competences between firms, which stimulates new knowledge and shared learning.

28. High-technology SMEs are in general markedly differentiated from 'conventional' SMEs in exhibiting exceptionally high levels of inter-firm and organisation networking and collaborative activity. A second collective learning process evident in most of the regional clusters studied is therefore local networking, collaboration and linkage. The nature of local networks does however differ between different regional milieux, perhaps reflecting cultural or sectoral differences.
29. Regional labour market movement between local firms, universities and research institutes of researchers, scientists, engineers or managers, individually or in teams, constitutes a third important collective learning process. In several regions, such as Cambridge, Oxford, Sophia-Antipolis, Pisa and Piacenza, the intensity of regional labour market recruitment is remarkably high given the small size of the particular labour market involved. Access to such localised labour markets and "knowledge communities" is a key motivation behind recently increased multinational firm investment in European SME regional clusters.
30. Regional universities are in many cases playing an important and growing contemporary role in promoting collective learning within their local high-technology SME cluster, while in several regions, new regional collective initiatives have emerged in the late 1990s aimed directly at encouraging processes of regional collective learning. This latter and novel trend involves the establishment of new regional private-public coalitions aimed at strengthening business support structures, overcoming constraints on business growth, fostering collaborative activity between firms and universities, and marketing the region globally. Examples of such collective initiatives now exist in Cambridge, Sophia-Antipolis and Grenoble.

### **Some Policy Implications**

31. From a policy perspective, the finding that proximity is important for the development of collective learning processes and that local and regional innovation networks strengthen the innovative capacity of both small and large high-technology firms provides support for a spatially focused network approach to innovation policy. Equally, the importance of collective learning processes in raising innovative capabilities suggests a potentially important role for policy in removing constraints on the development and functioning of such processes and in promoting the networking activities of SMEs. The significance of regionally based institutions in supporting and participating in the collective learning process also suggests a potential role for policy in supporting such institutions where they are poorly developed or absent.
32. The demonstrated importance of new firm spin-offs as a process of knowledge transfer between universities and industry is also of policy relevance. However, while supporting the general case for government policies to encourage spin-offs to facilitate the exploitation and diffusion of knowledge, the case studies indicate that policy needs to be based on a clear understanding of differences in local production systems and their appropriate geographical boundaries. Possible policy measures include provision of suitable premises, and hands-on advice on finance, marketing, and collaboration opportunities.
33. The past decade has seen a shift away from top-down regional/local policies emphasising 'inward' investment and demand re-distribution, towards policies in which regional organisations have greater autonomy and are an integral part of the collective learning process. There is also now widespread policy interest in strategies supporting the development of 'clusters' of firms engaged in formal and informal vertical and horizontal interactions. Thus the case study experiences would seem to confirm the changing focus of regional and local economic development strategies in many EU countries.