The Role of Clusters in Knowledge Creation and Diffusion – an Institutional Perspective

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1 In search of coordinating devices for knowledge exchange

Clusters and networks have received renewed attention in recent years not only as a tool for regional development in general but as an institution of knowledge creation and diffusion between the knowledge infrastructure of a region and the firms within the clusters. They are therefore often regarded as geographically condensed forms of economic cooperation and knowledge exchange.

The recent renaissance of interest in institutions as a factor shaping economic performance has therefore also implications for the creation and sustained existence of clusters and networks as a tool for knowledge management and as learning organisations within and across regions. This institutional perspective serves to identify additional factors influencing economic behaviour leading to cooperation.

Knowledge has been recognised as a major source of competitive advantage in an increasing integrated world economy (Dosi and Malerba 1996, Grant 1996, Foss 1999, Nonaka 2000). The most successful regions are perceived to be those whose firms display innovative capacity, being able to adapt to a rapidly changing marketplace and stay one step ahead of competitors. In fact, 'knowledge represents the fundamental resource in the contemporary economy and the process of learning represents the most important process' (Lundvall and Johnson 1994). This implies a change in the preconditions necessary for innovation and sustained growth: 'These changes are part of an even more far reaching process of socio economic change – we are moving towards a network society where the opportunity and capability to get access to and join knowledge and learning intensive networks is determining the relative socio-economic position of individuals and firms. The economy is becoming a hierarchy of networks with some global networks at the top and an increasing proportion of social exclusion at the bottom of the pyramid.' (Lundvall 2002, p. 26-27)

Several new elements are important for the changing character of the innovative process:

- New forms of economic behaviour enter the interpretative framework of economics emphasising the role of interaction and coordination processes in the economy that

are beyond the individual maximising concept (Nelson / Winter 1982; for a recent overview see Foster and Metcalfe 2001).

- The regional dimension gains new importance especially for the exchange of knowledge and for learning processes; here the focus is on the necessity and forms of proximity for knowledge exchange (Rallet and Torre 1998), on the specific character of knowledge and its aspect of regional governance (Gertler 1997, 2001; Maskell and Malmberg 1999).
- A third element is the necessity of guiding and coordinating institutions for their new forms of behaviour on a regional level. Interactions need institutions (such as markets). Yet if the focus is on learning and knowledge sharing markets alone will not suffice for these forms of interaction and additional institutions will be needed (Steiner 2003).

Clusters and their networks combine these three elements: In a first definitional attempt they can be regarded as regional specialisations on interlinked activities of complementary firms and their cooperation with public, semipublic and private research and development institutions. Clusters are therefore understood as a larger concept comprising the cooperation between firms and other institutions on a regular, more or less 'institutionalised' pattern whereas networks here are used as an element of clusters showing less regular and more informal ways of cooperation between firms.

In the following we will elaborate the specific importance of clusters and networks for regional knowledge networks as a tool for regional innovation policy and as an institution for knowledge sharing. Different perspectives can of course be brought to the cluster concept (Bergmann, 1998, mentions in this context the so called 'Rashomon effect' named after Kurosawa's film where different people see the same thing quite differently). In order to give an impression of these different concepts and possible perspectives from which to look upon the phenomenon of clusters several empirical approaches to get hold of clusters within a given region will first be outlined.

In a further chapter the institutional aspects of clusters will be emphasised and it will be argued that they present a specific form of 'social technology' (in the sense of Nelson and Sampat 2001) necessary to manage change in an advanced stage of regional

development. Different strands of institutional thinking –institutions as "social technologies" in the tradition of evolutionary economics, clusters as a form of Coase institution integrating positive external effects of technological knowledge, the importance of knowledge sharing in the context of the "New Institutional Economics" – emphasize that connectivity cannot be effectively coordinated by conventional markets. Clusters and networks are among the non-market devices by which firms seek to coordinate their activities with other firms and other knowledge-generating institutions.

In chapter 4 the evolving nature of these 'social technologies' will be discussed and the interdependence between technological change and organisational change will be underlined. It is also important to emphasize that clusters as coordinating institutions are not automatically just there but that they are the result of an evolving process shaped by policy activities and entrepreneurial behaviour responding to new challenges. Clusters as social technologies are co-evolving with new physical technologies and are therefore in constant need to change themselves. They can be regarded as an answer to the problems of achieving agreement and coordination in a context where there is a collective interest. They combine different additional elements that are important for regional development and economic growth.

In a final chapter some policy consequences will be drawn from this institutional perspective as well as open questions for research addressed.

2 Different concepts of clusters – some empirical approaches

Demonstrating the 'Rashomon effect' several empirical approaches on different aspects of cluster activities were taken by case studies concentrating on the identification of cluster potentials and on the material and immaterial dimensions of the networks. The specific feature of the approaches presented in this chapter lies in the fact that they were undertaken within a given region, the Austrian province (region) of Styria, a region that has undergone profound change in its economic fortunes. It was an old industrial area at the brink of decline, it is now within Austria among the regions with the strongest

growth rates. It was the first region within Austria to start with a pronounced cluster policy. So there were ample case studies to identify clusters and to evaluate their diverse potentials. Several of these are presented here; the main intention is not to give a detailed survey about methodology and approaches to identify clusters but to gain insights into functions cluster and cluster analysis may assume.

2.1 Cluster identification based on material linkages between firms and sectors

A first question of course was if clusters exist at all and how to identify potentials for the development of clusters. The 'Technology Concept Styria' identified in 1996 a three-fold cluster structure (Steiner et al. 1996):

- 'Traditional clusters' with strong material linkages between their firms including a material and metal producing and processing cluster, a wood-paper cluster and an automotive-transport-oriented cluster;
- Young dynamic sectors with strong growth potentials yet still weak forms of network relations. As an example a cluster of ecologically oriented firms – either in their product or in their process orientation was given;
- In addition sectors with rudimentary cluster structures could be identified: sectors using sustainable resources and energy and showing links to the ecology oriented firms and also to the transport cluster, but also strong single firms having no intraregional links yet networks of co-operation on the transregional and international level.

The methodology was more or less bottom up. It relied on expert knowledge and interviews with leading firms.

Four years later an empirically more refined approach revealed 5 cores of economic activity within Styria. It made use of a regional econometric input-output model for Styria on the basis of 1995 with approximately 40 sectors (2 digit NACE code). The core of the model is based on the Washington Projection and Simulation Model

(Conway 1990) and includes, beside the I-O-module, also a demand, income, population and employment module. This model allows the identification of linkages and multipliers between the sectors thus enabling to find „cores' of economic activity within the region. Apart from existing linkages a certain threshold level of employment was taken as an additional criterion. It resulted in the identification of 5 regional clusters within the Styrian economy: machinery and metals, automobile, wood/paper, information technology, chemistry/pharmaceuticals (Adametz et al. 2000, see figure 2.1).

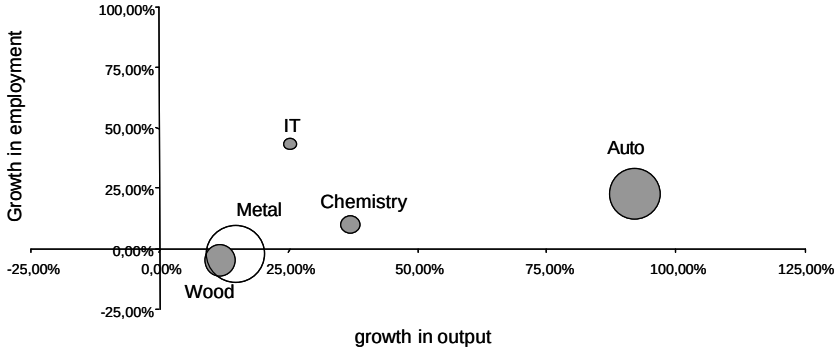


Figure 2.1 Development of the Styrian Clusters 1995 – 1998 (Source: Adametz et al. 2000)

So clusters do exist and different potentials and dynamics within these clusters could be revealed: The development (in terms of employment and real output) as derived from the I-O-model showed in particular for the automotive cluster an extraordinary dynamic in the past years: From 1995 to 1998 the number of employees has grown about +23% (Ø Austria +6%), real output has even grown about 92% (Ø Austria +25,6%). And in 1998 the core industry of this cluster comprised about 60 firms with 7.900 employees, producing an annual output of ATS 35 billions. The output per employee was in 1998 ATS 4,4 millions and has been growing from 1995 to 1998 by about 50%.

2.2 Knowledge networks

Yet these manifestations of clusters and their differences reveal the material dimensions of clusters, i.e. their linkages through input and output relations. There are strong presumptions that these linkages are accompanied by other forms of co-operation and by knowledge exchange yet which are not reproduced and shown by these methods of cluster identification. A series of case studies centred on knowledge dimensions of these and related clusters structures: are there technological spill-overs, do firms within clusters co-operate and how, what forms of learning takes place inside these clusters?

2.2.1 Technological clusters

Using Jaffe's (1989, 1993) concept of 'technological clusters' the patents of Styrian firms were analysed in order to localise technological spill-overs. This is based on the idea that firms having a similar patent behaviour and structure are also technologically similar and therefore form such 'technological clusters' (Jaffe 1989, Jaffe et al. 1993). Firms within such clusters are able according to this thesis , to use technological spill-overs. In contrast, firms which concentrate their production on single technologies within their regional environment, have little chance of benefiting from external effects. This approach relies exclusively on one output indicator, patents, and presumes that the agglomerated occurrence of patents within similar classes (= technology fields) is evidence of knowledge spill-overs.

Such technological clusters could also be identified for Styria. Especially in the sectors of electro/electronics/telecommunication and transport/traffic a high percentage of patenting firms could be found in Styria supporting the presumption of the existence of regional clusters: technologically similar firms are regionally concentrated and form the basis for technological spill-overs and positive external effects of knowledge diffusion (Steiner et al. 1996).

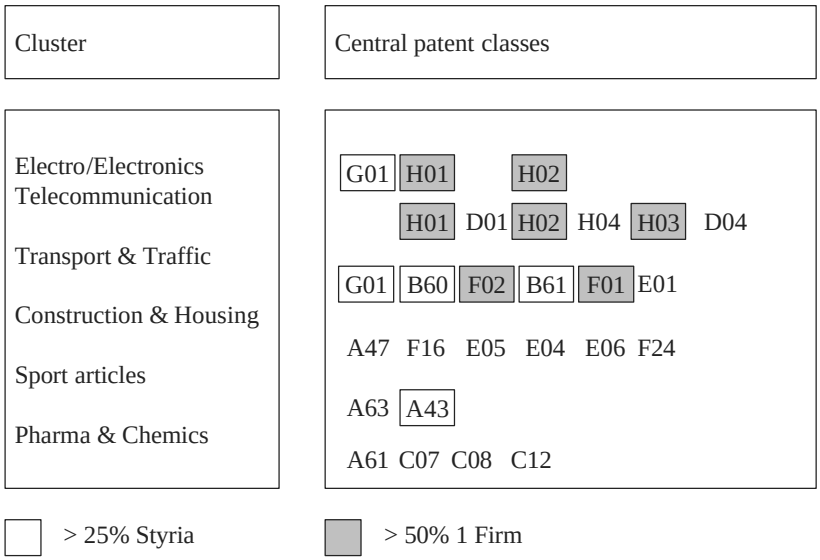


Figure 2.2 Technological Clusters within Styria (Source: Steiner et al. 1996)

In figure 2.2 those patent classes are marked which have a strong representation in Styrian firms (i.e. more than 25% of the patenting firms are from Styria); in the two clusters of construction & housing and pharmaceuticals & chemicals Styria is only weakly represented, but the electro/electronics and transport clusters are dominated by Styrian firms (the numbers represent specific patent classes such as F02 = internal combustion engine or H03 = electronic circuits). This again can be interpreted in support of the existence of regional clusters: technologically similar firms are regionally concentrated and form the basis for technological spill-overs and positive external effects of knowledge diffusion.

Yet these basically positive results (from a Styrian perspective) have to be qualified: rather small technological niches within these fields play a dominant role; it is mostly small and medium sized firms which concentrate on a specific field of technology within the patent class and, more important, the number of firms is rather small, i.e. many patents are performed by a limited group of innovative firms (more than 50 % of the patents are from one single firm) so that the potential for spill-overs is reduced.

2.2.2 Organisational learning within clusters

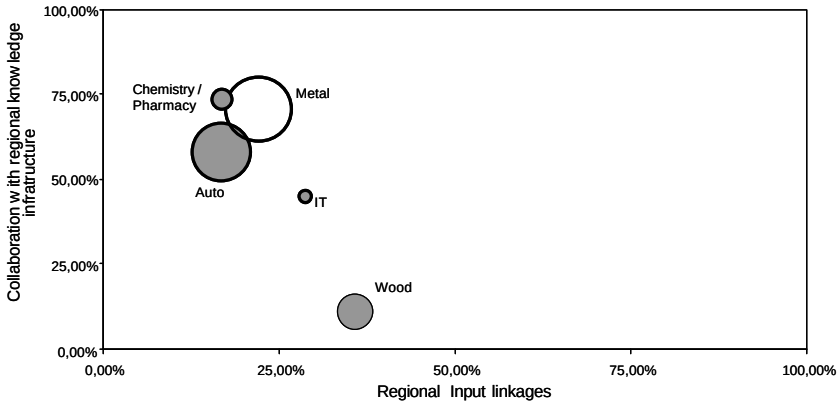
A further approach used concepts of organisational learning to identify forms of knowledge exchange within Styrian clusters and focussed on firms within the material and metal processing sectors. Qualitative interviews and a baseline survey were employed to identify different forms of firm specific knowledge acquisition, technology spill-overs and cluster specific inter firm collaboration and learning (Steiner/Hartmann 1998).

At the firm level learning by doing could be identified in most cluster co-operations in the qualitative investigations as well as in the survey carried out. In addition to these findings spill-over effects that are present at the cluster level could be detected. The most important sources of spill-overs identified were ‘waterholes' (informal meeting places), training sessions and seminars, and the incorporation of new members into the firms were identified.

Yet beyond these more or less agglomeration economies-like spill-overs additional inter firm links were identified. Here different concepts and approaches to ‘organisational learning’, such as lower and higher level learning (for these concepts see Argyris and Schon 1978, Dodgson 1993), were used. In the identified networks the member firms were all able to perform in particular higher level learning activities with such contents as technological learning through intense joint R&D efforts, management learning through the continuous improvement of the routines and procedures carried out together and marketing learning through the development of new products together with the clients. Thus clusters may be characterised as learning organisations when learning at the inter firm (cluster) level is present. The findings of this case study presume indeed that clusters are acting as learning organisations albeit loosely structured organisations in most cases.

2.2.3 Knowledge exchange within clusters

A further step to gain insights into forms of knowledge exchange and management used a combination of hard data (trade linkages provided by the above cited regional I-O-model) with soft data showing the collaborative behaviour of the firms in regard to knowledge exchange with the knowledge infrastructure of the region (again gained through a survey and in depth interviews). Close intensive collaborative links to regional universities or R&D Institutions ensure a swift exchange of innovations. In order to examine how learning and knowledge transmission within clusters takes place, the special forms of collaboration and cluster related activities, the inter firm learning behaviour, the diffusion of tacit knowledge, and prevailing learning systems were especially under scrutiny.



(Source: *Steiner / Hartmann 2001)*

Figure 2.3 Regional supplier linkages and knowledge intensive collaborations within the Styrian clusters

The empirical evidence of the analysis of this immaterial linkages based on the prior input-output relations of the clusters (as mentioned above) revealed again quite different forms of learning and knowledge management within the 5 clusters: Figure 2.3 reveals quite different intensities in these contacts with the regional knowledge infrastructure. The figures on the x-axis presenting the percentage of inputs of the clusters coming from within the region (indicating rather informal ways of knowledge exchange), the y-axis the percentage of firms within the clusters pursuing regular contacts with

universities and R&D institutions; the size of the circles indicates the number of firms within each cluster. The automobile cluster e.g. showed a rather strong orientation to collaborations with the regional knowledge infrastructure; within this cluster knowledge is created and shared mostly in an organised way that reflects also the highly structured activities in supplier networks within the automobile industry. As a contrast the wood/paper cluster relies on more informal learning activities on an interfirm basis instead of collaborations with the regional knowledge infrastructure. The chemistry cluster again reveals a very different learning style: it collaborates very intensively with the regional knowledge infrastructure (Steiner/Hartmann 2001).

2.3 Some interpretative remarks

What do the different approaches and empirical results tell beyond the direct messages of figures:

- There is no uniform methodology and no single one way to analyse clusters; it depends on the perspective from which we look at them.
- Clusters have different dimensions; beyond material linkages immaterial forms of knowledge exchange exist which via in depth interviews and surveys can be made tentatively visible.
- This exchange assumes different forms; technological spill-overs, formalised ways of getting knowledge via regular contacts to the regional knowledge infrastructure, informal ways of (more or less) ad hoc communications.
- Firms within different clusters do behave differently; also in their ways of gaining access to knowledge.
- Yet these forms of knowledge sharing are influenced by the clusters themselves; they influence the behaviour and they act as institutions to foster the exchange of knowledge.

This leads to further reflections on the specific character of clusters and the economic functions it can fulfil.

3 The role of institutions, organisational learning and social capital in knowledge creation

The complexity of co-operation (Axelrod 1997) and of knowledge sharing is a phenomenon that cannot be explained solely out of individual decision making strong rationality is not sufficient for relatively effective economic behaviour. Individual persons and economic units do not think out good practice for themselves but do rather well what is conventional in the context (Nelson/Sampat 2001). In our context this means that knowledge creation and technology management is not an automatic outcome of individually rational behaviour but needs guiding institutions such as clusters and networks.

The recent renaissance of interest in institutions as a factor shaping economic performance has implications also for the creation and sustained existence of clusters and networks as a tool for knowledge management and as learning organisations within and across regions. The point that is made here is that the institutional perspective serves to identify additional factors influencing economic behaviour leading to co-operation and that human behaviour has to be understood as a social and cultural phenomenon which is therefore influenced by institutions shaping this behaviour (Hodgson 1998).

This perspective in the context of clusters comprises several roots of institutional thinking:

- In the context of evolutionary economics, drawing on Nelson/Winter (1982), Nelson (1998) and Nelson/Sampat (2001), institutions can be regarded as ‘social technologies’. Human action in the form of an ‘economic activity’ sometime goes inside economic units, and sometimes between them. Social technologies involving ‘patterned human interaction’ become institutions as soon as they are regarded by the relevant social group as standard and become attractive ways to get things done. In contrast to a recipe that is anonymous regarding any divisions of labour (‘physical technologies’) the mode of coordination, once there is a division of labour, is regarded as a ‘social technology’, we proposed that the former is what

scholars often have in mind when they think of ‘physical technology’, and we proposed that social technologies are what many scholars have in mind when they use the term ‘institutions’ (Nelson, 2001, p. 24). In Nelson’s perspective this concept encompasses ways of structuring activity not only within particular organisations but also across organisational borders: They are not so much constraints on behaviour but rather an effective support as soon as human cooperation is needed.

- In close connection with this approach is the emphasis of a knowledge-based economy where there is a ‘pervasive interactivity and interconnectedness between elements of systems, pointing to the importance of linkages (or the effects of their absence) within innovation systems (and broader socio-economic systems).’ (Bryant 2001, p. 369) These systems operate at several largely self-organizing hierarchical levels, which yet are never fully isolated. Clusters at the local level are one specific perspective in this system. They are a special phenomenon within the social nature of the innovation process.
- An additional perspective arises out of the ‘New Institutional Economies’ and the specific role knowledge and knowledge sharing play within this context. The basic message here is first that those institutions that enable social interactions cannot be explained out of the economic division of labour (Richter/Furubotn 1999) and that voluntary action need a framework of shared institutions (Helmstädter 2003). To this adds the phenomenon of knowledge sharing demanding institutional specificities (Helmstädter 1999). Here the proposition is that knowledge sharing demands other and additional institutions than are need for the division of labour. In contrast to the division of labour the sharing of knowledge has a different object, – instead of goods it is knowledge; different forms of interaction – instead of transaction it is sharing; a different mode of interaction – instead of competition predominantly cooperation (Helmstädter, 1999, p. 44). The interest here lies in the institutions that make knowledge sharing efficient.

All these strands of institutional thinking in the context of knowledge creation and sharing emphasize that connectivity cannot be effectively coordinated by conventional

markets. Clusters and networks are learning organisations and among the non-market devices by which firms seek to coordinate their activities with other firms and other knowledge generating institutions. Thus, clusters are subtle and differentiated institutions for co-operation and interactive learning and connectivity of technology producing institutions should be a central concern of policy. The strategic significance of institutions lies in the economies that its functioning provides: They can lead to the reduction of transaction and production costs, increased trust among economic and social actors, improved entrepreneurial capacity, increased learning and relational mechanisms, reinforced networks and cooperation among the actors.

The basic interdisciplinary results for individual learning processes stress the importance of institutional arrangements for the generation of knowledge and learning networks, which are not all available in the markets (Maskell and Malmberg 1999, Navaretti et al. 1998, Lawson and Lorenz 1999):

- to reduce the uncertainty about the experiential knowledge of others (of other companies, research institutes etc.)
- to increase incentives for medium-(long) term investments into diffusion channels, e.g. common codes, products, for a, between the different participants in a network
- to develop and adapt research, production, distribution, and after sales strategies to increase the absorptive capacity of new information by the other participants
- to raise the specificity of development, processing and diffusing knowledge within the network to strengthen incentives for the participants to concentrate their investments in the network and protect new knowledge against competing networks

Learning can be considered as a social process of ongoing development embedded in a socio-cultural (regional) context. In particular, organisational learning is the conscious attempt of the part of the organisation to retain and improve competitiveness, productivity and innovativeness in uncertain technological and market circumstances (Argyris and Schon 1978, Dixon 1995, Dodgson 1993, Duncan 1979, Fiol and Lyles 1985, Hedberg 1981, Nevis et al 1995, Pedler et al. 1991, Shrivastava 1983, Stankiewicz 2001). Organisational learning takes place when the organisation develops

systemic processes to acquire, use and communicate organisational knowledge, as learning is conceived as something, that should deliberately be pursued by the organisation and its members. Thus, organisational learning may be recognised by the existence of learning systems that are independent of the individuals.

Theories of organisational learning emphasize the cognitive processes among organisational agents, the role of rules and the interactive processes of learning in loosely coupled organisations. Learning can also be seen as one type of adaptation (absorption capabilities, accumulation capabilities) of an organisation to its environment. One of the key (and elusive) concepts underlying the analysis of learning networks is that of 'integrative capabilities'. That is to say, one of the key features of interactive learning is that different fragments of knowledge, competencies, etc. have not only to be accessed but also integrated in specific configurations. So far, the available literature has focused mainly on the processes through which knowledge is accessed and acquired, much less on how it is actually integrated. Our case studies in chapter 2 hint that there are very different mechanisms at work. There is suggestive evidence that the ways different agents frame available fragments of knowledge and information constitutes a major source of differentials in competitiveness and leads to strongly differentiated performances. At the same time, the transfer of 'integrated knowledge' appears to be much more difficult than the transfer of specific pieces of knowledge and information, even within the same firms and organisations.

Integration or 'compatibility', however, is intensely linked with the availability of common diffusion channels, i.e. standards of communication, codes of expressing experiences etc., which emerge by common and repeated routines and intended investments. Whereas, in principle, explicit and codified knowledge may be traded on markets, tacit knowledge is untradable and requires non-market allocation (for instance, within the firm, in the context of inter firm networks or forms of co-operation between private agents and public institutions). Clusters and networks can then be regarded as economic clubs acting to internalise the problems of effective knowledge transmission. To this degree, they are a substitute both for formal markets and organisational integration.

In the literature, one often finds the concept of 'locally bounded knowledge spill-overs' (Feldman 2000). According to some contributions, knowledge 'is in the air' (at least locally) and everybody benefits (at least in principle) by the existence of such a 'stock of knowledge', as it is embodied for example in universities and research centres, other firms, etc. Others argue that knowledge is transferred mainly through face to face contacts, formal and informal conversations, etc. While both mechanisms are certainly important, these representations are too extreme and may fail to capture some fundamental processes and channels through which knowledge is exchanged and created. It might be argued, for example, that spill-overs are much less automatic than described in the literature and they are organised and mediated by a variety of other institutional devices, including the labour market, markets for technologies, labour mobility, etc. As hinted at in one of the case studies of chapter 2, the technological spill-over via 'agglomerations of patents' are just an assumption (and do not present 'clusters' in the precise sense of the concept).

Clusters and networks as a specific expression of innovation processes can be regarded as a form of Coase institution (Coase 1992) that tries to integrate the positive external effects of innovation, technological knowledge and development activities (Coleman 1988, Keeble et al. 1999, Lagendijk and Cornford 2000, Steiner 2002). Critical in this context, the concepts of trust and social capital are increasingly being applied in attempts to understand the underlying institutional features of clusters and network. Social capital is the more inclusive concept which, according to one popular definition (Putnam 1993) 'refers to features of social organisation, such as trust, norms and networks, that can improve the efficiency of society by facilitating co-ordinated actions'. Social capital can be seen as a conceptualisation of the glue that facilitates transactions, cooperation and learning in an uncertain world.

The creation of such institutions may be endangered/put into question by high transaction costs (Williamson 2000). Yet because of the specific character of technological knowledge, its asymmetric and tacit character these transactions have to be mediated by non-market methods, primarily through networks and other forms of arrangement between organisations and individuals, procedures which build trust and

work to limit the damaging consequences of asymmetric information. So we need the support of clusters by policy, reducing transaction costs.

4 Clusters and networks as evolving social technologies

One important aspect of the institutional approach is the necessity of clusters as an coordinating institution, knowledge creation and knowledge sharing is not an automatic outcome of individual rational behaviour. In the previous chapter it was suggested that clusters and networks are a useful concept for an analysis of factors moulding economic performance in the sense of supporting the diffusion of knowledge. But it is of equal importance to emphasize that also institutions, here: clusters and networks, are not automatically just there but that they are the result of a evolving process shaped by policy activities and entrepreneurial behaviour responding to new challenges. This implies a changing character of institutions in support of knowledge management. If we regard drawing again on Nelson/Sampat (2001) and Nelson (2001) institutions as evolving 'social technologies', they can be interpreted as a form of productive pathway co-ordinating human action and combining different factors that are important for growth such as technical advance, physical capital, growth of human capital. These social technologies are co-evolving with new physical technologies and are therefore in a constant need to change themselves. Social technologies are an answer to the problems of achieving agreement and coordination in a context where there is a collective interest. They combine different additional elements that are important for regional development and economic growth.

In developed industrial economies, producing for open world markets, innovation and sustained productivity growth is less based on material infrastructure and capital than previously (European Commission 1995 and 1999). This kind of economic setup and restructuring was predominant in the post war period through to the 1970s. This basically meant the introduction of modern machinery and equipment in order to realize physical productivity gains. This kind of restructuring was relatively easy and resulted

in relatively fast catch up or advances for Europe and the less developed countries of the world vis-à-vis the US.

Nelson (2001, 26 f), referring to Chandler's great studies about the rise of mass production in the United States in the last part of the 19th century and with enormous productivity growth, emphasised that also these changes leading to developed industrial economies involved new 'social technology'. New modes of organizing businesses were required to take advantage of the new opportunities for 'scale and scope': hired professional management, new financial institutions and associated markets, business schools.

Styria may serve as an example for a change in 'social technologies' between the early 70s up to the new millennium: At the beginning a typical example of an old industrial area with a heavy concentration of iron and steel production it became a technology oriented region in the second half of the 90s. This was made possible by a new design of policy strategies and instruments (Steiner 2003). Styria as the region with the most urgent problems of old industrial areas was the first region deliberately to pursue such a cluster strategy. It was partly a strategy to create and support a new, albeit in some respects complementary, automobile cluster in the southern part of the region in addition to the old declining concentration of steel manufacturing in the northern part of the country. As outlined in the case studies additional cluster potentials were found and promoted. Communications in the form of consulting, delivery services and moderating has become a new task of the mostly new institutions per se: building and supervising trust relations, forming new organisations, initiating learning processes and monitoring the outcomes were the essential instruments in the promotion and support of network relations.

Yet all this meant a change in policy regimes and accompanying 'social technologies'. The innovation process since the 80s and 90s in Europe was essentially marked by differing forms of innovative milieus and their supporting institutions: Here innovation and productivity gains are based on subtle forms of cooperation where the creation of new knowledge implies an intense process of interaction. This process is now repeating itself at a European level with the EU economic lagging regions and the CEE countries preparing for accession to the EU. Yet these forms of catching up still leave a large and

persistent ‘innovation gap’. This may be explained by the fact that the process of catching up after having reached a certain level through physical productivity gains, has to rely on other forms and processes, demanding more time and being based on additional strategies and instruments. In particular, the transition from a traditional model of industrialisation, based on economies of scale and capital investment, to a modern model of industry characterised by flexibility and innovation represents a challenge both for the EU economic lagging regions and the accessing countries.

An example for a persistent ‘innovative gap’ due to a lack of an accompanying change in adequate ‘social technology’ are the new German states. From 1991 (the first year with reliable national accounts after reunification) to 1996 an extremely fast process of convergence of eastern towards western productivity levels set in rising from 30 percent of western productivity up to 60 percent. Yet since that point of time not much has changed, in 2000 still eastern labour productivity amounted to not more than 60 percent of the West (Paqué 2003). This fast catch up can be explained by massive public infrastructure investment, a boom in the construction industry, a restructuring of manufacturing industry, it was an accelerated process of traditional industrialisation based on mostly material infrastructure and capital investment. Yet the more subtle form of innovation policies based on ‘knowledge creation’ by developing an indigenous innovative industrial base in the regions on a sufficient scale failed so far: ‘Nevertheless the problem remains that most urban areas in the east do not yet have the dense network of complementarities between public and private research that is so typical of fast growing innovative agglomerations. Casual observations suggest that there are threshold levels of agglomeration density that have to be surpassed before a self sustaining cumulative process of innovation driven growth sets in, with direct investment surging.’ (Paqué 2003, p. 113)

What makes the debate on networks and clusters more than just a discussion on specific forms of regional production systems are recent insights into the nature of innovative processes within international networks, the role of interactive learning and the importance international knowledge networks play in the process of European integration and cohesion also in the context of European enlargement. The basic message is that innovative milieus and their institutional background in forms of

clusters and networks are a decisive precondition for the sustainability of innovation, and hence for sustained increases in productivity.

This argumentation may be broadened and lifted especially in the context of the transforming economies to more general aspects of the role of institutions. One of the recently rediscovered aspects of institutions is its importance for reinforcing the rules of the game, especially with regard to the credibility of the rules and the credibility of economic policy. We have the spontaneous order of the market developing its own rules, yet there is also the need for the ruling hand of the state to guarantee the functioning of the market mechanisms. In this sense the new market economies are in need of a strong state: In these countries the rules of a market economy are sometimes not yet understood and not yet mastered, and governments are confronted with mistrust, such that their institutions do not yet work adequately (see Tomann 1999). M. Olson (1982) and M. J. Olson (1996) pointed to the fact that it is the institutional framework that explains national differences in income and the rise and decline of nations. These are factors which transcend the usual economic influences and which are elements of a civic culture. It is certainly true that the accession countries have created some of the new institutions necessary for a market economy, such as the constitutional protection of property, anti trust legislation and civil and commercial laws. Yet what are still lacking are the corresponding agencies, such as well functioning courts, a sufficient number of lawyers and a general trust in the workings of the judicial system. The creation of such a civic culture is only partly feasible through law and policy making, because it is formed, or forms itself, in the process of institutional development. Here we can make the distinction between legal property rights and intangible property rights. Intangible property rights are those rights for which we do not have a unequivocal legal definition, but which are especially relevant when dealing with long term contract problems.

5 Future challenges for policy and research

Clusters and regional knowledge networks can be regarded as evolving institutions for the coordination of these different but connected elements supporting the adoption of new technologies. They are a broad institutional concept responding to a change in the dominant form of production: a change from Fordist mass production to flexible specialisation calling for efficient means to co-ordinate firms in their sharing of knowledge.

Yet the patterned coordination does not come about automatically by individual human action, it is not an automatic evolutionary process. Also does policy not automatically render the necessary institutions. North (1990) pointed to the possibility of 'institutional obstruction' and to the potential failure of economies because of the lack of new institutions capable of adopting available productive technologies. Clusters and networks accordingly are necessary forces generating and sustaining cooperation and support of adoption of superior physical technology.

From a policy perspective it is a predominant task to assess the present state of technological and innovation policies with regard to these issues and develop strategies for an intensification of interactive learning processes and co-operation. It is necessary to indicate a set of policy recommendations for the creation of new hard and soft infrastructures or institutions, both at local and European levels, which can enhance the way in which knowledge and innovation networks existing in the most developed countries of the EU, may extend to the economic lagging regions in South Europe and the candidate countries in Central and Eastern Europe.

These policies aiming to promote knowledge and innovation networks should take into consideration the characteristics and differences in the European economic, social and institutional models, with respect to other world areas. In particular, the European economy is characterised by large regional income disparities and, while some regions are among the most advanced in the world in the adoption of new technologies, other regions have a high technology and productivity gap, increasing the risk of exclusion from transnational knowledge and innovation networks.

Moreover, the European economy is enriched by a wide diversity of social models and cultural and historical backgrounds. Thus the same policy framework may have different effects in different regions. In particular, the differences between the less developed regions in South Europe and the regions/countries in Central and East Europe have to be identified and studied (Cappellin/Steiner 2004).

From a research point of view, supporting these policy strategies, it is a challenge to show how the success of clusters in the most developed regions can be replicated elsewhere, especially in the case of the less developed regions in South and in Central and Eastern Europe. This raises the well-known problem of whether clusters can be artificially created. However, a more general objective of coming research is that to extend the lessons derived from the in depth analysis of knowledge and innovation networks in local clusters, in order to identify how interactive learning can occur at greater distance and promote a greater international/interregional integration between different national/local production and technology systems from the perspective of the model of the knowledge society.

It will also be important to analyse how the constraint of geographical proximity has been gradually relaxed and how learning processes are occurring on the base of the interaction between individuals/ organisations/institutions at a wider geographical scale. The challenge of globalisation and international competition justifies an effort aiming to remove the problems and obstacles hindering a tighter economic and technological integration between the countries/regions of Europe. In a theoretical perspective, the problem to be tackled by the research is that of finding ways to enlarge the geographical span of those interactive learning processes or knowledge spill-overs, which according to the literature are common when industrial and service activities are geographically concentrated in specific clusters or linked in local networks.

Thus we still have to investigate the key theoretical question of how important spatial proximity is for the sustainability of learning and innovation networks, and how the need for spatial proximity can be made compatible with the need for connectivity, in order to intensify European integration and cohesion and to bridge the gap between highly and low skilled in European economies.

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