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Cluster Renewal in Old Industrial Regions – Continuity or Radical Change?

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Abstract

The purpose of this paper is to explore conceptually the role of clusters for the economic recovery of old industrial regions. We will identify three types of cluster-based renewal, distinguishing between an innovation-oriented adjustment of mature clusters (incremental change), the emergence of new agglomerations in established industries (diversification) and the rise of knowledge intensive and high technology activities (radical change). It will be shown that each of these development scenarios for old industrial areas requires different firm strategies and presupposes varying degrees of changes in the region's knowledge infrastructure, its relational assets and institutional fabric, and its policy environment.

1 Introduction

The aim of this paper is to deal with the cluster approach in the spatial context of old industrial areas. Clusters are defined here as geographic concentrations of firms specialized in a particular field and horizontally and vertically related companies. Whilst not ignoring the legacy of clusters in mature industries, it will be shown that it has the potential to be a useful concept for the renewal of these regions. We intend to critically examine different kinds of approaches in this respect.

In the past years clusters have become a subject of major interest for scholars in regional studies and in related fields. Much of the ever growing literature on this topic emphasizes that the spatial concentration of similar or related firms is a key source of competitiveness encouraging innovation and learning at local and regional scales (Porter 1998, Feldman 2000, Keeble and Wilkinson 2000, Cooke 2002). This one-sided view on the benefits of clusters has recently been criticized by several authors (Martin and Sunley 2003, Trippel 2004, Chapman 2005, Hassink 2005, Hassink and Shin 2005) who stress that more attention should be devoted to the possible risk, fallacies and harmful effects of geographically concentrated industries.

Old industrial regions can, in fact, be regarded as a prime example of the negative side of clustering, uncovering the “failure modes” (Enright 2003) of a strong spatial concentration of industries in particular regions. Clusters are a main reason why these formerly dynamic and prospering regions have experienced an economic downturn (Cooke 1995a, Boschma and Lambooy 1999, Tichy 2001, Tödtling and Trippel 2004), challenging the prevailing view that clusters are always and overwhelmingly favourable for regional economic development.

Although we do not neglect this critique, we will argue here that clusters can play a key role for the renewal and recovery of old industrial regions. These areas face the

challenge to reposition their economies by promoting a transition towards more knowledge intensive forms of development. To scrutinize the relationship between clusters and regional renewal constitutes the core theme to be addressed in the following. The principal questions to be dealt with include:

- Which types of a cluster-based renewal in old industrialized regions can be distinguished and observed?
- What are the preconditions, supporting factors and key mechanisms for each type of regional change?

The remainder of this paper is organized as follows: Section 2 establishes a theoretical basis for analyzing these questions by identifying clusters as a main building block of regional innovation systems. Section 3 provides an overview of the key challenges of old industrial regions exposing its main socioeconomic problems as a fundamental innovation dilemma. This is followed by an examination of the prospects and conditions for a cluster-based renewal of old industrialized areas in Section 4. Finally, in Section 5 the key arguments are summarized and conclusions are drawn.

2 Clusters and regional innovation

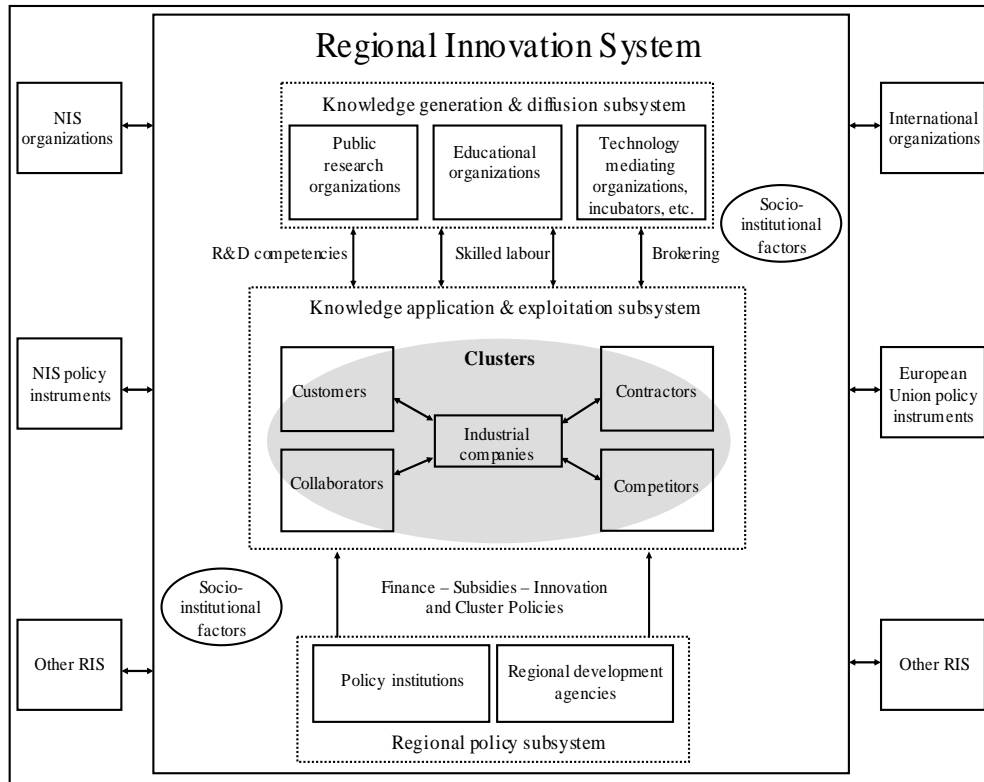
In order to analyze the problems of old industrial regions and to examine the conditions and critical factors for a recovery of these areas we propose a theoretical framework that highlights the embeddedness of clusters in the innovation setting of the region. From this perspective, clusters are regarded as an integral part of regional innovation systems (RIS). The RIS approach (Autio 1998, Doloreux 2002, Cooke et al. 2004) provides a useful conceptual basis for the purpose of this paper. Figure 1 depicts the architecture of

a RIS, revealing that clusters represent the key structures of the knowledge application and exploitation subsystem as it includes the industrial companies, their clients, suppliers, competitors as well as their cooperation partners. These firms and clusters are surrounded by a variety of organizations that are specialized in the production of knowledge and skills and in their diffusion and transfer to the business system. The main players here are public research institutes, technology mediating organizations (technology licensing offices, innovation centers, etc.) and educational bodies (universities, polytechnics, vocational training organizations, etc.). These actors constitute the knowledge generation and diffusion subsystem (i.e. the region's knowledge infrastructure). The development of clusters and regions is also influenced by the regional policy system and its innovation and cluster promotion activities. These three subsystems of a RIS are embedded in a common socio-institutional and cultural setting that is specific for the region. Of key importance in this respect are factors such as dominating patterns of behaviour, values and routines, the prevailing culture of cooperation, or also attitudes towards innovation and technology. Finally, it is important to note that a RIS has various links to national and international actors and innovation systems. These include both the extra-local contacts of regional firms that provide access to ideas, knowledge and technologies, which are not generated within the limited context of the region (Camagni 1991, Oinas and Malecki 1999, 2002, Bunnell and Coe 2001) and policy measures and actions undertaken at the national and European levels that shape the region's development and dynamics (Cooke et al. 2000).

What follows from this perspective is that the development problems of old industrial regions can only be fully understood, if the analysis is not confined to the business sector. The activities and orientation within the subsystem of knowledge generation and diffusion, the role of regional policy agencies and the prevailing mode of state intervention as well as the extent and nature of linkages of these subsystems to the

business sector and the socio-institutional fabric have also to be taken into consideration.

Figure 1: Clusters and their embeddedness in regional innovation systems



To link the analysis of the evolution of clusters and regions to the conceptual framework of RIS also enables us to identify critical conditions for the recovery of old industrial areas. The restructuring of the business sector (i.e. the knowledge application and exploitation subsystem) is only one aspect of such revitalization processes. The key idea that will be proposed below is that a cluster-based renewal of old industrial regions is critically dependent on changes in the other RIS subsystems and the relational and institutional fabric of the region. Consequently, the capacity of the region to transform the whole RIS turns out to be the decisive factor for renewal processes.

3 The innovation dilemma of old industrial areas

After almost three decades of research there exists a vast range of literature on the evolution of old industrial areas, documenting their rise, fall and, occasionally, revitalization in recent years (see, for example, Hamm and Wienert 1990, Häußermann 1992, Cooke 1995a, Chapman et al. 2004, Cooke et al. 2004, Hilbert et al. 2004, Sadler 2004, Hudson 2005). As we have argued elsewhere (Tödtling and Trippel 2005) the development problems of old industrialized regions are strongly related to the fact that these areas suffer from a fundamental innovation dilemma that becomes manifest in a lack of radical innovation. Indeed, many studies have shown that innovation activities in old industrial areas often follow mature technological trajectories and are frequently of an incremental character. Process innovation dominates over systematic efforts to introduce (radically) new products into the market (Tödtling 1992, Cooke 1995a, Cooke et al. 2000, Tichy 2001). We suggest that this diagnosis has to be interpreted against the background of particular deficiencies of the regional innovation system prevailing in these areas (see also Tödtling and Trippel 2005). The failures of the regional innovation system of old industrial areas have three main sources, including

- a narrowly specialized and declining industrial base,
- an overspecialized knowledge infrastructure, and
- various forms of lock-in.

Several authors have argued that clusters have to be considered as a key reason for the downturn of old industrial areas (Grabher 1993, Steiner 1998, Tichy 1998, 2001, Tödtling and Trippel 2004, Trippel 2004). This explanation rests on reflections on the danger of economic monostructures, suggesting that a narrow and specialized economic base could imply that the fate of the whole region is intrinsically tied to that of the

cluster. Indeed, there is ample evidence that old industrial regions exhibit a too narrow specialization in mature clusters experiencing decline.

It is, however, not only the subsystem of knowledge application and exploitation that hampers regional innovation and learning in old industrial regions. The poor innovation capabilities of these areas are reinforced by some specific characteristics of the knowledge generation and diffusion subsystem. The key point in this context is that this subsystem is often too strongly oriented on the traditional industries and technology fields of the region (Cooke et al. 2000, Kaufmann and Tödting 2000). Moreover, in many cases a supply oriented approach of technology transfer can be identified which reaches traditional and larger firms better than the smaller and young ones (Kaufmann and Tödting 2000, Asheim et al. 2003). This holds particularly true for old industrial areas based on heavy industries. The demand of small companies and young firms is often not met adequately and interactive learning is rarely achieved (Asheim et al. 2003).

Finally, there seems to be a widespread agreement in the literature that old industrialized regions are characterized by the existence of different types of lock-ins (Grabher 1993, Hassink 2005, Hassink and Shin 2005). Thus, the focus is on deficiencies of the relational and institutional fabric of regional innovation systems and clusters. Grabher's (1993) often cited elaboration of the concept of lock-in is based on a distinction between functional lock-ins (too strong inter-firm networks), cognitive lock-ins (homogenization of world views), and political lock-ins (strong, symbiotic relationships between public and private key actors hampering industrial restructuring). The lock-in concept has proved to be a sound theoretical basis for investigating these factors and their relations to low levels of adaptability, learning and innovation in old industrialized areas (Morgan and Nauwelaers 1999, Wößmann 2001, Isaksen 2003, Hassink and Shin 2005).

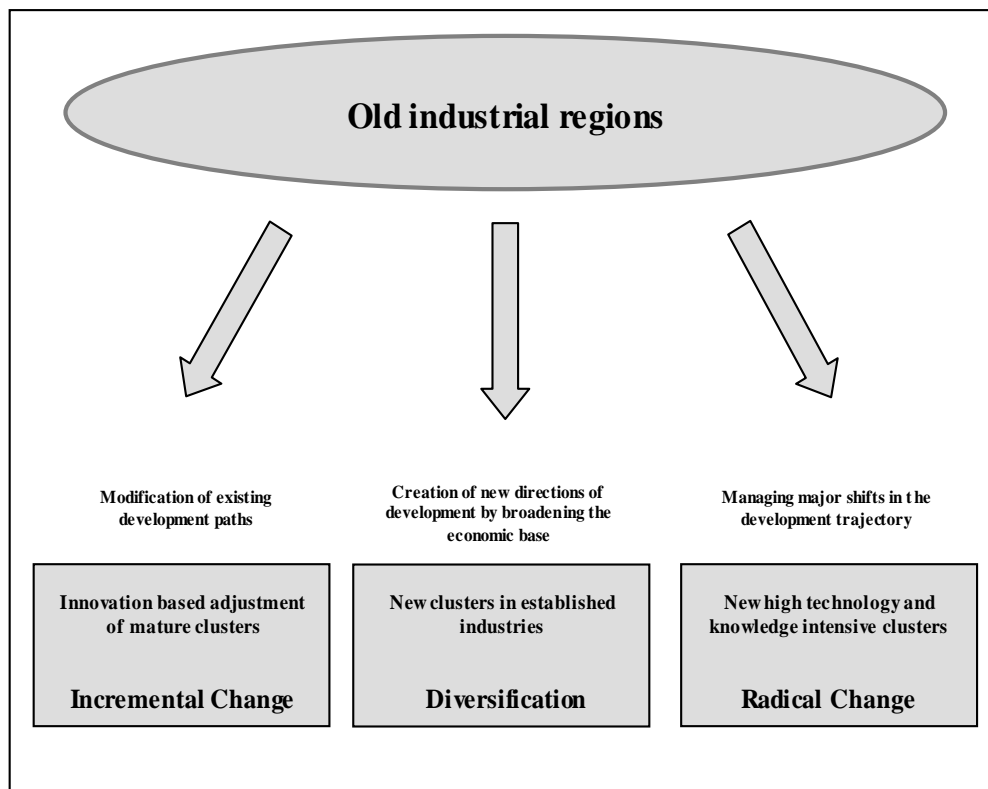
4 Challenges and prospects for a cluster-based renewal of old industrial areas

As old industrial regions suffer from an overspecialization in mature, declining industries they face the key challenge to revitalize these clusters and to build up new ones. In this section we are going to deal with the prospects for a restructuring and recovery of old clusters and for the emergence of new clusters. The aim is to identify specific conditions and critical factors for such a cluster-based renewal of old industrialized areas. This will be illustrated with examples of various old industrial regions in Europe and North America. The following types of renewal can be distinguished (see Figure 2):

- old clusters experiencing innovation-based adjustment processes,
- diversification into established industries that are new for the region, and
- new clusters based on knowledge intensive industries.

The differentiation between these types of clusters is important because they reflect varying degrees of regional renewal. An adjustment process of old clusters represents only an incremental change. The development of new clusters in traditional industries is a bigger step. The most fundamental change is brought about by the emergence of a really new cluster, i.e. the breeding of high-tech or knowledge intensive industries such as environmental technology or information and communication technologies.

Figure 2: Types of cluster-based renewal of old industrial areas



It is important to note that these types of cluster-based renewal are not mutually excluding phenomena. On the contrary, in many old industrial regions we might find a co-existence of traditional and modern clusters, indicating an overlapping of various development trajectories.

4.1 Incremental change: Innovation-based adjustment of old clusters

The revitalization of traditional clusters can be associated with an incremental, modest change in old industrial regions, modifying their existing development trajectory rather than altering it. At the core of such a transformation is a reconquering of competitiveness in the ancestral branches brought about by a “creative recycling” and further development of the existing regional knowledge base. An innovation-based restructuring of old clusters could embrace different forms, ranging from a shift from

mass products towards specialities and higher value products as is has been observed in the Styrian metal cluster (see Tödttling and Trippl 2004, Trippl 2004) to the introduction of new technologies and organizational practices as it was seen for example in the Swiss watch making industry (Maillat et al. 1997) and the automotive cluster in Ontario (Gertler and Wolfe 2004).

The capacity of a cluster to escape from lock-in and to regain its competitive position is critically depended on the nature of the restructuring strategies followed by the large, endogenous firms (Trippl 2004, Schamp 2005). In most cases a simple cost reduction response to a severe crisis is not a viable way, whereas a search for market niches and an orientation on innovation promises better results (Cooke 1995a, Maillat et al. 1997, Chapman et al. 2004). If the firms succeed in enhancing their competencies to operate innovatively within their existing markets and to move to the upstream end of their industries, the accumulated knowledge and skills are redeployed in a creative way. To take the innovation path, however, often presupposes a major reorganization of the large dominating companies. Organizational innovations and changes such as a decentralization (Maillat and Kebir 2001) – and in some cases a privatization – of these firms and an enforcement of innovation related functions (such as R&D) and management tasks might be regarded as crucial factors in this context (see the case of the metal cluster in the region of Styria as described by Tödttling and Trippl 2004). It would be too simplistic, however, to assume that an innovation-oriented restructuring of leading firms could always be equated with the rejuvenation of traditional clusters. This is only the case, if the core activities of the firms stay within the region and are not relocated abroad. In the latter case we might see a successfully restructured firm but a decline of the respective region.

The strong focus proposed here on the restructuring, reorganization and modernization of large endogenous firms dominating the cluster does not imply that

exogenous impulses are negligible. On the contrary, also subsidiaries of foreign companies can be an engine of change within old clusters. Provided that they do not remain “cathedrals in the desert” but become embedded in the local industry, such companies can be an important source of new knowledge. Gertler and Wolfe (2004), for example, report that transplant firms have contributed significantly to the enhancement of the innovation capacity of the automotive cluster in Ontario by diffusing best practices in the fields of quality control, simultaneous engineering, inventory management, and worker participation in design and production. Similar processes have been observed in Detroit, where Japanese firms have played a crucial role for the revitalization of the automotive cluster by transferring new management practices and production technologies to the region (Florida 1995).

To take into consideration firm strategies, however, is not enough to capture the complexity of cluster adjustment in old industrialized areas. The activities of research organizations, educational institutions and technology transfer agencies can be vital to the restructuring process of mature industries, pointing to the importance of the region’s knowledge infrastructure. Compared to the other development paths discussed later, an innovation-oriented revitalization of traditional clusters in most cases does not presuppose a far reaching transformation of the knowledge generation and diffusion subsystem. The changes required are more modest in nature, being largely about an adaptation of existing structures. This has at least two dimensions: On the one hand, there is a need of research and educational organizations that support firms to introduce new technologies and to move towards an upgrading and improvement of their products by providing specialized knowledge and highly qualified labour. Thus, to adapt the knowledge infrastructure can have an essential impact on the recovery of old industrial areas, leading to the application of new technologies in traditional sectors. The metal cluster in the region of Styria (introduction of laser techniques and new compound

materials) and the watch industry in the Swiss Jura Arc (introduction of microelectronics) demonstrate the significance of rejuvenating by building bridges to new technologies (see Maillat et al. 1997, Tödting and Trippel 2004). In such cases new technological trajectories may be opened up for traditional industries. On the other hand, in many cases a stronger orientation of knowledge providers to the requirements of smaller firms is also crucial. As outlined above old industrial areas hosting heavy industries are often characterized by a supply driven approach of technology transfer which reaches larger firms better than the smaller ones. A cluster wide adjustment can only be realized if restructuring and innovation are not confined to the larger companies. Smaller firms must also be enabled to improve their innovation capabilities. This underscores the importance of improving the existing technology transfer system by placing more emphasis on the needs of smaller companies.

Finally, as already outlined above, changes in the socio-cultural fabric and the relational assets of the cluster and its hosting region are also necessary. Breaking out of lock-ins and overcoming various forms of rigidities are a key precondition for the recovery of mature clusters (Morgan 1997, Lagendijk 2000). To get rid of the institutional legacy of the past and of ossified networks, however, might be the most difficult aspect in the process of cluster regeneration. Drawing on evidence from the North East England, Hudson (2005), for example, has shown convincingly that traditions and old patterns of behaviour and thought can be long-lived, indicating the negative impact of institutional persistency on regional adaptation and change.

Institutional unlearning encompasses several dimensions: First, there is the need of a renewal of business networks by forging a substitution of hierarchical inter-firm linkages by more innovation-oriented interactions leading to regional collective learning and innovation processes. This is not an easy task given the low level of trust in old industrial regions. Nevertheless, several authors have suggested that promoting the

emergence of social capital in such areas is not an impossible endeavour (Sabel 1992, Morgan 1997, Storper 2002). Second, a substantial amount of policy learning is crucial for mature clusters to follow an innovation-oriented development path. To break up petrified policy networks and to unlearn old patterns of intervention such as the provision of subsidies for declining industries in favour of new growth coalitions and modern approaches of governance are crucial in this respect. To refer once again to the experiences of the region of Styria such changes are clearly visible. We have seen a withdrawal of the state from the cluster as an owner of the large companies and permanent source of industrial subsidies and its re-emergence as promoter of research-industry interfaces, thus facilitating networking and collective learning activities (Tödting and Tripl 2004).

4.2 Diversification: New clusters in traditional industries

Diversification as a mechanism of the renewal of old industrial regions involves a more significant change than the regeneration of mature clusters. It opens up new directions of development, broadening the economic base of the regional economy. Diversification is defined here as the emergence of clusters in established industries, that are, however, new for the region. Examples include the automotive cluster in the region of Styria (Tödting and Tripl 2004, Tripl 2004) or the automobile and electronic industries in Wales (Cooke and Morgan 1998, Cooke 2004). The rise of new clusters in such industries can take different routes.

There is the way of exogenously driven development where diversification occurs through inward investment. The potential role of foreign companies as key agents of change is highly contingent on the specific nature of their activities. Classical branch plants of multinational companies seldom serve to encourage the birth and growth of

innovative clusters in established sectors. Foreign companies, in contrast, that feature high value-added functions and embed themselves in the local economy by forming long-term linkages to regional suppliers and partners can give an important impetus to the emergence of a new complex. Processes like these have been observed in Wales where the arrival of global transplant firms and their subsequent embedding in the local economy has fuelled the creation of clusters in the automotive and electronic industries (Cooke and Morgan 1998, Lagendijk and Charles 1999, Cooke 2004). The attraction of foreign direct investment has been combined with various measures aiming at establishing an endogenous supplier base with strong innovation capabilities and the promotion of networks and vertical supply chain links between foreign firms and the indigenously developed supplier companies. Thus, the critical factors for successfully constructing an innovative cluster around the operations of foreign companies are the nature of their activities and the type of their interactions with local firms. An exogenous-led cluster building is, however, not without danger. The case of the region of Wales is instructive to demonstrate that the withdrawal of foreign companies from the cluster often has negative impacts for the region (Cooke 2004).

It would be misleading, however, to argue, that diversification is only driven by foreign direct investment. This type of cluster-based renewal can also have endogenous sources. In this case the emergence of a new cluster is based upon sectoral diversification activities of home grown firms that are capable to move into new sectors by redeploying existing assets and capabilities. It goes without saying that a new cluster can only be built up, if such diversification strategies are regionally based. This is not always the case. The case of the Ruhr Area underscores the importance of the geographical focus. Several steel groups diversified into the mechanical engineering industry, plant construction and supply to the motor industry and ship-building,

whereby many of these activities are located outside the region (see Rehfeld 1999, Hilbert et al. 2004).

The emergence of new clusters in traditional industries could also be the outcome of a combination of endogenous and exogenous factors. This is clearly demonstrated by the case of the automotive industry in the region of Styria where an interplay of the attraction of foreign owned companies, diversification strategies of home grown firms and the existence of some traditional roots and competencies in automotive sector has resulted in the establishment of a new growing cluster (see Tödting and Tripl 2004, Tripl 2004).

The formation of new agglomerations in established industries can be heavily supported by an accompanying reconfiguration of the knowledge generation and diffusion setting of the regional innovation system. The changes required in this field are twofold: On the one hand there is the need of a reorientation of those research and educational organizations that are too strongly oriented to the old industrial specialization pattern. On the other hand it appears to be significant that new institutions are established to support the rise of new clusters in old industrial areas. The Styrian automotive cluster provides a good illustration for the relevance of spurring such a process of institution building in order to encourage the growth of new complexes. The establishment of a technical college for automotive engineering and the creation of various cooperative research centers between universities and firms had a positive effect, enhancing the learning and innovation capabilities of the regional automotive industry (Tödting and Tripl 2004).

A regeneration of old industrial regions by diversifying their industrial base is tightly connected to the creation of networks in the newly emerging cluster. This highlights the necessity of changes in the relational and institutional structures of the region. The key challenge in this context is to avoid that the traditional arm's length and

hierarchical ties prevailing in the region are replicated in the new cluster. To establish more cooperative and innovation relevant interactions is a far more advantageous strategy. This, however, often requires changes in the prevalent pattern of behaviour that are directed to trust building and interactive learning (Morgan 1997, Lagendijk 2000). To break up institutional inertia and to initiate such a socio-cultural shift towards more cooperative attitudes in order to build up an innovation enhancing stock of relational assets is one of the key tasks of policy makers and regional development agencies. A policy strategy that is concentrated on the attraction of foreign direct investment or on supporting the diversification efforts of endogenous firms alone is clearly not enough. The emergence of new clusters in established industries can only be effectively supported, if the key agents in the political system promote the reconfiguration of the region's knowledge infrastructure and if they redefine their role and learn to act as interlocutors and facilitators of innovation networks (Cooke and Morgan 1998). This is exactly what has been observed in the regions of Wales and Styria, where policy makers have essentially contributed to the rise of new clusters in the automobile and electronics industries (see Morgan 1997, Tödting and Trippel 2004).

4.3 Towards a radical change: The rise of high-tech clusters

The most radical form of change in old industrialized areas is certainly brought about by the emergence and growth of knowledge intensive and high technology industries (Hospers 2004), implying a major shift in the development trajectories of these regions. What are the prospects for old industrial areas that aim at introducing new growth sectors? The conventional wisdom in literature appears to be that new industries eschew old industrial regions (Hall 1985, Storper and Walker 1989, Castells and Hall 1994) due to economic, social and institutional rigidities prevailing in these areas. Also Cooke

(1995b) concluded from a comparative analysis of old industrialized regions in Europe and North America that leapfrogging into high-tech industries is not a viable way. These assessments might have been too pessimistic. Several old industrial regions have done the unthinkable as they have opened up new trajectories of development by breeding new high technology clusters. Examples include the IT cluster in the Finish region of Tampere (O’Gorman and Kautonen 2004, Schienstock et al. 2004), the emergence of medical technology activities in Styria, the environment protection industry in the Ruhr Area, the software and IT-service branch in the city of Dortmund (Hilbert et al. 2004), the rise of biotechnology in Scotland (Leibovitz 2004) or the ICT cluster in the Canadian region of Ontario (Gertler and Wolfe 2004).

Such high tech clusters could not be built from scratch or by fiat. More specifically, a regional renewal of a radical nature requires the existence of specific assets, resources or competencies rooted in the area. Otherwise the efforts result in what Enright (2003) has referred to as “wishful thinking cluster” as they lack specialized competencies or resources on which the industry can grow. These could include amongst other factors an excellent scientific base or the availability of a highly skilled labour force. The development of a new high tech agglomeration might also be the result of a strong local demand.

The emergence of such knowledge intensive clusters hinges less on incumbent firms but more on the establishment of completely new companies. This constitutes a demanding challenge for old industrial regions specialized in heavy sectors, as they are often characterized by low rates of new firm formation, which is mainly due to the dominance of large enterprises and trade unions. To emphasize the importance of new firm creation does not mean that existing endogenous firms or foreign direct investment cannot play a powerful role in “seeding” a new high tech complex. The rise of the software industry in Ireland, for example, has been spurred on essentially by the

attraction of foreign companies (O'Malley and O'Gorman 2001) and the IT industry in the Finnish region of Tampere exemplifies the importance of large home-grown firms such as Nokia that stimulate the growth of the local cluster by acting as sophisticated customers (O'Gorman and Kautonen 2004). The environment protection industry in the Ruhr area is another good example in this context. It has its origins in the old mining and steel complex (Hilbert et al. 2004). The leading firms of this cluster and their suppliers were forced by legal restraints and other political measures to reduce pollution and contamination caused by their traditional business by developing internal solutions to the environmental problems. What is essential here is that they managed to transfer these competencies and skills situated within the old cluster into new markets, giving rise to the new environment protection industry. Nevertheless, compared to the two other development scenarios of cluster-based renewal discussed here, new firm formation is a crucial element for the emergence of high technology industries (Audretsch 1995, Feldman et al. 2005).

The formation and growth of high technology clusters in old industrial regions presupposes a major transformation in the knowledge generation and diffusion dimension of the regional innovation system. Taking the high tech road is strongly linked to intensive processes of institution building and institutional change. To create or further develop a relevant scientific knowledge base, to upgrade the education and training system, and to establish specialized support structures are key factors that contribute to developing and sustaining new knowledge intensive clusters. The presence of excellent research organizations, higher education institutes and supporting agents such as science parks, academic spin-off centers, incubators, technology licensing offices or innovation centers that are specialized in promoting young high tech companies can have an important impact on the emergence of high technology agglomerations.

New firm formation and the creation of a variety of new knowledge organizations and supporting institutions has to be complemented by the development of strong connections and linkages within the emerging cluster, leading to regional collective learning and innovation. Furthermore, the relevance of knowledge and resources from outside the region might not be neglected. This holds in particular true for those regions that lack expertise and resources necessary for promoting high technology industries (Leibovitz 2004, Rees 2005), a condition that is often given in old industrial areas. Consequently, extra-local networks emerge as a key factor supporting the rise of new high tech clusters in this type of regions.

Policy makers can play an important role in encouraging the development of new high technology clusters in old industrialized regions. To stimulate new industries can not be done with old policy recipes and traditional instruments such as subsidies, tax incentives or low costs labour (Audretsch 2003, Feldman and Francis 2004, Trippel et al. 2006). It requires a new mode of state engagement, covering aspects such as investments in the knowledge infrastructure, securing of the availability of risk capital and other measures to promote entrepreneurship and assisting the formation of innovation links to encourage a steady flow of knowledge. Furthermore, to pick up aborning future topics and projects with uncertain outcomes (see, for example, the case of fuel cell in North Rhine-Westphalia, Institut Arbeit und Technik et al. 2003) might also be an important step towards opening up new development trajectories. This requires a long term perspective and willingness to take risk within the political system. Consequently, in old industrial regions a substantial amount of policy learning is necessary as the key agents of the political system have a good knowledge and experiences of how to support traditional sectors but often lack a profound understanding of the needs of high tech industries. If this learning challenge is met, then policy makers can play a critical role in encouraging new agglomerations of high

technology activities. There is evidence from several old industrial areas indicating that policy interventions had a favorable impact on the emergence of the knowledge intensive clusters (see, for example, the case of the region of Tampere as described by O’Gorman and Kautonen 2004 and Schienstock et al. 2004).

5 Summary and conclusions

In most of the literature on clusters there is a strong focus on explaining the advantages of specialized agglomerations of economic activity. What is often ignored is the fact that clusters can be a blessing and a curse for regional development as the experiences of old industrial regions show. These areas face the challenge to reinvent themselves by rejuvenating their economy. We have argued that the cluster approach might be a useful concept in this respect, distinguishing between

- an innovation-based adjustment of mature clusters,
- a diversification into established industries, and
- the development of clusters based on knowledge intensive industries.

These three different types of clusters reflect various degrees of regional renewal. An innovation-oriented transformation of old and declining clusters could be equated with continuity in the economic evolution of the region, as it implies a maintaining of the status quo in sectoral terms. In comparison, the rise of new clusters in established industries constitutes a more significant transformation. Finally, the emergence of agglomerations based on knowledge intensive activities represents the most radical form of change.

Departing from a theoretical framework that conceives clusters as an integral part of regional innovation systems we have identified four dimensions that are of key relevance for analyzing cluster-based renewal processes in old industrial areas. These include

- the subsystem of knowledge application and exploitation (firm dimension),
- the subsystem of knowledge generation and diffusion (knowledge infrastructure dimension),
- the relational assets and institutional fabric of the region (network and institutional dimension), and
- the political system (policy dimension).

Each mode of cluster-based renewal discussed here has specific preconditions and hinges on various critical factors. Table 1 provides an overview of our key findings in this respect, revealing considerable differences between the three development strategies for the regeneration of old industrial areas.

- *Firm dimension:* Each mode of cluster-based renewal requires specific firm strategies. Not every type of firm is able to be a key agent of change for all kinds of regional renewal. Large endogenous firms usually play a key role in the rejuvenation of old industries, provided that they follow an innovation-oriented restructuring strategy that is regionally based. Also foreign companies that become embedded in the region may trigger processes of change within mature and declining clusters by transferring new management practices and production technologies to the region. Foreign direct investment can also give a decisive

impetus to the rise of new clusters in established industries, if they feature high value added functions and are anchored to the region by forming innovative relations to local firms. But also regionally based diversification strategies of home grown firms can pave the way for this type of cluster-based renewal. The development of high technology and knowledge intensive clusters, in contrast, depends much more on newly founded small firms that act as crucial innovation agents in the new field.

Table 1: Critical factors of different types of cluster-based renewal in old industrial regions

	Incremental change innovation-based adjustment within mature clusters	Diversification new clusters in established industries	Radical change new knowledge intensive clusters
Firm dimension (RIS subsystem of knowledge application and exploitation)	<ul style="list-style-type: none"> regionally based innovation-oriented restructuring, modernization and reorganization of large, endogenous firms foreign companies as providers of new knowledge 	<ul style="list-style-type: none"> innovative “embedded” foreign firms as catalysts of new directions of development diversification of endogenous firms 	<ul style="list-style-type: none"> newly founded small firms as key agents of change supportive role of larger endogenous and exogenous firms
Knowledge infrastructure dimension (RIS subsystem of knowledge generation and diffusion)	<ul style="list-style-type: none"> focus on modernization of traditional industries and on building bridges to new technologies orientation to needs of smaller firms 	<ul style="list-style-type: none"> break up overspecialization in old industrial / technological pattern focusing on requirements of new industries 	<ul style="list-style-type: none"> emphasis on basic research in new fields orientation on higher education institutes, science parks, academic spin-off centres
Network and institutional dimension	<ul style="list-style-type: none"> breaking up petrified ties reconfiguration and renewal of existing relations 	<ul style="list-style-type: none"> creation of supplier networks formation of innovation linkages 	<ul style="list-style-type: none"> creation of local knowledge links, university-industry linkages insertion into extra-local networks
Policy dimension	<ul style="list-style-type: none"> support of restructuring of large endogenous firms support adaptation of knowledge infrastructure new growth coalitions 	<ul style="list-style-type: none"> attract and “embed” foreign direct investment support reconfiguration of knowledge infrastructure promotion of innovative networks 	<ul style="list-style-type: none"> promotion of (academic) entrepreneurship support transformation of knowledge infrastructure fostering of local and international knowledge links

- *Knowledge infrastructure dimension:* It has been argued that the institutional infrastructure that generates knowledge and promotes innovation and learning is a crucial element of cluster-based approaches to regional renewal. The degree of changes necessary in this setting varies markedly between the scenarios of development discussed here. An innovation-oriented restructuring of mature clusters in many cases implies only an adaptation of the knowledge infrastructure that allows to build bridges to new technologies. Taking the diversification path, in contrast, requires bigger steps such as the creation of a variety of specialized research and educational institutes focused on the new clusters, leading to a reconfiguration of the subsystem of knowledge generation and diffusion. The emergence of new high technology agglomerations is linked to a fundamental transformation of the knowledge infrastructure brought about by the “introduction” of a range of new elements, including excellent research organizations and higher education institutes, academic spin off centers, science parks and technology licensing offices.
- *Network and institutional dimension:* Transformations in the relational and institutional fabric have been identified as another key factor contributing to the regeneration of old industrial areas. Again, the nature of these changes can only be specified in dependence on the route that is followed. An innovation-oriented restructuring of old clusters is critically dependent on overcoming institutional inertia. A breaking up of petrified ties and a reconfiguration of existing relations are of key importance in this respect. For new clusters in established industries to grow the emergence of trust based co-operations and interactive learning plays a crucial role, highlighting the challenge of creating social capital in old industrial

regions. The development prospects of high technology clusters are largely influenced by the formation of local and international knowledge intensive networks.

- *Policy dimension:* The three types of cluster-based renewal require different degrees of policy learning. To escape from political lock-in by replacing old policy networks by new growth coalitions appears to be an essential ingredient for fostering an adjustment of traditional clusters and for supporting diversification. Also new modes of state intervention such as the promotion of innovation networks might be essential for effectively supporting the regeneration of old clusters and the rise of new ones in established industries. Wholly new high technology agglomerations, in contrast, can only be “seeded” if additional steps are taken, reflecting a more substantial policy learning process. Policy makers face the challenge to acquire knowledge about the needs of knowledge intensive industries, to create a variety of new institutions in order to transform the region’s knowledge infrastructure and to develop new financial and support structures that encourage the emergence of a culture of entrepreneurship.

A key conclusion that can be drawn from these considerations is that processes of cluster-based renewal are a complicated and challenging endeavor, resting on a complex interplay of firm strategies, changes in the knowledge infrastructure, institutional innovations and policy learning processes.

The question remains of how to support an innovation-oriented restructuring of old clusters and to build up new ones whilst avoiding the pitfalls of specialized concentrations of economic activity. To prevent a repeat of history is indeed a key challenge for every strategy of cluster-based renewal in old industrial regions. What seems to be of utmost importance in this context is a more or less regular search for and

support of new clusters and new applications of existing competences to elude the risk of a too narrow regional specialization (see also Tichy 1998). To work against a “closure” of business and policy networks (Messner 1997) that underpins lock-in effect might be another crucial factor. To keep networks open for new members and to “inject” new ideas and knowledge into existing ties could be sound precautions that secure that clusters do not turn into obstacles for regional development.

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