# Merging a Firm-centred and a Regional Policy Perspective for the Assessment of Regional Clusters: Concept and Application of a "dual" Approach to a Medical Technology Cluster

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*In the last decade the phenomenon of clusters has gained considerable attention, in particular from regional planning institutions and policy makers. In order to support their decision making process, an elaborated "top-down" analysis of clusters has evolved, i.e. the regional agglomeration as a whole is the object of analysis. The importance of cluster-membership for the management of individual firms and their "bottom-up" view of a cluster, however, has attracted much less attention. To get a more integral picture of the structure of and the interaction within a cluster and to facilitate taking direct action, this paper therefore proposes a "dual" approach to cluster assessment: based on an integral view of clusters a survey-tool is developed to capture the top-down perspective, i.e. the perspective of the complete regional system. It is supplemented with a bottom-up view using structured interviews in a core firm and an analysis of its supply structure. The application of the dual approach is demonstrated using the case of a medical technology cluster. Analysing a cluster not only top-down, but simultaneously bottom-up, yields recommendations for policymakers and firms alike. It can be concluded that the method may demonstrate particular value for analysing clusters with a heterogeneous size structure of firms, i.e. if there is a limited number of larger core firms supplemented by a multitude of small enterprises.*

**Keywords:** cluster, cluster analysis, strategic management, business administration

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## Introduction

Cluster and cluster approaches are fashionable topics in economic geography as well as in regional economy: theory has been refined, hundreds of regional-sectoral agglomerations were "discovered" in the last few years and their functionality was studied (for an overview see the anthology Cantwell 2004). A meta-study was able to collect more than 800 documented clusters all over the world (van der Linde 2003).From a regional policy perspective the interest in clusters is straightforward, regarding clusters' strong effect on creating local employment (Porter 2003). Employment growth, however, is the "output" result of successful clustering. The "input" is that firms can directly benefit from being located in a cluster: the results of an American and a British study showed, for example, that an employee density two times higher than the standard of a certain sector in a region correlates with an increased productivity of 6% and 7%, respectively (Baptista 2003; Ciccone & Hall 1996). Furthermore, there are indications that firms in clusters tend to be more innovative than isolated firms (Baptista & Swann 1998). Research in economic geography has shown that innovations have a tendency to appear in a concentrated way in selected centres (Breschi & Lissoni 2001; Feldman 1999). The result of higher productivity and innovative power is that – ceteris paribus – companies in clusters have a chance to become more profitable than their isolated competitors:

- The analysis of 64,000 balance sheets commissioned by the Banca d'Italia resulted in companies in agglomerations showing a return on investment of 10%, whereas comparable isolated companies only achieved 6% (Fabiani & Pellegrini 1998).
- In another study using data from Mediobanca a difference of slightly more than 2% was found between cluster companies and isolated companies (Hermes Lab 2000).

Based on these findings, it can be concluded that there are indications that companies which are positioned in clusters show a higher productivity on average and at the same time higher innovative power than isolated firms. As a consequence, they are more profitable. The competitiveness of a company is therefore also shaped by its location in space. Firms may have an interest in developing their cluster.

However, "…given a focus on describing, comparing and classifying official cluster policies […] most scholars overlook that cluster effects emerge also from predominantly private initiatives…" (Fromhold-Eisebith & Eisebith 2005, p. 1251). In analysing and developing (potential) clusters ideally not only the "top-down" regional planning view, but also the "bottom-up" firm centred view are integrated. In order to obtain a complete picture, a "dual approach" to cluster analysis is being proposed in this paper.

The extensive discussion the cluster approach found in the last decade, on the one hand allowed science to progress, on the other hand resulted in a multitude of definitions and models on clusters. Therefore, in the next section, a brief introduction into the cluster-model used here is given. Subsequently tools for the analysis of clusters from a firm's view and the public planner's perspective are introduced and, finally, were applied to a the case of a medical technology cluster.

## Describing the Structure and the Interaction in Regional-sectoral Agglomerations

### *Porter's Diamond and the Innovative Milieu Approach: "Hardware" and "Software" of a Cluster as a Frame for Analysis*

The cluster concept is often associated with the work of Michael Porter (1990) who defines a cluster as "…a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementaries…" (1998, p. 199). Even though not uncriticised (Moon et al. 1995; Waverman 1995), Porter's "diamond of competitive advantage" (1990) constitutes one of the most influential concepts on clusters. It represents the results of a four year study based on the statistical evaluation of input-output analyses and more than one hundred case studies. The diamond determines the key elements of a company's environment that influence its potential for international competitiveness:

(1) *Factor conditions* can be divided into "basic factors", like natural resources and unskilled labour force, and "advanced factors", such as highly qualified manpower, e.g. engineers and academics. A nation's competitive advantage strongly relies on the existence and maintenance of the advanced factors which are unique to a cluster and consequently hard to imitate by other actors not rooted in the same system.

(2) *Demand conditions* are particularly reflected by the amount and the sophistication of local demand. Highly sophisticated customers who anticipate international trends influence quality standards, the number of innovations, as well as the technological progress of a nation (Beise & Gemünden 2004).
(3) *Related and supporting industries* can be used to share ideas, knowledge, and skills. The presence of local suppliers and firms that use similar or identical technologies to produce a complementary good enables cost-effective collaborations, e.g. joint ventures for R&D projects.
(4) *Firm strategy, structure, and rivalry* play a significant role in Porter's diamond model. A strong base of local competitors is one of the major stimulations for innovation and upgrading.

These four determinants form an interlinked and dynamic complex where each element is affected by the other three. The simultaneous presence of all factors and the bi-directional interdependences between all determinants lead to an environment that promotes the formation of clusters. Note that in the Porterian view, clusters can be confined to a region or appear on a national level.

Similar to older approaches, such as the Filière-Approach (Stoffaes 1980) and Marshall's model of agglomerations (Marshall 1961), this analysis, despite mentioning "social glue", focuses on the structure of a value-creating system. The diamond provides an account of which actors do form a successful structure of a regional-sectoral agglomeration, the "hardware" of the system. According to the diamond-model the particular success of firms in clusters largely relies on externalities. In a mainly competitive environment, where firms pursue their individual interests in a multitude of uncoordinated actions, cluster-economies arise through a combination of chance and the law of large numbers (Gordon & McCann 2000; Newlands 2003; Rugman & Verbeke 2003). However, this is only a part of the analysis. In addition to the presence of potentially synergetic organisations and the associated externalities, the culture of an industry agglomeration as well as the behaviour of its members towards each other – the "software" of the cluster – also have been found to play an important role.

Prominent approaches more focused on the local interaction are those around the modern industrial district theory (Becattini 1991; Brusco, 1982) and the research on the innovative milieu which was essentially influenced by the GREMI group. Since the mid-1980s the GREMI has continuously endeavoured to explore the diverse aspects of innovation processes in regional economic milieus (Aydalot 1984; Maillat et al. 1993; Ratti et al. 1997). Each inquiry, by contrasting examples and counter-examples, has led to a more precise description of innovative milieus. On a theoretical level, the concept of the innovative milieu has evolved from a black box to a stabilised conceptual framework explaining the economic development processes in their spatial and temporal context (Crevoisier 2001). An innovative milieu can be defined as: "…the set, or the complex network of mainly informal social relationships in a limited geographical area, often determining a specific external 'image' and a specific internal 'representation' and a sense of belonging, which enhance the local innovative capability through the synergetic and collective learning processes…" (Camagni 1991, p. 3).

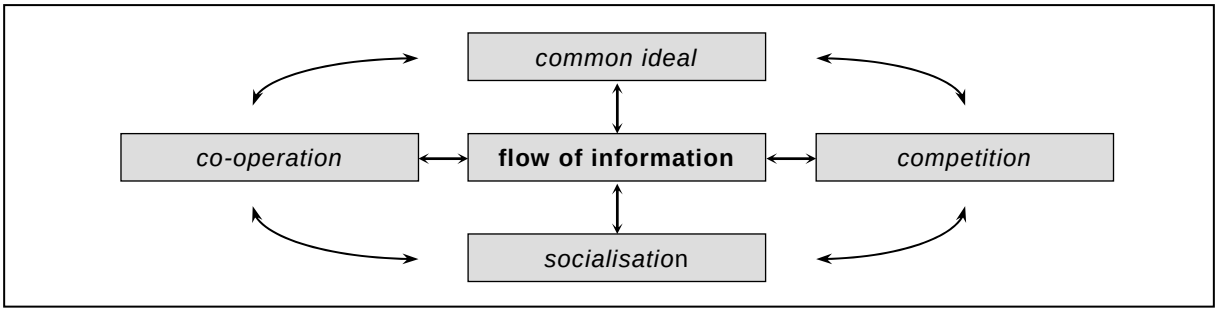


**Figure 1.** Linkages within an innovative milieu. *Source*: Steinle et al. (1998, p. 374)

In contrast to the implications of Porter's diamond model, the mere presence of a set of actors in a region is not sufficient to achieve innovative results, unless these actors show an intensive interaction, thus taking advantage of proximity. According to the GREMI school, an innovative milieu represents a social network resulting from synergetic interaction and collective learning processes. A basic characteristic is the simultaneous coincidence of co-operation and competition (Hansen 1992; Franz 1999). This antagonism becomes possible by an intensive communication level that is based on a homogenous socialisation background and a region's common ideal (see figure 1).

A common ideal, reflected by a conscious sense of belonging, constitutes the basic element of the milieu approach (Fromhold-Eisebith 1995). On the one hand, a collective region-related identity determines common goals of locality development and essential principles of collaboration. On the other hand, it fulfils the important function of defining milieu-specific norms to sanction antisocial behaviour. The homogenous socialisation background forms a coherent unity and facilitates a dynamic communication network and trustful inter-firm co-operations. The relevance of a specialised professional education is thus being highlighted due to its role in the process of socialisation.

Being embedded into a socio-cultural local milieu stimulates the number of coincidental informal face-to-face contacts which enhance the direct diffusion of tacit knowledge and enhance organisational learning in networks (Håkansson et al. 1999). These dynamic processes act as an uncertainty-reducing mechanism that exceedingly influences a region's innovation potential (Camagni 1995). An intense flow of information effectuates an open circulation of ideas, skills, and know-how and thereby boosts the pressure of competition between the local actors.

The approach of the innovative milieu complements Porter's cluster model by describing and explaining an ideal interaction level within an agglomeration, i.e. the co-operative and competitive behaviour between the localised actors provide a basis for taking advantage of the potentials arising from the cluster's structure.

***The Concept of the Innovative Cluster as an Integrative Point-of-View***

Models of value-creating systems tend to either concentrate on a cluster's structural characteristics to clarify which members constitute a successful value-creating system, or on the way these actors interact to realise competitive advantages. In order to describe both "hardware" and "software" of a cluster the research at hand is based on the 'innovative cluster' approach, which combines the structure- and the interaction-focused streams (Schiele 2001; Steinle et al. 1998). The name of this model reflects its two main roots: the *innovative* milieu and the Porterian *cluster*, the integrated form being the *innovative cluster* (see figure 2).

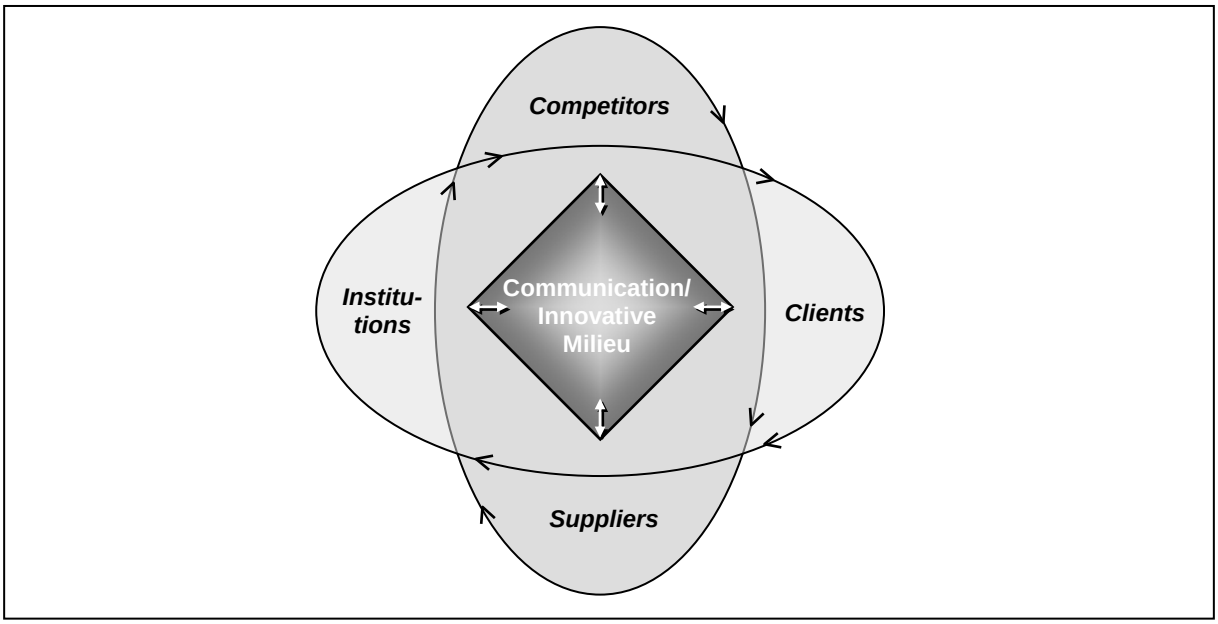


**Figure 2.** The 'innovative cluster'. *Source*: depiction by the authors.

This paper approves an integral perspective that has regards both characteristics, structure and interaction, because "[innovative] clusters are not a simple concentration of independent economic agents, but display at an inter-industrial level, underlying networks of interrelated cooperating businesses" (DeBresson 1996, p. 161). The innovative cluster arises from the synopsis of complementary cluster approaches and represents an ideal value-creating system that can structurally be described by the four facets of the diamond model, but in addition is characterised by the intense interaction level of an innovative milieu.

The innovative cluster reflects an innovation and productivity boosting system of several organisations, their direct competitors, highly sophisticated and anticipatory key customers, a specialised supply chain, as well as cluster-specific institutions (structure) whose success results from an intensive flow of information between its actors that are linked within a co-operative and competitive milieu (interaction).

The innovative cluster approach as a tool for environmental analysis gives further information on a cluster's character and its individual development stage. From a firm's perspective it can either be isolated with no local partners, be in a simple agglomeration with no more than a diamond structure present, or it can be a member of an innovative cluster, if structure and interaction are fully developed.

In addition, an integrative perspective on clusters enables a complete ascertainment of the benefits arising from both structure and the innovative processes. The presence of a fully developed structure already increases the efficiency of a cluster as the critical mass is reached earlier, a reduction of the vertical integration becomes possible (specialisation) and firms can concentrate on their core competencies. Furthermore, a skilled labour-pool can develop and the consumer search cost is reduced.

An economic explanation for the additional benefits that result from the innovative milieu can be found in the theory of a club (Cornes & Sandler 1996; Weder & Grubel 1993). A limited group with voluntary membership enables the establishment of conventions. Unsocial behaviour ruins the actor's reputation and can be sanctioned directly because it is possible to exclude actors from joining the club. By reducing opportunism the efficiency of co-operation in the cluster can increase. The proximity of similar actors enables the 'cafeteria effect' and thus a high information flow that increases the potential for new solutions to be found by chance. Finally, the coexistence of co-operation and competition facilitates a region's innovation level since knowledge spill-overs between the partners pushes companies to innovate quickly.

For the subsequent analysis of a regional agglomeration the claim to reflect both the structure of the agglomeration and the interaction taking place between its actors has an important consequence: It is proposed to operationalise the hardware and the software of a value-creating system along six dimensions of analysis. These dimensions are the four determinants explored by the Porterian diamond (competitors, clients, suppliers and institutions) in addition to an explicit consideration of the communication and interaction taking place in the value-creating system, by adding a relationship and an innovation dimension.

Finally, it is worth noticing that Porter's primary intention was to explain the success of firms, anchored in nations or ideally in regions. Most other approaches, e.g. the milieu approach, search explanations for the success of regions. Integrating these views therefore does also mean to bridge business orientation and public policy orientation. The analysis and subsequent development of a cluster can benefit from such a "dual" approach, reflecting these two perspectives.

## Analysing a Cluster from a Firm-Centred and a Regional Policy Perspective: Developing the Dual Approach

### *The "Traditional" Analysis and its Shortcomings: Limited Attention to the Interactions and Insufficient Consideration of the Management-Perspective*

In general, two essential steps of cluster analysis can be distinguished: (1) identification of a cluster, e.g. to verify the existence of a spatial agglomeration, and (2) analysis of the network relations within an industry cluster. Screening the literature on value-creating systems reveals that there is no consistent and generally agreed procedure of identifying regional production clusters. The appropriate methodology is individual and depends on the specific research objective and the questions to be answered. At least five different techniques can be used to identify a regional agglomeration (Bergman & Feser 1999; Roelandt & den Hertog 1999):

*(1) Case studies,* i.e. the Porter studies on the forces that underlie a nation's competitive advantage describe regional clusters using statistical data, expert interviews and information from grey literature. However, to case studies shortcomings such as difficulties with the generalisation of results are attributed.

(2) *Location quotients* are another common method of identifying an agglomeration's critical mass, e.g. the existence of a geographical proximity of a multitude of synergetic firms. The relative spatial concentration of an industry sector is often measured by the ratio of employment shares. Sternberg and Litzenberger (2004), for instance, propose the cluster index that identifies a cluster by the product of the relative industrial density, the relative industrial stock, and the reciprocal of the relative size of the establishment. However, coefficients of concentration are inadequately meaningful until there is no agreement on what degree of spatial concentration an industry constitutes a cluster (Martin & Sunley 2003).

(3) *Correspondence analysis*, like for instance factor analysis or principal components analyses, uses statistical data to identify groups of firms or industries with analogue characteristics, i.e. an identical innovation style or an equal level of co-operation. Similar to location quotients, correspondence analysis has difficulties to picture inter-firm linkages.

(4) *Input-output analysis* create a picture of trade linkages between industry groups in the value chains of an economy by describing flows to and from industries and institutions. Disadvantages of this method arise from data limitations and conceptual difficulties.

(5) *Network analysis,* based on the direct recording of corporate relations may, eventually, be added. Identifying the existence of a spatial agglomeration is the basis of cluster analysis. The next step, analysing the network relations to document the existence and development stage of an innovative cluster, is most often neglected (Krätke 2002). Network analysis can be done by company surveys, assessing transaction and communication relations between firms, which are subsequently analysed graphically. This technique supports the detection and analysis of the interaction. However, network analysis has its limits in data availability. The lack of user-friendly software that helps to interpret the complexity of data is seen as another disadvantage of network analysis (Bergman & Feser 1999).

The various techniques complement each other as they answer different questions, provide different kinds of information, and have specific assets and drawbacks. In practice, a mixture of diverse instruments at different levels of aggregation is used to overcome the methodological limitations and disadvantages arising from using one single technique (Roelandt & den Hertog 1999). Which methods will be combined to identify the critical mass of a cluster finally depends on the specific needs and questions of the research objective.

Shifting the perspective from the instruments to the addressees shows that the overwhelming majority of cluster studies has been carried out in order to generate policy recommendations, while the success of the latter depends on the interests of local firms. In contrast, there is no comparatively high pervasiveness of the cluster concept within business administration and firm oriented research. The overwhelming majority of cluster-based literature is dedicated to regional planning, with a few exceptions discussing clusters and firm strategy (Enright 1998; Jacobs & de Man 1996; Lauterbach 2005; Porter 1990; Rugman & Verbeke 1993; Rutten 2003; Schiele 2003; Schiele 2001; Steinle et al. 1998).

Why has business thinking so far been largely ignoring clusters? There may be at least two possible answers to that: first, the phenomenon may be questioned in its existence and future relevance due to the globalisation and the digitalisation of business, which could lead to a "death of distance" (Heng & Schaaf 2002; Morgan 2004). Interestingly, a hundred years ago a similar discussion took place, with the expectation that the automobile would render space unimportant (Krugman 1991).

The second reason may be traced back to the conceptual tools at hand: both dominant perspectives of strategic management, market-based and resource-based view, extensively ignore that sustained competitive advantages can also result from being located in a geographically bound network of organisations. Recent strategic management approaches, however, argue that a firm's success is in such a way affected by its linkages. External partners – for instance local suppliers – have to be interpreted as a highly valuable source for competitive advantage (Duschek 2004; Dyer & Singh 1998; Steinle et al. 1998).

The cluster concept completes the predominant perspectives by emphasising geography as an important influential factor of competition and therefore makes strategic recommendations for business administration possible. However, with the exception of the case study approach, the above mentioned "classical" methods of cluster analysis do not take the individual firms as a starting point of analysis. Here a sixth technique of analysis may be helpful: resorting to firm level data, such as purchasing and sales volumes segregated according to the location of the business partners.

***Methodical Procedure: Combining a Top-down Survey and Bottom-up Firm Data Analysis***

In consideration of the identified methodological shortcomings the dual approach combines instruments and perspectives in order to get both an overview of the entire cluster (the 'traditional' top-down perspective of politics) as well as insights from one or more key companies (the bottom-up business perspective). In the dual approach the four elements of the Porterian diamond are operationalised, in addition to a focus on the interaction and the innovation process. For the two perspectives different techniques of analysis are employed:

*Top-down view:* to gain the bird's eye view of the total system, a survey questionnaire sent to the entire population of the cluster can be used. In the dual approach the four elements of the Porterian diamond are operationalised, in addition to a focus on the interaction. In dependence on Sako's methodology (Sako 1992) the interaction between companies can be mapped in a continuum between arm's length and obligational relationships. The intensity of trust and the level of inter-firm communication may act as substantial indicators within a profound relationship analysis. To get a more precise description of an innovative cluster the dual approach finally proposes to analyse the innovation process. The process of clustering may be particularly intense in industries characterised by network-innovations, which require the combination of different competencies from different organisations, as opposed to the classical laboratory type of innovation (Servatius 2004; Steinle & Schiele 2002).

To capture the four determinants of the diamond in the survey, firms are asked to indicate (1) the origin of their competitors, (2) the specialisation of their supplies as well as their origin, (3) the size and sophistication of the local demand and (4) the importance and specialisation of the local institutions, with an explicit section concerning the local education and labour market. On top, (5) the predominant type of innovation and the origin of their partners for innovation is seized. In order to get indicators for the quality of the milieu, (6) firms are asked questions on the frequency of interaction and on the trust level developed, differentiating between regional, national and international partners, as well as on their consciousness of belonging to the cluster or not. The existence of a local cluster initiative greatly favours this kind of research by providing lists of the cluster members and introducing the researchers.

*Bottom-up perspective:* one or more core firms of the cluster are chosen for an in-depth analysis. The management related importance for an individual firm of the same six dimensions previously mentioned is assessed by semi-structured interviews. On top, the supply structure of the core firm is being analysed concerning the localisation of the suppliers. For this purpose, quantitative company-data is used. This data can be drawn from the firm's enterprise resource planning system, such as SAP. The buyer-seller relation to a local firm is a strong and reliable indicator that helps to identify the scope of the regional network. An option would be to do the same type of analysis for sales, identifying and classifying the customers.

Bottom-up and top-down analyses shed light on a cluster from two different angles. They can be matched and thus offer additional power of explanation. At the same time, recommendations for the firms as well as for the cluster as a whole can be derived - as will be discussed in the next section - by applying the dual approach to an application case.

## Application Case: Identification of a Medical Technology Cluster with Limited Interaction

In principle, clustering is expected if a long value-chain including multiple competencies is detected, the market is volatile and therefore honours flexible reaction and, finally, innovation processes contribute to the re-organisation of the system (Steinle & Schiele 2002). Medical technology is a sector of industry that fulfils five out of six criteria considered to be fostering the formation of clusters. In particular, it has a long value chain requiring different competencies and it is highly innovative, with more than 50% of the products being younger than two years (BMBF 2003). Not surprisingly, several regional agglomerations were documented, in particular in the largest market for medical technology, the United States. No less than 35 cluster initiative around the globe try to promote their medical technology cluster (Sölvell et al. 2003).

With a world market share of about 15% the German industry ranks second. Roughly a fifth of the total German employment in the sector is located in the region considered. Within the top-down approach, together with the local cluster initiative, 101 economic actors which can be clearly assigned to the medical technology industry were identified. The delimitation acted in accordance with the five-digit classification of the German economic sector classification system (see table 1). The top-down analysis relied on a survey instrument containing 23 questions, with at least two questions assigned for each of the six dimensions used to map the cluster. The questions were elaborated based on Schiele (2003), adding more details on the interaction (intensity of knowledge exchange and trust developed), in addition to collecting general firm data and performance indicators. The respondents were asked to classify their situation on a four digit scale. Anchor phrases were used to ensure the reliability and compatibility of responses. After three mailings, the support of the mayor and telephone calls to non respondents, 37 companies participated in the survey. About 40% of the cluster's workforce is employed with the core firm, which was subject to the bottom-up analysis, thus completing the dual approach.

**Table 1.** Statistical delimitation of medical technology

| Code* WZ 93 | Description |
|---|---|
| 33.10.1 | Manufacture of electric medical instruments and equipment |
| 33.10.2 | Manufacture of technical medical equipment |
| 33.10.3 | Manufacture of orthopaedic appliances |
| 33.10.4 | Dental laboratories |
| 33.40.1 | Manufacture of spectacle lenses, contact lenses, spectacle frames and frames fitted with lenses, whether or not the lenses are optically worked |
| 35.43.0 | Manufacture of invalid carriages |

Code WZ 93: German Code of Standard Economic Industry Classifications.
*Source:* German VAT Statistics 1997.

The top-down analysis revealed that the more successful firms use the cluster more intensively, but that in general all six dimensions of the cluster are not fully developed. Most competitors and suppliers from the surveyed firms come from other German locations, not from that particular region. In line with this finding, mapping the firms and institutions active in medical technology in Germany reveals about six regional centres (Invest in Germany 2005).

A similar picture appears when analysing the interaction: in terms of trust and knowledge exchange international partners score lower, while regional and German partners show higher values – but without a substantial difference between the region and the rest of Germany. The survey indicates that key features allowing to describe the region as having an innovative milieu are still underdeveloped. 40% of the respondents were not aware of being located in a special cluster. In some firms it appears as if the notion of a cluster had not diffused very much within those firms, across all functions. The same picture emerged with the core firm: they had a person responsible for cluster-interfaces, but his work was more dedicated to research and development issues, rather than, for instance, purchasing and supplies. In spite of that, a higher cluster-awareness was identified with older firms. At the same time, the sample indicated that almost 60% of the firms had been founded in the period since 1990. One interpretation is that this is a cluster still in its growth phase, which is typically associated with a less pronounced interaction (Lauterbach 2005).

The top-down survey indicated medium scores for all six dimensions analysed to map the cluster (figure 3). Apparently there are elements of a well-functioning cluster present, in particular with the infrastructure specialised in medical technology. However, regional suppliers and innovation partners are not abundant, i.e. firms often have to rely on partners from other German regions to access these important resources. A dependence on foreign clusters has not been detected, which is an indicator for the overall competitiveness of the German system.

The bottom-up analysis showed that the core firm was sourcing the overwhelming majority of their supplies in Germany, with 43% of their production materials coming from the region. Medical technology supplies were slightly below this average. As a comparison, the sourcing analysis in an American cluster revealed 90% of the medical devices being purchased within the same region (Clayton-Matthews 2001). Underscoring the results of the top-down analysis, the core firm's supplier evaluation

identified lower scores for international suppliers and better scores for domestic firms. Again, and opposed to the milieu-thesis, the satisfaction with regional suppliers was not outperforming the scores from the rest of Germany.

Based on these results, the Porterian idea of a national cluster comes to mind. In this case, however, not with firms evenly distributed throughout the country, but with half a dozen interconnected regional agglomerations. Firms apparently find competent partners within Germany, but few are strongly relying on this exact region. Not demonstrating a particular high level of regional integration, some of the cluster-firms may be losing the opportunity to profit from their region.

The top-down survey contained a self-assessment of the firms' performance. Generally, it has been found that subjective performance measurements tend to be accurate and thus can be used in case of absence of exact data (Dess & Robinson Jr. 1984). The assumption of possibly unexploited potential is thus being reinforced if one considers the correlation found between firms' good performance and their more intensive utilisation of local suppliers, regional partners for innovation and an infrastructure specialised for their purpose. In the sample, these were also the firms with an above average cluster-awareness.

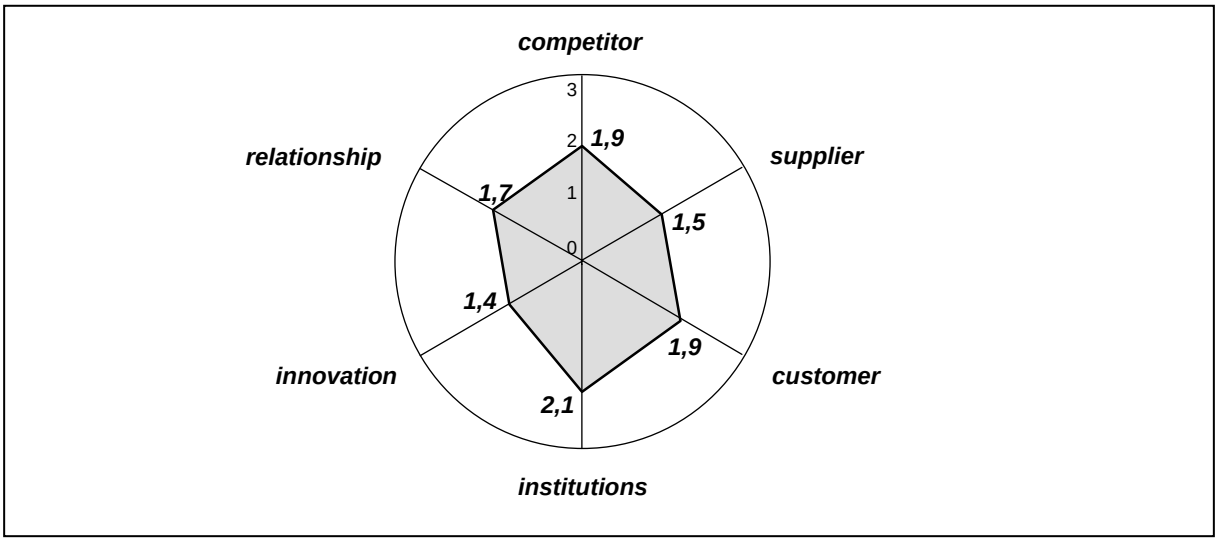


**Figure 3.** Six dimensions of cluster assessment. *Source*: depiction by the authors.

Of course, these results have to be handled with care: a sample size of 37 is challenging in terms of statistical analysis. In this case, the statistical significance is on the 10% level, with the exception of a stronger relationship to "partners for innovation". Furthermore, a correlation does only indicate a relationship, not its direction. However, the results are in line with the hypotheses that firms draw profits from being anchored in a regional-sectoral agglomeration in general and from the one examined in particular.

How can this regional agglomeration further mature and develop a milieu-type local interaction between the firms? One advantage of the dual approach is that - based on the core firm's data - a group of local suppliers who could profit from supplier development can easily be identified. These firms could form the nucleus of a cross-auditing circle. In this model a team from local firm A visits local firm B and consults them on improvement measures based on a common scheme. Later, firm B will visit firm C and this firm, on their turn, consults firm A etc.. Such a programme, which can be organised by the regional authorities or cluster developers and which is in the perfect interest of all firms involved, not only improves the quality of the participating companies, but also fosters the interaction between them, thus overcoming one of the main weaknesses of this agglomeration.

## Conclusions

With the dual approach, a supplementary way of analysing a cluster has been discussed and tested. It fosters awareness-building within firms and produces a more complete and valid picture of a regional

agglomeration. However, there are some limitations: The dual approach is confined to such clusters which are grouped around one or more core companies and requires their co-operation to produce results. If these conditions are met, surveying a local value-creating system by establishing a top-down view and simultaneously integrating the bottom-up perspective allows for an integral view of a cluster and facilitates the implementation of measures for its improvement. Furthermore, the above research has highlighted the suitability of sourcing data for cluster analysis, whose further exploration for the assessment of clusters could be a fruitful way for future research.

## References


Aydalot, Philippe (1984), *Milieux innovateurs en Europe*. Paris: GREMI.

Baptista, Rui (2003), "Productivity and the Density of Regional Clusters," in *Innovation Clusters and Interregional Competition,* Johannes Bröcker et al., eds. Berlin, New York: Springer, 163-181.

Baptista, Rui and Swann, Peter (1998), "Do firms in clusters innovate more?" *Research Policy*, 27, 525-540.

Becattini, Giacomo (1991), "Italian Industrial Districts: Problems and Perspectives," *International Studies of Management & Organisation*, 21, 83-90.

Beise, Marian and Gemünden, Hans G. (2004), "Lead markets: A new framework for the international diffusion of innovations," *Management International Review,* 83-102.

Bergman, Edward M. and Feser, Edward J. (1999), "Industrial and Regional Clusters: Concepts and Comparitive Applications (accessed April 20, 2006), [available at http://www.rri.wvu.edu/WebBook/Bergman-Feser/chapter3.htm].

BMBF (2003), *Kompetenzzentren für die Medizintechnik. Von der Forschung in die Praxis*. Bonn.

Breschi, Stefano and Lissoni, Francesco (2001), "Knowledge Spillovers and Local Innovation Systems: A Critical Survey," *Industrial and Corporate Change*, 10, 975-1005.

Brusco, Sebastiano (1982), "The Emilian model: productive decentralisation and social integration," *Cambridge Journal of Economics*, 6, 167-184.

Camagni, Robero (1991), "Introduction: from the local 'milieu' to innovation through cooperation networks," in *Innovation Networks: spatial perspectives,* Robero Camagni, ed., London: Belhaven Press, 1-9.

Camagni, Robero (1995), "The concept of innovative milieu and its relevance for public policies in European lagging regions," *Papers in Regional Sciences*, 74, 317-340.

Cantwell, John (2004), *Globalization and the Location of Firms*. Cheltenham, Northamton: Elgar.

Ciccone, Antonio and Hall, Robert E. (1996), "Productivity and the Density of Economic Activity," *American Economic Review*, 86, 54-70.

Clayton-Matthews, Alan (2001), *The medical device industry in Massachusetts*. Boston.

Cornes, Richard and Sandler, Todd (1996), *The Theory of Externalities, Public Goods and Club Goods* (Second Edition). Cambridge: Cambridge University Press.

Crevoisier, Olivier (2001), "Der Ansatz des kreativen Milieus. Bestandsaufnahme und Forschungsperspektiven am Beispiel urbaner Milieus, " *Zeitschrift für Wirtschaftsgeographie*, 45, 246-256.

DeBresson, Christian (1996), “Why Innovative Activities Cluster,” in *Economic Interdependence and Innovative Activity. An Input-Output Analysis,* Christian DeBresson, ed. Cheltenham, Brookfield: Edward Elgar, 149-164.

Dess, Gregory G. and Robinson Jr., Richard B. (1984), “Measuring Organizational Performance in the Absence of Objective Measures: The Case of the Privately-held Firm and Conglomerate Business Unit,” *Strategic Management Journal*, 5, 265-273.

Duschek, Stefan (2004), “Inter-Firm Resources and Sustained Competitive Advantage,” *Management Revue*, 15, 53-73.

Dyer, Jeffrey H. and Singh, Harbir (1998), “The relational view: cooperative strategy and sources of interorganizational competitive advantage,” *Academy of Management Review*, 23, 660-679.

Enright, Michael J. (1998), “Regional Clusters and Firm Strategy,” in *The dynamic firm*, Alfred D. Chandler, ed., Oxford et al.: Oxford Univ. Press, 315-342.

Fabiani, Silvia and Pellegrini, Guido (1998), Un'analisi quantitativa delle imprese nei distretti industriali italiani: redditività, produttività e costo del lavoro, *L'Industria. Rivista di economia e politica industriale*, 19, pp. 811-831.

Feldman, Maryann P. (1999), “The new economics of innovation, spillovers and agglomeration: a review of empirical studies,” *Economy Innovation New Technology*, 8, 5-25.

Franz, Peter (1999), “Innovative Milieus: Extrempunkte der Interpenetration von Wirtschafts- und Wissenschaftssystem,” *Jahrbuch für Regionalwirtschaft*, 19, 107-130.

Fromhold-Eisebith, Martina (1995), “Das kreative Milieu als Motor regionalwirtschaftlicher Entwicklung. Forschungstrends und Erfassungsmöglichkeiten,“ *Geographische Zeitschrift*, 83, 30-47.

Fromhold-Eisebith, Martina and Eisebith, Günter (2005), “How to institutionalize innovative clusters? Comparing explicit top-down and implicit bottom-up approaches,” *Research Policy. A journal devoted to research policy, research management and planning*, 34, 1250-1268.

Gordon, Ian R. and McCann, Philip (2000), “Industrial Clusters: Complexes, Agglomeration and/or Social Networks?,” *Urban Studies*, 37, 513-532.

Håkansson, Håkan; Havila, Virpi and Petersen, Ann-Charlott (1999), “Learning in Networks,” *Industrial Marketing Management*, 28, 443-452.

Hansen, Niles (1992), "Competition, Trust, and Reciprocity in the Development of Innovative Regional Milieux," *Papers in Regional Science: The Journal of Regional Science Association International*, 71, 95-105.

Heng, See and Schaaf, Jürgen (2002), *Business locations in a networked world - No death of distance*, Deutsche Bank Research Nr. 30, Frankfurt a.M.

Hermes Lab (2000), *Check-Up economico finanziario dei distretti industriali. Rapporto esplorativo sui risultati economici dei distretti industriali italiani 1997-1998,* Montebelluna.

Invest in Germany (2005), *German Medical technology: Milestones and Clusters*, Berlin: Invest in Germany.

Jacobs, Dany and de Man, Ard-Pieter (1996), “Clusters, Industrial Policy and Firm Strategy: A Menu Approach,” *Technology Analysis & Strategic Management*, 8, 425-437.

Krätke, Stefan (2002), “Network Analysis of Production Clusters: The Potsdam/Babelsberg Film Industry Example,” *European Planning Studies*, 10, 27-54.

Krugman, Paul (1991), *Geography and Trade*. Leuven, London: Leuven Univ. Press.

Lauterbach, Christian E. (2005), *Regionale Wertschöpfungssysteme und Kernkompetenzen: Konzept, empirische Untersuchung, Gestaltungsempfehlungen*. München et al.: Hampp.

Maillat, Denis and Perrin, Jean-Claude (1992), *Entreprises innovatrices et Développement territorial*. Neuchâtel: GREMI.

Maillat, Denis; Quévit, Michel and Senn, Lanfranco (1993), *Réseaux d'innovation et Milieux innovateurs: Un pari pour le développement régional.* Neuchâtel: GREMI.

Marshall, Alfred (1961), *Principles of Economics. An introductory volume*, Ninth (Variorum) Edition. London: Macmillan.

Martin, Ron and Sunley, Peter (2003), "Deconstructing clusters: chaotic concept or policy panacea?," *Journal of Economic Geography*, 3, 5-35.

Moon, Hwy-Chang; Rugman, Alan M. and Verbeke, Alain (1995), "The generalized double diamond approach to international competitivness," *Research in Global Strategic Management*, 5, 97-114.

Morgan, Kevin (2004), "The exaggerated death of geography: learning, proximity and territorial innovation systems," *Journal of Economic Geography*, 4, 3-21.

Newlands, David (2003), "Competition and Cooperation in Industrial Clusters: The Implications for Public Policy, *European Planning Studies*, 11, 521-532.

Porter, Michael E. (1990), *The Competitive Advantage of Nations*. Houndmills, London: Macmillan.

Porter, Michael E. (1998), *On Competition*. Boston, Massachusetts: Harvard Business School Press.

Porter, Michael E. (2003), "The economic performance of regions," *Regional Studies*, 37, 549-578.

Ratti, Remigio; Bramanti, Alberto and Gordon, Richard (1997), *The Dynamics of Innovative Regions: The GREMI approach.* Adlershot: Ashgate.

Roeland, Theo J.A. and den Hertog, Pim (1999), "Cluster analysis & cluster based policy in OECD countries. An introduction to the theme," in *Boosting Innovation. The Cluster Approach*, OECD, ed. Paris: Organisation for Economic Co-operation and Development, 9–26.

Rugman, Alan M. and Verbeke, Alain (1993), "How to Operationalize Porter's Diamond of International Competitiveness," *The International Executive*, 35, 283-299.

Rugman, Alan M. and Verbeke, Alain (2003), "Multinational Enterprises and Clusters: An Organizing Framework," *Management International Review*, 43, 151-169.

Rutten, Roel (2003), *Knowledge and innovation in regional industry: an entrepreneurial coalition*. London et al.: Routledge.

Sako, Mari (1992), *Prices, quality and trust. Inter-firm relations in Britain and Japan.* Cambridge: Cambridge University Press.

Schiele, Holger (2001), *Strategisches Management in Wertschöpfungssystemen. Clusterbezogene Umweltanalyse - Gestaltungsempfehlungen - Anwendungsfall.* Wiesbaden: DUV.

Schiele, Holger (2003), *Der Standort-Faktor. Wie Unternehmen durch regionale Cluster ihre Produktivität und Innovationskraft steigern.* Weinheim: Wiley VCH.

Servatius, Hans-Gerd (2004), "Next Practice des Innovationsmanagements," *Information Management & Consulting*, 19, 53-60.

Sölvell, Örjan; Lindqvist, Göran and Ketels, Christian (2003) *The Cluster Initiative Greenbook*. Stock-

holm: Ivory Tower.

Steinle, Claus and Schiele, Holger (2002), “When do industries cluster? A proposal on how to assess an industry's propensity to concentrate at a single region or nation,” *Research Policy. A journal devoted to research policy, research management and planning*, 31, 849-858.

Steinle, Claus, Eickhoff, Martin and Schiele, Holger (1998), “Zur Perspektivenerweiterung des Strategischen Management: Der ’innovative Cluster’ als Wertschöpfungssystem und die Entwicklung von Kernkompetenzen,” *Zeitschrift für Planung*, 9, 367-390.

Sternberg, Rolf and Litzenberger, Timo (2004), “Regional Clusters in Germany – their Geography and their Relevance for Entrepreneurial Activities,” *European Planning Studies*, 12, 767-791.

Stoffaes, Christian (1980), “Introduction: filières et stratégies industrielles,” *Annales des Mines*, 186, 9-20.

van der Linde, Claas (2003), “The Demography of Clusters - Findings from the Cluster Meta-Study,” in *Innovation Clusters and Interregional Competition. Advances in Spatial Science,* Johannes Bröcker, Dirk Dohse and Rüdiger Soltwedel, eds. Berlin et al.: Springer, 130-149.

Waverman, Leonard (1995), “A critical analysis of Porter's framework on the competitive advantage of nations,” *Research in Global Strategic Management*, 5, 67-95.

Weder, Rolf and Grubel, Herbert G. (1993), “The New Theory and Coasean Economics: Institutions to Capture Externalities,” *Weltwirtschaftliches Archiv. Review of World Economics*, 129, 488-513.