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**Conference Paper**

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**Publication date:**

2003

**Permanent link:**

<https://doi.org/10.3929/ethz-a-004621601>

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# Identifying and Managing Clusters - Evidence from Switzerland

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## **Abstract**

After discussing and synthesising various aspects of cluster theory in a nutshell the authors identify potential high-tech clusters in Switzerland, highlighting firm agglomerations around Zurich, Basle and Berne-Jura. These agglomerations are but a first indication for a potential economic cluster. Operational guidelines for defining and identifying clusters are very rare in practice and theoretical literature does not provide a lot of help in this respect. To overcome these problems a two steps approach is proposed: First identifying clusters with a top-down approach (quantitative measurement) then applying a bottom-up approach (qualitative measurement). A first step is presented in this paper, providing basic information to already existing cluster organisations and economic development agencies in Switzerland. The second step is part of ongoing research by the authors at the Swiss Federal Institute of Technology in Zurich.

**Key words:** cluster analysis, high-tech industry, territorial development, management of places, Switzerland

# 1 Introduction

Switzerland is a small open economy with few natural resources. The creation of knowledge and its valorisation within the innovation process are therefore crucial to economic development. Innovative activities usually tend to cluster. In the best of cases, geographical, social and institutional proximity - together with positive external spillovers – produce agglomerations of innovative firm activities that nowadays are used to be called clusters. So, to officials on all levels of public administration, clusters became the obscure objects of (policy) desire. But only the moment they emerge from the general landscape of economic activities they get to be known as clusters. One wonders if this Porter-style of ex-post identifying clusters is all there is for innovation policy and territorial development policy.

The paper proposes a methodology to ex-ante identify the potentials for developing economic clusters. It proposes a combination of countrywide macro data analysis (top-down approach) with a case study approach on firm level (bottom-up). After laying out the methodological basis the paper presents first results of the ongoing top-down analysis, thus focusing on Swiss high-tech industries, which are said to be innovative above industry average. We find that certain Swiss regions display a quantitative clustering of firms. But only a thorough bottom-up analysis shows whether there are the necessary localised knowledge and production linkages between these firms. That again will allow tacit knowledge to circulate more effectively among cluster-firms. The result of this analysis allows identifying a potential economic cluster.

The paper then draws attention to the policy side of cluster-formation. Various institutional approaches within Switzerland are discussed that all focus on the management of places. This conglomerate of policies can be summarised as knowledge oriented cluster policies that encompass innovation, technology, education and territorial development policies.

## 2 Identifying Clusters

Geographical clusters are not a discovery of the 20<sup>th</sup> century. In almost every period of history one can find agglomerations of inter-linked firms within a geographical area. The reasons are various – be it for easy access to natural resources or for being integrated in a country’s science base – the main point is always the same: companies hope to benefit from self-reinforcing advantages that a clusters offer, like positive spillovers, reduced transaction costs and face-to-face contacts that facilitate the transfer of tacit knowledge.

The seminal work of LASUÉN (1973), based on the growth poles theory of PERROUX (1955), initiated the discussion about the role and function of clusters. But it was Porter that made the cluster theory popular by combining Lasuén’s cluster approach with more conventional demand and supply side economics and illustrations of ex-post case-studies of large and well known branch developments around the world (PORTER 1990). Ever since, clusters have become something as a hype for social scientists, promotion agencies and entrepreneurs alike. Although the definition of a cluster rests vague, one can at least identify a dividing line along the dichotomy of analytical and normative-symbolic discussion (DÜMMLER, THIERSTEIN 2002).

A whole range of studies try to define and analyse on various spatial and activity levels the empirical content and reality of such clusters (HUTSCHENREITER 1994; VAN DEN BERG et al. 2001). On the other hand, it is the normative policy approach that tries to come up with some recommendations on how to identify, foster, promote and market such clusters. Wishful thinking to copy ‘Silicon Valley’ (ROGERS, LARSEN 1984) and to initiate a lasting turnaround still lingers around in many restructuring or economically depressed regions. The objectives may vary but centre around the following objectives: regional development, regional innovation networks, technological change, competitiveness and structural change, upgrading of regional or local labour markets (THIERSTEIN, WILHELM 2001).

But still, the concept of economic clusters stays quite vague and very much open to interpretation. The question thus prevails: what are the basic features of a cluster approach? At first and second glance it becomes clear, that clusters have connotations with spatial concentration of economic activities, functional relationships between actors, networking, mobilising localised and specific resources etc. Clusters have long since the days of MARSHALL (1920) developed and encompass not only

- the *manufacturing sector*, but as well
- the *scientific sector* with its important role on technological innovation,
- the *sector of producer services* which provide assistance or support to industrial firms for the development and/or introduction of new products or processes, and

- the *institutional sector* which includes first formal institutions like employer associations, non-profit organisations or legal and regulatory frameworks, and second informal institutions including the prevailing set of rules, conventions and norms that prescribe behavioural roles and shape expectations.

The above lines of discussion form the vertical axis of table 1 below. The horizontal axis is formed by the fact that the discussion on innovation and clusters can be structured on the one hand along the dichotomy of territorial or localised based innovation systems and on the other hand along technology and sector oriented networks. One of the main discriminating criteria for the two approaches is the degree to which geographical proximity is perceived and valued as a precondition for the existence of a territorially based system (TORRE, GILLY 2000). A proximity that is only geographic in nature can provide the basis for the presence of an agglomeration of firms, but not necessary for the presence of a system of innovation (FISCHER 2001). In general, most definitions of clusters “share the notion of clusters as localised networks of specialised organisations, whose production processes are closely linked through the exchange of goods, services and/or knowledge” (VAN DEN BERG et al. 2001).

Recently, authors place the cluster approach within a broader framework of knowledge economies and of evolutionary approaches to socio-economic development (COOKE 2002; LAMBOUY 2002; VAN DEN BERG et al. 2001). One of the key problems with the cluster approach is the biased focus most empirical studies apply: the concentration on well-performing large-scale regions like the Third-Italy, Baden-Wuerttemberg, Silicon Valley, Research Triangle Park in North Carolina, or Cambridge. But in order to draw workable and viable conclusions from such cases it is necessary to adopt an analytical approach that goes beyond the economic activities and criteria most studies apply. Clusters thus should be studied in an integral way, from the view that clusters are embedded in the spatial-economic, cultural and administrative-political structures of an urban or even rural region. A very instructive example and a good starting point for that kind of analysis is Saxenian’s comparative study of Silicon Valley and Route 128 – Boston (SAXENIAN 1996). A comprehensive analytical framework for identifying clusters has been proposed by VAN DEN BERG et al. They assume that three interrelated elements influence the growth of a cluster (2001: 189):

1. *spatial-economic conditions* (demand conditions, quality of life, accessibility, cultural conditions),
2. *cluster-specific conditions* (size and development level, presence of cluster engines, degree of strategic interaction among actors, level of new firm creation), and
3. *organising capacity regarding the cluster* (presence of vision and strategy in a cluster, quality of public-private networks, level of societal/political support for cluster development).

Table 1 tries to synthesise the different aspects around the analysis and discussion of clusters.

**Table 1 The roles of clusters - a theoretical taxonomy**

Spatial logic □	Territorial approach	Network approach
Cognitive logic □		
Functional approach	<b>CLUSTER</b> <ul style="list-style-type: none"> <li>• Diversification and specialisation of activities</li> <li>• Concentration of externalities</li> <li>• Density of proximity contacts</li> <li>• Concentration of tacit knowledge</li> <li>• Reduction of transaction costs</li> </ul>	<b>INTERCONNECTION</b> <ul style="list-style-type: none"> <li>• Cluster as a node in multiple and interacting technological, communication and economic networks</li> <li>• Cluster as interconnection between place and node</li> </ul>
Symbolic approach	<b>MILIEU</b> <ul style="list-style-type: none"> <li>• Substrate of collective learning</li> <li>• Uncertainty-reducing operator through: <ul style="list-style-type: none"> <li>• information transcoding</li> <li>• ex-ante co-ordination of private decisions (collective action)</li> </ul> </li> </ul>	<b>SYMBOL</b> <ul style="list-style-type: none"> <li>• Cluster as a 'landmark' for an innovative region</li> <li>• Cluster as a status symbol for local or regional promotion agencies and politicians</li> <li>• Cluster as a producer for symbols and codes of 'change towards a brighter future' and as 'change agent'</li> </ul>
Normative approach	<b>LEARNING REGION</b> <ul style="list-style-type: none"> <li>• Promotion of regional innovation and production systems (RIPS)</li> <li>• Support for higher educational system (HES) to foster human capital</li> <li>• Information and mobilising platform for local and regional actors of small size clusters</li> </ul>	<b>INTERNATIONAL COMPETITIVENESS</b> <ul style="list-style-type: none"> <li>• Ranking of international technological Centres of Excellence</li> <li>• Support of incubator centres, start-up or spin-off firms</li> <li>• International promotion platforms of locations and cluster competencies</li> </ul>

Source: DÜMMLER, THIERSTEIN 2002, based on CAMAGNI 2001.

### 3 High-Tech Clusters in Switzerland

As mentioned in the introduction, Switzerland does not possess any major natural resources. Therefore the production process, especially in the high-tech industry - heavily relies on knowledge. The following analysis focuses on the spatial distribution of the high-tech companies in Switzerland, trying to identify the potential for high-tech clusters.

The high-tech industry is defined as being highly R&D intensive and includes the following sectors: aircraft and aerospace, electrical machinery, office and computing equipment, communications equipment, pharmaceuticals, precision instruments and medical devices (definition based on DÜMMLER, THIERSTEIN 2001, 2003; OECD 1994; OECD, EUROSTAT 1997; OECD 2001).

Table 2 shows the labour force in the high-tech industry compared to the Swiss total of all sectors. During the period 1995-2001 the high-tech industry employed an increasing share of the total

Swiss labour force, reaching 5.73% in 2001. This may seem to be a small portion, but high-tech – as defined above – only includes the labour force in mainly manufacturing oriented industries and does not take into account knowledge intensive business services (KIBS).

Interesting is the fact, that although most of the Swiss industries faced a severe economic recession between 1995 and 1998 and had to lay off employees, this seems not to be the case for the high-tech industry. Even though the total number of the Swiss labour force declined, the high-tech industry could increase employment not only in relative but also in absolute terms.

**Table 2 Labour force in the high-tech industry**

	Labour force in high-tech	Labour force in Switzerland (total)	Share high-tech
1995	188'616	3'548'815	5.31%
1998	193'835	3'471'428	5.58%
2001	210'296	3'668'468	5.73%

Source: own calculations; Data: Swiss Federal Office of Statistics (BUNDESAMT FÜR STATISTIK 2003).

One method to identify potentials for high-tech clusters is using data from the federal business census in 1995, 1998 and 2001. But mapping the absolute values of total employment per municipality for high-tech does not include any relative measure. Adding a relative measure accounts for the different size in terms of employment in the municipalities. We therefore selected the location quotient (LQ; see figure 1) on the basis of persons employed in high-tech.

**Figure 1 Location quotient (LQ)**

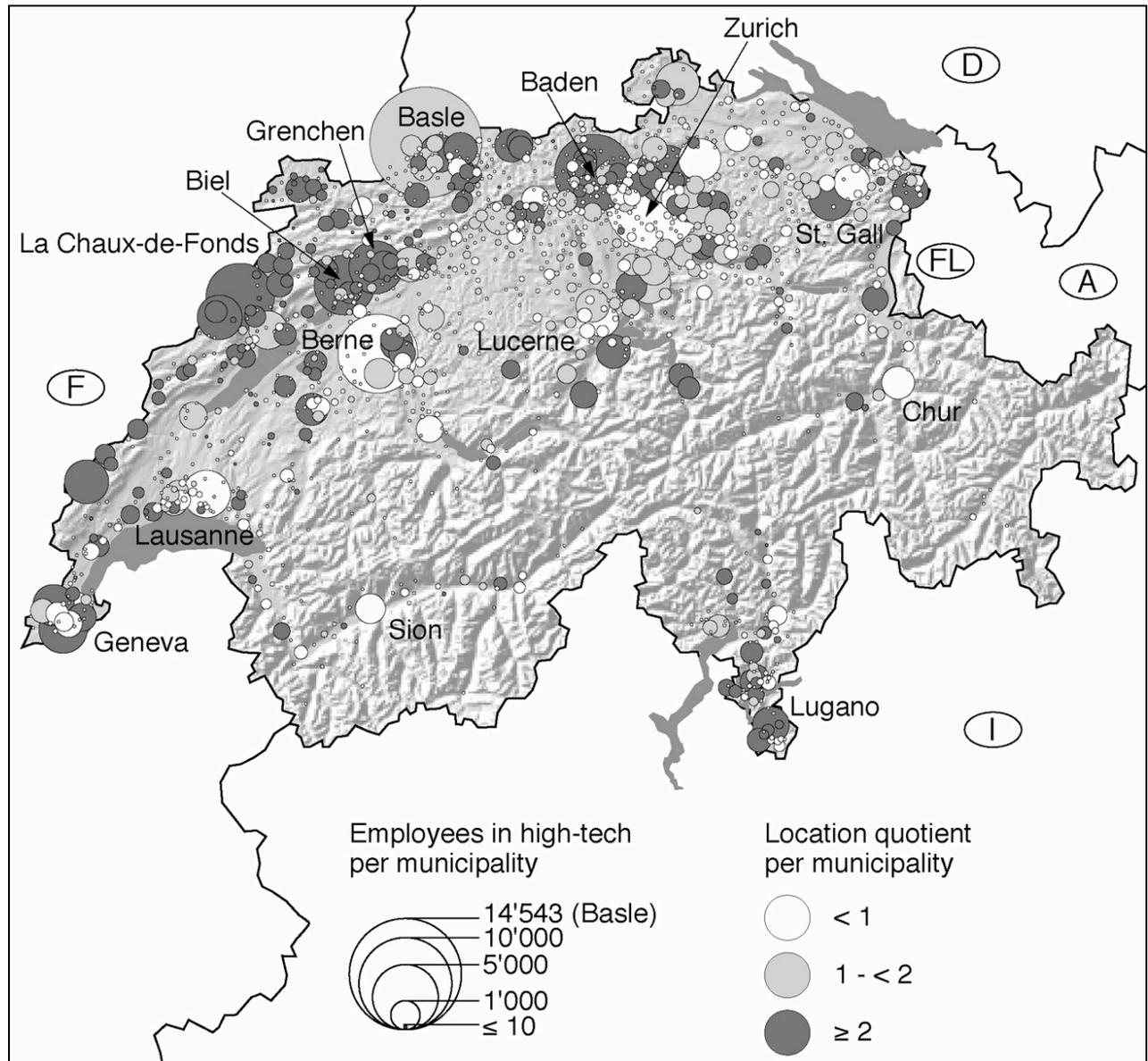
$$LQ_{ij} = \frac{Y_{ij}}{\sum_{i=1}^n Y_{ij}} : \frac{\sum_{j=1}^m Y_{ij}}{\sum_{i=1}^n \sum_{j=1}^m Y_{ij}}$$

$Y_{ij}$  = labour force of one industry (j) in one municipality (i)  
 $\sum_{i=1}^n Y_{ij}$  = labour force of one industry (j) in all municipalities (i)  
 $\sum_{j=1}^m Y_{ij}$  = labour force of all industries (j) in one municipality (i)  
 $\sum_{i=1}^n \sum_{j=1}^m Y_{ij}$  = labour force of all industries (j) in all municipalities (i)

Source: SCHÄTZEL 1994.

The LQ measures the structural deviation of one municipality from the industrial structure of all Swiss municipalities. In this analysis the LQ therefore shows whether the high-tech industry in a specific municipality is relatively over ( $> 1$ ), equally ( $= 1$ ) or under-represented ( $< 1$ ) compared to the whole of Switzerland. Thus, a location coefficient of 1.5 indicates that 1.5 times the percentage of workers is employed in high-tech than on Swiss average. Figure 2 shows employment in high-tech for 2001, combining absolute (circle size) and relative values (shadings).

**Figure 2 High-tech employment 2001**



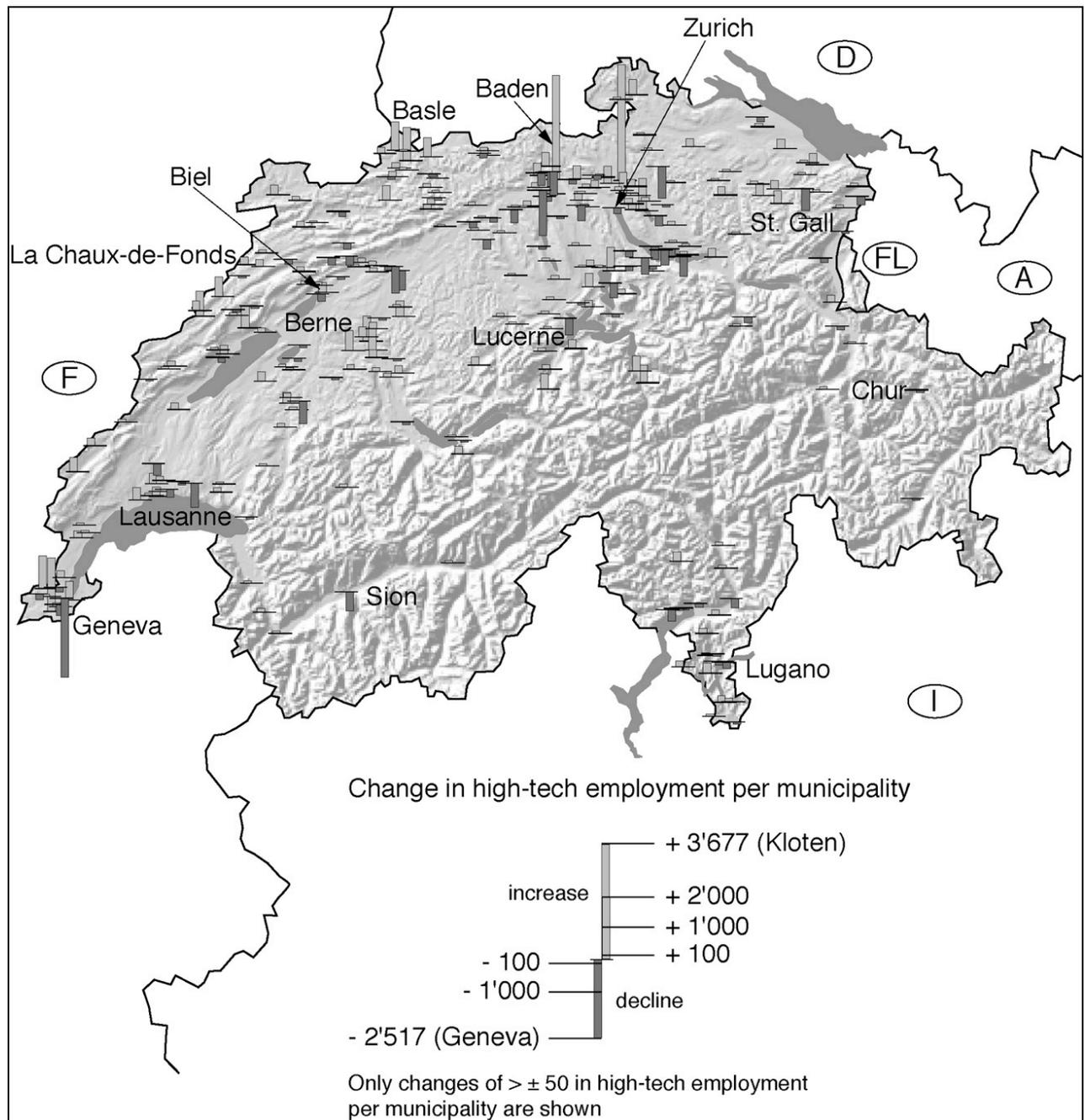
Source: own calculations; Data: Swiss Federal Office of Statistics (BUNDESAMT FÜR STATISTIK 2003); Cartography: Lars Glanzmann.

Three major cluster potentials are identified:

- The cluster of Zurich: Encompassing the city of Zurich with a large absolute number of employment in high-tech but with a percentage share of high-tech employment compared to total employment below the national average ( $LQ < 1$ ). A very strong presence of high-tech industry can be found north-west of the city of Zurich in Baden, with more than 7'000 employees in high-tech and a LQ of 5.17. Several production sites of the multi-national firm ABB are located in Baden, leading to many spin-offs and attracting engineers from all over the world, whereas the global headquarter of ABB is located in the City of Zurich. The Zurich high-tech cluster stretches out into eastern and central Switzerland and is mainly based on electrical machinery.
- The cluster of Basle: Dominated by the city of Basle with almost 15'000 employees in high-tech and a LQ of 1.72. Basel and its agglomeration are strongly based on pharmaceuticals and chemicals with the two global headquarters and various production sites of Novartis and Roche, which also attract a highly skilled labour force and led to a number of spin-offs.
- The cluster of Berne-Jura: This cluster has its core in La Chaux-de-Fonds (LQ 4.55), Biel (2.22) and Grenchen (6.21; total of 13'000 employees in high-tech for the three municipalities), with also a strong absolute presence in the city of Berne. This cluster is mainly based on precision instruments and medical devices (DÜMMLER 2003).

As shown in table 2 above, employment in the high-tech industry from 1995 to 2001 increased by 11.5%, compared to 3.4% in all branches. The analysis shows that most of the jobs in the high-tech sector were created very close to or even within larger cities (figure 3), taking advantage from a very dense infrastructure, the vicinity to universities, research laboratories and other high-tech companies.

- The biggest increase is found in the Zurich cluster with the two municipalities Kloten (Zurich airport) and Baden, accounting for a third of the total (figure 3). On the other hand the Zurich cluster lost employment in high-tech due to the restructuring process of the machine manufacturing industry, mainly south of Baden and in Winterthur (north-east of Zurich).
- The Basle cluster took advantage from the expanding pharmaceutical industry, leading to even more start-ups and spin-offs in and around the city of Basle, creating more than 3'000 new jobs.
- The Berne-Jura cluster grew in and around Berne and La Chaux-de-Fonds, without much change in Biel and Grenchen.

**Figure 3** Change in high-tech employment 1995-2001

Source: own calculations; Data: Swiss Federal Office of Statistics (BUNDESAMT FÜR STATISTIK 2003); Cartography: Lars Glanzmann.

As already mentioned in section 1, the here presented analysis focuses solely on the quantitative aspects of the clustering of similar economic activities (horizontal clusters). We did not yet consider the backward and forward – with suppliers and customers as in vertical clusters – or up-stream and downstream linkages – with firms of related branches as in lateral clusters – of these activities. In this sense, the method applied of analysing employment data and calculating location quotients has its clear limits. An exclusively statistical study does not help reveal the complementarities, which exist between the various activities in a region, regardless of whether these com-

plementarities are to be found in purchasing/selling relations, in the technology employed and the related know-how inter-linkages or whether they are of a different nature. Thus in order to better grasp the more complex interrelationships of the various clusters, it is necessary to follow a framework approach described in section 1 and 2. In doing so, it would be helpful to use more qualitative data which in turn would mean to resort to two sources of information: interviews with regional experts and existing regional monographs.

The following section will take a closer look at some of the main cluster initiatives and strategies in Switzerland.

## 4 Managing Clusters – the Swiss case

### 4.1 Innovation policy and cluster strategy

The discourse on concepts and theories of clusters leads to concluding that clusters come in ‘all colours and shades’. Which means that an integral analysis will produce clusters of different sizes, be they small and barely recognisable on the quantitative level or be they large and internationally well-known. There is a saying: ‘from small things big things come’, which means that even Silicon Valley (ROGERS, LARSEN 1984) or the Cambridge Phenomenon (KEEBLE et al. 1999) almost started from scratch.

Clusters never just pop up like mushrooms in autumn. There always is public or private help and support, and more often it is both. Switzerland is recognised to be a country with a very liberal overall economic policy that is known as ‘Ordnungspolitik’. That means that economic development is left to the private market and firms activities. Thus, industrial policy does not count among the Swiss traditions in political behaviour. Switzerland does not even subscribe to an explicit technology or innovation policy. In 1992, the Swiss government declared technology policy to be more of a general economic policy with a technology focus (BUNDESRAT 1992).

Only recently, the Swiss Office for Professional Education and Technology produced an unpublished report on Switzerland and the global competition on innovation (BUNDESAMT FÜR BERUFSBILDUNG UND TECHNOLOGIE 2002). Following a more up-to-date definition, innovation policy in the narrow sense of the term in Switzerland thus should encompass research and education policy while in the wider sense of the term innovation policy would also count in labour market policy, budget policy, anti-trust policy as well as foreign economic policy.

Taking into account this broad portfolio of policy fields it becomes comprehensible that not only the Swiss Office for Professional Education and Technology cares about the innovation process but also the Swiss State Secretariat for Economic Affairs that has adopted an explicit cluster strategy. ‘Business location Switzerland’, the promotion branch of the State Secretariat, focuses on six activity or technology clusters: bio-tech, med-tech, micro/nano-technology, information and

communications technology, environmental technology and shared service centres (SSC) or headquarters (HAFEN 2003).

However, in order to assess the impact and the effectiveness of such strategy, one has to bear in mind the institutional structure of Switzerland. Due to the Swiss federalist structure, it is above all the sub-national level – the cantons – that in general allocate more funds for fostering regional economic development, including promotion of innovativeness, than does central government. ‘Business location Switzerland’ thus acts as a multiplier and platform on the international marketing level for Swiss regional cluster initiatives and as a gateway for incoming business to be addressed towards regional cluster networks. ‘Business location Switzerland’ has started to be fully aware of the fact that managing clusters today means more than just to care for attractive places. It means to foster networks of competence that at the same time bring together localised knowledge and international expertise. Among the most promising regional cluster initiatives in Switzerland are:

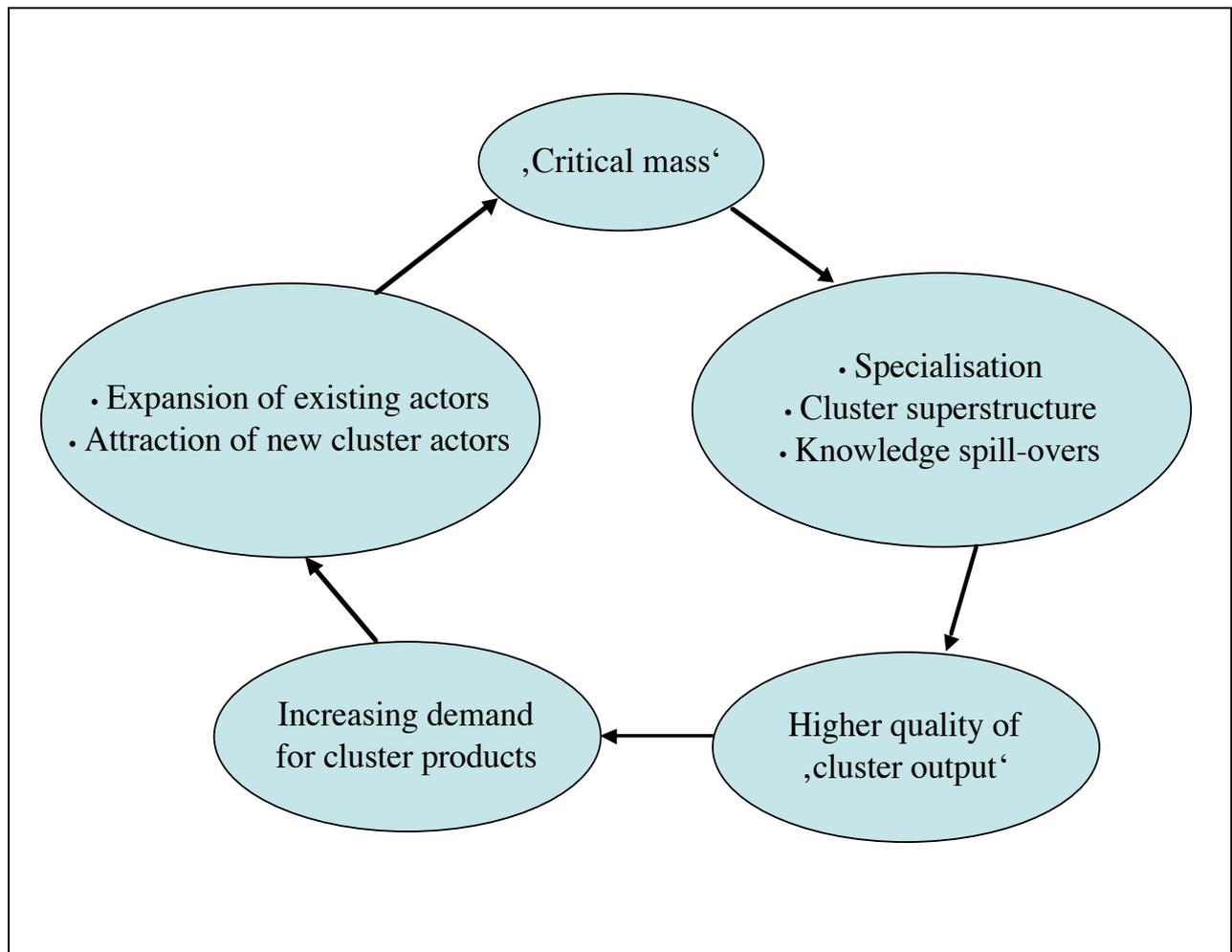
- Greater Zurich Area (GZA): The GZA has been established in 1999 and is a public-private location marketing organization that covers a region around one-third the size of the whole of Switzerland. GZA is home to 45 percent of its inhabitants (3.2 million). Its workforce of 1.6 million is employed in approximately 140,000 companies, producing aggregate national income totalling CHF 170 billion. The GZA cluster strategy covers four distinct industrial focuses: Medical and biotech companies; high-tech companies with their strengths in micro- and nanotechnology and a strong focus on sensors, photonics and applications of materials; IT & new media; headquarters (GREATER ZURICH AREA 2003).
- BioValley has started in 1996 as a tri-national, public-private initiative that has been funded by the European Commission initiative INTERREG II. BioValley focuses on life sciences and puts together private market potential and university research know-how of institutions and firms within the triangle of Freiburg (Germany), Basle (Switzerland) and Strasbourg (France). BioValley today covers more than 400 companies and 200 research institutions or departments, in addition the multi-nationals of Roche, Aventis and Novartis (SIEGENFÜHR 2003).
- The cluster strategy of the canton of Berne includes six industrial focuses that have been launched in 1998 in the wake of the new cantonal law on economic promotion. The most important three clusters all have established an association to foster the promotion of their cluster activities: The Medical Cluster Berne (MCB), the Telematics Cluster Berne (TCB) and the Consulting Cluster Berne-Espace Mittelland (GRISEL 2003).

## 4.2 Strategic management of clusters

In order to close this paper, let us have a brief look at one of these cluster strategies. The Zurich MedNet cluster strategy seems to be the most ambitious among the four cluster strategies of the Greater Zurich Area (ZURICH MEDNET 2003). Recognised as a world leader in biotech and pharmaceuticals, Switzerland is also a significant producer and provider of medical devices, equipment and services. Equally important, the largest concentration of the medical/bio-related industry in Switzerland is centred around Zurich (DÜMMLER 2003). This medical/biotech cluster, a community of more than 400 companies, hospitals, labs, medical-related service organisations, venture capital funds, banks and foundations, together with some of Europe's most prestigious universities, is Zurich MedNet.

In December 1999, building on a close relationship between the cities of Zurich and Winterthur, Zurich MedNet became a medical/biotech cluster of the Greater Zurich Area. Focusing on the importance of universities to business, Zurich MedNet was designed to promote economic development, while strengthening its economic competitiveness independently and in partnership with allied communities. Accordingly, in the beginning of 2000, Zurich MedNet developed the first prototype of ZurichMedNet.org, a web portal, and entered into a strategic alliance with the University of Minnesota's MBBNet.umn.edu, the largest linked, regionally based, medical/bioscience web portal in the United States (UNIVERSITY OF MINNESOTA MEDICAL SCHOOL 2003). Together, Zurich MedNet and MBBNet represent the first web-based international industry/university cluster alliance in the world, and the first international web search linking of regional clusters ever (KÄRCHER-VITAL 2003).

Now if one compares the quantitative concentration of medical/bio-related industries to other industries across Switzerland, the Zurich MedNet does not show up (DÜMMLER, THIERSTEIN 2002). Thus, on a strategic policy level, does this mean that there is no legitimacy for such a cluster? Or does it just happen that Zurich MedNet still is in its embryonic phase and thus not easily detectable in quantitative terms and therefore did the cluster not yet cross the threshold of being recognised as being one? These questions do not have definitive and precise answers but lead us to have an even closer look. Clusters tend to grow and it is exactly that growth pattern which interests researchers and politicians alike. But there is no uniform growth pattern due to the varying initial spatial-economic and cluster-specific conditions as well as the organising capacity of a cluster. But nevertheless, empirical evidence from scientific analyses and case studies lead to formulate the following 'virtuous circle' for cluster development (figure 4).

**Figure 4** An ideal growth pattern for cluster development - the 'virtuous circle'

Source: DÜMMLER, THIERSTEIN 2002.

How does one interpret this virtuous circle? Obviously there is no fixed starting point. Taking up the Zurich MedNet example described above, the critical mass to get recognised quantitatively is not yet reached. Thus the Zurich MedNet cluster, albeit being highly specialised, will have to further and enlarge its cluster superstructure – for example privately operated education and child caring facilities – and foster knowledge spillovers. Consequently this will lead to a higher quality and attractiveness of the MedNet's output, which in turn impacts positively on the demand of the clusters output in economic as well as in structural and knowledge terms. And again, attractiveness and success breeds success: The already existing actors within the Zurich MedNet cluster will thrive and new ones start up, spin off or locate within its area. Finally the virtuous circle completes itself and a self-sustaining critical mass will be reached.

But to be precise, on the strategic level of location or regional policy it is not so much important that an economic cluster such as Zurich MedNet is recognised by its pure size but by its excellence and networking capabilities. And although a success story sets in motion a virtuous circle, there still is no deterministic development pattern. Empirical evidence is strong enough to send warning signals to all actors involved that success is not stationary and may carry the germ of failure. Lock-in phenomena (COWAN, GUNBY 1996; GRABHER 1993), conservatism among the key players and change agents will eventually lead to sclerosis and inertia.

To sum up, counting on a quantitative analysis of employment and location quotients, potential high-tech clusters show up. But only a closer look with the help of an integral framework approach will identify the singular qualities and features of specialised clusters. The Zurich MedNet serves as an example for a small-scale cluster that at first sight is barely 'visible' but eventually surfaces and may thrive to become a first-class address even on an international level. There is no sure-fire way to guarantee success but combining smart cluster management with location and network management will help some.

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