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Potential to Network Innovative Clusters in the Baltic Metropoles Regions

Present State and Perspectives

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1 Introduction

The Baltic Metropolises Innovation Strategy Project (BaltMet Inno) is a joint innovation project of the capital cities in the Baltic Sea Region. It aims at strengthening the role of cities as developers of innovation environments at local, regional, national and international levels.

The project goal is to produce a common innovation policy framework for the Baltic Sea Region and to create transnational metropolis-driven innovation networks. BaltMet Inno activities aim at strengthening innovation capacities of metropolises with a focus on the following themes or work packages:

1. local innovation strategies
2. regional marketing
3. innovative business clusters
4. innovation competencies and entrepreneurship
5. innovation policy framework

The lead partner is the City of Helsinki and the project co-ordinator Culminatum Ltd. The other 14 project partners are the cities of Berlin, Copenhagen, Riga, Malmö, Tallinn, St. Petersburg, Stockholm, County Administrative Board of Stockholm, WISTA Management GmbH, Technology Foundation Berlin GmbH, EVU Center for Business Start Up, Growth and Development, and St. Petersburg State University. In addition, the cities of Oslo, Warsaw and Vilnius participate as observers.

BaltMet Inno is the key project of the Baltic Metropoles Network. The mission of the network, set up in 2002, is to promote innovativeness and competitiveness in the Baltic Sea Region by engaging the focal actors in the area – cities, universities and business enterprises – into close co-operation. Focus of the co-operation is on innovation policies, promotion of mobility of top experts and on pooled marketing. The 2.6 M€ budget of BaltMet Inno is co-financed by the Baltic Sea Region INTERREG III B Neighbourhood Programme. The Project was launched at the beginning of 2005 and will be completed in the end of 2007.

Work package 3 which is the object of this report was especially concerned with the development of clusters. The aims of work package 3 were reinforcement of collaboration in cluster development work and identification and improvement of transferable cluster elaboration tools between the cluster developers in the Baltic metropolitan areas. The developed cluster tools and instruments provide for increased interaction and focused cooperation between the Baltic metropolitan areas in cluster development. This would lead to better networked regions, improved growth conditions and easier market access for innovative companies. Work package 3 was coordinated by Wista Management GmbH jointly with TSB Innovationsagentur Berlin GmbH.

This report first gives a short conceptual background on clusters, cluster development, and on cluster alliances. This section is followed by a description of the methodology that can be used for identifying and comparing clusters and the methods used within work package 3 to gather the relevant information. In section 4 the clusters and developing clusters and networks in selected technological areas in the six regions of Berlin, Øresund, Helsinki, Stockholm, Riga and Tallinn are presented. In section 5 first some conceptual thoughts on opportunities to network clusters are presented. This is followed by a presentation of networking opportunities at the level of technology parks. This leads to a discussion of networking potential at additional levels. Finally in section 6 a summary will roundup this report.

2 Clusters, Alliances and Cluster Alliances – Conceptual Thoughts

2.1 Cluster Definition, Development and Policy

Silicon Valley, Route 128, the Third Italy, Baden-Württemberg and the like – the names stand in the forefront of the regional agglomeration phenomenon. The essence of the phenomenon traces to the fact that firms of specific industries locate in close proximity of one another and thereby expect economic benefits and positive externalities from geographic proximity (Ketels, 2003).

The cluster phenomenon can hardly be labelled as new. Already in the late 19th century, the economist Alfred Marshall (Marshall, 1890) investigated production networks (industrial districts in his wording). He identified and investigated externalities that were caused by the local availability of qualified labour, a growing demand in the location and a high specialization of companies at different levels of the values chain within the region and came to the conclusion that the industrial atmosphere inherent in a region is idiosyncratic and immobile and can hardly be transferred to other regions (Bathelt, 1998) making each industrial district special.

Since then, but especially since the late 1980s, the phenomenon of regional agglomeration has received increasing interest among scientists, business leaders and politicians. In science scholars from various disciplines as diverse as geography, sociology, economics, management science etc. have tried to shed light on this phenomenon. Different theoretical perspectives have been applied and have resulted in numerous, partly confusing names and definitions. Regional agglomerations are titled as clusters, regional networks, learning regions, industrial districts, new industrial spaces, local production systems, local entrepreneurial milieux, local and regional innovation systems among others. Evidence for the growing popularity of these concepts is the rapidly expanding body of literature on this topic, the increasing number of political programs and extensive budgets for cluster development. Such programs have recently been developed and implemented at regional, national as well as supra national levels. Ever since the influential Harvard Business School professor and industrial economist Michael Porter has introduced the cluster concept and pointed to its innovation and productivity benefits to companies within such clusters companies take the regional cluster context into account before deciding on a new location for a subsidiary for example.

But what factors explain that some regions are more innovative and/or productive than others? And what explains the innovative/productive performance at the regional level? One school of thought emphasizes the role of clustering of innovative and industrial activities in specific regions. The agglomeration of innovative and industrial activities facilitates the level of innovation in a region in particular through the social interaction and exchanges between local actors. The concept of Regional Innovation Systems (RIS), (Cook, 2001) emphasizes the role of interactions between local actors (e.g. firms, research infrastructures, local authorities and institutions) also called the Triple Helix model (Etzkowitz & Leydesdorff, 2000). On the other hand cluster approaches (Porter, 1998) highlight the role of local demand and industrial structure through vertical links between customers and suppliers as well as related activities such as services supporting the local economy. Additionally at the horizontal level Porter stresses the existence of competing and collaborating firms as being conductive for innovation and productivity gains at the cluster level.

2.1.1 Cluster Definition and Criticism

The one concept of regional agglomeration that has caught most attention over the last years undoubtedly is the cluster concept by Michael E. Porter. Because of its widespread acceptance and application but especially because we find it useful to apply in the context of the Baltic Metropoles Innovation Project it will be presented in more detail in the following section.

According to Porter clusters are „geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also co-operate" (Porter, 1998: 197).

The dynamics of a cluster develop along a core activity, technology or industry that can be understood as a geographic concentration of interacting actors of a value creating system. This core to a large extent influences the directions of developing markets and processes. The relationships between cluster actors in the field of the core activity, technology or industry are rather quite divers and include formal relations (in form of cooperation agreements or memberships, for example) as well as informal personal contacts. Only the continuous exchange forming, using and thereby reproducing these different channels generates the necessary climate for mutual learning, experimental situations and resulting cluster dynamics.

As a result another feature of the cluster can be identified. Cluster actors tend to bundle their competencies and activities in order to better be able to offer specialized resources, products and services. This would not be possible if the individual cluster actor would have gone alone. Resulting from the concentration of resources and the sharing of risks as well as the development of complementary competencies cluster companies can realize *economies of scale and economies of scope*. In the discussion of different forms of interaction and cooperation elements of competition shall not be neglected for it plays an important role in clusters. Using the metaphor of "healthy competition" points to the fact that competition often stimulates innovation and productivity growth and to a large extent influences cluster dynamics.

According to Buchinger (2006) a functioning cluster displays at least three main features: (1) Dynamic focus: A core is present (core companies, research organisations core product and/or services, technology), that is developing along a specific path. (2) Dynamic interweavement: A critical mass of actors representing the extended value creation system needs to be present. The companies compete but also cooperate and thereby advance the development of the cluster. (3) Localization: The interacting actors are co-located in a particular region and thereby share the same natural, institutional and political/legal/administrative as well as infrastructural context conditions.

As a consequence of the localization as well as the relatively high density and intensity of interaction among organizations clusters are in danger of closure processes like group think, cognitive, institutional or technological lock-ins and the fixation in topics within the local education and qualification system. If cluster actors concentrate exclusively on internal affairs symptoms of paralysis are likely. A sufficient level of competition, external contacts and a balanced account of opening and closure processes appears to be necessary in order to establish a sustained development path.

Many criticisms of Porter's framework exist (Martin and Sunley, 2003, for example). The conceptual problems start with the boundaries of the cluster: at what level of industrial aggregation shall a cluster be defined? Clusters can be found at almost any level of aggregation and their boundaries are everything but clearly drawn. Another problem concerns the density of interactions among the actors and the often sighted critical mass of actors of the agglomeration.

Clusters rarely conform to industrial classification systems. That is why national statistics will hardly contain exact data on clusters (though clusters are subsumed in the data). The cluster concepts ambiguity, the conceptual absence of social networks within or beyond clusters and the missing dimension of cluster identity belong to the criticised aspects of the concept (Asheim et al., 2006). However over the years, the theoretical and empirical base has become more solid due to a wide body of conceptual literature, numerous case studies in various industries and countries and plentiful past and current cluster mapping projects. Further, numerous projects used and use Porter's model. Additionally it is exactly the ambiguity of the components of Porters cluster definition that provides interested agents, managers and politicians in particular with a degree of conceptual flexibility that may be quite helpful for a variety of policy approaches (Jacobs and de Man 1996).

2.1.2 Cluster Evolution and Managed Development

The analysis of cluster evolution and development has shown that cluster development takes time. Deliberate cluster development therefore should have a rather long time perspective because empirical findings indicate that the evolution of clusters may take decades. Often chance events are the starting point of cluster evolution and the roots of contemporary clusters often go back many years. Natural factors like resources (like coal or water) or the existence of initial institutions (companies or research organizations) can be seen as a crystallization points in time and space may serve as cluster seeds. Initial companies or research facilities in early stages of cluster evolution have been spinning-off companies and attracting investment other companies that are located outside the region. In such a process the economies of proximity have been incentive enough for other actors to stay or locate within the specific regional developing cluster leading to a self-reinforcing cycle. In other cases dedicated efforts have been undertaken to upgrade developing clusters. (cf. Ketels, 2003)

A number of life cycle models that distinguish a number of identifiable phases have been developed (see for a recent approach Menzel/Fornahl 2007). In contrast to such generalizable life-cycle and phase models it should be considered that each cluster develops – and is developed – in a non-linear, rather unique way. Such a cluster evolution and development is more or less controlled by cluster and organizational management. For researchers it is an important task however to identify certain developmental patterns over time. These tend to be rather idiosyncratic, i.e. cluster- and context-bound, and, eventually, even path-dependent – thus questioning the applicability of general managerial principles, not to mention so-called 'best practices'.

Cluster policies can act as a facilitator of cluster dynamics. The answer to the question weather or not clusters can be created is probably yes. However the more appropriate question appears to be "whether the resources spend to 'create' a cluster generate economic value higher than their opportunity cost, and whether the cluster is sustainable once the initial support is removed. The evidence is quite negative, suggesting that cluster creation is a very long and costly process with a high failure rate that for many regions does not pay off and creates long-term dependency on government funds" (Ketels 2003, 15).

An important rule in cluster policy therefore has been formulated by Porter (2000): „to justify cluster development efforts, some seeds of a cluster should have already passed a market test". According to the Porterian cluster-based economic policy approach that is heavily inspired by industrial economic thinking all clusters are important and mutually eligible for enhancement – and not only the so called high-tech sectors. Cluster efforts are a means to influence the underlying conditions aiming at higher levels of productivity and innovation of firms and regions.

A result may be a higher market share of local companies or employment growth. Policies directed at enhancing productivity allow competition to move to a higher level of productivity and unique value, and do not restrict competition. High levels of rivalry in a location are seen as a vital condition for the evolution and development of competitive clusters and therefore should be facilitated. (cf. Ketels 2003)

According to this view cluster policy should concentrate on already existing or emerging activities and agglomerations and "removing the most serious bottlenecks for higher productivity and innovation for a cluster by mobilizing the capacity of cluster participants to act jointly" (Ketels 2003, 16). The authors of the *Cluster Policies Whitebook identify the* following activities for cluster policy (Andersson et al. 2004):

- Building on existing cluster structures,
- Developing tailored measures for the specific problems of a particular cluster,
- Assurance of continuity (commitment, leadership, communication),
- Taking catalytic effects of all cluster actors (not only companies) into account,
- Provision of infrastructure,
- Maintaining the role of a facilitator, broker, initiator (i.e. by evaluating the performance of a cluster),
- Integration of political actors at different governance levels.

Cluster development can be facilitated at different levels (organization, inter-organizational networks, clusters, regions, nations). Increasingly actors representing these different levels and different societal spheres (economic, research, political) within regional clusters, regional industry associations but also regional developers are looking for contacts to other regionally based clusters and begin to establish strategic relationships between clusters. Within cluster research this new development up until now appears to be a largely neglected phenomenon. In the following section some first conceptual thoughts will be presented. Based on established conceptions of strategic alliances the idea of cluster alliances is developed.

2.2 Forms of Alliances

The modern economy exhibits distinctive characteristics like decentralization, networking, and agility. Flexibility today plays a key role in business activities. In addition the transition to the knowledge-based economy can be ascribed to the changes in the global business environment: On the micro level, the pace of technical change is accelerating. Product life cycles have become significantly shorter forcing companies to generate continuous streams of innovations. In order to cope with the growing diversity of knowledge and escalating R&D costs and to account for the importance of speed and flexibility, firms deconstruct their value chains through outsourcing and partnering. Information technology is considered as one of the key success factors. On the macro level, economic liberalization, deregulation and standard harmonization take place.

Alliances of companies can be reckoned as an answer to changing environmental conditions. Alliances can be found in most industries. In certain knowledge-intensive areas like ICT, pharmaceutical and biotechnological industry, leading companies maintain over hundred alliances. For example, Elli Lilly employs over 150 alliances with R&D institutions and biotechnology companies (EFOM 2001). Firms cooperate vertically along the whole value chain. R&D, procurement, operations, marketing and sales belong to the most prominent examples of

departments involved in the management of alliances. Essential characteristics of strategic alliances are:

1. Strategic alliances are a temporary organizational form. Their duration is limited per definition, though alliances might often have a long-term character which is stressed in the term "Strategic".
2. Ex ante coordination mechanisms like agreements play a crucial role in alliances.
3. Firms in alliances constitute legally independent entities.
4. Cooperation between alliance firms is based on voluntarity. Partner firms make economic independent decisions.
5. Each partner tries to improve its competitive position.
6. However, involved parties are interdependent.

Based on the identified characteristics, we can develop a working definition of strategic alliances: *A strategic alliance is a predominantly formal, often long-term agreement between two or more legally and economically largely independent partners which pursue the goal to improve their competitive positions through reciprocal exchange and development of selected resources and competences.*

2.2.1 Alliance Typologies

Alliances cover a variety of forms in economic reality. Alliances may involve different numbers of partners. They may vary in terms of their formality and governance structure, geographical dispersion and resources involved. This section outlines the most important alliance dimensions on which the concept of cluster alliances can be built (see table 1).

Dimension	Attribute	Comments
Geographic reach	local, regional, national, international, global	
Direction of the cooperation	horizontal, vertical, lateral	In lateral alliances, firms from different stages of unrelated value chains cooperate with each other.
Number of involved firm functions	one to numerous	Firms might cooperate only in one specific area (marketing, for example). Alternatively, the cooperation can have a broader basis and involve several organizational functions.
Number of partners	two to numerous	
Intensity of relations	weak to strong; repeated or sporadic	
Type of resource linkage	consolidation, coordination	Alliance resources can be consolidated in a separate organization (joint venture, for example) or be coordinated within projects between alliance partners.
Contributed resource types of partners	property-based, knowledge-based	Property-based assets include, for example, production facilities, knowledge resources might be patents, routines etc.
Resource profile	„closing gap", „critical mass"	„Closing gap" alliances are also called complementary, link or X-alliances. Their main

Dimension	Attribute	Comments
		purpose is to exploit asset complementarities and to acquire new capabilities. „Critical mass“ alliances are known as Y-or scale alliances. They aim to combine strengths, to increasing efficiency and market power. Scale alliances pool similar resources to reduce the costs of collaboration (Gibbert and Durand 2006).
Time horizon	short, mid, long	Though the term of strategic alliances emphasizes long-term aspects of cooperation, alliances may have different planning horizons.
Transaction form	informal agreement, contract, equity, non-equity alliances	
Management structure	dominant-parent, shared-management	In dominant-parent alliances, one of the partners plays a dominant role and controls the alliance. Shared-management alliances are based on the equal weight of partners in the alliance management.

Table 1: Alliance dimensions (list is not exhaustive but rather displays central alliance dimensions

Partly depending on such dimensions and derived from an alliance vision a number of distinct alliance goals and benefits can be identified that organizations pursue by entering an alliance.

2.2.2 Potential Alliance Goals/Benefits and Risks

First of all, two levels of strategic goals can be differentiated: the goals *of* alliances and the goals *for* alliances. The former are formulated in a collective negotiation process between alliance partners. The latter are set by each partner individually (Justus 1999).

Alliance goals may have different priorities in the firm goal hierarchy. The priority depends on the expected alliance contribution to the achievement of the firm’s own strategic goals (Justus 1999). A classification of alliance goals is presented below. However, the goals are mostly interlinked and can be separated only for analytical reasons. The presented classification is based on Schächtele (2004), Zentes, Swoboda and Morschett (2003), Contractor and Lorange (2002), Tracey and Clark (2003), Das and Teng (2000) and Grant and Baden-Fuller (2004):

- Access to knowledge and other resources: Transfer and appropriation of partner knowledge is often seen as a dominant objective of alliances. Firm knowledge might include technology, management know-how etc. However, such a view imposes several limitations. The life span of such alliances is limited to the period it takes to acquire the partner’s knowledge and to reduce the dependence on the alliance. Due to the fact that each partner has constraints in terms of the absorptive capacity, he can concurrently and efficiently serve only a limited number of alliances. The knowledge assessing approach, which is gaining popularity, says that the total value of the alliance would increase if the alliance partners focus on their complementary capabilities and keep their own specialization. Such an approach allows maintaining many alliances simultaneously without sacrificing efficiency. Knowledge-accessing alliances can be extremely stable over long-term periods. In general, alliances allow for improving the system competence of participating firms in the management of alliances. Resource alignment between partner firms in an alliance is considered a critical success factor. Resource alignment includes

such aspects as resource similarity and resource utilization. Alliances improve the utilization of knowledge within the alliance. Alliances allow to share or aggregate resources that are not perfectly mobile, imitable substitutable and thus cannot be efficiently obtained in the market, by M&A or developed by the firm within an acceptable time frame. This helps to retain underutilized resources within the firm. The underutilization might be caused by the mismatch of resource sets (knowledge, for example) and product sets. The larger the mismatch, the greater are the advantages offered by alliances. Moreover, alliances provide access to specific know-how of new markets and regulatory issues of particular countries and industries.

- Flexibility/time advantages: Flexibility belongs to the main alliance benefits. On one hand, joint development of new products in an alliance shortens the development cycle. On the other hand, the combined sales network of alliance partners allows faster market penetration for new products. This leads to rapid amortization of investments which is in particular interest of small companies possessing limited financial reserves. By joining and releasing capacities, alliances can avoid production bottlenecks and gain flexibility. This may result in better customer satisfaction and allows avoiding time lags imposed by learning needs.
- Cost advantages: Alliances offer significant cost-related advantages. Joint financing reduces the bound financial resources of partners. Alliances allow sharing high fixed costs related to the creation of new and complex knowledge and reducing knowledge-related transaction costs. Alliances provide for economies of scale and scope since the costs of replicating and transferring knowledge tend to be lower than the costs of knowledge creation.
- Division of risks: The combined knowledge base of alliance partners improves risk management and allows achieving better risk diversification in projects. Moral hazards are reduced in alliances by emerging interdependencies between alliance partners and long-term cooperation horizons.
- Access to new markets: Alliances help to overcome trade barriers imposed by local regulations through local partners. Alliances allow building up local presence with a quasi-insider image in shorter time and with less effort.
- Alliances increase market power of alliance partners: An alliance can even have sufficient power to influence industry structures. This aspect may be important in pre-market competition for example to enforce specific technological standards earlier than competing firms/alliances.
- Alliances can help to improve trust and social cohesion between firms by encouraging shared values, norms and ways of working used for problem solution and other collective actions.
- Creation of strategic options is considered one of the most valuable alliance goals. By entering an alliance, partners create a ground for future, currently not specified or not specifiable advantages. For example, the creation of new knowledge is approached through strategic options.

Figure 1 presents a comprehensive (but not exhaustive) overview of alliance benefits and goals described above.

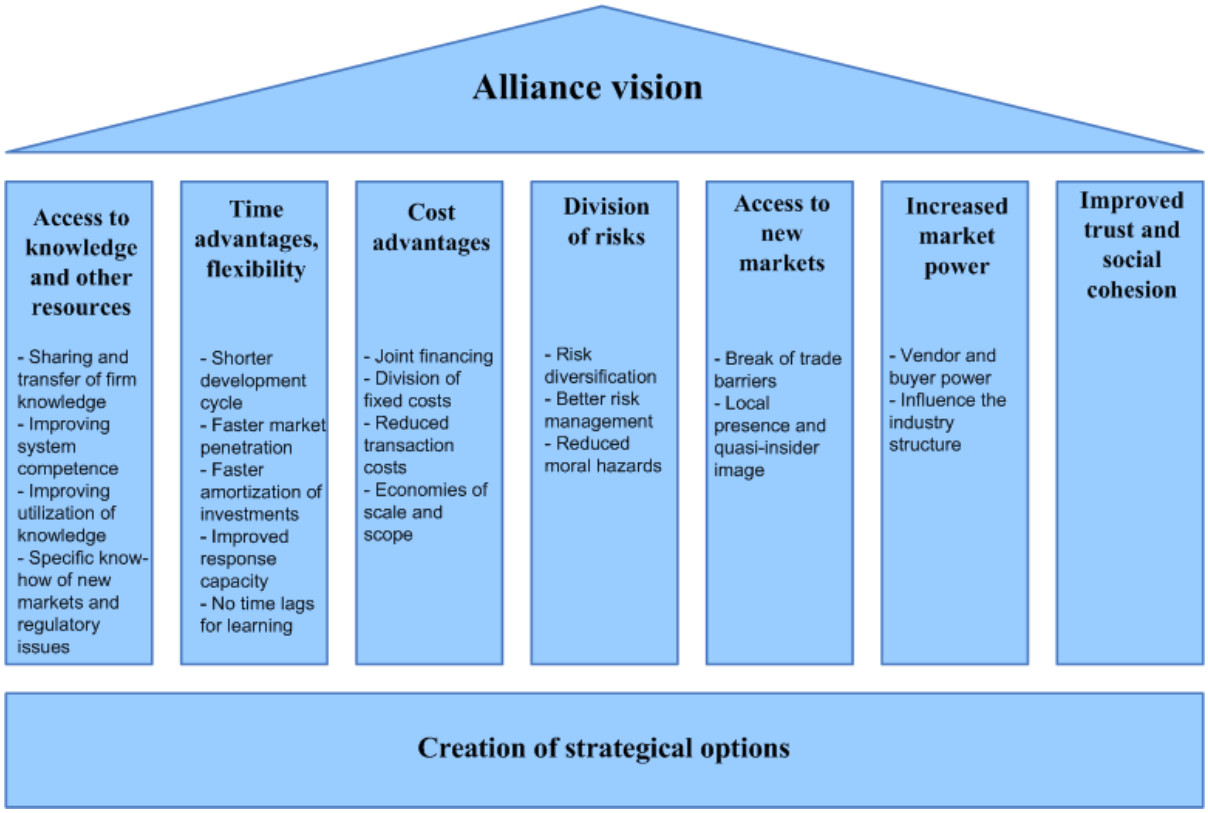

Figure 1: House of Alliance Goals and Benefits

Though strategic alliances offer numerous advantages to partner firms, they bear substantial risks which might cause alliance failure. Some of them are unrealistic expectations, diverging strategic goals, lack of trust between partners that prohibit open exchange of knowledge, lack of commitment from coworkers, failure to understand cultural differences. Outlearning and the loss of competitive knowledge belong to the common knowledge-related risks. Moreover, resource incompatibility might lead to inefficient integration of partner resources thus reducing the benefits from the alliance.

2.3 Cluster Alliances

A new trend is emerging in the world of clusters. Clusters begin to establish partnerships with other clusters. They create meta clusters, networks of networks or cluster alliances which span a number of regions, neighboring countries or even the entire globe. This new development can be observed in different industries (for ICT see Saxenian and Hsu (2001), for photonics see Sydow and Lerch (2007) and for biotechnology see Kutsenko (2007)). Inter-cluster alliances contribute to what is called a “transnationalisation of clusters [that] permits to preserve a local system of embedded ties, while favouring their international openness through a parallel system of arm’s lengths and embedded ties with foreign organizations belonging to other local clusters. In such a multiple embeddedness, frame innovation is favoured, home structure and culture of firms are subject to renewal, and the risks of lock-in and district sterelization are reduced” (Zucchella 2006: 32).

The working definition of alliances presented above can be applied to cluster alliances which conform to the key elements of the definition. Cluster alliances tend to be strategically managed. They exhibit a mostly formal character of relations. On one hand, clusters in the cluster alliance behave like collective actors. Clusters, or rather their representatives, develop individual cluster

strategies for the alliance as well as collective strategies of the alliance in joint efforts with other clusters aiming to improve their competitiveness. Clusters negotiate alliance contracts. A specificity of cluster alliances is the fact that clusters themselves comprise a set of agglomerated, interlinked, but economically independent organizations. Clusters are a result of individual and collective strategies developed by companies and other organizations. Investments into clusters (as organizational entities) in order to obtain uniform control in the alliance are not possible due to the specificity of the cluster's organizational form. With regards to the formal regulation, alliance partners are mostly excluded from direct competition. Indeed, alliances see the maintenance and improvement of the competitiveness within their structures as a crucial feature: Market test must be provided at every cluster alliance level. Herewith, an integrated concept of cluster alliances demands consistency of individual and collective strategies at the levels of the clusters alliance, participating clusters and firms[1].

2.3.1 Dimensions of Cluster Alliances

The chapter "Alliance typologies" has introduced the dimensions of strategic alliances. Not all of those dimensions are relevant for or applicable to cluster alliances due to the specific characteristics of clusters mentioned above. A distinguishing classification of cluster alliances includes the following dimensions:

Cluster alliances encompass different **geographical scope**. Depending on the boundaries spanned, clusters alliances might be local, regional, national, international or even global.

Though the term of strategic alliances emphasizes the enduring aspects of cooperation, strategic alliances may have different planning **time horizons**. They can be planned as short, mid or long-term cooperation forms. However, the development of trust, of a common communication and knowledge base takes time. For this reason, cluster alliances are more likely to have a long-term character.

With regards to the **number of partners**, two or more clusters can participate in a cluster alliance with different intensity of relations from weak to strong. The relationships can have repeated or more sporadic character.

The clusters in a cluster alliance may pass different stages along the cluster life cycle. The cluster life cycle model includes an embryonic, emerging, developing, mature and transforming **cluster stage**. The alliance management process requires mutual adjustment and coordination between clusters participating in the alliance. For example emerging and more mature clusters tend to have developed pronounced identities that allow clusters to behave like collective actors. Consequently, cluster alliances are more likely to be initiated between clusters in mature life cycle stages[2].

In a cluster alliance, one of the partners may play a dominant role and control the alliance. In this case, the cluster alliance has a dominant **alliance management structure**. Alternatively in the shared management alliances, all clusters possess equal weight in alliance decisions.

Cluster interrelatedness is defined as the extent to which industry or research organizations or both in the involved clusters rely on overlapping or more complementary resources with regards to scientific knowledge, production experience or labor pools, for example.

[1] The firm or rather organizational level here includes public organizations, e.g. universities
[2] Once the alliance has been established, it can facilitate clustering processes in other regions.

Finally, alliance resources can be linked in different ways or by different typ**es of resource linkages**. They can be consolidated in a separate alliance organization or be coordinated between alliance partners.

2.3.2 Benefits, Disadvantages and Conceptual Shortfalls of Cluster Alliances

Clusters provide flexibility which is crucial for the competitiveness of firms in the cluster and the cluster itself. Firms in the cluster can efficiently draw on more specialized assets within shorter time than vertically integrated firms or firms outside the cluster and thus satisfy more sophisticated demand. Clusters allow easy monitoring of competing firms in the cluster and immediate comparison of products and services. Knowledge spillovers support fast diffusion of knowledge in the cluster, increase the average level of innovation, and thereby cluster competitiveness. However, this are the active interaction and fast knowledge spillovers which make knowledge in the cluster converge towards a common base in the long run. The problems of knowledge convergence lead to inertia, technological isomorphism, even lock-ins making clusters vulnerable to technological discontinuities and shifts in buyers' demand.

Cluster alliances offer a broad spectrum of advantages for participating clusters and firms.

“Local buzz and global pipelines” (Bathelt, Malmberg and Maskell (2004) denotes an appropriate metaphor for cluster alliances. Local buzz is a communication environment which is created through face-to-face contacts between firms located within the same region and industry. Local buzz can be used as a synonym for clusters in the cluster alliance. Due to geographical proximity, local buzz generates opportunities for spontaneous and unanticipated situations and repeated face-to-face interaction. Interaction facilitates fast knowledge diffusion in the cluster due to knowledge spillovers. The repeated character of contacts reinforces the development of a common communication basis and trust.

Cluster alliances may balance out both the processes of knowledge exploration and exploitation. In the cluster alliance, participating clusters are linked together. We can call the links “pipelines”. Diverse knowledge flowing through pipelines forces the clusters to review and update existing knowledge stock. New knowledge from other clusters spills over to other firms in the cluster through the local buzz. In this way, alliance clusters avoid rigidities, technological lock-ins and inertia thus improving the competitiveness of the cluster alliance itself, also member clusters and cluster firms.

Joint learning is one of the means to improve the management competence of alliance partners. At the cluster level, cluster actors are able to learn quickly from each other. Joint learning at the cluster alliance level taps even more potentials. Through collective activities, clusters learn how to manage cluster alliances and exchange specific practices of cluster and firm management thus increasing their architectural knowledge at all levels. Shared knowledge covers not only architectural knowledge, but also production-related component knowledge which is relevant for the production of goods and services.

Cluster alliances allow to close resource gaps more effectively and thus to achieve better resource alignment than clusters do. Cluster alliances extend the shared knowledge base that helps to improve utilization of resources and to reduce the cognitive distance in the cluster alliance. The larger the resource gaps within clusters, the greater are the advantages offered by cluster alliances. The process of identifying, assessing, assimilating and applying knowledge entails considerable costs. Due to a broader available knowledge stock, cluster alliances allow to minimize the costs of information search.

The role of geographical proximity for cluster alliances is another important question. To answer the question which knowledge forms are more likely to be transmitted in cluster alliances through which modes and under which conditions, we shall investigate knowledge flows in cluster alliances. Explicit and tacit knowledge exhibit different transfer mechanisms and require different strategies. Explicit or codified knowledge is characterized by low, almost zero costs of knowledge replication in comparison with the high costs of knowledge production and codification. Codified knowledge can also be transferred at low costs. However, knowledge sharing in alliances strongly depends on trust development between alliance partners due to the non-exclusive and non-exhaustive character of knowledge (Marshall, Nguyen and Bryant 2005). In the course of alliance evolution, the phases of the life cycle show different level of trust and consequently different amount and quality of shared knowledge. In the initial alliance stages, partners will develop calculative trust into alliance partners, if previously unknown. Calculative trust is based on the rational comparison of costs and benefits derived from the relationship. At the beginning, partners will supposedly exchange those explicit knowledge artifacts which are necessary for the alliance configuration in order to detect partner fit and resource alignment. The artifacts might be at this stage routines, market data, technologies, or patents.

If the primary goal of a cluster alliance is to get access to and to transfer explicit knowledge, then the cluster alliance will be less space-sensitive. In this case, clusters may be distributed and can be connected over long distances. Such cluster alliances must merely provide that the formal scope and the cumulative level of trust are sufficient to exchange codified knowledge.

Tacit knowledge is more valuable for long-term competitiveness, but more difficult to transfer due to its limited geographical mobility and other characteristics. Revealed by its application, tacit knowledge requires geographical proximity or at least “virtual proximity” through collective actions in the virtual space. Partners will share valuable tacit knowledge only if they possess a higher level of trust than in the case with explicit knowledge. Cluster alliances bear opportunities for the transmission of tacit knowledge as they involve coordination within and across cluster borders. With growing alliance maturity, the alliance is better integrated into cluster- and firm-level strategies. Partners know each other better than at the beginning. Networks on multiple layers are established among alliance partners. With growing alliance experience, partners might develop a deep sense of trust, even strong identification with the alliance. The identification is based on mutual understanding of partners’ qualities and intentions and cannot be easily derived from the cost-benefit analysis of the relationships. Higher level of trust improves the flows of strategic-relevant and highly valuable knowledge through the pipelines of the cluster alliance and accelerates knowledge spillovers in the local buzz.

If a cluster alliance aims at the transfer of tacit knowledge, the geographical proximity of alliance clusters will have positive effects on the transfer. Clusters that are located in close geographic proximity to other clusters in the cluster alliance will benefit from unexpected contacts, joint learning and knowledge spillovers more than isolated or distributed clusters. Repeated meetings, collective activities and other forms of face-to-face communication help to develop common trust and lead to the exchange of explicit as well as valuable tacit knowledge in the long run. Therefore, cluster alliances where partner clusters are connected over long geographical distances, need to facilitate the development of trust through the emulation of proximity (“virtual proximity”) in order to encourage the exchange of tacit knowledge between partners.

Networks are an essential element of cluster alliances. Cluster alliances are social systems which encompass numerous formal and informal networks. Applying the idea that “clusters are successful as much as networks of firms within the clusters are”, it can be stated that the success of cluster alliances depends much on the networks within the cluster alliances. Cluster alliances

embrace the totality of networks rather than only the relationships between the formal members. However, network "membership" is required to get access to valuable knowledge flowing through networks. Networks also affect the external image of cluster alliances. The circular process of the strong market applies to cluster alliances: A successful cluster alliance provides for better awareness of the alliance and cluster image. The strong image attracts valuable resources into the regions where alliance partners are located which makes the cluster alliance and participating clusters even stronger. On the other hand, cluster alliances project a broader image than separate clusters and attract more diverse resources. The heterogeneity of resources in the cluster alliance enhance the local innovative capability, make the participating clusters and the regions more successful, attractive for firms and human resources and allow to remain them competitive in the long run.

Weaknesses of the cluster alliance concept are not to conceal. Clusters project their conceptual shortfalls on cluster alliances. Alliance boundaries are defined through the borders of member clusters as their intersection. Without a satisfactory solution at the cluster level, alliance borders can't be consistently determined. Reality shows evidence of opportunistic behavior that must be integrated into the concept. Finally, few available empirical examples do not allow statistically significant conclusions and need further investigations.

2.3.3 The Management of Cluster Alliances

With reference to the presented model, the management of cluster alliances includes a range of activities which help to achieve the benefits described above.

In general the management of cluster alliances can be inspired by the management of inter-organizational networks. Here four distinct management functions have been derived: selection, regulation, allocation and evaluation (Sydow and Windeler 1997, 151). These functions can also be identified in the management of clusters and can be applied in the management of cluster alliances. In the management of cluster alliances the question needs to be answered which clusters should be part of or should remain within the cluster alliance. Also the domains of the cluster alliance' activities needs to be selected and representatives form the clusters need to be identified who are spanning the boundaries of the clusters. Within the regulation function representatives of the clusters need to regulate the way how tasks and objectives of the cluster alliances are achieved. The cooperative relationships between the clusters need to be regulated as well. These activities include regulation of collective decision making, transfer of personnel and knowledge and the electronic linkage between the clusters (i.e. a common data base). Further the question needs to be answered how resources and tasks shall be allocated within the cluster alliance. And finally the question of costs and benefits of the cluster alliance needs to be evaluated and how they are distributed amongst the cluster alliance partners. This appraisal may include clusters, relationships between clusters, cluster alliance activities or the entire cluster alliance.

In more precise terms the management of cluster alliances can focus more specifically on the generation and exchange of knowledge. The management of cluster alliances can improve the effectiveness and efficiency of knowledge exploration and knowledge exploitation by developing both of the above mentioned elements - local buzz and global pipelines. In the local buzz, appropriate measures must intensify local interaction in order to increase the speed of knowledge dissemination. These practices need to be identified and transferred to other clusters in the alliance in order to strengthen the other clusters or rather organizations (firms and research organizations within the clusters) within the clusters and thereby the cluster alliance might be strengthen. The links between clusters therefore need to be created and broadened to provide

constant exchange of routines and diverse knowledge within the cluster alliance. However these need to be selected, regulated, allocated and evaluated.

The development of cluster alliances can be fostered at and from different (administrative) levels. At the lowest level there might be individuals that promote the idea of cluster alliances because these individuals most likely have a self interest in establishing links between clusters. Another appropriate level might be the organizational level in form of companies or research organizations. These organizations might have an interest in connecting to other organizations located in other clusters in order to access the local knowledge and resource base of the partner cluster or to enter markets with the help of partner cluster organizations. Technology parks might play a vital role in providing hubs for cluster boundary spanning practices because they are able to provide infrastructure needed by companies and other organizations to step into other regional markets. Further it could be in the interest of cluster representative organizations or network administrative organizations representing clusters to connect to other cluster NAOs in order to organize lobbying or to exchange ideas on cluster development. Finally regional developers, the local economic policy as well as the national policy and supra national policy level in recent years exhibited an interest in connecting regional clusters. The aims that organizations at these levels have include the interregional integration, the exchange of cluster development best practices and thereby the strengthening of the local region.

In order to manage clusters and engage in and foster the development of cluster alliances clusters and the potential to network clusters need to be identified in the first place. The following section first gives a short overview of some of the cluster identification methods that can be found in the wide spread literature on economic geography, sociology and economics. Secondly the methodology used in work package 3 of the BaltMet Inno project in order to identify innovative clusters and potential to network these clusters in the Baltic Sea region is introduced.

3 Methodology

In general clusters can be identified and characterized in a number of ways. However because of different forms and sizes but also because of their idiosyncratic and partially path-dependent evolution clusters are not only difficult to compare but also to identify. First of all the sum of the firms involved in a given clusters are normally not listed in a statistical category that would be used to identify firms within of a particular industry in a given region. Companies in regional clusters cooperate vertically along the value chain, and horizontally with competitors and sometimes even laterally with complementary but unrelated companies and other organizations like research facilities. Especially in high technology fields complex interdisciplinary relationships among cluster organizations are the rule. Traditional Standard Industry Classification (SIC) codes do not seem to capture the totality of the organizations and elations belonging to a cluster because the boundaries of these high tech clusters are often very fuzzy. Additionally research organizations and supporting infrastructure like law firms, capital providers, and consultants would not be listed in such statistics. Secondly R&D and transaction relationships are not part of official statistics.

Many structural properties of clusters are mentioned in the definitions and descriptions in the cluster literature. These are presented as either constitutive or complementary and can also be used to characterise clusters. The identification of clusters across geographies however remains difficult. Structural properties of a cluster may include (based on Porter (1998), Enright (1999), Pfaehler and Lublinski (2003)):

- Sophisticated local customers and downstream-industries
- Competitive related industries
- Suppliers of complementary goods and services
- Capable locally-based specialized suppliers of goods and services
- Accessible financial services
- Innovative core companies and original equipment manufacturer (OEM)
- Locally-based competitors
- Sophisticated local labour market
- Involvement of the local education system
- Research and development and knowledge transfer infrastructure
- (Trade and labour) associations
- State actors and regional economic development
- Critical mass of organizations

Today a number of measures to identify and compare clusters exist. However there is no universally applicable measure or cluster identification process available today and each measure and approach has its limitations.

In an early cluster evaluation and mapping approach based at the Harvard Business School (Institute for Strategy and Competitiveness) scholars around Professor Michael Porter used statistical techniques to profile the performance of regional economies in the United States, with a special focus on clusters, over time. They defined clusters statistically and created objective, detailed profiles of regional economies across the United States and now the data is used to

identify important clusters in specific regions. A specific region's cluster position can be compared to other regions. The drivers of a region's relative wages, employment growth, and formation of new establishments and region's patenting performance can be analysed. In short the raw data in this cluster mapping project are County Business Pattern data (excluding agriculture and government) on employment, establishments, and wages by four-digit Standard Industrial Classification (SIC) Code by U.S. County. In addition, U.S. patent by location of inventor are allocated to industries and clusters using a concordance of technology classifications with SIC codes. So the limitations inherent in SIC codes are incorporated in this special methodology. There are also confidentiality limitations, which mean that the actual data are not disclosed for every county and economic area in every industry. Various techniques are used to compensate for missing data (for more details see the Cluster Mapping Project's web site at: http://data.isc.hbs.edu/isc/index.jsp)

In a similar approach scholars like Ketels and Sölvel analyse data on geographical patterns of specialisation across cluster categories, national and regional portfolios of clusters, cluster organisations, and finally national and regional policies and programmes related to innovation and clusters in the EU cluster mapping project. The European Cluster Observatory is managed by the Center for Strategy and Competitiveness (CSC) at the Stockholm School of Economics, and is financed by the European Commission, DG Enterprise and Industry, under the Europe INNOVA programme. The Observatory covers EU-27 countries, Iceland, Norway, Switzerland, Turkey and Israel. The Cluster Mapping database combines the dimension of geography and industry in order to statistically trace regional agglomerations of employment and to identify statistical regional clusters, across Europe. The geographical dimension is operationalised through 259 regions, predominantly NUTS 2 regions[3]. On the sectoral side employment data on the 4-digit industry level (and in a few cases 3-digit data) is used. Unfortunately data on wages, value added, or productivity at the level of regions and detailed industries was not obtained. Instead Regional Innovation Statistics (not separated by cluster category) to differentiate between regional clusters in high innovation environments from clusters in low innovation environments had to be applied. In addition national export data classified by cluster category (not separated by region) to separate out regional clusters in high export national environments from clusters in low export national environments was used (for more details on the methodology see www.clusterobservatory.eu).

In economic geography a number of identification measures of regional economic agglomerations have been developed. However to this day there is no general and theoretically sound method is available spelling out variables that need to be measured in the identification and the selection process of clustering potential (Sternberg/Litzenberger 2004). Sternberg and Litzenberger (2004) recently developed a comprehensive measure – the *Cluster Index* (CI) – which represents the product of the relative industrial density (ID), the relative industrial stock (IS), and the relative size of the companies (SB). The product takes the respective sector (j) and the region (i), the number of employees (e_{ij}), the number of enterprises (b_{ij}) as well as the size of the region (a_i) and the inhabitants of the region (i_i) into account.

$$CI_{ij} = ID_{ij} \times IS_{ij} \times \frac{1}{SB_{ij}} = \frac{\frac{e_{ij}}{\sum_{i=1}^{n} e_{ij}}}{\frac{i_i}{\sum_{i=1}^{n} i_i}} \times \frac{\frac{b_{ij}}{\sum_{i=1}^{n} b_{ij}}}{\frac{a_i}{\sum_{i=1}^{n} a_i}}$$

[3] NUTS 2 regions have been defined by EU to subdivide member countries for statistical purposes. In the EU Cluster observatory NUTS 1 regions are used for Belgium, Greece, Netherlands and Turkey so that the size of the regions both in terms of land area and employment are reasonably comparable. NUTS 1 is also used for Ireland due to data availability.

A (beginning) regional agglomeration or specialization can be identified if the cluster index value is greater than one. But according to Sternberg and Litzenberger (ibd.) the critical value for the existence of a cluster is four. However the authors admit that an exact threshold does not exist. The critical value depends on the scale of the region, the level of the industrial aggregation (see Krätke & Scheuplein, 2001, p. 6), and on the number of clusters intended to be identified (Sternberg & Litzenberger, 2004: 780). A problem with this measure arises because the identified cluster cut across sector classifications and therefore cannot be represented within SIC and NACE codes. Additionally the characteristics of a cluster cannot be discovered by calculating the index. However the developed index appears to be a helpful starting point in identifying clusters.

To give just another example of measures using quantitative date, the *Economic Development Cores* approach that was recently developed by the Institute for Economic Research in Halle (IWH) shall be shortly mentioned. The Measure is using quantitative indicators like employee and patent counts in combination with qualitative data derived from surveys (Rosenfeld et al. 2004). Such an economic development core is proposed to be present if a regional industry specialization or focus (measured by the number of employees), company networks and innovative competence fields (measured by patent applications in a given period) are found in a given region.

Koschatzky and Lo (2007) criticise that the use of these relatively simple measures is not sufficient enough for identifying relevant regional economic agglomerations that could then be effectively addressed by structural and innovation policy. The main problems arise from the lack of data on the regional level and problems in identifying and demarcating the relevant industry. A possible solution lies in the marriage of quantitative and qualitative methods (Austrian, 2000). Koschatzky and Lo (2007) collect and list methods and compile indicators that can be used in the identification and characterization of clusters. (for a comprehensive overview see Koschatzky and Lo (2007)).

Collecting and using statistical data on high tech fields is rather difficult because such industries (as described above) are not represented properly within national statistical data. The problem becomes even worse when comparing innovative high tech clusters across national boundaries. Therefore this project is using an integrative approach. Available statistical data was incorporated and regional development and industry experts were interviewed to identify and characterize clustering and networking potential in and across the Baltic Metropoles Regions.

In a first step the general innovation context as well as a general characterization of clusters and cluster like structures as well as activities within cluster development approaches in the different Baltic Metropoles Regions were identified and characterized (Summer 2005). The identification of a common understanding of clusters was important for the first steps of the project. Within the project clusters were defined also in the Porterian way (see section 2). Now the project partners could collect and describe the critical information which was needed in the following steps for the decision process. The project partners were asked to give a broad overview about the technology sectors and the potentials of further development in the special regions. This information was needed to develop the technology fields with the most potential in the regions and in the future in the following time period of the project. The given information was analysed and clusters and networks were identified using the following differentiations (clusters, centers of excellence, competency fields and innovation fields (see table 2)).

Clusters	
• High concentration of SMEs, R&D, and also big companies • Close co-operation between the players	• Internationality • Interconnectivity high
Centres of Excellence/ Competence center	
• High concentration of SMEs, R&D, (only a few or no big companies) • Co-operation between the players mid-dle/high	• Internationality to be developed • Interconnectivity high/middle
Competency fields	
• Relatively high concentration of SMEs, R&D, (no big companies) • Co-operation between the players to be developed	• Internationality to be developed • Interconnectivity low
Innovation fields	
• Some specialized SMEs, R&D, (no big companies) • Almost no / no co-operation between the players	• Internationality to be developed • Interconnectivity low

Tab. 2: Differentiation of Technological Fields in Baltic Sea Capital Regions used in the Project

In the end of this part process the project team developed a result matrix, displaying clusters, centers of excellence, competency fields and innovation fields in different technological fields in the regions (see figure 2). Hereafter and as a result of the analysis, the team decided on three technology sectors, which were forecasted to have the most future influence onto the sum of the partner regions. The project partners agreed upon the following selection criteria: the agglomeration should exist in most of the participating regions (quantity); the agglomeration should be of economic importance for the regions (quality); the agglomeration should have a good potential for growth (sustainability). The fields of biotechnology and medical technologies; information and communication technologies and media; and optics, micro systems and nanotechnologies were selected for further analysis.

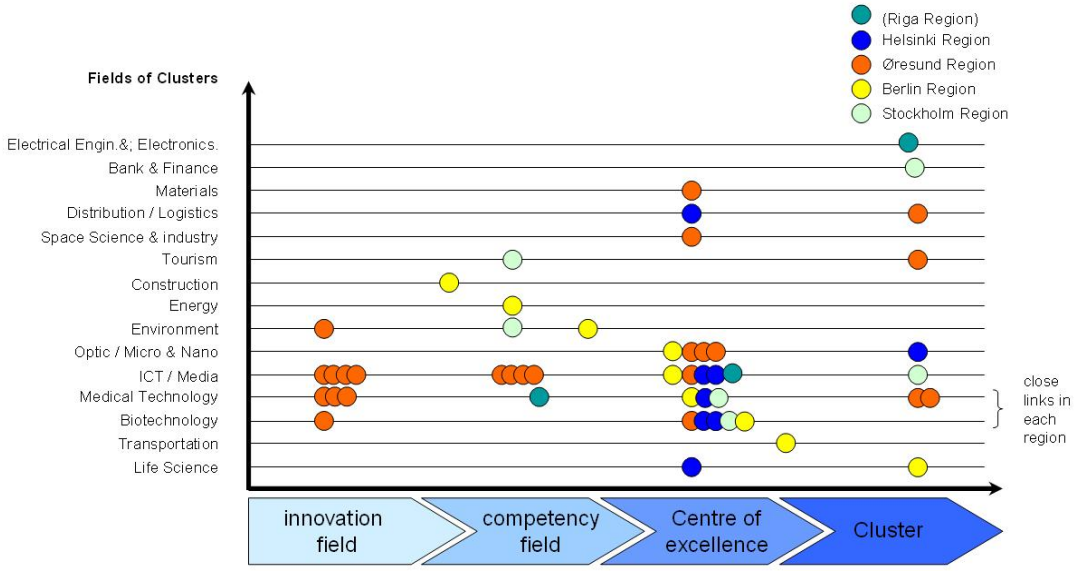

Figure 2: Technologically Oriented Clusters and Fields in Baltic Sea Capital Regions

In a second step on basis of this decision for the three technological fields (1) biotechnology and medical technologies; (2) information and communication technologies and media; and (3) optics, micro systems and nanotechnologies as the fields with the most clustering potential in all regions a second questionnaire was developed and information for a SWOT analysis of clusters in these technological fields in the Baltic Metropoles Regions was collected (Fall 2005) (see appendix 8.1). Aim of this second evaluating process was the detailed description of the technology sectors for further work. This was needed to build up an information base on which the project team could work and develop methods, to develop the region and complete the work task. The main objective in this process was to identify common issues that were relevant to all partner regions. This helped to derive an effective intervention in the three technology fields, without building up a complex and expensive infrastructure or the use of support facilities. The idea of this method was, to use the existing development and support structures of the partner regions. In the next step exactly these development and support structures needed to be named and collected.

In 2006 a specific means of cluster development and a potential means to network clusters – services provided e.g. by technology parks within regional clusters – was analysed in more detail. After the collection and separation of the independent development and support structures of the partner regions this was the logical consequence. It was now important to understand the possible connection points of further interregional-cooperation in detail at the level of technology parks. In more detail it was useful to collect information on and compare influencing methods in the regions and sectors. After this the strengths and weaknesses of the supporting activities were discussed at several meetings and new services based on the third evaluation and the cooperation potential of the region could be processed. Some results will be presented in section 5.2 and specific potential to network innovative clusters in the Baltic Metropoles Regions will be derived. (The results of the benchmark are displayed in appendix 8.2).

Finally a fourth round of information gathering was conducted in the summer of 2007 by semi-structured interviews in order to analyse and characterize the evolution and development of the three identified innovative clusters in the Baltic Metropoles Regions. The questionnaire was sent to the interviewees in order to collect especially updated statistical data on the clusters. In a subsequent follow-up telephone interview (approximately 30 minutes to one hour each) especially the topics of cluster development and central cluster activities were discussed. Table 3 displays

the organizations and their representatives that were involved in the data gathering over the last three years.

City	Organisation	Name	First Name
Berlin	WISTA-Management GmbH	Neumann	Helge
Berlin	Senatsverwaltung für Wirtschaft Arbeit und Frauen	Nicksch	Marion
Berlin	TSB Technologiestiftung	Stens	Eberhard
Stockholm	Stockholm Economic Development Agency	Lundberg	Irena
Stockholm	Stockholm School of Entrepreneurship	Hakanen	Claudia
Malmö	MINC (Malmö Incubator)	Mosell	Rickard
Malmö	City of Malmö	Ohlsson	Kristina
Copenhagen	EVU	Lohse	Steen
Helsinki	Culminatum Ltd. Oy/Helsinki Region Centre of Expertise	Heinonen	Kimmo
Riga	Riga City Council International Project Division	Pukite	Linda
Tallinn	Hansson,Leego & Partner	Leego	Erkki
Tallinn	Technopol	Ruubel	Rein
Oslo*	Oslo Teknopol IKS	Grindheim	Jan Erik
Warsaw*	City of Warsaw (Mayor's Advisors Department)	Poninska	Isabele
St. Petersburg*	Committee for External Relation - St. Petersburg Government	Eshchenko	Mikhail
Vilnius*			

Table 3: Project Partners and Interviewees

*) observing partners

4 Innovative Clusters in the Baltic Metropoles Regions

The Baltic Metropoles Regions include the cities and larger metropolitan areas of Berlin, Helsinki, Riga, Stockholm, Tallinn, Øresund (including Copenhagen and Malmö), Oslo, Warschau, St. Petersburg and Vilnius. The later four capital regions acted as observers within the project.

In the following section the six regions Berlin, Øresund, Helsinki, Stockholm, Riga and Tallinn are characterized in terms of general innovation and cluster policies and contexts, followed by a brief introduction and characterization of the three selected technological fields in each city/region. Herein clusters, developing clusters or simply technological and industrial potential are identified and networking activities are described.

4.1 Berlin

Berlin, the capital of Germany, features an immense potential. At the same time the City is still confronted with radical structural economic changes. In order to manage the challenges and to concentrate on opportunities of growth and employment Berlin is concentrating since the late 1990s on future growth areas in which the city's potential holds a national and international competitive position.

During the last years the Berlin Senate has realigned the economic development policy which is based on a newly developed regional innovation policy. Since 2005 a "coherent innovation strategy" provides the framework for innovation policy in Berlin. The state of Berlin now concentrates its regional development activities on three identified cluster: life sciences (Gesundheitswirtschaft) including biotechnology, pharmaceuticals, medical technology and health care), communication, media and culture (creative industries) as well as transportation systems technologies. As the technological foundation of these clusters political and regional development actors from the Berlin senate and Technologiestiftung have developed the "coherent technology and innovation strategy" that is concentrating on five competence areas with high growth and innovation potential. These competence fields include biotechnology, medical technology, information and communication technology transportation technology and optical technology. For each of the competence fields' strategic goals, objectives and projects have been formulated by the actors in the field and integrated in a master plan. The implementation of these activities is carried out in close collaboration of the Berlin Senate, Technologiestiftung Berlin, Investitionsbank Berlin, Berlin Partner GmbH, IHK Berlin as well as additional partners from science.

The "coherent innovation strategy" identifies the life sciences as a developed cluster. Transportation, bio- and medical technology, ICT, optical/micro systems technologies as a so called competence center whereby the latter three are essentially supplying the life science cluster. Additionally the "coherent innovation strategy" classifies water technology, energy technology and construction as competence fields and nutrition as innovation field (see figure 3).

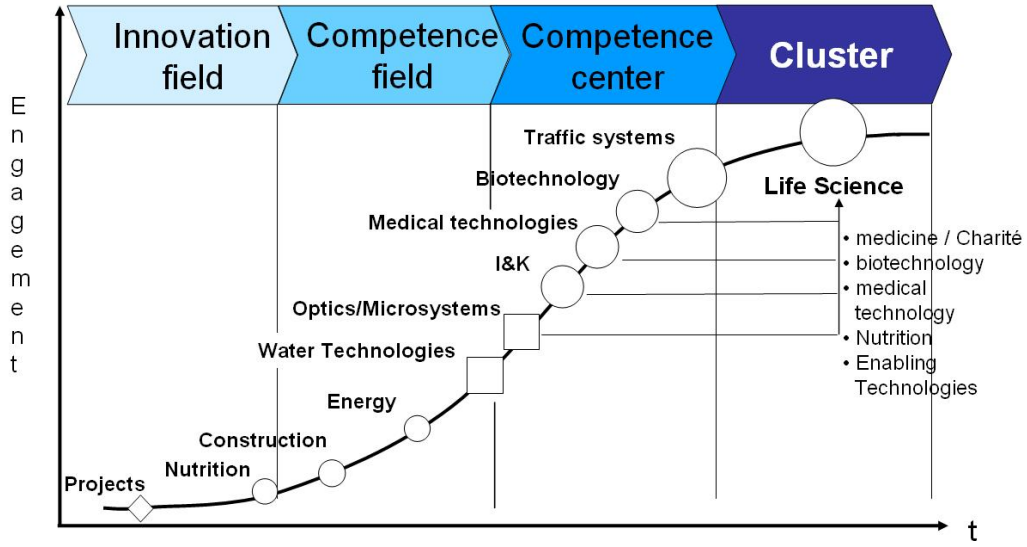

Figure 3: Coherent innovation strategy in Berlin (Source: Technologiestiftung Berlin)

According to the European Cluster Observatory project ten clusters or rather industrial agglomerations can be found in Berlin. These include finance (67,515 empl.); business services (43,918 empl.); education (35,790 empl.); transportation (35,611 empl.); power (10,991empl.); Biopharma (10,350 empl.); instruments (7,533 empl.); medical (4,283 empl.); sporting (2,515 empl.); and tobacco (1,882 empl.) (for more details see appendix 8.3).

4.1.1 Biotechnology and Medical Technology in Berlin

Biotechnology Statistics for Berlin
• ca. 170 companies (ca. 3.200 employees) • 250 scientific working groups in 25 research institutes (ca. 5.000 employees) • 135 Mio.€ Funding/Grants in 1996 – 2002 • Mostly networking projects (Companies – R&D) • Main fields: Structural Biology; RNA-Technologies; Clinical Pharmacology; Glykobiotechnology; Research on Human Genome; Autoimmune Diseases

Source: Masterplan Biotechnologie und Biomedizin 2005; BioTOP (2007)

Medical Technology Statistics for Berlin
• ca. 150 productive and R&D intensive companies and ca. 150 service provider • ca. 6.000 employees generate € 0,8 Mrd. sales • 12 non university research institutes • Charité Universitätsmedizin ((Campus Mitte, Campus Virchow-Klinikum Wedding, Campus Steglitz; Campus Buch) ca. 15.000 employees), Vivantes-Hospitals (ca. 12.000 employees), German Heart Center (Deutsches Herzzentrum Berlin) ca. 1.000 employees); BIOTRONIK GmbH & Co. KG – the largest medtech company (950 employees in Berlin) • Main fields: imaging, oncology, cardio-vescular, tele-medicin and medical applications of information technologies

Source: Masterplan Medizintechnik 2005

In national comparison Berlin holds a rather strong position in biotechnology when it comes to the generation of patents (German Patent Office 2007). In 2006 the Berlin based biotech, medical technology, health care and pharmaceuticals companies and research organizations joined forces

to create the necessary critical mass to form an administrative body for the entire health sector in the Berlin region – "Gesundheitsstadt Berlin". Within this cluster a number of internationally active large companies (Schering AG (ca. 2.500 empl.); Berlin Chemie (ca. 2.000 empl.); Siemens Medizintechnik (ca. 600 empl.)) and (University) hospitals (Charité (ca. 10.000 empl.)); are present and active.

The following section will focus on the biotechnology and medical technology fields of Gesundheitsstadt Berlin. The Berlin-Brandenburg biotech region is characterized by about 170 small and medium seized companies of which a large proportion have a strong focus on medical applications. Many of the companies have their origin in the numerous research organizations in Berlin and the surrounding region. Besides the smaller companies a number of internationally active large companies are present in the region (Bayer Schering Pharma AG, Berlin-Chemie AG, Altana AG and subsidiaries of Bayer AG and BASF AG. Berlin also has an enormous research and development potential in the life sciences. In biotechnology the region offers 14 departments and 34 institutes at five universities, three universities of applied sciences, seven federal research institutions, four "large research infrastructure", four Max-Planck-institutes, two institutes of the Fraunhofer-foundation and six institutes of the Leibniz-association. Additionally a number of biotech parks have been build up over the last decade. These parks[4] recently have joined to form BioCampus to promote and market the infrastructure.

A number of networks, cluster initiatives including NAO exist in the region. BioTOP (www.biotop.de) an initiative of the two states Berlin and Brandenburg was founded in order to promote biotechnology in the region. BioTOP Berlin-Brandenburg is he central contact point for all issues concerning biotechnology in the region. It coordinates BioCampus, BioFINANZ (a network for financing biotech companies), BioScience (a R&D network in a number of technological focus areas (i.e. nutrigenomics, regenerative medicine, RNA technologies and more).

BioTOP has a number of staff available to conduct a large array of activities. Among others BioTOP offers wide-ranging information and provides a comprehensive web site. It (co-) organizes a large number of workshops and promotes colloquia at the various research organizations. A newsletter and an annual Biotech report Berlin-Brandenburg are compiled and distributed. At the annual Bionale the who-is-who of the biotech sector in Berlin meet.

Besides the activities coordinated by BioTOP a number of other instruments contribute to improve the networking within the cluster. A council of the Berlin secretaries of state (Steuerungsrunde der Staatssekretäre) aims at implementing a coordination and control system for the health care cluster Berlin-Brandenburg.

A second significant field within the Berlin health and life science sector are medical technologies which are also characterized by small and medium seized companies. Here about 6.000 people are employed and a large proportion of these companies have its origin in one of the numerous research organizations in Berlin. Internationally acknowledged medical research institutions in Berlin are Charité - Universitätsmedizin Berlin; Max-Delbrück-Center for molecular medicine; German Heart Center; Laser- und Medizin-Technologie GmbH; laser clinic Elisabeth Klinik; Deutsche Rheumaforschungszentrum; Unfallkrankenhaus Berlin and Max-Planck-institute for Molecular Genetics.

[4] Campus Berlin-Buch, Biotechnologiepark Luckenwalde, BioTechnologieZentrum Hennigsdorf, berlinbiotechpark, Charlottenburg, Biotech Campus Potsdam-Hermannswerder, Zentrum für Umwelt - und Energietechnologie (UTZ) Berlin-Adlershof

In the area of medical technologies the TSBmedici initiative was created in 2000. TSBmedici is an initiative of the TSB. The objective is to develop Berlin as a centre of excellence in the field of medical technologies with supra-regional pre-eminence.

TSBmedici among other activities (representation of the technological field, organization of the transfer of technology, organization of a dialogue between industry and science) is managing networks in the field of medical technologies.

SWOT-analysis for the health care sector of the Berlin Region

Strength	**Weaknesses**
• Berlin-Brandenburg has enough capacity to mange the whole value chain • high innovative infrastructure and nation wide networks • high density of research institutes (public and private) • concentration of main research areas (e.g. molecular medicine, biotechnology) • tight networks between researchers and companies in the region • leading-edge companies and public institutions with high reputation • high capital investments in the region (public and private) • leading location for genomics in Germany • 280.000 employees and 17,3 billions turn over in Berlin-Brandenburg • ca. 10 national and international medical conventions • powerful infrastructure for conventions, seminars and fairs • Berlin-Brandenburg occupies a top position in terms of external funds • Leading national biotechnology location (international backlog) • “Enabling Technologies” are excellent represented in Berlin-Brandenburg • relatively low cost structure in Berlin-Brandenburg • Berlin as capital city attracts young and creative people	• lack of communication for public invitations (especially for international calls) • non-transparent health care market in terms of quality and output • lack of overview and overall strategy for prevention and health promotion in Berlin-Brandenburg • poor equity capital base of SME’s • Leading national biotechnology location (international backlog) • men power shortage

Opportunities	Threats
• demographical change (more elderly people) • preventive medicine is gaining in importance • genetic engineering leads to new innovations • organisational and financial changes within the health care system initiates more competition • technological change in the context of micro system engineering, optoelectronics and health provision • technological change in the context of information and communication technologies leads to high saving potentials • outsourcing of former public services • growing aplomb and informational needs of patients leads to more transparency, quality management, clarification duties and responsibility	• demographical change (manpower shortage) • organisational and financial changes within the health care system initiates more competition • Changing customer needs due to growing aplomb and informational needs of patients leads to more transparency, quality management, clarification duties and responsibility • outsourcing of former public services

Inter-cluster and inter-regional networking in the field of Biotechnology and medical technology exists under the umbrella of the ScanBalt BioRegion project which encompasses a number of regional networks between universities, industry, hospitals, public institutions and other important actors within the life science arena in the Baltic and Scandinavian region and includes organizations in DK, EST, FIN, Iceland, LAT, LITH, N, S, PL, DE, and Western Russia.

Additionally a number of interactions of the clusters with other regions and interregional projects exist. These include NATIBS (New Approaches and Tools for Incubated Biotech SME's); membership in the Society of Biomedical Engineering, MedTech-Projects and "Regenerative Medizin Initiative Berlin (RMIB)" which is linking regional players and a platform for an international partnership with the Pittsburgh Initiative for Tissue Engineering.

4.1.2 Information and Communication Technology

Statistics for Information and Communication Technology in Berlin
• ca. 3.100 companies (31.500 employees and 2, 65 Mrd. € turnover/a) • 30 research institutes • Main fields (High Performance Computing (HLRN); Media- and Communication Sector; Digital mobile TV; New mobile Applications in the interface of DVB-T, DAB, UMTS and W-LAN; XML based Internet)

Source: Projekt Zukunft Berlin 2003

Berlin is a center for information and communication technology and media in Germany. The counting of numbers companies and their employees and sales is difficult and depends on the drawn boundaries of the cluster or industry. Depending on the way of counting about 94.000 to 115.000 people are employed in the very inclusively defined field information and communication technology and media. The field includes a variety of sub sectors (data processing services, printing, broadcasting, telecommunications services, telecommunication hardware, advertising, movie production and others). In 2002 about 10.600 companies were active in information and communication technology and media in Berlin. About 84% of these companies

were service providers. The mayority of the companies can be found in data processing services (27%), advertising (21%), news and journalists (14%) and in the film and movie industry (9%). Leding research institutes include Fraunhofer-Institut für Rechnerarchitektur und Softwaretechnik FIRST, Gesellschaft zur Förderung angewandter Informatik e.V. – Gfal e.V., Deutsches Zentrum für Luft- und Raumfahrt e.V., Konrad-Zuse-Centre for Information Technologies and important companies are ROHDE & SCHWARZ GmbH & Co. KG, Arnold & Richter Cine Technik GmbH & Co. Betriebs KG, TV+SYNCHRON Berlin GmbH among many others (Sen WAF 2007).

In Berlin a variety of networks and initiatives has emerged and has been initiated over the last years. The leading organisation or cluster initiatives are initiated by TSB. The TSB IKT is a department of the TSB. It supports the cooperation between science and industry for research and innovation activities from brainstorming to planning and implementing IT project to transferring the results. Through linking local and regional players like research institutes, universities, companies, associations, policy and administration the IKT department is pooling the knowledge and transferring it into innovation activities. TimeKontor AG is a spin-off of the TSB. As a strategic initiative it is responsible for the activity spheres eHealth / Telemedicine and IT Security. Together with the Senate for Economics, Technology and Women's Issues / Projekt Zukunft, the Investitionsbank Berlin, the Berlin Partner GmbH and the IHK Berlin, it has made a significant contribution to the master plan for information and communication technology of the state Berlin. TimeKontor AG offers mainly three services: networking, consulting and marketing and distribution support. Finally "Projekt Zukunft" was initiated by the Berlin Senate in order to support the networking between media, IT and creative industries with each other as well as with science, politics and administration. Support is given through initiatives and projects, PPPs, events, information campaigns and publications.

Instruments to improve the networking within the clusters include the delivery of important infrastructure, networking events, the organization or fairs and exhibitions and the support of economics and science projects. Within the very diverse field of information and communication technology and media numerous platforms and networks can be found.

In the field of Information and communication technology and media in Berlin a host of instruments and tools for cluster development has emerged. To name only the most important: round-table discussion on the potential for WLAN and WIMAX in Berlin; Broadband forum; Telecommunication Atlas; DVB-H center of excellence; Berlin-Brandenburg IT Security Day (regular fair); Technology initiative „Security" (part of the marketing initiative „We-make-IT Berlin-Brandenburg"); IT-Profits (convention, fair, workshops, platform for presentations of regional networks and initiatives); Best Practise Contest in the context of IT-Profits; E-Learning Initiative "City of Knowledge" which is an E-Learning platform on the basis of XML, mainly for SME and evaluation of suppliers, projects and initiatives for e-learning; "Sicherheit mit IT" a professional internet platform, based on the analysis of potential under point seven and within the frame of the initiative we-make-IT; certification centre for Biometry; Galileo Initiative Berlin-Brandenburg; XML-Days, structural planning by Studio Berlin and Fraunhofer FIRST; development of the network/cluster organisation TimeKontor AG and coordinated package of measures for ICT development in the Berlin region.

Looking at the strengths and weaknesses and opportunities and threats for ICT and Media in the Berlin Region the following table can be compiled:

Strength	Weaknesses
• above average growth in employment requiring social security contributions • broadband coverage above German average • Part of the innovation plan of Berlin • Synergy potentials with other technology areas	• No leadership structure on hand • Lack of cooperation
Opportunities	**Threats**
• high growth potential in broadband internet market • High start-up rate • Development of IT media fields • Cluster coordination to generate external economies of scale	• No lighthouse companies • Very broad technology field • Weak local market

Inter-cluster and inter-regional networking in the field of ICT include the IMMOS Project and the LUMOS Project. The IMMOS Project aims to devise an integrated method for the model-based development of embedded control units. Funded by the German Ministry for Research and Education (BMBF) it is part of the "IT-Forschung 2006" programme. The LUMOS Project aims to develop and conceive an airborne system to apprehend the situation on the road as a whole in the context of latest sensor technology.

4.1.3 Optical and Micro systems- and Nanotechnology in the Berlin region

Statistics for Optical Technologies for Berlin-Brandenburg Region
• ca. 270 companies (ca. 7.400 employees; ca. 1,8 Mrd. € turnover/a) • 37 research institutes (2.500 employees) • Main fields (biomedical optics; optical technologies for transport and space; optical technologies for the internet; UV- und x-ray technologies; laser technology; spectroscopy and measurement; classical optics; lighting) • Apart from numerous SME large internationally active companies like Osram (2000 empl.); NokiaSiemens Networks (450 empl.); ADCKrone (650 empl.); Berliner Glas (600 empl.) are located in the region. • Additionally internationally active companies recently began to acquire operations located in the region (Röntec → Bruker; Aglaia → Hella; Elight → Jenoptik; LAS → Newport Spectra-Physics) or invested in operations in the region (i.e. Fisba Optik; Jenoptik)

Source: OpTecBB (technology analysis, annual presentation 2006)

The post-reunification era in Berlin saw a dramatic downsizing of eastern institutions. The Academy of Sciences and its Central Institute of Optics and Spectroscopy in Berlin-Adlershof were closed resulting not only in a huge number of job losses, but also in quite a number of spin-off companies and newly-founded research institutes in Berlin-Adlershof. Adlershof today can be seen as *the* centre of photonics, biotechnology, nanotechnology and media in the Berlin-Brandenburg region. The natural sciences of the Humboldt University and BESSY were also relocated to Adlershof towards the end of the 1990s. About half of OpTecBB's more than 90 member organizations are located in Adlershof.

In 2000 OpTecBB e.V. was founded in Berlin-Brandenburg as a regional industry association to take part in the German national competition for federal grants for regional cluster building processes in the field of photonics. In 2001 an office in Adlershof was staffed with a CEO and a secretary and an additional employee who is responsible for IT and other administration work. As early as 2001 in Berlin-Brandenburg, four technological focus groups were organized that represented a critical mass of competences in the region (photonics in telecommunication; uv- and x-ray technologies; bio-medical applications; photonics application in space and traffic). An additional focus group was set up to cover activities in education and qualification in photonics. Each of the four focus groups has one spokesperson from academia and a deputy from business (or vice versa) in order to reflect the intention to collaborate across distinct societal spheres. Additionally, OpTecBB e.V. is governed by a board whose work is supported by the NAO.

One of the most important measures to foster the cluster building process in Berlin-Brandenburg appears to be the annual two-day strategy workshops called "Networking Days" in November or December that take place in addition to the annual members' meeting which is required by law and in which the board and the NAO report on the activities and the financial situation of the past year. Another important measure is the event "Members Introduce Themselves", which takes place around four times per year and in which the inviting member presents the profile of its organization to the visitors, organizes a tour through the facilities and closes with an informal get-together.

Because of Berlin-Brandenburg's exposed research potential in different locations in Berlin and in Potsdam, Brandenburg, there is a wide range of colloquia and presentations in photonics related issues which is not administered or coordinated by a central body like OpTecBB. Another measure to foster collaboration is the meeting of members within the technological focus groups and the collaborative (mainly project-based) work in these groups (especially in the groups working on photonics for telecommunication and on x-ray-technologies).

OpTecBB also has a very comprehensive website www.optecbb.de with a presentation of upcoming activities, profiles of the competences in the region and, within OpTecBB's internal member base, a very extensive news archive and a competence database of the members. Furthermore, OpTecBB is quite active in public relations activities and issues photonics related news releases on photonics in the region, and collects and displays news about its member organizations. About twice a year OpTecBB issues a newsletter on different topics. Moreover, the second largest photonics exhibition in Germany (Laser-Optik-Berlin) is organized in Berlin-Adlershof every two years by TSB (beginning in 2008 organized by Messe Berlin)). TSB, OpTecBB or the technological focus groups within OpTecBB actively support members to collectively participate in international exhibitions. OpTecBB further organizes presentations of the photonics region Berlin-Brandenburg at international trade shows. In Berlin the association moderated a process to draft a strategic technology concept "The Future of/through Optical Technologies" which was aimed at and, in the meantime, has been accepted by politicians and economic development representatives in Berlin.

The Laserverbund Berlin-Brandenburg (www.laserverbund.de) was founded in the early 1990s is an association of mostly personal members (representing companies and research organizations) active in the field of laser material processing. Under the umbrella of the Laserverbund a so called Stammtisch is regularly organized where industry experts give a presentation of the latest developments in laser materials processing technology. The Laserverbund also organizes a number of seminars offering hands on training for employees working with lasers. So far the activities of the Laserverbund have been independently from public funding and independent from OpTecBB.

Another relevant cluster organization in the field of optics/micro systems/nanotechnology in Berlin is ZEMI (www.mst-berlin.de). ZEMI is an association of research facilities located in Berlin that aims to focus the intellectual and technical resources of the member institutes in one location for the benefit of industry users. In November 2001 the official start of the ZEMI network took place. In the following two years the technical facilities in Berlin-Adlershof were completed. This project was founded by the Berlin government and the European Union. Since 2004 ZEMI acts on his own initiative and the operation is financed by the ZEMI associates. ZEMI's objectives are to provide access to the intellectual and technical resources of the associates; to support companies in development and production; to shorten development times while reducing innovation costs; and to provide comprehensive, expert project management services. ZEMI participates in a network called MANO which aims to improve the education and professional training situation in the field of micro systems technology. Further under the umbrella of ZEMI numerous projects from different fields of application were so far accomplished - from automotive to zytometry. An emphasis is placed on the development of hybrid micro systems. The projects include activities in the fields of life science, communication technologies, micro-optics, and materials technology.

With ZEMI, a network of research facilities has been established in Berlin-Adlershof which provides a complete technology portfolio, supporting companies in their innovations. The competencies cover the whole value chain - from design of a micro systems technology product via the development of production technologies and the manufacturing of prototypes to the testing of the products. Presently a number of prototype and product development projects are under way.

Looking at the strengths and weaknesses and the opportunities and threats of optics/micro systems/nanotechnology in Berlin region the following SWOT-analysis can be presented:

Strengths	**Weaknesses**
• Optical technologies are an accepted significant economic force in the region • Unique agglomeration of 270 companies and 30 research organizations • Advanced interconnectedness of the actors • OpTecBB is a strong and established overarching member based network • Berlin-Adlershof is a focal point in optical technologies and micro systems technologies • Regionally based optics companies have above average sales per employee and increases in sales are expected to reach 10 %/a over the next five years	• The absence of strong/large international optics companies with a "light house function" • The relatively low level of capital resources in the small an medium sized companies that are characteristic for the region hindering innovative technological innovation • The still weak perception of optical technologies, micro systems and nanotechnology within the regional technology policies as a relevant regional economic factor • In (inter-)national comparison the presentation of optical technologies in the region by companies, researchers, and politicians is still insufficient

Opportunities	Threats
• Variety of industrial and research areas opens up opportunities for inter-disciplinary innovation and synergies • Optics, micro systems and nanotechnologies provide significant chances for economic growth in the region • The 2004 adopted development concept for optical technologies provides a coordinated frame for a concerted development of the technological field	• Beginning lack of qualified personnel • Increasing competition from Asia and America

Source: Master plan optical technologies for Berlin

There is a wide array of activities and projects underway between individual companies and research organizations in Berlin and international partners. At the cluster level cooperation agreements with other important photonics regions exist (Optics Valley in France or the Scottish Optoelectronics Association). The international cluster alliance between OpTecBB and clusters in Tucson, Arizona, USA and Ontario in Canada needs to be mentioned. Within this arrangement a number of activities have been organized (reciprocal visits of region's representatives including businessmen and researchers; international summer school, cluster breakfast at photonics trade fairs). However this alliance is still evolving and rather emergent than planned.

For summing up the three technological clusters the following table (see figure 4) provides an overview:

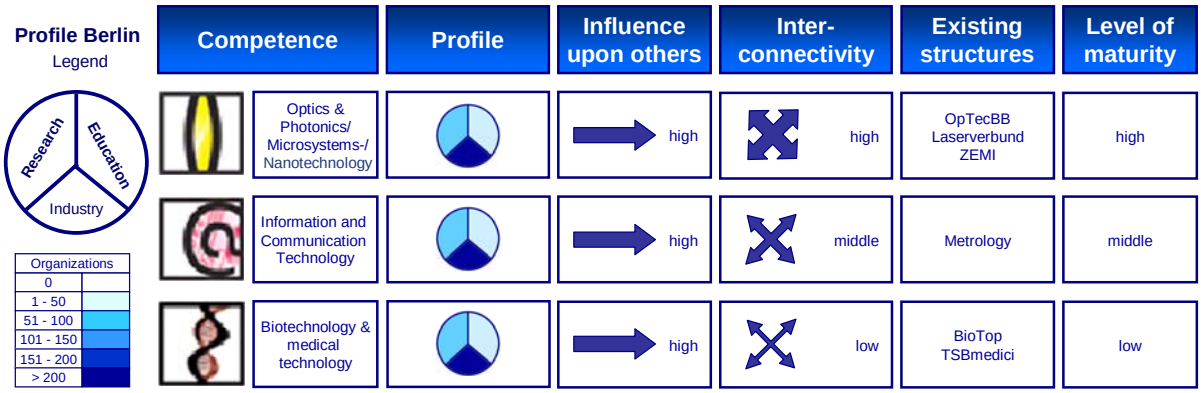

Figure 4: Overview of selected competence fields in the Berlin Region

4.2 Øresund (Copenhagen and Malmö)

Geographically, the Øresund region comprises of Zealand, Lolland-Falster, Møn and Bornholm in Demark as well as Scania (Skåne), the southern part of Sweden. The region has 1/3 inhabitants on the Swedish side and 2/3 on the Danish side.

Danish cluster activities go back to the early nineties. The Danish government adopted the cluster concept as one of the first countries in Europe and in the world. Analysis was conducted based on the mega clusters as building/construction, food products, bio-health, ICT etc. However, the mega clusters were too broadly defined to provide a focused and effective cluster policy. In the late 90's, the government turned the focus towards smaller clusters such as biotech, aluminium

processing and industrial design while still maintaining the mega clusters. Currently, the cluster policy has low national priority due to cost savings measures. Although Danish national cluster policy is officially non-existing, significantly more cluster initiatives than ever before are currently in process. Several programmes to promote regional initiatives or regional growth environments have been started in 2000 and are supported by the Ministry of Science, Technology and Development. The procedure runs similar to the Swedish Vinnväkst program, but is less extensive. The goal of the environments is faster distribution of knowledge, faster innovations, implementation and job creation. Further, the purpose is to intensify and develop cooperation between the participating parties and to contribute to the development of lasting cooperative relationships and increased knowledge sharing between partners.

The highly innovative region around Copenhagen and the City of Malmö is called the Øresund Science Region (ØSR). The Øresund region is understood not as two countries, but as a whole region. It promotes integration across the borders of disciplines, academia, industry, the public sector, Denmark and Sweden, the Øresund Region and other regions in the world.

The European Cluster Observatory project has detected 28 clusters in Denmark (without differentiating them on lower geographical levels) and more than 35 in Sweden. Three of them are located in or around the City of Malmö (Sweden). The appropriate table in the annex presents the identified clusters.

The ØSR's mission is to develop the Øresund Region into one of Europe's most attractive knowledge-based economic growth centres. Its pillars are the innovation platforms and projects. Following the Triple Helix approach, they create linkages and facilitate cooperation in identified core competencies. Platforms are established in the areas of life science, environment, ICT, food science, logistics, nano, digital entertainment and humanities. Medicon Valley Alliance (medico/biotech), Øresund IT Academy (ICT), Diginet Øresund (digital entertainment) and Nano Øresund (nanotechnology) are among the eight platforms that have been established since 1997 in the Øresund Science Region. The activities are aimed toward the development of an innovative environment and efficient commercialization structure, providing global branding and marketing of the Øresund Region as a high tech region, securing sustainable economic growth while maintaining a high ethical and humane standard. Other activities include matchmaking, benchmarking of members, enhancing research and education, innovation and technology transfer.

There are several organizations which promote the Øesund Region. Among them are Invest in Denmark; Invest in Sweden Agency; Ministry of Science, Technology and Innovation of Denmark; Copenhagen Capacity and Position Skåne.

The region encloses fourteen universities. Some of them are both large and internationally highly ranked. All universities are linked together within the umbrella organization Øresund University. The goal of the Øresund University is to increase cooperation between the universities within education and research as well as collaborations with business and industry in the region, local and regional authorities and other organisations in Øresund. A number of science parks (one of them is the largest in Europe) and incubators are located in the region. The Øesund Region is also home to high-tech multi-national companies. Astra Zeneca, Duni, Epsilon, Findus, Oriflame, Sony Ericsson, Tetra Pak and a large number of innovative small and medium enterprises all have their headquarters or research centres in the region. Numerous cluster development initiatives are currently active in the Øesund Region with the Baltic Sea Initiative and Scanbalt among the most prominent.

4.2.1 Medical Technologies and Biotechnology in Øresund Region

Statistics for Life Sciences and Biotechnology in Øresund Region
• ca. 400 companies (ca. 35.000 employees) • 5000 R&D employees • 11 educational and R&D institutions • Main fields: clinical trials, metabolism, vaccines, cardiovascular, central nervous system diseases, cancer and inflammatory diseases, diabetes

Source: Business Link Greater Copenhagen (2007) and Invest in Denmark (2006)

The biotechnology, medical technology and the pharmaceutical industry in Denmark hold an internationally strong position. This can be signified by a number of indicators: (a) the region is no. 1 in Europe in terms of biotech patents as percentage of total patents (OCED, Science and Technology Compendium 2006); (b) most Biotech venture capital investments in Europe (percentage of GDP) (OCED, Science and Technology Compendium 2006), (c) the 3rd largest commercial drug development pipeline in Europe in absolute numbers (Ernst & Young, Beyond Borders 2006).

Global players like Novo Nordisk, Astra Zeneca, Lundbeck, Pfitzer, Biogen Idec, Nycomed and Leo Pharma, and a large number of small- to medium-sized enterprises like 7TM Pharma, Dako-Cytomation, Action Pharma, Symphogen and NeuroSearch reside in the Øresund Region.

In total, more than 400 biotech and life science companies employ 35,000 people and particularly 5.000 dedicated R&D employees. The close collaboration of these biotech companies has lead to leadership in the areas of clinical trials, metabolism, vaccines, cardiovascular, central nervous system diseases, cancer and inflammatory diseases. Moreover, the Øresund region is considered the leading region in the world within diabetes treatment. This is mainly due to Novo Nordisk but also a number of research groups that are internationally competitive. Hearing aids are a long time strength area which is heavily dominated by 4 companies of which 3 are situated in Copenhagen: Oticon, GN Danavox and Widex. Together these 3 companies hold a 30% share of the world market.

Research areas like stem cells, enzymes, proteins and bioinformatics are potential future strongholds for the region. However the cluster structure is generally weak as the area is dominated by global companies. The growth potential for certain areas is highly uncertain, even if they have high political priority (cancer, for example).

12 universities enrol 150,000 students in total. All universities are part of the Øresund University. There are six university hospitals. Each university offers PhD programmes in this field resulting in 400 PhD's and 5,500 master's theses every year.

The yearly funding support of biotechnology is estimated € 300m. The amount of external university research funding was € 226.5m in 2004. The major life science funding programs in Denmark and Sweden are Vækstfonden, Danish National Research Foundation, The Swedish Research council and VINNOVA. Current activities and programmes supported by VINNOVA in the area of life sciences include Knowledge Platform Biotechnology; Pharmaceuticals and Diagnostics; Biomedical Engineering; BioNanoIT; Brain Power and an international project called Multidisciplinary Bio.

Several biological and medical networks are active in the Øresund region: Biopharma Övre Norrland Biotech Umeå; Medical Västsverige Healthcare Technology Alliance; Biopharma

Sydsverige GöteborgBio; Biopharma Östra Mellansverige Uppsala BIO; Biopharma Denmark; Östra Mellansverige BioLogue. Medcoast Scandinavia; Kalmar BioScience; Medicon Valley Alliance are members of the Scanbalt meta-region network.

Medicon Valley Alliance (MVA), also known as Medicon Valley, is the continuously growing cluster organisation for the Medicon Valley bioregion, which geographically covers the Danish-Swedish Øresund region. The Medicon Valley Alliance currently has more than 260 members representing life science companies, universities, hospitals and other organisations.

The universities are a key component of the Medicon Valley concept. Danish universities hold strong research traditions and are home to R&D based life science companies. There are 6 leading universities in Medicon Valley with R&D in biotechnology and life sciences: University of Copenhagen; Denmarks Technical University; Roskilde University; The Royal Veterinary and Agricultural University; The Danish University of Pharmaceutical Science and the Lund University. Significant contribution to the R&D input of human resources in Medicon Valley is made.

Together with other central players in the region, Medicon Valley facilitates life science partnering and networking activities. Medicon Valley has launched a network focused on diabetes since 2002. The Bladder Academy is a network within urology with the goal to strengthen the urology competences in Medicon Valley. The Bladder Academy arranges meetings, seminars and provides funds for PhD projects within urology. The Medicon Valley Alliance is a partner of the Europe Innova InJection project. The objective of the InJection project is to focus on how small and medium size enterprises active in the medical device sector can obtain funding for innovation in order to achieve sustainable growth.

Through these activities MVA improves the conditions for science and knowledge production, technology transfer and innovation. In addition, MVA supports cluster-to-cluster collaborations and have global ties to world class bioregions. The Ambassador Programme aims to build a strategic network of long-term contacts and active collaborations with ten of the leading life science clusters in the world by 2010. There is a business academy to strengthen business ties among members, a hepatocyte user group and numerous other initiatives.

Active start-up activities in Medicon Valley make strong contribution to the innovation level in the region. Several incubators are located in Medicon Valley. The major of them are Symbion; Teknologisk Innovation; DTU Innovation and Ideon. Venture capital companies like SEED Capital; Ventur Lab; Connect or Ideon Innovation; Medicon Valley provide access to risk capital.

Strengths	Weaknesses
• Mature cluster with strong leading organisation - Medicon Valley Academy • Presence of global players • Networks between large numbers SME • Good cooperation between research institutions and companies • Numerous external co-operation projects • Historically strong areas of research • High political priority of several research areas • Excellent scientific foundation • Good input of skilled workforce • Fast development of the cluster • High rate of spin-offs • Favourable tax system for entrepreneurial activities • Favourable IP protection system • Presence of incubators for start-up companies • Good reputation and focus on end products	• General economic situation in Denmark: high local prices, falling employment and productivity growth • Uncertain development in new research areas • Not sufficient seed capital and start-up financing • Weak communication of success stories • Weak cooperation between small and big pharmaceutical companies • Cross-border cooperation is not satisfactory • Low level of spin-offs in 2005 due to the general economic situation and changes in funding programs • Low research and technological level in some communities
Opportunities	**Threats**
• Huge marker potential • Strong external demand and exports • Biotechnology defined as a strategic technology by the state, strong national and international political focus • Extensive EU funding programs • Identifying, mapping and assessing the resources and competencies of the region in the biotech and life science area • Development of joint objectives and strategies to ensure maximum exploitation of the competencies and resources among all actors and institutions in the field • Increasing of mutual awareness and visibility of activities and among the key actors • Development of the region's image, enhancing the attractiveness of the region for human resources in the field • Improved interdisciplinary research and entrepreneurship, cross initiatives and networks with other clusters	• Strong and growing competition from UK, USA and Asia • Large international dominating players • Brain drain to UK and USA • High influence of the cluster on other industries in the region • Very expensive high risk development projects

4.2.2 Information and Communication Technologies in the Øresund Region

Statistics for Information and Communication Technologies in Øresund
• ca. 13.870 companies (ca. 110,000 employees) • 8.000 R&D employees and 500 public researchers in 21 research organizations • Main fields: wireless and mobile technologies, audio, business software, data networking, semiconductors

Source: Business Link Greater Copenhagen (2007)

Information and communication technologies (ICT) are one of the major engines for growth, innovation and economic development also in the Øresund region. Denmark which encompasses the largest part of the Øresund region scores very high in numerous categories with regards to ICT (e.g. No. 1 in the world on E-readiness according to The Economist & IBM, 2006).

Over 13.000 dedicated ICT companies with almost 110.000 employees, more than 8,000 R&D personnel and 500 publicly employed researchers are active in the ICT industry. Within the ICT industry, the region boosts particular strong competencies within wireless and mobile technologies. Especially in the Copenhagen area, there are a number of both small and big companies working with wireless technology and especially bluetooth, radio frequency technologies, embedded software, test equipment, chip-set reference designs, user interface and mobile business solutions to production and satellite technologies. Many international corporations on the mobile market such as Ericsson, Nokia and Motorola have placed R&D facilities in the region.

Acoustics and electro-acoustics is considered one branch within ICT with significant importance for the region. Pervasive computing, complex application software and bioinformatics cluster are new promising industries with growing potential. The bioinformatics research in the greater Copenhagen area is internationally competitive. However the commercial potential has not been yet fully discovered and there is no clear vision or strategy for the field in the region. Pervasive computing bears optimistic future expectations due to the integration of microprocessors in a growing number of products. However, the commercial breakthrough is still ahead.

Several ICT-related networks operate in the Øresund region. The network Crossroad Copenhagen has been formed between the IT-College, Copenhagen University, DR and Nokia. Networking activities have been detected in the areas of ERP-software and ICE technology. In the area of communication, the following networks are active: Mellersta Norrland Fiber Optic Valley; IT Norra Mellansverige Compare Karlstad; IT Sydsverige TelecomCity; Sydsverige Microwave Road; IT Norra Mellansverige Future Position X; IT Småland InternetCity. There are IT-related networks Norra Mellansverige and Västsverige Center of Visualisation and the entertainment network Sydsverige Brew House present in the region.

Øresund IT Academy (ICT) and Diginet Øresund (digital entertainment) belong to the eight platforms which have been established in the Øresund Science Region in the ICT industry. Diginet Øresund is a network and a forum for the digital entertainment industry (games, film, learning and entertainment). The goal of this network is to promote the development, production, distribution and sales of creative digital content, e.g. computer games, new film formats, audio design etc., within sectors of entertainment and learning. Øresund IT Academy is a not-for-profit network organization with a focus on IT technologies. The Øresund IT Academy counts currently 95 members. Activities of the Øresund IT Academy aim to make the region more attractive and include conducting executive roundtables, seminars, networks and conferences; matchmaking

through the extensive network within business, higher education and public institutions and providing information about regional stakeholders, venture capital providers etc.

The activities in the ICT cluster in Øresund in 2006 have been centred on three main areas: human resource challenges, mobile & wireless technologies and cross-sector interfaces. A distinguishing feature of the cluster is the combination of the Swedish and Danish innovation systems with cross-industry linking between organizations within medico, food, environment, logistics and design industry in the area.

Strengths	**Weaknesses**
• Strong competitive position of the region regarding ICT-readiness, high broadband and mobile phone penetration • Presence of global players • Good reputation of the region due to world-class software development recognized for user-friendliness and quality. • High value chain depth • Fast cluster growth • Presence of several incubators for start-up companies and other favourable entrepreneurship conditions • Good access to skilled workforce with than 100.000 employees • Excellent scientific foundation with advanced research and educational institutions • Good input of new workforce from the Øresund University • Good funding from public and private R&D programs, venture capital market	• Stagnating economic situation in Denmark • Diversified industry with little focus on cross cluster potential • Too many players make coordination difficult • Lack of knowledge sharing between actors • Uncertain future of some technologies • Medium connectivity • Clustering potentials haven't been fully exploited yet • Lack of risk capital • Low rate of start-ups
Opportunities	**Threats**
• Integrated labor market • Strong market with huge market potential • Leaner company structure • Market potentials from interdisciplinary research • Increased mutual awareness and visibility of cluster activities • Development of joint objectives and strategies to ensure maximum exploitation of the competencies and resources among all actors and institutions in the field	• Strong competition • Lack of qualified resources • Brain drain to UK and USA • Risk of too strong focus on existing strengths • High influence on the industries in the region

4.2.3 Optics, Micro Systems and Nanotechnologies in the Øresund Region

Statistics on Optics, Micro Systems and Nanotechnologies in the Øresund Region
• ca. 12 optics companies • 6 research organizations in optics / 3 research institutions in nano area • Main fields: optical fibers - crystal fibers

Source: Business Link Greater Copenhagen (2007)

In the Øresund Region there are no dedicated cluster activities in the field of optical technologies. The field however exists in the sense that it is covered by other clustering activities in the area of fibre technologies and the application of photonics in communication technologies. Nevertheless there are no statistics available on optics in the Øresund Region.

Nanotechnology also belongs to the promising and fast growing technological fields. The United States is a clear leader today in nanotechnology in terms of investments, on the number of patents and start-up companies. Public investments in nanotechnology in Denmark and Sweden are far behind other leading countries in this field. Germany invested in nanotechnology 2004 €293 million, France - €224m and the United Kingdom about €100m. In comparison, Sweden invested only €15 million from public funding for nanotechnology, while Denmark only €9 million (Øresund – the Nordic Nanohub). However, the Action Plan "Technology Foresight on Danish Nanoscience and Nanotechnology" developed by the Ministry of Science, Technology and Innovation foresees a substantial increase of public investments in nanotechnology in the next years.

Within the field of nanoscience and nanotechnology, the Nordic countries have three regions with significant position: the Stockholm region, the Helsinki region and the Øresund region. The latter has been the leading region in the Nordic countries within research and education, the number of publications and also regarding the number of citations. Denmark and Sweden have an important share on the world market of nano-science and nanotechnology. The nano- and sensory technology is used in hearing aids, mobile phones, metal powders, catalysis and food packaging. A national survey "Technological Foresight for Danish Nanoscience and Nanotechnology" by the Danish Ministery of Science, Technology and Innovation from December 2004 provided the follwing 7 prioritized technology sectors within nanoindustry: Nanomedicine and drug delivery, biocompatible materials, nanosensors and nanofluidics, polymer electronics, nanooptics and nanophotonics, nanocatalysis and nanomaterials. Of specific interest to the Øresund region is the application of nanoscience and nanotechnology in the food industry.

Nano Øresund, also called „the Nordic Nanohub", is one of the eight platforms established in the Øresund region in the area of nano and sensory technologies. It is a network organisation which concentrates on intensifying the commercial development of nanotechnology in the Øresund region. The primary objective of Nano Øresund is to provide the base for all aspects of nanotechnological cooperation in the region by combining nanotechnology strengths in innovation, education, research and laboratory infrastructure on the Danish and Swedish sides of Øresund. Nano Øresund is a fairly new cluster organization with a unique factor combination: access to cutting-edge technologies, highly skilled human resources combined with concentrated nanoscience and nanotechnology education. In the greater Copenhagen area there are app. 1.500 employees working in the field.

There are strong and well established BSc., Masters and PhD programmes at three universities in the Øresund region in the field of nanoscience: University of Copenhagen, Technical University of Denmark and Lund University.

The Nano Øresund benefits from the advanced infrastructure in the Øresund region. Numerous science parks, incubators, venture capital providers and other supporting organizations create favorable business environment and conditions for technology transfer in the area of nanoscience and nanotechnology in the region: LU Innovation, Teknopol, Ideon, Innovationsbron, Medeon, KU Tech transfer, DTU Innovation, SCION-DTU, techtrans.dk, CATSymbion, Teknologisk Innovation and Nano spin-offs. Besides Nano Øresund, NaNet is another active network in the field of nanotechnology in the Øresund region.

At the governmental level, Nano Øresund is supported by the region Skåne, the Greater Copenhagen Authority, the Danish Ministry of Science, Technology and Innovation, The Danish Ministry of Economic and Business Affairs, Vinnova and by the European Commission.

Cluster activities cover a broad rage of measures. Nano Øresund organises different kinds of events from small network meetings and matchmaking opportunities to international conferences with the goal to provide opportunities for people in the field to meet, exchange ideas and acquire new knowledge, to strengthen its business networks and partnerships among cluster firms and outside the cluster. Nano Øresund maintains close relationships with the Finnish and Danish National Nano Networks, Finnano (Spinverse) and NaNet. Contacts were established with the Institute of Nanotechnology and the European Nanotechnology Trade Alliance (ENTA).

Nano Øresund generates analyses and produces other kinds of publications. By these means, the cluster continuously keeps track of the development and maps the resources of the region. In June 2007 Nano Øresund has launched a new nano-knowledge database.

Strengths	**Weaknesses**
• Expertise in bringing projects from research to up-start company • Strong education and research level due to the early start with nano degree courses • Internationally respected scientific research in several fields • Good collaboration between universities and industry • Well-equipped for cross-disciplinary research • New production facilities • Strong focus on technology transfer as an important instrument for cluster development	• Small cluster with mainly small companies • Companies work in different areas of the nanotech/microtech business and thus lack incentives to nurture BtB relations • Research is still uncoordinated and lacks critical mass • Not visible on an international scale • Gaps between regional and worldwide public spending on nano science and technology • Limited access to venture capital compared to clusters in other regions • Lack of instruments to attract and young promising researchers • Universities have no strong expertise in handling of patents and other IPR

Opportunities	Threats
• High priority of nanoscience and nanotechnology within the EU, one of the seven thematic areas of 6th framework programme on research and technological development • Establishment of the High-Tech Fund (Højteknologifonden) with a total capital of EUR 2 bill. and strong focus on nanotech, biotech, and ICT • Unified or simplified patent law across the Swedish and Danish borders • Cooperation between academia and industry must be widened and strengthened • Attracting more foreign companies • More power for network organisations to increase interconnectivity • High potential in creation of jobs • Strong market potential of nanotechnology in many industries • Higher public awareness about technological advantages and disadvantages • Stronger effort on the information on nano opportunities for other industries due to currently insufficient use of nanotechnology in other fields • Increase production of university graduates and researchers • Establish nanotechnology centres for strategic research and innovation	• Strong competition between a few global research and industrial centres. • Risk of brain-drain if other regions are more dynamic resulting in the lack of qualified people • Fluctuating marker – the cluster must create or find new market segments • Possible lack of knowledge resources • Unrealistic expectations to nanotechnology

The following table is summarizing the characterization of the three clusters or technological fields in the Øresund Region:

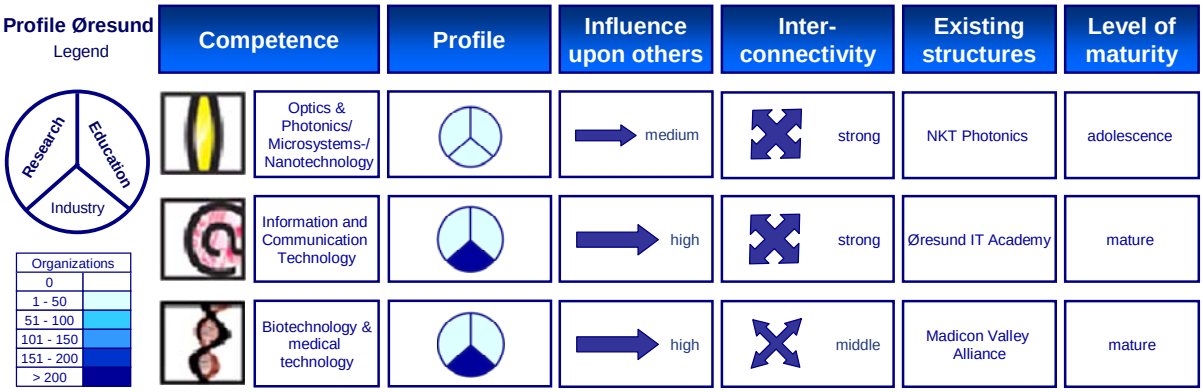

Figure 5: Overview of Selected competence Fields in the Øresund Region

4.3 Helsinki

The common targets of regional development in Finland are based on the Regional Development Act and the Government decision on national regional development targets. One of the main programs of the Regional Development Act is the Centre of Expertise Programme, which aims to improve the preconditions for the establishment and development of internationally competitive business and research operations. The National Centre of Expertise Programme is divided into 21 Regional Centre of Expertise Programmes. Over the years 2002 - 2006 the Helsinki Centre of Expertise Programme covers six fields of expertise: 1. Adaptive materials and micro systems; 2. Gene technology and molecular biology; 3. Software product business, 4. Medical and welfare technologies; 5. Digital media, content production and learning services and 6. Logistics.

The first five fields of expertise will be discussed in the following three sections according to their affiliation to the corresponding technologies.

Within the Helsinki Region there are various cluster facilitators, incubators and programmes for cluster development. One of the main players in this field is Culminatum Ltd. Qy - Helsinki Region Centre of Expertise founded in 1995. The main function, of Culminatum is to implement the National Centre of Expertise Programme in the Helsinki region in association with the host organisations for the selected expertise sectors, to strengthen the international competitiveness of the Helsinki region. Through implementing the National Centre of Expertise Programme Culminatum Ltd. Oy aims to develop high expertise clusters, to foster the expertise potential and to enhance the innovative environment within the Helsinki Region. The shareholders of Culminatum are the Helsinki regions universities and polytechnics, the Chambers of Commerce of the Metropolitan Area, The Science Park organizations, the cities of Helsinki, Espoo and Vantaa and the Regional Council.

Another important actor is Tekel – the Finnish Science Park Association. In cooperation with the Ministry of the Interior, Ministry of Trade and Industry, Ministry of Education, Ministry of Labour, Tekel coordinates the 21 regional Centre of Expertise Programmes. Thus Tekel fosters the corporation between science parks and operates as a facilitator between policymakers and science parks. (see also www.tekel.fi)

Additionally Tekes - the Finnish Funding Agency for Technology and Innovation, which is the most important governmental “financing and expert organisation for research and technological development in Finland”, aims to strengthen the competitiveness of the Finnish economy by technological means. Tekes is funding both industrial R&D projects and projects of universities and research institutes. The later programmes are mainly responsibly for assisting the knowledge transfer from universities and other scientific research institutes into business. Tekes is concentrating its activities primarily on specific focus areas. Those focus areas are divided into two groups: the technology focus area and the application focus area. The technology focus area is driven by new emerging technologies that have a high potential to enable new applications and products. They consist of the following technology fields: ICT, biotechnology, materials technology and nanotechnology. The application focus areas in contrast are customer driven and therefore derived from strategic opportunities and based on market needs. The application focus areas are: Renewing products and business concepts, Environment and energy, Health and well-being, Services, Security and safety and Work and leisure. All areas place an emphasis on ICT as an unexhausted development potential and as a cross-sectional technology. (see also www.tekes.fi)

The driving force of the economic growth in the Helsinki Region has been the ICT sector. This sector has attracted numerous skilled workers and thereby strengthens the growth in other sectors

as well. The most important single factor, not only for the growth of the ICT sector in Helsinki, but for the growth of the Finnish economy as a whole after the recession that ended in 1994, is Nokia. Nokia's success has spurted the knowledge-based services in Helsinki in a never seen before manner. 22,000 of Nokia's 54,000 employees (in 2001) are working in the Helsinki metropolitan area. 10,000 of them are working in the R&D, marketing and management field.

The European Cluster Observatory project identifies nine agglomerations within the Etela-Suomi (Southern Finland) region (see appendix 8.3): transportation (58,005 empl.); education (37,062); forest (22,858); communications (18,465); construction (46,242); finance (36,689); business services (34,965); IT (19,819) and power (4,716).

4.3.1 Biotechnology and Medical Technology in Etela-Suomi

Gene Technology and Molecular Biology Statistics for Helsinki
• Ca. 75 companies (ca. 5300 employees) • Ca. 20 research organisations / units • Main fields: Molecular medicine; Molecular biology; Drug discovery and development; Diagnostics; Functional food; Biosystems

Source: Finnish Bioindustries Association (FIB)

Medical and Welfare Technologies Statistics for Helsinki
• Ca. 140 companies • turnover of these companies is approximately 1.5 billion euro (Region Uusimaa) • Main fields: Health-related software; Hospital and diagnostic equipment; Welfare technologies

Source: Finnish Healthcare Technology Association (FiHTA)

The HealthBio cluster is divided in four sub-clusters. The first Cluster, the Invitro Diagnostics Cluster, was founded in 1995. The coordinator is Risto Lammintausta, CEO of Hormos Medical Oy. The second one, the Pharmaceutical Cluster, was founded in 2000 and is coordinated by Jouko Haapalahti, Assistant Vice President, Technical Partnerships Orion Diagnostica Oy, R&D. The Biomaterial Cluster, which was founded in 2003 is the third sub-cluster in the Biotechnology and medical technology field. It is coordinated by Kauko Kurkela, former CEO of Vivoxid. The fourth sub-cluster, the Bioinformatics / BioSystems Cluster was found in 2006. This cluster has no specific coordinator.

One important actor in the biotechnology and medical technology fields, is the Finnish National Fund for Research and Development (Sitra), which is supervised by the Finnish Parliament. Their objective is to improve the country's economy by encouraging effective research and innovative projects, organizing training programs and providing venture capital funding. "Sitra also actively assists companies in finding cooperation with other important actors in this field and works with Tekes, the Academy of Finland and other public organizations to coordinate effective funding of worthwhile 22 projects and companies". Furthermore Sitra helps foreign companies to make contact with Finnish partners in the private and public sector.There are more than 120 biotechnology companies in Finland. Finland is on the sixth position in Europe for life science companies in absolute numbers. 75 percent of those companies were founded in the late 1990s. Most start-ups where found in late 1990s, because Sitra was providing venture capital for start-ups in the field of biotechnology. "More than half of the companies operate in the health sector, carrying out research and developing or manufacturing drugs, diagnostics, biomaterials or functional food". Most SMEs are specialising in innovative niche areas.

The biotechnology cluster development is for the most part coordinated by the Centre of Expertise of Gene Technology and Molecular Biology (CoE-GT), which mainly "develops and implements activities that help biotech companies to launch their products and services into international markets." The CoE-GT is coordinated by the Helsinki Business and Science Park Ldt. The Centre works in corporation with the Helsinki Business and Science Park Ltd. in the Viikki Science Park and the Meilahti and Kumpula campuses and the Helsinki Business Campus. Furthermore they cooperate with Sitra, the National Technology Agency of Finland, the Academy of Finland and the Finnish Bioindustries (FIB), which is a national key player in the biotechnology cluster. Biotechnology is also one of Tekes' technology focus areas. "Focus areas for strategic development are systems biology, bioprocess technology and combining biosciences and ICT."

The medical and welfare technology cluster development in the region of Helsinki is chiefly coordinated by the Centre of Expertise for Medical and Welfare Technologies (CoE-MWT), which lunched its activities in 2003. The CoE-MWT works in close cooperation with Biomedicum, the Helsinki Business and Science Park Ltd. and the Technical Research Centre of Finland. The coordinative body of the CoE-MWT is the Cluminatum Ltd. in Espoo. The University of Helsinki, the Helsinki University of Technology and the Hospital District of Helsinki and Uusimaa are coordinating their activities in a joint venture, namely Technomedicum Ltd. The Technomedicum Ltd. is the main coordinative body for innovative research in the Helsinki region and fosters the corporation between medical experts and academic researchers in both fields – basic research and applied research. Furthermore they aim to yield larger Centres of Expertise, strengthen the competitiveness of the Finish research activities and to promote start-ups by providing access to appropriated services. Approximately 100 companies in the region of Uusimaa are operating in the field of healthcare technology with a total turnover of circa 1.5 billion euro. Health and well-being is one of Tekes technology focus areas. It concentrates "on productivity, quality and human approach of health care services, and also health and well-being products and services."

SWOT-Analysis Biotechnology and Medical Technology for the Helsinki Region

Strengths	**Weaknesses**
• The Helsinki Region is the largest cluster in Finland • Strong networking within and between research / educational institutes and the industry • Organized & high level health care in Finland • Strong governmental support, in particular start-up funding • Excellent science and infrastructure base • Broad supply of R&D services (private and public) • Global players in the region • Turnover and profitability of medical companies has decreased in recent years	• Relatively small domestic market • Clinical work & clinical research are kept apart in university hospitals • Too limited strategic & operative outsourcing • Limited international and commercial networking of Finnish pharmaceutical industry • Lack of international and managerial business skills • R&D investment has been recently declining • The public image of pharmaceutical industry (especially regarding start-ups) is not very positive • Insufficient coordination and cooperation in development projects between companies and (public) service providers • Bio and health sectors are strongly concentrated • Bio sector companies are highly dependent on

	public and venture capital R&D funding • Both bio and welfare sector companies are rather young and small • Turnover and profitability of bio companies has decreased in recent years
Opportunities	**Threats**
• Utilisation of present international contacts • Utilisation of new technologies • Launch of coordinated R&D activities • Orphan and niche markets exist that can support small to medium sized Finnish pharmaceutical industry • Pharmacogenomics, gene therapy, nanotechnology, stem cells, individualized therapeutic options may produce quantum leap changes in the industry • The number of drug candidates in development stage is at all time high • Low cost of excellent infrastructure and highly trained professionals together with government incentives can be used to attract international pharmaceutical companies	• Public financing is low • Lack of experienced and competent employees for development work • Lack of exit opportunities • The domestic pharmaceutical market strongly depends on the world market • R&D expenditure will not increase • Global clinical trials will decrease • Clinical drug development is moving abroad • Growth can only be generated by moving abroad • Europe as a whole continues to lose ground to USA

4.3.2 Information and Communication Technology in the Helsinki Region

Software Product Business Statistics for Helsinki
• Ca. 570 companies, • Ca. 6 research organisations / units • Main field: Mobile solutions; Games; several industry sectors like energy and utilities; government and public administration; industrial manufacturing; logistics and transportation • Ca. 160 million euro revenue in the capital region (Pääkaupunkiseutu) in 2005

Source: Software Product Industry Survey 2007

Digital Media, Content Production and Learning Services Statistics for Helsinki
• Ca. 700 companies • turnover of these companies is approximately 300 Mio Euro (2002) • Ca. 35 research organisations / units • Main research projects (2006): RFID for retail shops; VirtualAd II • Main fields: learning services (50%); digitally supported learning and working solutions; digital applications of data management and creation

Source: Contentbusiness.fi, learningbusiness.fi

The Information and communication technologies are divided into two clusters: The software product business cluster and the digital media, content production and learning services cluster. The software cluster development is managed by the Centre of Expertise for Software Product Business (CoE-SPB). The Centre of Expertise operates out of the Otaniemi headquarters of Technopolis Ventures Ltd, the largest business incubator in the Nordic area.

Technopolis Venture Ltd is Finland's largest business incubator with more than 180 high-tech and knowledge based companies within their program. It is supporting entrepreneurs in Helsinki, Oulu, Lappeenrante and Jyväskylä with various services including business development and consulting. Technopolis Venture is a non-profit organisation, but its parent company the Technopolis Group is a profit orientated company. Technopolis Venture is providing the Technopolis Group with successfully established start-ups, that possibly became loyal customers.

The big private player in this area is, as mentioned above, Nokia. The company is employing more than 22,000 people in the Helsinki Metropolitan area. Nokia operates one of its research facilities, know as Nokia Research Centers (NRCs), in the region. It is located in Ruoholahti, 2 km from the centre of Helsinki. They are specialized in six research areas: access and connectivity, digital services, physical touch - digital match, human interaction, data and content technologies, and device architecture. (see also www.research.nokia.com)

The Centre of Expertise for Software Product cooperates with companies, universities and research centres within the Helsinki Region, especially with the department of software and telecommunications technology at the University of Technology. It aims to develop a competitive and innovation friendly environment to support the internationalisation of products and companies. More than 50% of ca. 1000 software production companies (with approximately 400 million euro export and over a billion euro turnover in 2002) and 76% of the biggest companies are located in the Uusimaa region. Furthermore 72% of all software developing companies with a revenue over 3 million euros are located in the capital region (Pääkaupunkiseutu).

The digital media, content production and learning services cluster development is coordinated by the Centre of Expertise for Digital Media, Content Production and Learning Services (CoE-DM), which is coordinated by the Culminatum Ltd. in Helsinki. The CoE-DM aims to promote growth, internationalisation and customer relations of businesses. The target group consists of circa 700 companies with a turnover of approximately 300 million euro in 2002. "Companies that provide products and services for the needs of various consumer and organisation customers are highly concentrated in the region of Uusimaa. Approximately one half of the companies operate in creative fields and the other 50% is concerned with learning services".

Another important actor in the field is the Forum Virium Helsinki (FVH), which was founded in 2005. The FVH is a autonomous unit of the RTT Oy, a non-profit research and development organisation in the field of radio and television. Forum Virium Helsinki is an independent cooperation cluster that fosters international contacts and promotes the development of digital services by linking ideas and content creators to high-growth and established companies and public organisations. Additionally it is creating a Living Lab test environment in the Helsinki metropolitan area. Forum Virium Helsinki's key member companies are Destia, Digita, Elisa, Nokia, TeliaSonera, TietoEnator, Veikkaus, WM-data, YIT-Group and Finnish Broadcasting Company. Partners include IBM, Itella, SOK, MTV Media, Swelcom and Vaisala. The public sector is represented by the City of Helsinki, SITRA, TEKES and VTT.

SWOT-Analysis Information and Communication Technology

Strengths	Weaknesses
• Digital content and learning services companies are strongly concentrated on the Helsinki Region accounting for more than half of the companies and turnover • Personal contacts are easy to achieve in a small country like Finland • Cluster developers know each other well • Already extensive cooperation between different actors in the field • Standardised operational frameworks are being formed • Company mapping project is helpful in finding the right partners • The software cluster is relatively mature • SWbusiness.fi web service in the Finnish Digibusiness portal • Turnover, profitability, employment, and level of internationalisation of software product and learning services companies has increased in recent years • Ability of the Centres of Expertise to gather key stakeholders for development activities	• Financing for development programs/projects is difficult to get • Lack of sharing the responsibilities in cluster's development projects • Projects are unclear / not well defined • Vision and technology foresight work is not yet strong enough • Financing for internationalisation activities is difficult to get • Fast/clear market results for R&D work are not easily achieved • Companies have difficulties in getting early stage financing • Digital content and learning services companies are young and small; more than 70 % have started after 1995, ¾ having less than ten, mainly only one or few employees • Digital content cluster is vulnerable for economic trends
Opportunities	**Threats**
• Shared strategy for the cluster • Specialising in traditional strong clusters (e.g. electronics) • Mini clusters; dividing the cluster into smaller parts and focusing on their special needs • Cooperation at national level, 'the national software cluster	• Lack of capable people • Global competition

4.3.3 Optical, Micro Systems and Nanotechnology in the Helsinki Region

Adaptive Materials and Micro Systems Statistics for Helsinki
• Ca. 80 companies (ca. 3000 employees) • Turnover of these companies is approximately 400 – 500 Mio. € • Ca. 6 research organisations / units (ca. 500 employees) • 160 Mio.€ funding/grants in 2005 – 2010 • Mostly workshops, fairs, mini seminars (business breakfasts), seminars

Source: Eeva Viinikka, Culminatum Ltd Oy

The cluster development for micro and nanotechnologies in the Helsinki Region and Finland in general is managed by the Centre of Expertise for Adaptive Materials and Microsystems (CoE-

AMM), which is coordinated by the Technopolisventure Ltd. in Espo. The objective of the Centre of Expertise for Active Materials and Microsystems is to spur the implementation of micro- and nanotechnologies and new materials in products and processes, to promote the launching of business activities in the field and to support companies in the development of products and business models as well as in their internationalisation. The core activities are consulting, networking and dissemination of information.

Tekes contributes cluster specific know-how and is among others specialized in materials technology and nanotechnology. Both materials technology and nanotechnology are part of Tekes technology focus areas. For materials technology the focus is set on increasing the level of value added and the functionality, intelligence and compatibility of materials, and on materials life cycles. For nanotechnologies the focus will be on innovative nanostructured materials, new structures for nanoelectronics, and nanosensors and actuators.

Within the cluster the complete value chain can be found, whereas microelectromechanics, medical applications and molecular modelling form the special competencies in the region. From 2004 to 2006 the number of firms in the field of micro and nanotechnology in Finland increased by 125%. 50% of these firms are located in Helsinki. Two-thirds of all companies in the field are in an early stage of growth. Whereas most companies start as an university spin-off, company spin-offs are also common (according to Eeva Viinikka of Culminatum Ltd.).

Nokia is also the main private player in the cluster for Adaptive materials and micro systems. In the NRC in Ruoholahti Nokia is doing research on nanosciences as well. Their three research topics are: new signal processing methods and devices, functional materials and Carbon based material. The NRC is collaborating with the University of Cambridge and the Helsinki University of Technology.

The main important research institutions operating in nanotechnology in the Helsinki region are the Helsinki University of Technology, the Finish Technical Research Centre VTT and the University of Helsinki. These three institutes count more than 30 laboratories and research groups and about 200 researchers.

Furthermore there are the HelsinkiNano initiative and Finnish Micro and Nano Technology Network, FMNT of importance. The HelsinkiNano initiative was founded in 2004. Its objectives are to “spur the Helsinki region into a central position in nanoscience and technology”, to foster the use and commercialisation of nanotechnology and to encourage the networking within the nanotechnology field. The initiative aims to facilitate the introduction of new technologies into business and to support new nanotechnology-based start-ups.

FMNT is a Finnish corporation network for companies in the field of micro and nanotechnology and adaptive materials. Its main purpose is to link the Finnish micro and nanotechnology industry to its European and global counterparts and to foster the cooperation with worldwide networks in that particular field. FMNT is administered by the CoE-AMM.

SWOT-Analysis optical, micro systems and nanotechnology in Helsinki region:

Strengths	**Weaknesses**
• More than half of the companies and national research resources in the field are located in the Helsinki Region • Multi technology resources are available in the region • Turnover and profitability of the companies has increased from 2004 especially of those exporting • Otaniemi Technology Park community, the biggest technology park in the Nordic Countries as resource base	• Cities don't devote enough resources for cluster development • Commercialisation of technological innovations is poor • Lack of venture capital • The micro and nanotechnology cluster is strongly concentrated on a few companies • The five biggest companies count for 40 % of turnover and half of labour force • Micro and nanotechnology companies are rather young; more than half of them have started after 1995
Opportunities	**Threats**
• Ability to develop technologies • Masters of Nanotechnologies Training Programme • Active facilitators • Nokia's (nanotechnology) Research Center leads to more optimism and investment • Helsinki's R&D intensity in general	• Pace of internationalisation is too slow • weak networking on the companies side

Source: Eeva Viinikka, Culminatum Ltd.

In order to sum up the characterization of the three discussed technological fields or clusters in the Helsinki region the following table can be presented:

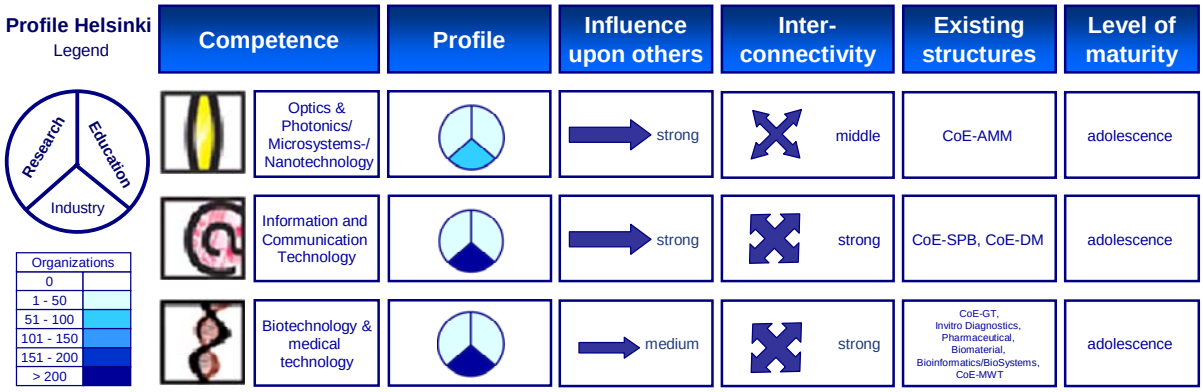

Figure 6: Overview of Selected Competence Fields in the Helsinki Region

4.4 Stockholm

In Sweden the concept of clusters was also introduced already in the early 1990s. By 2001 a new cluster promoting initiative VINNOVA (Swedish Governmental Agency for Innovation System), was formed. Its focus is on needs-driven R&D and improving the overall Swedish innovation system. A special focus within VINNOVA is on technology transfer and the improvement of SMEs capacity to engage in R&D. The "Forska och Väx" program is similar to the American federal SBIR program which encourages the involvement of SMEs in R&D. VINNOVA introduced the cluster program "Vinnväxt" in 2003. In this program clusters or public-private partnerships involving firms, universities and local authorities compete for ten year public funding. However co-financing of cluster activities is required. In addition "VINN Excellence Centers" is a program under which applied research centers throughout Sweden have received funding in different technological areas. (c.f. Ketels and Sölvell 2006)

Stockholm, the capital of Sweden, is a leading economic region not only in Sweden but also in Europe with a high concentration of information technology, health care industry and research. In Stockholm a large number of multinational corporations and numerous SME are located. Many of them are science and technology-based companies. About 20 universities and university colleges are located in the Stockholm region, with a variety of disciplines. It comes as no surprise that the Stockholm region regularly scores high in international innovation, creativity and competitiveness rankings. As a market, Stockholm has become an important hub in the expanding Baltic region, as well as being an integral part of the growing EU market.

In addition there are a large number of national and regional R&D institutes and private initiatives in the Stockholm Metropolitan Area. Many of them cluster around the Royal Institute of Technology and Electrum in Kista. On the one hand the research institutes closely collaborate with Swedish companies on R&D projects and on the other hand also put much emphasis on facilitating and fostering start-ups and spinning-off new firms. Recently a comprehensive consolidation has taken place among the local industry research institutes. Many of the institutes are now under the umbrella of IRECO Holding AB (a limited liability company owned by the Swedish government (55%) and the Knowledge Foundation). The objective of IRECO is to promote Swedish industrial growth and international competitiveness through ownership and support to industrial research institutes.

Within the Stockholm region four competitive clusters have been identified by local authorities: IT & telecom, life sciences, financial services and environmental technology. Additionally the field of creative industries is rapidly growing in importance. On the one hand local policy makers presently strive to find a coherent innovation strategy based on the triple helix model, i.e. cooperation between industry, academia and public policy. On the other hand Stockholm Innovation & Growth (STING) is an established comprehensive and qualified support system for stimulating the foundation and growth of new companies focusing on ICT, Telecommunication and recently also medical technology in Stockholm. It is based in both Kista Science City and the Royal Institute of Technology (KTH) campus in central Stockholm. STING is directed towards entrepreneurs from the business community, academia and research institutions, who have technology-based ideas for founding new companies. A similar innovation environment with technology transfer and seed-financing of mainly drug development companies have been built up by Karolinska Insitutet's holding company. These structures include Karolinska Institutet Innovation AB, Karolinska Institutet Development and Karolinska Institutet Science Park.

The European cluster observatory identifies eight agglomerations in the Stockholm region in the areas of finance (45 765 empl.), business services (41 041 empl.), transportation (40 880 empl.), IT (34 633 empl.), education (27 167 empl.), Entertainment (20 470 empl.), Communication (11 455 empl.), Biopharma (10 325 empl.) (see Table XXX in the appendix).

4.4.1 Life Sciences in the Stockholm Region

Life Science Statistics for Stockholm
• Approx. 460 companies (with approx. 26 000 employees total) • 88 Life Science Investment in 2006 to a value of 530 million SEK (57% of life science investments in Sweden) • Six universities active in biotechnology research in the region (approx. 28 000 students and 4 400 professors and other researchers) • The Life science cluster in Stockholm is characterized by world-leading basic and applied science and commercial companies active along the entire value chain from small biotech start-ups to big pharma with both production capacities and marketing. Within basic and applied, clinical research the following areas are particularly strong: neuroscience, oncology, infectious diseases, immunology, circulation and respiration, metabolic diseases, regenerative medicine, tissue engineering and stem cell research. Many companies are active within these fields but there are also companies within diagnostics, medical technology and biotech tools and supplies. The region has also a broad representation of service companies ranging from early drug discovery and development to clinical research organizations.

Source: Stockholm Business Region

The greater Stockholm region (including Uppsala, Södertälje and Strängnäs) dominates the Swedish life science sector and also holds a strong position in Europe. More than half of Sweden's biotechnology companies are located in the greater Stockholm region. Companies like AstraZeneca, Pfizer, Biovitrum, GE Healthcare and Siemens Elema are located in the region and world-leading products such as Fragmin (Pfizer), Healon (AMO), Sephadex (Amersham Biosciences), Xylocaine (AstraZeneca) and ReFacto (Wyeth/Biovitrum) have originated here. These products are not only examples of leading biomedical and biotech research but also examples of effective technology transfer performed in an entrepreneurial interaction between academia and industry. Also large production facilities are located in the Stockholm region. For instance, AstraZeneca's production facility for tablets is the largest of this kind in the world and Pfizer is in the process of building a new bio-pharma production facility in Strängnäs. Furthermore, a large number of international pharmaceutical companies i.e. Amgen, Bristol-Myers Squibb AB, CSL Pharma, EISAI, IVAX Scandinavia AB, Johnson & Johnson, Merck AB, Schering Group, Serono, Wyeth AB, Roche Group have their marketing and sales offices serving the Scandinavian market in Stockholm.

On the research side the cluster consists of six universities with research within life science (Karolinska Institutet (KI); The Royal Institute of Technology (KTH); Stockholm University; Södertörns University College; Uppsala University; Swedish University of Agricultural Sciences). Karolinska Institutet is one of the largest medical universities in Europe and ranked fourth worldwide among medical universities after Harvard, Cambridge and Oxford (The Times Higher Education Supplement 2005).

From basic research to target validation, clinical testing, pharmceutical production as well as sales – all value creation elements of the Pharma value chain are present and located in the Stockholm region (see figure 7). Thus, business encompasses the full spectrum from research-oriented highly

specialized firms and biotech suppliers to multinational pharmaceutical companies with capacity for both research and production.

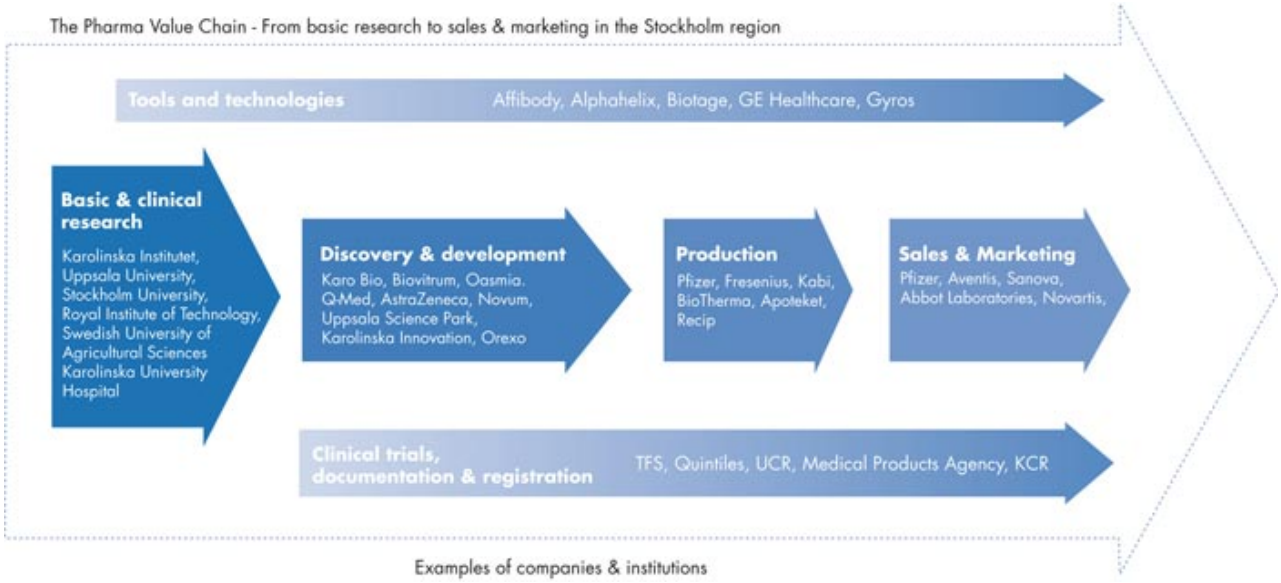

Fig. 7: Examples of life science actors in the Stockholm region

The Stockholm region has a number of support organisations and functions in the field of biomedicine and biotechnology to promote collaboration, knowledge transfer, technology transfer, innovation and growth of the sector. Below some of these organisations are listed and briefly described:
Karolinska Innovation AB (www.karolinska innovations.ki.se) (KIAB): KIAB is a legal entity with the basic task to identify and commercialise research results, mainly from Karolinska Institutet. After having passed an evaluation step where the commercial potential is critically examined, the idea is further developed for out-licensing or to start a company. Promising projects are typically further developed with seed-financing from Karolinska Development AB.
Karolinska Development AB (www.karolinskadevelopment.ki.se) (KD): KD is an investment company, where selected projects and companies emanating from KIAB receive support and seed-funding for further development.

Karolinska Institutet Science Park (KISP) offers laboratory and office space to life science companies. KISP is present in two geographical locations, one in Flemingsberg with Karolinska Institutet's south campus, Södertörns University College and Karolinska University Hospital Huddinge as the immediate neighbours and one in Solna, next door to Karolinska Institutet's north campus and across the street from Karolinska University Hospital Solna. On the north location, a new complex consisting of three new buildings is currently under construction with inauguration planned in 2009. Biovitrum, one of Europe's most prominent biopharmaceutical companies will occupy half of the space from day one.

Stockholm School of Entrepreneurship (www.sses.se) (SSES) is a joint initiative between KI, KTH, SSE and Konstfack – the leading universities in medicine, technology, economics and design in the Stockholm region. By pooling the talents of these institutions, SSES acts as a mobilizing force or catalyst, gathering their innovative and entrepreneurial competencies in joint education and training programmes that are accredited by the member schools.

Stockholm Science City is a foundation owned and financed by Karolinska Institutet, KTH – the Royal Institute of Technology, Stockholm University, the city of Stockholm and the Stockholm

County. Stockholm Science City - Bioscience runs a number of activities including initiation and support of new multi-disciplinary research projects between scientists at the three universities. These projects are intended to further strengthen the academic foundation for the development of the life science cluster in close proximity to the universities which will be part of a new city development project with the project name Karolinska / North Station.

A major engine for the development of the new city section, Karolinska / North Station will be the creation of a new university hospital, New Karolinska Solna with a strong focus on translational research, e.g. basic and applied, clinical research in close collaboration.

Novum Biocity is another, future development project aiming at strengthening the life science cluster in Flemingsberg, where Karolinska Institutet's south campus and Karolinska University Hospital Huddinge is located.

Biotechvalley.nu is a network based in Strängnäs, focusing on biomanufacturing. The basic concept is to create a platform for viable business development around the manufacturing competence.

Finally SwedenBIO, located in Stockholm is the Swedish Biotechnology Industry Organization with more than hundred member companies. SwedenBIO´s main objective is to create a world leading environment for a sustainable life science industry in Sweden covering areas from improving early seed-financing, world class R&D and to having the highest standards in commercialisation's and globalisation. The goal will be achieved by close collaboration with member companies, academia and decision makers.

A number of collaborative projects between actors within the Stockholm region but also with other partners in Sweden and Scandinavia have been created within the Stockholm life science cluster environment. Examples from a broad portfolio of projects are presented here:
The *Swedish Human Proteome Resource Program* is devoted to Antibody Proteomics, systematic generation of quality assured specific antibodies to human proteins and to use these for expression profiling and localization studies in human normal and disease tissues and cells. The *Swedish Brain Power Program*, led by Karolinska Institutet, is a national program to bring out the best in Swedish research into brain diseases. *Stockholm Brain Institute* is a multi-disciplinary scientific venture in the absolute research front within neuro-science, combining complementary research skills from 10 research groups from three universities with strong industry representation (i.e. AstraZeneca and IBM).

The greater Stockholm region is involved in as many as every third EU project within Life Science and Health financed by the 6th frame work program. Karolinska Insitutet alone is involved in more EU projects within life science than any other European university. One example of a major EU project is *Eicosanox*, focusing on research on prostaglandins, leukotrienes and nitric oxide, all of which are central to widespread diseases like cardiovascular disorders, atherosclerosis, dementia and cancer. It is coordinated by Karolinska Institutet with 15 research groups around Europe, including a team from Canada and two biotech companies. *CASCADE* is another, major EU financed Network of Excellence aiming at providing Europeans with a durable, comprehensive, independent network in research, risk assessment and education of health risks, associated with exposure to chemical residues in food. There are many more networks, i.e. integrated projects and networks of excellence within FP6. Other instruments of networking and cluster development include networking, articulating needs/lobbying, collaboration/joint action, education/training and promotion.

A number of agencies of relevance for the life science area are located in the region including the Swedish Medical Product Agency, the European Centre for Disease Prevention and Control, and the National Food Administration and the National Veterinary Institute.

The SWOT-analysis for life science including biotechnology and medical technologies in the greater Stockholm region (including Uppsala and Strängnäs) is displayed in the following table.

Strengths	**Weaknesses**
• Strong science base with a critical mass of world-leading research within six universities in a broad spectrum of areas • Two university hospitals with abundant clinical research • Agencies such as Swedish Medical Product Agency, the European Centre for Disease Prevention and Control, the National Food Administration, the National Veterinary Institute • Strength in both biology- and technology-driven research • Strong Entrepreneurial culture and good climate for collaboration • Strong competence base and skilled work force • Teachers exemption and an efficient and innovative innovation systems • Presence of Big Pharma • Growing company base representing the entire value chain from start-ups to production within drug development, diagnostics and medical technology • Companies striving for the global market are global from day one • Strong financial sector and availability to venture capital • Effective Networks with strong tradition in Industry/academia/hospital collaborations • Access to person register and biobanks • Strong brands, Nobel, Karolinska, Stockholm • Highly competitive business costs	• Relative competitive disadvantage compared to other regions/countries in US, Canada, Singapore, etc.: • - available resources • - public support and financing of infra structure • - taxes and subsidies • Public policy and incentive developments too slow • Regional coordination, many actors each with sub-critical mass • Too few middle size and large companies

Opportunities	Threats
• Take a leading role in the development of the next generation of diagnostic tools, drugs and other life science products • Take advantage of new opportunities in conjunction with the establishment of a new university hospital • Build new concepts based on unique technologies and world-leading medical science – collaborate internationally within the Innovative Medicines Initiative. • Develop more inter -disciplinary research collaboration between complementary science areas e.g. utilise further interaction between information technology and biotechnology • Big Pharma's need to fill the pipeline gap, thus dependent on collaboration with small biotech firms • Implement new business concepts with the aim to keep the value growth in the region	• Need for competent business leaders not meeting demand • Rapid international changes, China, India, Singapore, etc leading to even tougher competition • A weakening of the competitive situation relative to other regions could lead to • - companies leaving the region • - more difficult to attract top-scientists and companies • - diminished critical mass of science and competence leading to less efficient innovation environment

4.4.2 Information and Communication Technologies and Media in the Stockholm Region

Information and Communication Technologies Statistics for Stockholm
• Ca. 5900 companies (with ca. 80.700 employees total) • 231 billon SEK (ca. 26 billion €) turnover in 2002 • Main fields include Wireless communications and mobile internet applications; broadband technologies, Fibre optics and optical networking solutions; applied ICT like software for financial systems and electronic trading; industrial IT and automation; integrated E-business solutions; digital media; coding technologies, i3 Micro Technology, interactive broadcasting, mobile satellite communication; computer games and software; bioinformatics, applications for healthcare and pharmaceutical industry)

Source: Stockholm Economic Development Agency

Stockholm is among the top 10 innovation ICT locations in Europe. A number of wireless technologies like NMT, GSM, EDGE, WCDMA, and Bluetooth have originated in the Stockholm region in labs of wireless innovators such as Ericsson, Sony Ericsson and TeliaSonera. The region is also internationally known as the Wireless or Mobile Valley. Kista Science City (www.kista.com) in the northeast of Stockholm has helped the region to build and strengthen this position.

About 5.900 companies with about 80.700 employees (ca. 26 billion € turnover in 2002) are active in Stockholm's ICT cluster. Other estimations on the more inclusive TIME sector (Telecommunication, Information Technology, Media and Entertainment) count about 25,000 companies belonging to his sector of Stockholm's regional economy and employ one fifth of the overall private sector employees in the area, i.e. 130,000 persons. The Swedish ICT sector is rather centralized. 60 percent of all Swedish employees within the TIME sector are working in the Stockholm region (c.f. www.ricarda-project.org). Sweden's largest ICT companies include Ericsson, TeliaSonera, Tele2, Tietoenator, Scribona, Hewlett-Packard, IBM, WM-Data, Atea, and Ingram Micro – they are located in Stockholm. The main fields of activities include wireless technology and services; broadband technologies, and applied ICT like in finance, industry automation/robotics, media related, and life science (c.f. www.stockholmbusinessregion.se).

Stockholm's ICT cluster is inseparable connected to Kista Science City. Kista is Sweden's largest business park. Presently more than 450 ICT companies are located at Kista (about 1/3 of the total number of companies at Kista: 1350**)**. Besides several multinational companies like Ericsson, IBM, Microsoft, and Oracle newly started companies with a small number of employees and focusing only on the local Swedish market can be found at Kista. Ericsson, now with over 9,000 employees in Kista, was the first company to establish here in 1975. The company has a leading role in the cluster development together with the city of Stockholm, the Royal Institute of Technology.

On the research side world leading research and an increasing number of students within the ICT area are enrolled in Stockholm and especially active at the Kista campus. The IT University of Kista has more than 3500 students (the numbers are increasing again after a couple of years with a decrease of interest). Approximately 1,100 researchers both in research institutes like Acreo and in larger companies like Ericsson and Nokia are in Kista (c.f. www.ricarda-project.org).

In Stockholm and especially in Kista a number of platforms and networks have evolved. Kista *Mobile Showcase* is a live and concrete demonstration environment that markets the region's combined competence in mobile applications and services, with players in the mobile communications sector in the Stockholm region. The companies taking part create a network of their own. *Kista Broadband Alliance* is an association for collaboration between companies and institutions operating in the broad-band field in the Stockholm region. *Kista Technology Network-wireless* is a network for companies and research institutions within wireless systems. In addition to the networks, *Kista Science City* initiates projects and organizes events, seminars and international conferences with a focus on mobile services, wireless systems and broadband systems. In more detail Kista Science City promotes close collaboration between the business community, institutes and academic institutions, and a climate of co-operation between new people with different types of competence. In part, this is created by several well-functioning networks between the companies and between them and educational/research organizations. The goal of these networking activities is to strengthen the growth potential of participating companies, the attraction of the research organizations, and to improve collaboration between education/research and the business community. Apart from the ICT cluster, there is close collaboration with related and partly co-located clusters such as bioinformatics and micro technology and optics. Among the major centers are the IT University, the Swedish Institute of Computer Science (SICS), Acreo, which conducts R&D in the optics and microelectronics fields, the Swedish Defence Research Agency (FOI), and the Institute for Packaging and Logistics (Packforsk).

Strengths	**Weaknesses**
• Strong ICT commitment in the region • Ranked high as an innovative region and outstanding competitive position • Strong innovative clusters in ICT (Mobile Valley and Kista Science Park) • Highly skilled human resources • Strong research base • Ericsson as a flagship ICT enterprise with worldwide significance • Large number of SME high technology enterprises	• Globally located in the periphery with relatively long distances to major European capitals • Commercialisation of the results of the innovation capacity • Moderate level of IS related co-operation within the emerging Baltic Sea Region • No clear high tech strategy for ICT, • Projects are unclear • Companies have difficulties in getting early stage financing

Opportunities	Threats
• Development of a shared strategy for the cluster • Baltic Sea region as an opportunity for building new co-operation relations to the Baltic States and Russia • growing international demand for ICT wand related technologies • Stockholm active in certain new initiatives like Testmarknad Stockholm and Innovativa Åtgärder, which may create new spin-offs	• Shake-ups in the economy and marketplaces for new IT/ICT technologies, including telecommunications • Weakening role in the EU driven development schemes • Growing demands due to international competition of skilled workforce and the necessary economy of scale of research, development , production and marketing • Some recorded doubts about the true innovative "aggressive drive" of Stockholm itself, in comparison with some other Swedish regions (Öresund, Gothenburg…..)

Source: partly cited from Haglund and Nevalainen (2004)

4.4.3 Optics, Micro Systems and Nanotechnology in the Stockholm Region

Optics; Micro Systems and Nanotechnology Statistics for Stockholm
• No current statistics available

Optics, micro systems and nanotechnology in Stockholm does not independently stand out as a cluster. Its significant local potential in Stockholm is rather embedded in a broad engagement in fundamental research as well as a lively photonics industry in Sweden. In general many of Sweden's photonic efforts today are directed towards fiber optical communications. Fundamental as well as applied research is carried out basically at only three universities: the Royal Institute of Technology (KTH) in Stockholm; the Chalmers University of Technology in Göteborg, the second largest city in Sweden, and the Mid Sweden University in Sundsvall, in central Sweden. The independent research institute, Acreo AB in Stockholm, can be seen as a knowledge transfer organization between basic academic research and industry's needs. Here the latest technologies are transferred into new products.

The organizational and ownership structure of Acreo is somewhat complex (see figure 8). In 2005 the group Swedish ICT Research AB (SWICT AB) was formed by bringing the research institutes in the ICT area together. SWICT is owned by the industrial Associations FMOF and FAV (earlier FAS) together with IRECO AB (a limited liability company owned by the Swedish government (55%) and the Knowledge Foundation). Acreo AB is therefore indirectly jointly owned by an industrial association and the Swedish government and directly fully owned by SWICT. On the other hand Acreo and KTH are working together in photonics. Acreo and KTH founded a joint research centre in 2002, the Kista Photonics Research Center (KPRC). The centre has more than 100 scientists and is an important player at the European level.

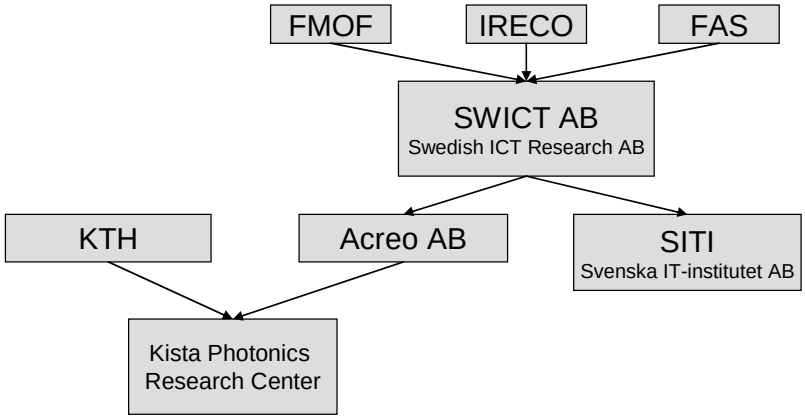

Fig. 8: Organizational structure of Acreo AB

Acreo AB (www.acreo.se) formed in 1999 through the merger of Sweden's respected Institute of Optical Research (IOF) and the Industrial Microelectronic Center (IMC), both with roots in the early fifties. It is a research institute carrying out contract research and technical development in the field of optics and microelectronics. Acreo is refining and transferring research results into viable products and processes in microelectronics, optics and communication technology and consequently has a broad competence spectrum encompassing Integrated Circuit Design, Micro-electronic Process Technologies, Optical Components and Systems, Packaging Technologies, Robust Electronics, Sensor Technologies, and SME Services. Acreo has comprehensive and well-equipped lab and fab resources. Its success in transferring research results into viable products is seen by the number of spin-off companies started in recent years. Several of these start ups have shortened time-to-market by relying on Acreo's lab resources as a production incubator. Another example of technology transfer is Acreo's support to SMEs. Acreo is a national actor with headquarters based in Kista, Stockholm, but has also offices in Norrköping, Hudiksvall and Jönköping. Acreo has currently 140 employees.

FMOF - "Föreningen Mikroelektronisk och Optisk Forskning" ("Association for Research in Microelectronics and Optics") is a non-profit industrial organisation representing companies in business areas where hardware oriented ICTs are the enabling technologies. The main objective of FMOF is to support the development of the ICT industry and the ICT technologies in line with the needs primarily of the Swedish industry. This is fulfilled by influencing the industrial and financial conditions for research and entrepreneurship in general, and the direction of actual research within Acreo. The total number of members in FMOF is 23 companies. Members are found among large international companies as well as small and medium size enterprises. Most of Acreo's spin off companies have chosen to keep close ties with its "mother company" by joining FMOF.

The group Swedish ICT Research (SWICT AB) consists of Acreo and the SITI group, which hold the majority-owned IT institutes: SICS (Swedish Institute of Computer Science), Viktoria Institute, Interactive Institute, and the Santa Anna IT Research Institute. Together the institutes in the group hold competence in the whole ICT area, ranging from hardware (Acreo) to software (SITI). In total, including Acreo, there are 370 employees.

Photonics research at KTH covers a broad range of areas. This allows for combining expertise in photonic networks and transmission with device research and research in basic enabling mechanisms. The focus of applications is laying on telecommunications, where the relevant research issues today concern solving the partly interrelated problems of low functionality, large

physical size and high cost. However, in-house technology also encompasses other emergent application areas, notably biophotonics, which corresponds well with Sweden's strong biotech position. Dominant research areas include ultrafast technology and systems, quantum information technology and systems, optical transmission, integrated photonics devices as well as material science and technology in III Vs and silica/silicon systems. Global breakthroughs have occurred in several of these areas. Research at KTH has formed the basis for several start-up companies, and has provided strong support for existing businesses, in telecom and other segments. (c.f. ISA 2003)

Kista Photonics Research Center (KPRC) (www.kprc.se) is a joint effort between Acreo and the department of IMIT at the Royal Institute of Technology KTH and includes about 100 researchers. KPRC concentrates and coordinates research, education and industry cooperation in Swedish photonics. KPRC thus strengthens the highly innovative Swedish photonics infrastructure in the Kista area. Research topics include Biophotonics, Photonics integration, Photonics communication, and other interdisciplinary issues. In September 2004, KPRC organised ECOC 2004, the largest conference on optical communication in Europe, and one of the largest - and oldest - events in this area in the world.

Another relevant structure, even though not located directly in Stockholm, appears to be the Fiber Optic Valley (www.fiberopticvalley.se). Fiber optic components and systems play an important role in the telecommunications networks of the future, and within growth areas such as sensors and telemedicine. Within the Fiber Optic Valley network new projects are continuously started to develop services within the broadband network while pushing the development forward. One of the on-going projects is research within elder care - old@home - and another one is the test-bed that Acreo is developing and managing.

On the companies side Ericsson as one of the largest ICT companies also has a long tradition of developing fibre optic technology. However, the burst of the telecoms bubble and the subsequent downturn especially affected the fibre optic industry. Ericsson decreased its activities in this area resulting in the formation of new fibre optics businesses in the Stockholm area when the market turned around. Several former Ericsson employees saw an opportunity to start their own company. Although many of Stockholm's photonics companies are engaged in the telecommunication industry, there is a large variety of other applications also. Relevant companies include Acreo AB, Artema Medical AB, Cobalt AB, Comlase NT, Flir Systems AB, Future Instrument AB, Micronic Laser System AB, Net Insight AB, Nyfors Teknologi AB, Optonova AB, Optronic Consult AB, Phasein AB, PhoXtal Communications AB, Proximion Fiber System AB, Spectrogon AB, Svedice AB, Syntune AB, Transmode Systems AB, Zarlink Semiconductor Scandinavia. Relevant fields of application include Measurement, imaging, information and communication, lightning and display, manufacturing tools, healthcare and biotechnology.

SWOT for optics, micro systems and nanotechnology in Stockholm

Strengths	Weaknesses
• High technical competence • Unique collaboration between research-industry-society (“triple helix”) • Large number of SMEs	• Short term financing • “Broken value chains”
Opportunities	**Threats**
• New start-up companies • New local competence centres	• Long term financing • Increasing global competition

Summing up the information on the three discussed clusters in the Stockholm region results in the following table:

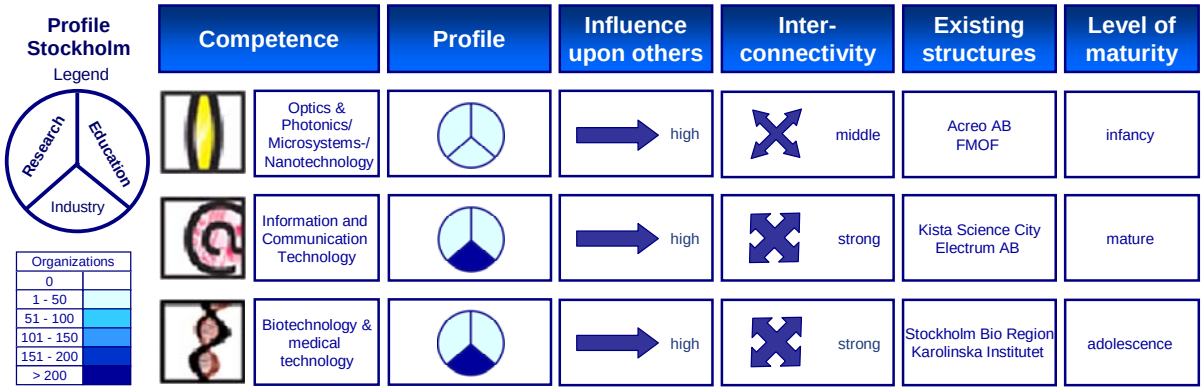

Figure 9: Overview of Selected Competence Fields in the Stockholm Region

4.5 Riga

Since Latvia restored its independence from the USSR in 1991, Latvia has developed to one of the leading countries in the Baltic Region and tops even EU statistics. Latvian population counted about 2.3m inhabitants in 2006. Almost 1m of the total population lives in Riga, the capital and the largest city in Latvia and the Baltic States. After the integration into the EU, Latvia's internal market increased dramatically in volume from 2.3 million to 450 million euros. With the annual GDP increase more than 8% (2001-2005), Latvia has consistently demonstrated one of the highest economic growth rates in the EU. With a corporate tax rate of a flat 15%, and individual taxes at a flat 25%, Latvia has created one of the most favourable entrepreneurship environments in Europe. Latvia is third in terms of the business competitiveness (BCI) ranking in Baltic countries. The stability of business environment is reflected in the number of start-ups, which reached with 13,500 firms (in 2006), the record number of the last 11 years (+22% as compared to the previous year). Latvia registers high employment with the unemployment rate of around 8% (2006).

Despite the low unemployment and low price index, Latvia suffers from low productivity. The high level of employment is driven almost entirely by high hours worked per employee. Companies still compete largely on low costs. Innovative capacity of Latvia has shown a very low performance. However, Latvia is trying to compensate the weakness by currently the highest investment rates among countries in the Baltic Sea region at between 28% and 29% of GDP.

Latvia ranks lowest overall in the Baltic Sea Region on science indicators which include university/industry collaboration, intellectual property protection, patenting and other. This can be seen as the consequences of massive emigration of scientists during and after the World War II (60% of pre-war scientists emigrated to the West). The Latvian Science Council and the Latvian Academy of Sciences have been established with the aim to facilitate the development of the national science base. The National Program for Innovation sets out a broad range of activities focused on skills upgrading, finance, research infrastructure, and higher education. A new program on the "Promotion of science competitiveness" provides funds in five state research programs and a new Law on Research Activity revises the legal structure of research institutions.

The strategically important sector of information technology, which stimulates the development in all other sectors, is especially promising. Latvia's Information Systems cluster strategy has spurred growth in software development, IT consultation, hardware development and data transmissions solutions. Other key sectors include manufacturing, forestry and woodworking, metal processing and engineering, textiles, chemicals and pharmaceuticals, logistics and transit, construction and real estate.

The one year PHARE programme "Support for Industrial Cluster Restructuring" funded by the EU helped to launch an initial cluster program in 2000 in Latvia. The European Cluster Observatory project has detected 7 agglomerations in Latvia: Education (43,105 employees); Transportation (41,697); Construction (30,582); Food (25,385); Entertainment (19,294); Furniture (16,082); Fishing (12,158) and (see annex 8.3 for more details). None of them is active in the areas of life sciences, ICT, optics, micro & nano technologies. However, the State of the Region Report 2006 "Baltic Sea Region – Top of Europe in Global Competition" report has identified biopharmaceuticals in Latvia as a potential, but losing market share cluster. According to the OECD report "Clusters and Cluster Policy in Latvia", there are four clusters in Latvia: Information systems (IS), Engineering, Timber or forest products, Scientific research and high technologies. Despite of different clusters identified, Latvia shows high cluster awareness among

the Baltic Countries related to the absolute size of its economy. More than 70% of companies in cluster-like environments indicate their awareness of being part of a cluster.

After the termination of the PHARE programme, only two (IT, forest products) of the four cluster initiatives continue their activities (Ketels, C./Sölvell, Ö., 2006). Currently, cluster programs have low governmental priority.

4.5.1 Medical Technologies and Biotechnology in the Riga Region

Statistics on Life Sciences and Biotechnology in the Riga Region
• ca. 30-50 companies (biotechnology) • 6 research organizations • Main fields: organic chemistry and biopolymer research, microbiology and virology, genomics, immunology, biotechnology and wood chemistry

Source: Latvian Biotechnology Association, Biotechnology and Pharmaceuticals in Latvia report by the Latvian Investment and Development Agency

During the Soviet times, Latvian scientists and specialists belonged to the pioneers in the areas of biotechnology and life sciences in the country. Political and economical changes in the 90th in connection with massive emigration of scientists to Western countries caused deep stagnation in this sector. Only after joining the EU, the sector has been slowly recovering from the deep crises. Currently, about 30 biotech companies operate on the Latvian market. Asla Biotech, Biosan, Elmi, Biotehniskais Centrs, Genera, Grindeks, Olainfarm, Biolat, igra, harmaidea are the most significant of them.

The medical and biotech market is monitored by the Agency for Health Statistics and Medical Technologies. This state agency is responsible for registering any medical technologies made in or imported to Latvia. In order to coordinate activities in the medical and biotech industry, the Latvian Council of Science and the Latvian Academy of Sciences have been established. The former deals with research funding, information on ongoing projects, preparing the science budget close together with the Ministry of Education and Research of Latvia. In 2006, the Association of Biotechnology of Latvia has been created with the aim to provide information about perspectives of biotechnology projects in Latvia and to mobilize Latvian companies in the biotechnology field. Furthermore, there are also a variety of associations and organisations representing the industry: Latvian Association of Dentists, the Association of Surgeons etc.

The Riga Stradins University can be considered as the central educational organisation in medical technologies in Latvia. Other leading universities and research institutes in Latvia with R&D in Biotechnology and Life Sciences are the Faculty of Biology at the University of Latvia, Latvia University of Agriculture, Riga Technical University, Research Institute of Biotechnology and Veterinary Medicine “Sigra”, Latvian Institute of Organic Synthesis and Biomedical Research and Study Centre (BMC). The BMC is involved in activities of the ScanBalt meta network. The Institute of Organic Chemistry is active in the area of pharmaceuticals. Besides the mentioned, there are several other institutions currently involved in life sciences and biotechnology: Institute of Microbiology and Virology, Institute of Wood Chemistry, Institute of Microbiology and Biotechnology at the University of Latvia. The educational institutions provide for significant input of young professionals in life sciences and biotechnology. About 880 students receive bachelor degree and ca. 224 their master degrees annually in life sciences. PhD programmes are

offered by each university with more than 150 Ph.D. graduates per year. Organic chemistry and biopolymer research, microbiology and virology, genomics, immunology, biotechnology and wood chemistry belong to strong areas in Latvian life science research.

One of the most significant projects for the development of the life sciences cluster is the project "Riga Centre for Development and Innovation of Biomaterials" located at RTU. The total budget of the project is 2.1m EUR funded by the PHARE Economic and Social Cohesion Programme. The objective of the project is to develop the research infrastructure and buildings for developing medical implants for blood vessels and bone tissue made from biomaterials. Other (completed) projects that support the development of the cluster of medical technologies and biotechnologies in Latvia are: Support to the Infrastructure of Development of Biomedicine and Protoaeomics at the University of Latvia; Technical Equipment for the Creation and Operation of the Genome database of the Population of Latvia at the University of Latvia; Modernisation of Research Infrastructure for Fields of Biotechnologies, Biomedicine, Organic Synthesis, Environmental Science, and Ecology at the University of Latvia; Development of the Research Infrastructure of the Institute of Organic Synthesis of Latvia. An ongoing relevant project is the Modernisation of the Research Infrastructure of Riga Stradins University. The projects listed above were or are funded from ERDF.

The provision of opportunities for personal contacts between entrepreneurs and scientists (researchers) is one of the instruments to improve the networking within the life sciences cluster. The ongoing project "Development of Technology Transfer Contact Point at the Riga Technical University for the Promotion of the Utilisation of Structural Instruments", supported by the Ministry of Economy, aims in this direction. Similar contact points have also been organised by Connect Latvia with the aim to stimulate the development of companies by linking entrepreneurs with sources of know-how and capital and to speed up the start-ups' commercialization and thus create additional jobs in Latvia. Connect Latvia organizes: springboards, financial forums, partnership forums, seminars and educational courses.

The ERDF state aid scheme "Support to Development of New Products and Technologies" is important for developing cluster relations. This state aid scheme supports research institutions which promote the commercialization of the technologies developed at the research institutions.

Strengths	**Weaknesses**
• Strong technological area is the development of implants made of biomaterials, which is certified by a number of international patents • All necessary raw materials are available in Latvia • Very good co-operation with medical staff thus it is possible to find out the most specific details concerning biomaterials needed	• very low expenditure on health care in Latvia, as well as for the infrastructure of health care • Decreasing number of medical personnel, very weak supply of new personnel • Low value chain depth (ca. 60%) • Component production instead of end products

Opportunities	Threats
• Attraction of EU funding for the development of the health care infrastructure, as well as for the development of research infrastructure in medical technologies and biotechnologies • High priority of material sciences for Latvian Industrial policy. The state will provide more focused assistance in cluster development, i.e, by providing state-paid studies for the potential participants of the cluster. • Creation of innovative enterprises based on the "Riga Centre of Biomaterial Innovations and Development" where competitive biomaterial products will be produced and employment for scientists will be provided. • By carrying out more complex and additional research, it is possible to develop new innovative high value added products thus Latvia will develop competitive advantage in this field. • Better collaboration among research-companies • Stronger workforce upgrading • Production of eco-materials as this can open access to more wide markets.	• Outflow of staff skilled in medical technologies and biotechnologies to Western countries • Very weak supply of new personnel

4.5.2 Information and Communication Technologies and Media in Riga

Statistics for Information and Communication Technologies and Media in Riga
• ca. 14 companies • 5 research and educational institutions • Main fields: software development and maintenance, manufacturing of computers and electronics and telecommunications

Source: Riga City Council (2007)

The Information and Communication Technologies (ICT) sector has been demonstrating one of the highest growth rates in the Riga region. Economic activities related to production of goods and services of ICT in 2004 equalled to approximately 8% of GDP and about 6% of all working persons are employed in ICT sector. In Latvia the ICT sector includes tree main sub-fields: software development and maintenance, manufacturing of computers and electronics and telecommunications.

The ICT sector has been selected by the government of Latvia as one of the priority sectors. Government has introduced measures to improve the IT-related business environment by simplifying immigration procedures for IT engineers, accelerating depreciation schemes or tax incentives for training. In 1997, the government has launched the Education Information System (LITS). The Latvian government implemented the Information Systems (IS) cluster among other

clusters in the scope of the PHARE project "Support to Industrial Cluster Restructuring". The Information Systems cluster is a collaborative network of companies, educational institutions, software developers, professional training centres, data centres and independent testing agencies, web content and marketing companies. The core activities of the IS cluster are: financial and other support for export activities, training for employees of cluster participants, information provision for participants and penetration of the cluster's image in the society.

The Latvian Information Technology and Telecommunications Association is the organisation which is responsible for the development of government policy in the area of information technologies. Another important co-ordinating organisation is the Latvian Electrical Engineering and Electronics Industry Association. This non-governmental organization unites companies, research and educational institutions and supports cooperation with other branch associations in Latvia, as well as related organizations of European countries.

The key education institutions are the University of Latvia with the Institute of Mathematics and Computer Science and the Institute of Electronics and Computer Science, the Riga Technical University with the Department of Computer Science and Information Technology and the Department of Electronics and Telecommunication, and the private Institute of Transport and Telecommunications. The Latvian government has targeted the IT sector as a top priority in terms of strategic development and has been boosting the number of students in IT-related disciplines by over 30% in recent years. On the basis of the recently established Vidzeme university college, an IT technological park "Cybercity" involving industry and universities has been developed.

Several projects have targeted the development of the ICT cluster in Latvia. The ongoing project "Development of the Information Technologies, Computer Science, Electronics and Telecommunications Research Equipment and Infrastructure at Riga Technical University" and the already finished project "Development of the Infrastructure of the Centre for Research of Software Engineering at the Institute of Mathematics and Computer Science of the University of Latvia" are among them. Both projects have been funded by the ERDF.

There is a great variety of interregional projects in the ICT sector including the EU FP6 project "Web-based Mobile Solutions with Logistics and Maritime Applications: ELGOMAR – M", the EU FP 6 project "Promotion of IST Solutions in Baltic States – IST 4 Balt", the FP6 project "Concepts and Methods for Exploring the Future of Learning with Digital Technologies – KALEIDOSCOPE". The three projects are carried out at the Riga Technical University.

In the scope of the project "Development of Technology Transfer Contact Point at Riga Technical University for the Promotion of the Utilisation of Structural Instruments", contact points between entrepreneurs and scientists (researchers) are organized. Similar projects are also implemented at the University of Latvia and by Connect Latvia. The ERDF state aid scheme "Support to Development of New Products and Technologies" plays an important role in the transfer of technologies from research institutions to the industry.

Strengths	Weaknesses
• Strong government support of the sector with the focus on university – industry collaboration • Skilled workforce with strong background in mathematics • Strong traditions in the export of software development • Political independence of the media, ban on censorship • High value chain depth (ca. 90%)	• Productivity of the local ICT industry is still considerably below the European average • Concentration on reselling of ICT products made elsewhere rather than on developing new ICT applications • Low wages in the sector • Comparatively low use of computers and Internet in Latvia • Low pace of digitalisation of the state broadcast channels • Lack of financing in education • Involvement of science in this sector is weak because of the lack of qualified personnel
Opportunities	**Threats**
• Attracting EU funding for research infrastructure of ICT, as well as for learning and the improvement of workforce skills • Potential for further sales revenues due to improvement of infrastructure in the scope of governmental programmes and in the private business sector (banking, insurance, transportation, telecom) • Digitalisation and privatisation of former state-owned broadcast media • Increase of start-up activities through favourable business conditions	• Outflow of qualified ICT personnel to Western countries

4.5.3 Optics, Micro Systems and Nanotechnologies in the Riga Region

Statistics for Nanotechnologies in Riga
• 2 companies with about 300 employees • R&D basically takes place at the Institute of Solid State Physics (ISSP) of the University of Latvia and the Institute of Inorganic Chemistry at the Riga Technical University • Main fields: functional and nano-structured materials, nano-sized particles; materials and technologies for optical information recording and imaging; development of new inorganic materials (such as single crystals, glasses, ceramics, thin films) for optics and electronics

Source: Riga City Council (2007)

Optical technologies are of no special relevance to companies and research institutions in the Riga region. The only known organization active in the filed is the Institute of Solid State Physics of the University of Latvia.

During the Soviet times, nanotechnologies played an important role in Latvia because of the supplies for the military and other strategic technological areas. The loss of military orders after Latvia gained independence lead to deep stagnation in the field. Currently, nanotechnologies have been recapturing scientific and economic interest in Latvia. A number of research institutions have turned towards nanoscience as a prospective area of technological development. Currently,

active research is being carried out in the fields of functional and nano-structured materials, including nano-sized particles which can be used both in photonics, in microelectronics, in medicine and other fields.

The activities in the optical/nano industry are monitored by the state authority Latvian Electrical Engineering and Electronics Industry Association (LETERA). The Latvian Council of Science helps to organise joint projects funded by the Latvian state.

The state research programme "Development of modern functional materials for microelectronics, nano-electronics, photonics, biomedicine and development of constructive composite as well as consonant technologies" supports projects in the following areas in the time frame 2005 till 2008: perspective inorganic materials for photonics and energetic; nano-electronics, opto-electronics and microelectronics, development of nano-particles, nano-structural materials and thin layers technologies. The ERDF state aid scheme “Support to Development of New Products and Technologies” supports the transfer of the technologies developed at Latvian research institutions to the commercial sector. Moreover, the ERDF project “Modernisation of the Infrastructure for Scientific Research in Material Sciences at the Institute of Inorganic Chemistry of Riga Technical University” has been launched in order to support the development of nanotechnologies in Latvia.

Latvia participates in numerous cross-border and international projects. “Transnanopowder”, “Innovative methods of obtaining nanostructure materials in the solar furnace”, X- TIP **(**Nano-scale chemical mapping and surface structural modification by joined use of X-ray microbeams and tip assisted local detection), SoC-SME (Provision of System-On-Chip technology for Small and Medium sized Enterprises), Minatuse **(**Micro-Nano Technology Use by SMEs) are only a few of them. The Excellence Centre of Advanced Material Research and Technology (CAMART) funded by the EC “Excellence Centre Program” promotes research and dissemination of knowledge about modern functional materials and high technologies with special emphasis on applications in micro-electronics and photonics. An important goal of the excellence centre is to improve the links with other European centres and researchers.

One of the key research and educational organisations in nanotechnologies is the University of Latvia. It carries out fundamental and applied research in the areas of tender functional magnetic nano-materials, inorganic, biological and molecular nano-components for bio and nano-technologies, properties of individual nanoelements etc. Other major research organizations are:

- University of Latvia: Institute of Solid State Physics (ISSP), Institute of Atomic Physics and Spectroscopy, Institute of Polymer Mechanics, Institute of Physics
- Riga Technical University: Institute of Inorganic Chemistry, Institute of Silicate Materials of the Department of Material Science and Applied Chemistry

Institute of Solid State Physics at the University of Latvia (ISSP) is a leading organization in the field of materials science and engineering in Latvia with the focus on single crystals, ceramics, glasses, polymers, thin films and covers all scale from the level of the atoms and molecules to that of final devices. Main research directions of the Institute of Inorganic Chemistry of Riga Technical University include plasma chemistry and technology of inorganic compounds, manufacturing of nanosized powders, new ceramics, cermet materials and coatings. Two companies are active in the area of nanotechnologies in Latvia: Neomat and “Plazma, keramika, tehnoloģijas”. Neomat Co. is a internationally well-known company going with its roots into Soviet times and production of nano-materials for military and space industry. Neomat actively participate in scientific conferences and publish numerous scientific articles. “Plazma, keramika, tehnoloģijas” supplies a number of nitride, oxide and carbide nanopowders to its worldwide customers.

The concept of Technology Transfer Contact Points belongs to the important networking instruments in Latvia. Contact points have been organised at the Riga Technical University, the University of Latvia and by Connect Latvia. Their aim is to organise contact points between entrepreneurs and scientists (researchers) thus linking entrepreneurs with sources of know-how and capital, to speed up the commercialization of innovation and to create additional jobs in Latvia.

Strengths	**Weaknesses**
• Very old traditions in nano-research • Numerous patents obtained • Strong educational base • Participation in numerous international projects	• Outdated research infrastructure • Inadequate salaries for research fellows make impossible to attract new personnel as well as to retain the existing personnel in this region • Low number of participants • Low value chain depth • Scarce start-up activities • Weak interconnectivity • Networking activities within education and between industry and education in the embryonic phase
Opportunities	**Threats**
• Very high potential for growth in the near future • Dissemination of knowledge and promotion of nano technologies to broad publicity • EU investment in research, scientific infrastructure, promotion of the skills of human resources.	• Technological outflow from the region • Personnel outflow to Western countries • Weak supply of new research personnel

For summing up the three technological clusters the following table (see figure 10) provides an overview:

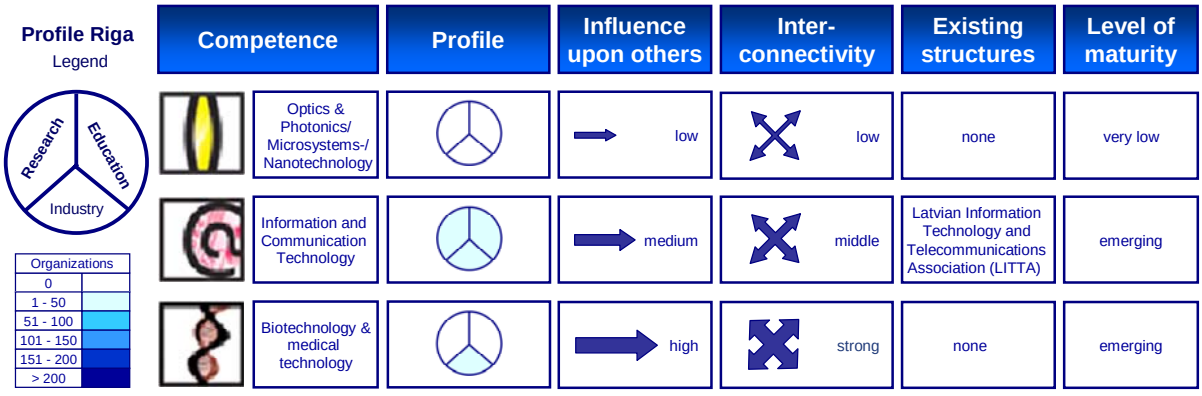

Figure 10: Overview of Selected Competence Fields in the Riga Region

4.6 Tallinn

Estonia gained independence from the Soviet Union in 1991. The last Russian troops departed in 1994. In 2006 Estonia became a member of the European Union. Today the country has an economy growing at double-digit rates. Tallinn the capital of Estonia is the centre of Estonian political and business life. There are roughly 400 000 inhabitants in Tallinn (about 30% of the Estonian population of 1.4 million). The Estonian economy is characterized by a rather centralized structure meaning that Tallinn is home to about half of all Estonian companies, which are responsible for ca 50-60% of GDP and nearly 3/4 of total business profit. The Estonian economy is closely connected to the neighbouring Scandinavian countries. This has attracted extensive foreign investments, facilitated the acquisition of modern expertise and increased foreign trade resulting in annual real growth of GDP of about 8% (i.e. in 2004 and 2005).

Tallinn's industrial output makes up almost 1/3 of the total national output. Tallinn is home to both traditional and new branches of industry. They include machine building, metal processing, textile, food and furniture industries, biotechnology. Electronics and apparatus plants represent the new industrial generation, strongly oriented to exports. Tallinn houses leading industrial companies like ABB Eesti and Elcoteq Tallinn, which provide outsourcing services for high-tech electronics components for international companies like Ericsson, Nokia, ABB, Philips and others. (Tallinn City Enterprise Board 2007).

Whereas a new research and development and innovation (RD&I) strategy has been introduced in Estonia, a set of policies specific to cluster development has so far not been formulated. Cluster development in Estonia is in its very early stage, because private entrepreneurship has started less than 20 years ago and during these years most of the companies have set their targets for gaining market share and strengthen the company's competitive position – first signs of recognizing needs for wider cooperation and cluster-like activities have emerged just over the last years. Cluster development measures provided through Estonian Enterprise will be worked out during the next years. In the context of the country's new RD&I strategy, Estonia will focus on activities which support the rise of prioritized key technologies (these technologies include ICT, Biotech and Materials) and which address key socioeconomic challenges (like environment, energy, security, health care). These two general focus areas will be part of future cluster support measures. The clusters to be supported will be identified through a call for proposals, where clusters will be required to illustrate their potential based on a number of criteria. Currently there are cluster initiatives that are formed and active – but up to now they have not been supported by the public sector.

The authors of the European Cluster Observatory project do not differentiate between Tallinn and Estonia and map the respective clusters for the "region" or better for the entire state of Estonia. According to this analysis nine clusters or rather industrial agglomerations can be found in Estonia: Construction (28,752 employees); Transportation (22,121); Education (17,026); Food (14,921); Furniture (13,272); Apparel (12,115); Textiles (11,234); Fishing (7,361); and Oil and Gas (5,440).

4.6.1 Biotechnology in Estonia and in Tallinn

Biotechnology Statistics for Estonia
• Ca. 40 companies (SME with ca. 170 employees total) • 16,6 Mio.€ turnover in 2005 • 15 biotechnology research organizations (ca. 300 employees) • Main fields include medical biotechnology like immunology, genomics and cancer research; industrial biotechnology including biochemistry, organic synthesis, environmental and food biotechnology; diagnostics; drugs and chemicals; clinical research; laboratory services; laboratory equipment and reagents; antibodies; bioinformatics; biosynthesis, industrial bioproducts; biosensors; biopreparations, plant biotechnology)

Source: Estonian Biotechnology Association

Estonian biotechnology is still at an embryonic stage. However the country has a century long tradition in molecular biology. In particular biotechnological research began to play a major role in Estonia when significant investments into R&D were placed by the state in 1970s to develop genomic studies. In the 1980s two leading research institutions – the Estonian Biocentre in Tartu and the Laboratory of Molecular Genetics at the National Institute of Chemical Physics and Biophysics in Tallinn were established. Since then research institutions and companies have mainly clustered around Tallinn and Tartu. One of the characteristics of the Estonian biotech community is that its actors are strongly interlinked. Additionally a large number of co-operative linkages exist to partners outside the country, especially in the Nordic region.

As in the other sectors of the Estonian economy there have been no cluster strategies in the region. The biotechnology companies present today have largely been formed in the 1990s. The main competences that have been developed in Estonian biotech lie in biomedicine and human health, mainly concentrating on diagnostics and pharmaceuticals. Industrial biotechnology also has its significance, involving biochemistry, organic synthesis and laboratory equipment and reagents. "Green biotechnology" is mainly the subject of research.

In 2003 the Estonian Biotechnology Association (EBio) [www.biotech.ee] was founded by an initiative of biotechnology research institutions and companies. The aim of the association is to support the development of biotechnology in Estonia; and to represent the sector towards decision-makers, the general public, and towards the biotechnology sector abroad. The association offers information and networking services, organizes events and leads the process of composing the Estonian biotechnology strategy. Currently the association has 20 members. EBio organizes activities in the following areas of (1) information distribution like publishing news on EBio's website or conducting studies; (2) mediating contacts and partnerships; (3) promotion of Estonian biotechnology by composing and distributing promotional materials and representing Estonian biotechnology on fairs; (4) organizing events and opportunities to get together like the biotechnology roundtable, biotechnology career days; (5) representing Estonian biotechnology by for example leading the process of composing the Estonian biotechnology strategy and (6) participating in one-off projects (within the 6th EU Framework program or BioSPINNO 2 - an Estonian-level project facilitating technology transfer). Other instruments to improve networking within the biotech community in Estonia include seminars and conferences organized by the local research organizations; financial support for networking like foreign assignments, fair visits and exporting and joint research and commercial projects.

In addition to the Estonian Biotechnology Association a number of other significant biotech organizations drive the development of the field: Estonian Genome Foundation

(www.genomics.ee); Tartu University (www.ut.ee); Tartu Biotechnology Park (http://www.biopark.ee/?lang=2); Estonian Biocentre (http://www.ebc.ee/EBC/); and Tallinn University of Technology, Technomedicum (http://www.cb.ttu.ee/). Among the 15 biotech research organisations in Estonia the most central organizations are the National Institute of Chemical Physics and Biophysics; the Gene Technology Institute of Tallinn University of Technology out of which several spin-off companies and the Competence Centre for Cancer Research have emerged over the last years; the Estonian Biocentre; Tartu University, the biggest university in Estonia which hosts the Institute of Molecular and Cell Biology, the Institute of Organic and Bioorganic Chemistry, the Faculty of Medicine and the Tartu University hospital; and finally the Estonian University of Life Sciences with its Institute of Agricultural and Environmental Sciences. In the small biotechnology industry a number of rather small companies have been established. The most successful companies include the following: Quattromed Ltd; Asper Biotech Ltd; Solis BioDyne Ltd; Celecure Group.

In the Estonian Biotech sector a number of networks and collaborative projects have been organized. The Competence Centre for Cancer Research was established in 2005. The co-operating partners include Tallinn Technical University, North Estonian Regional Hospital and companies in Estonia and abroad. The centre is conducting research projects in the field of developing new generation cancer drugs as well as in the field of new technologies for early-stage diagnosis and prognosis of cancer. The centre is financed by the founding partners and by the Competence Centre program of Enterprise Estonia. Another collaborative project is the BioSPINNO 2 project. The project aims to foster cooperation of companies with R&D institutions, public authorities, national organizations supporting entrepreneurship and investors in the biotechnology sector.

In addition to these national projects inter regional projects and interactions between biotech clusters have begun to gain momentum. For example a broad range of co-operation projects are organized under the ScanBalt (www.scanbalt.org) -umbrella within the FP6.

The SWOT-analysis of the biotechnology cluster in Tallinn/Estonia is displayed in the following table:

Strengths	**Weaknesses**
• fast development of the cluster • the creation of spin-offs increases • cluster benefiting from several general policy measures • good scientific foundation • many external contacts and co-operation projects • skilled workforce – plenty new graduates entering the labour market each year • incubators for start-up companies • collaborations within the sector • taxation system favourable to enterpreneurship • advanced and harmonized legislation (for example in the field of human genome research) • relatively good reputation outside	• Lack of interdisciplinarity in research and entrepreneurs • Lack of managers with a knowledge in science • Low awareness on IP issues • Lack of start-up financing • no biotechnology-specific policy measures

Opportunities	Threats
• Biotechnology defined as a strategic key technology by the state • The Human Genome Project (Population health and gene database) • Potential cluster development programmes from the state • more contact with big pharmas • External demand (applications of biotechnology in other fields, potential procurements from the state) • Entrepreneurial education to scientific staff • Repatriating scientists	• Too much focus on basic research • Asia positioning as a cost-effective region • Science losing general popularity • Political, religious and bioethics groups against certain research

4.6.2 Information and Communication Technologies in Estonia and in Tallinn

Information and Communication Technologies Statistics for Estonia
• Ca. 300 companies (SME with ca. 1500 employees total) • Six ICT research organizations • Main fields: e-government, e-banking, e-ticketing, web-applications, software development, manufacturing of computers and components

Source: Technopol

Within a rather short period of time the ICT sector in Tallinn and in Estonia has emerged and developed into a dynamic field. A starting point can be seen in the "Tiger Leap" program that envisioned providing all schools with PCs and Internet connections by 1999. During the last decade other modern means of communication have been introduced to and have become an inseparable part of the daily life of Estonians. The use of mobile telephones and Internet is more widespread in Estonia than in other EU member states. E-commerce and e-government are gaining ground and to date, an e-government and an e-meeting system have been introduced and are in use Estonia. In the banking sector internet bank usage is 98%. Several innovative technical solutions and applications have been developed locally, for instance a mobile parking system of payment for parking by mobile telephone, MPS (mobile positioning system) and e-ticket in public transport. The majority of domestic IT products are designed in Tallinn. The attitudes of the population and the size of the country make Tallinn a prime place for testing new ICT (cf. Tallinn City Enterprise Board 2007).

Although there have been several cluster seminars and workshops organized by Tallinn City Enterprise Department, ITL (Association of Information Technology and Telecommunications), Ministry of Economic Affairs and Communications as well as some other organizations, there's no sign of real cluster development in Estonian ICT sector. Further there are no dominant leaders in the ICT cluster development identifiable in Estonia. The main reason seems to be the lack of business interest within the dispersed ICT sector – Estonian companies are very diffuse in the fields of application. Additionally the large number of small ICT firms (about 1500 one-man-companies) lacking resources for growth and cooperation appear to hinder a more managed cluster development process.

A number of established ICT companies exist in Estonia and especially in Tallin today (Reaalsüsteemide AS; AQRIS SOFTWARE AS; Võrguvara AS; Elion Ettevõtted AS; Data

Telecom OÜ; Microlink AS; Pro-STEP OÜ; Trigger Software OÜ; Makato Eesti OÜ). Estonian ICT research organizations include the five universities: University of Tartu; Tallinn Technical University; Estonian Business School; University Nord; and Tallinn Pedagogical University. In addition a number of polytechnic educational institutions and many training companies provide basic and specialized education in IT and IT management. The E-Governance Academy (EGA is located in Tallinn) was created in 2002 as a non-profit organization for the development and analysis of e-governance and e-democracy. The objectives are to transfer knowledge to top policy-makers and government ICT specialists in developing nations. EGA provides training services, organizes research, facilitates networking and enables the exchange of experience in broad areas of e-governance. The IT College was created in 2000 as a co-operation project between the two largest Estonian public universities, the Tallinn Technical University and the University of Tartu, and the Estonian ICT industry. The IT College is a private institution, it works very closely with both universities as well as with the IT and telecom industries.

In 2000 the Association of Estonian Information Technology and Telecommunications Companies (ITL) (www.itl.ee) was formed by merging the Estonian Computer Association (AFA, founded in 1992) and the Association of Telecommunications Companies (TEL, founded in 2000). ITL has about 40 members and is a voluntary organisation, whose primary objective is to unite the Estonian information technology and telecommunications companies and to promote co-operation. Further it represents and protects the interests of its member companies and expresses their common positions towards ITL stakeholders. Main activities of the association include popularisation of ICT, promotion of vocational education and amendment of legislation. The association organises projects related to information technology and telecommunications (information fair CONT@CT; ICT forum FROM VISONS TO SOLUTIONS and summer event OK-fest) (ITL 2007).

The Estonian Information Technology Foundation (EITF) (http://www.eitsa.ee) is a non-profit organisation that aims to assist in the preparation of highly qualified IT specialists and to support the ICT-related development in Estonia. Representatives from the five founding members (Estonian Republic, Tartu University, Tallinn Technical University, Eesti Telekom and the Association of Estonian Information Technology and Telecommunications Companies) constitute the council of the EITF. They appoint the 3 members of an Executive Board. The Foundation is annually audited by a sworn auditor. EITF established and manages the Estonian IT College and administers the National Support Program for ICT in Higher Education “Tiger University”

Although a functioning cluster in the Estonian ICT industry cannot be identified, several activities have been organized in order to develop the ICT field in Tallinn and Estonia. As the first step, seminars and visits to companies belonging to functioning clusters have been organized for Tallinn ICT representatives. Other means to develop the ICT cluster in Tallinn are the Ajujaht business plan competition and the „Tiger Leap“ program which aims at improvement of the infrastructure and learning environment in higher educational establishments.

A number of meetings and interactions between ITL and associations of other Estonian industries have been organized in order to learn more about cooperation possibilities and cluster development (i.e. workshop between ICT, engineering, food processing, wood processing and building material associations). Finally, as in the other clusters a number of international and inter-regional projects and activities can also be identified in ICT in Tallinn. First of all there is the beginning establishment of a Baltic ICT cluster between ITL, LITTA (Latvia) and INFOBALT (Lithuania). There is a membership in and cooperation with the European Information & Communications Technology Industry Association (EICTA). A meeting of Baltic and Scandinavian ICT unions was organizes and the participation in IST 2006 in Helsinki conference which was organised by

the European Commission in cooperation with Tekes, Finnish Funding Agency for Technology and Innovation, and the Ministry of Trade and Industry of Finland.

From an analysis of the Tallinn ICT sector the following SWOT-analysis can be derived:

Strengths	**Weaknesses**
• Despite of slowdown in the ICT sector, Estonia has still a good image as IT community • The ICT infrastructure in Estonia is very well developed • Wide selection of electronic and mobile services are available both in private and public sector • Estonian citizens are widely using different on-line services like Internet-banking, tax reporting etc. • Personal contacts are easy to achieve in a small country like Estonia • There's a small number of cluster developers who know each other well	• Very large number of small ICT companies • Lacking ambitions for growth • Lack of experience of large scale business • Financing for development programs/projects is difficult to get • Projects are unclear / not well defined • Vision and technology foresight work is not yet strong enough • Financing for internationalisation activities is difficult to get • Companies are lacking resources for R&D
Opportunities	**Threats**
• Lack of human resources increase the need for ICT solutions in all industries • Better opportunities for nearshoring business • Increasing need for electronic services • Increasing need for cooperation and sharing resources • ICT sector becomes more attractive because of several success cases	• Lack of human resources • Increasing salaries and cost level in all industries • Global competition • Political uncertainity in Russia can affect several industries

4.6.3 Optics, Micro Systems and Nanotechnology in Estonia and Tallinn

Optics, Micro Systems and Nanotechnology Statistics for Estonia
• Eight optics companies • 47 companies are dealing with micosystems but only some are producing some nano-system based products • Two optics/micro systems/nanotechnology research organizations • Main fields include microscope development, development of new sensor-materials, measuring instruments and calibration devices based on nanotechnology; Impact of electromagnetic radiation on human health; new methods of laser diagnostics in medicine; impact of environment factors on health; assessment of effectiveness related to rehabilitation procedures; new methods for diagnosing cardiovascular diseases; optical methods for clinical monitoring

Source: Technopol

Optics, micro systems and nanotechnology in Estonia do not form a notable agglomeration or cluster. Rather there are separated activities in this technological field. The main industry using the photonics/micro/nano systems are the producers of electronic devices. Estonian photonics/ micro/nano systems companies act as sub-contractors of some foreign companies. In this sector of the Estonian economy the companies are rather medium-sized enterprises with relatively big turnover, at least in comparison to the Estonian ICT sector.

The leading organizations in the field of photonics/micro/ nano systems include the Nanotechnology Development Competence Centre (http://www.spmtips.com) which was established at Tartu University in February 2005 and the TTU Technomedicum (http://www.cb.ttu.ee) that has been established at Tallinn University of Technology in 2006. Technomedicum is an innovative and interdisciplinary scientific institution linking together Tallinn University of Technology, hospitals, and other organizations/institutions related to healthcare. Photonics companies in Estonia include Laser Diagnostic Instruments AS, Neweks Ltd., and Interspectrum OU.

There is no organization or association developing the field and no national instruments exist within the field of photonics/micro/ nano systems to improve networking.

International projects include NEXUS - European Microsystems Network Association; Helsinki-Tallinn Twin City of Science project; Dynamic Adaptive Modeling of Human Body - DynAMo (Academy of Finland); Network for Future Regional Health Care (EC INTERREG III C Programme) and Optical Methods for Diagnosis and Monitoring of Clinical Parameters (NATO).

SWOT-analysis of optics, micro systems and nanotechnology field in Tallinn:

Strengths	**Weaknesses**
• Half of the national research resources in the field are located in Tallinn Region; • Multi technology resources are available in the Region; • Most of the companies in the field are located in Tallinn Region; • Tallinn Technology Park providing business development services is existing in the Region	• No systematic approach in innovation development in Region; • Poor commercialisation abilities of technological innovations; • Lack of early stage venture capital; • Optical and micro- and nanotechnology cluster is strongly concentrated to few young companies
Opportunities	**Threats**
• Ability to develop new innovative technologies; • Cluster development programme at Enterprise Estonia (National Business Development Agency) starting in 2008;	• internationalisation is too slow; • low working force resources;

The following table sums up the main characteristics of the three described clusters or technological fields under investigation in the wider Tallinn area:

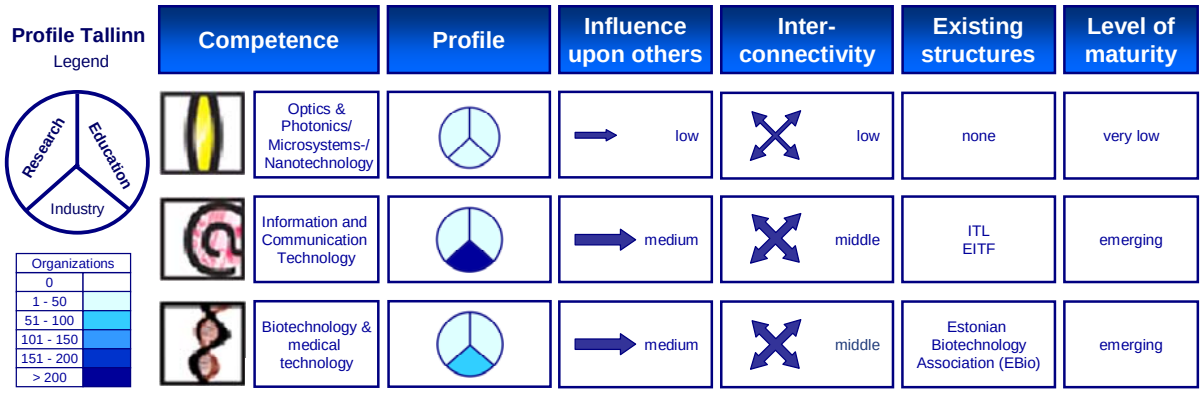

Figure 11: Overview of Selected Competence Fields in the Tallinn Region

5 Networking Innovative Clusters in the Baltic Metropoles Regions

The last section displayed the cluster potential and the different developmental stages of innovative clusters or rather high-technology fields (biotechnology and medical technology; information and communication technology; optics, micro systems and nanotechnologies) in the six Baltic Metropoles regions of Berlin, Øresund, Helsinki, Stockholm, Riga and Tallinn. The analysis has shown that the development of business clusters is a very complex process. Many players are involved; often regional innovation strategies accompany the development process, and/or the process is part of a larger triple helix approach within the respective region. The different Baltic Metropoles regions follow their own regional strategies for selecting fields of competence and cluster development. Industry is often the driving force. Regional strategies and developments follow different patterns: technology base and economic potential; regional orientation and existing cooperation culture; existing knowledge base and competencies in R&D; human resources; and estimated market development and reach.

As this process is very specific, long term, and complex, the project partners have agreed to focus on the inter-regional networking aspect of cluster development

- Identifying mechanisms for better inter-regional networking of regional clusters
- Identifying important players for realizing networking strategies and approaches
- Identifying instruments for better networking
- Exchanging best/good practice in development and use of networking instruments

In the following section potential to network these clusters or technological fields in these regions will be identified. First some conceptual thoughts in line with the discussion in section 2 will be presented. Secondly concrete inter-regional collaboration and networking potential at the level of technology parks will be presented. Technology parks and especially collaborating technology parks may play a vital role in providing companies from innovative clusters entry opportunities into external markets. Since the benchmark of technology parks in the Baltic Metropoles regions had a special emphasis within work package 3 of the BaltMet Inno project, the analysis and result are presented in more detail. Thirdly the question of networking innovative clusters in the Baltic Metropoles regions at alternative levels will be discussed.

5.1 Conceptualizing the Networking of Innovative Clusters

Picking up the conceptual discussion on cluster development and cluster alliances from section 2.3.3 it can be stated that the networking of innovative clusters can be facilitated at and from different (administrative) levels and from actors from different societal spheres (economic, scientific, political). At the lowest aggregation level individuals or cluster promoters or rather cluster alliance promoters were identified as potential boundary spanners between clusters. At the organizational level companies or research organizations might have an interest in connecting to other organizations located in other clusters. Technology parks as shown in the analysis in section 4 are present in all the Baltic Metropoles regions. They primarily provide infrastructure to local companies. However, they also provide services for local companies and research organizations to access other regional markets or clusters via their relationships with other technology parks The analysis in section 4 also revealed that in most regions and technological fields/clusters some kind of association or network administrative organization representing the community of companies and research organization exists. These associations or NAOs in recent years began to connect to

other clusters in order to exchange ideas on cluster development; on progress of the respective technology or to organize lobbying at higher political levels. Clusters are always embedded in some kind of regional support infrastructure including chambers, political actors, regional developers and the like. Organizations at this level try to promote economic growth in their region. A means to do this is seen in recent years in the interregional collaboration of clusters. These organizations provide infrastructure that offers potential to be networked as well.

Figure 12 depicts the potential levels to connect clusters. However, it is also possible that relations are established between clusters but at different aggregation levels. This could be the case when a research organization from cluster A establishes a relationship with an NAO in cluster B. At the same time a representative from a technology park may establish a relationship with a strategically relevant company from another cluster.

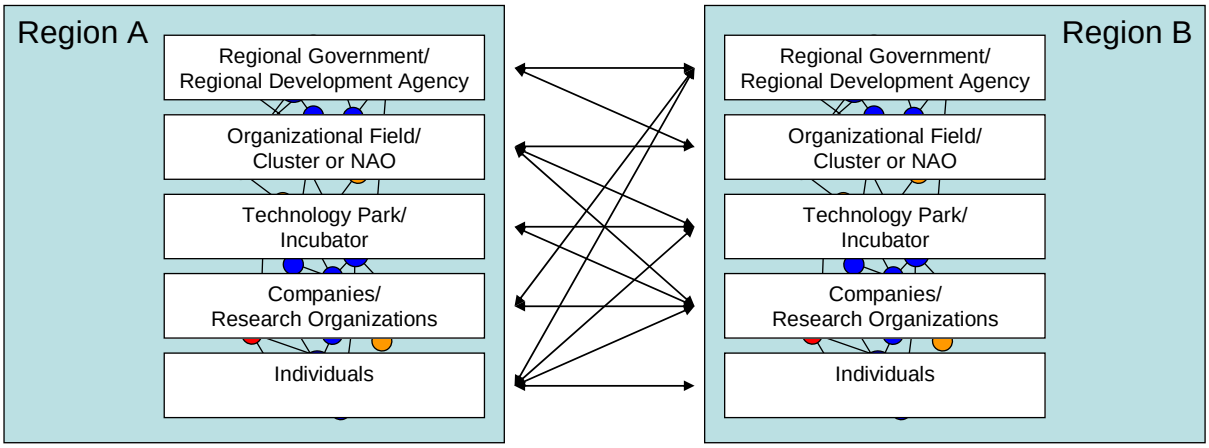

Figure 12: Levels of cluster collaboration and interaction

From a knowledge perspective on cluster alliances adequate routines to exchange and to improve the utilization of knowledge need to be installed at these different levels. Such measures may include the mapping of knowledge resources and competencies within the clusters and provision of the mapping results to alliance members. The measures to improve the system competence of a cluster alliance shall primarily target joint learning and other collective activities. This creates a shared knowledge base, and also helps to improve knowledge flows in the alliance.

The measures to improve knowledge flows in a cluster alliance need to be differentiated according to the type of knowledge to be transferred. To improve the flows of explicit knowledge, the cluster alliance must merely provide that its formal scope or/and the cumulative level of trust among partners are sufficient to exchange this knowledge form. In this case, the cluster alliance will be less space-sensitive due to the low costs of transferring codified knowledge; the clusters in the alliance may be distributed and can be connected over long distances without efficiency losses. With regards to tacit knowledge, the alliance must vastly increase the level of interaction and trust in order to improve the flow of valuable tacit knowledge through the relationships and to accelerate the spillovers in the local context. The proximity of clusters has positive effects on the transfer of tacit knowledge besides the trust level. Clusters, that are located geographically close to other clusters in the alliance benefit from more frequent contacts, dense face-to-face communication as well as other activities supporting trust development in a higher degree than distributed clusters. Therefore, cluster alliances where clusters are connected over long distances need to compensate the lack of face-to face contacts and thus lower pace of trust development through the emulation of proximity (“virtual proximity”) to encourage the exchange of tacit knowledge between alliance partners.

5.2 Inter-regional Networking by Means of Linking Technology Parks

One of the central objectives in WP 3 was to deliver proposals and suggestions on concepts for setting up trans-national cooperation within selected clusters of different metropolitan areas. In the following section the activities undertaken to identify these networking potentials at the level of technology parks are reported.

In the process of identifying the technological potential and analyzing the cluster development process of each region as well as the networking potential of the clusters and emerging technological fields and networks in the Baltic Metropoles Regions it became clear that networking between clusters is heavily depending on existing innovation infrastructure and the quality of communication and cooperation platforms.

Prerequisites of inter-regional networking are:

- Appropriate infrastructure,
- Communication platforms,
- Internal and external networking structures and their organization
- Existence of providing company related services, entrepreneurial services
- Existing synergy potentials between the different players from, e.g. science and industry
- Close links between education (human resources), research (technology know how) and application (innovative companies, realization of innovation)
- Support new innovative business.
- Mechanisms and quality of transfer of technology and know how

In this sense Science and Technology Parks play the important role as facilitator and catalyst of cluster development processes. Analyzing the existing innovation potential in the Baltic Metropoles Regions, it was found, that in all participating regions science parks have been established and are active.

Science and Technology Parks and business innovation centers provide:

- Entrepreneurial and business related infrastructure and services,
- Focus on key directions in regional economic development,
- Business creation and incubation excellence,
- Actively provide cooperation competence and platforms,
- Create synergies between tenants - companies and research facilities,
- Have qualified &experienced management, active players in regional business development
- Access point for transfer, for cooperation and networking
- They have excellent knowledge about regional markets;
- Often involved in international networking activities, with
- High visibility and marketing expertise

The examples of the science and technology park in Berlin-Adlershof, KISTA Science Park in Stockholm and the Otaniemi Science Park in Helsinki illustrate, that science parks are mayor players in regional cluster development. They have concentrated know how in developing technology agglomerations, providing necessary services and are experts in both internal and external networking. They have an important role in improving interconnectivity and networking of selected clusters from participating regions.

To better utilize the advanced potential of Science and Technology Parks and Innovation Centres for inter-regional networking of clusters, the project partners have started a more detailed analysis of the role and functionality of science parks and to try to benchmark the partner parks. The benchmark study was developed and carried out between early 2006 and May 2007.

The benchmark of science parks was seen by the project partners as a helpful tool for linking science parks and innovation centers across regions. The idea of comparing the performance of the different parks was to identify and exchange efficient and transferable services and skills.

The tasks with respect to supporting cluster development can be summarized as follows:

- Improving management and services offered within the park
- Optimizing structures
- Optimizing relations to partners of the site – in the park and the region
- Finding and realizing priorities
- Develop targeted partnership and efficient interregional cooperation
- Accelerate strategy building
- Getting better international visibility (incl. partner for IASP, peer reviews)

The benchmark of the technology parks also tried to give a better understanding of the different regional profiles, competencies and structures of the project partner regions. Thirdly the benchmark was conducted in order to establish a reliable platform for improved inter regional cooperation based on a strong and personal linked network of the related park management organizations. Finally the benchmark process was intended to initiate a better market access for innovative SME from the different partner regions; based on:

- High quality information about regional markets, given by the park management of the partner regions
- High quality information about technology profiles of the regions
- Support and assistance in addressing the key persons, institutions and businesses to the requesting companies by the park management, providing a “one stop approach”
- Interactive approach and feedback between the park managements.

The benchmark process was planned to provide the foundation for the creation of inter-regional alliances within the Baltic Sea region, providing advantages to the partners, such as:

- Better access to knowledge and other resources of partner regions;
- Time advantages and higher flexibility
- Cost advantages in cooperation and division of work
- Risk reduction by sharing with partners

- Faster and more profound access to new markets within the partners region
- Increase the market power of the companies accessing these "Neighbour markets" by partnering

While the benchmark study and its results will be given separately (see appendix 8.2), conclusions from the study can be drawn on providing better links between business clusters within the Baltic Sea regions. One important result of the benchmark was the understanding of the importance of spatial planning for regional clusters and science park structures and its development which must be included in the development process of technology parks and clusters. One of the concrete practical results of this understanding was the meeting of official spatial planners of the partner regions in May 2007 to start a knowledge transfer between the regions.

Derived from the benchmarking process first practical approaches towards networking the partner regions via science and technology parks were identified. These instruments or measures of inter-regional networking by means of linking technology parks include:

Connecting Science Parks

Network of Science Parks to better inform and market the regional potential and competencies of BaltMet partners, provided by park management

Strategy Seminars with neighbour regions are complementary activities to better learn about and cooperate with partner regions. An example was the strategy seminar of SCION Science Park from Copenhagen, held in Berlin in May 2007. Partners exchanged ideas about actual development and future planning in their activities. Potentially joint approaches were identified and discussed. A similar format is planned with KISTA and Helsinki/Technopolis Venture.

Exchange of best practice for building innovation infrastructure was started also with parks in development stage (Helsinki and Berlin with Tallinn, St. Petersburg; Warsaw, Riga, and Vilnius). BaltMet best practice will be used in coaching and supporting partners in creating their own innovation infrastructure.

Educational Sector Networking:

Mutual opening and participation at graduate schools and/or summer schools. A first positive result was the Berlin Summer School in applied optics/micro optics in August 2006. Participants from BaltMet partners took benefit from the 3 day seminar hosted by the Humboldt University, the optics cluster OpTecBB and the Adlershof Science Park Management, WISTA-MG. International experts from Science and industry gave a intense curse in micro optics to about 60 participants – university students and young graduates from industry.

Soft Landing Services for Companies; Cooperation and Trade Centres

Mutual provision of office and meeting space and market knowledge for companies and institutes from partner regions. Help to open markets and to find best matching partners for business development and production cooperation, distribution and sales. Companies from Helsinki, Malmö, Copenhagen, Tallinn and Warsaw have already used these services to test markets in partner regions of the Baltic Sea network. A particular service was introduced as "Business welcome package". This business development service allows a first market access for interested companies. For a limited period of time it provides a fully equipped office, a furnished apartment to live as well as consulting services about taxes, legislation and market opportunities.

Visiting, Meeting and Matchmaking Programs

Groups of institutions, administrations and companies can be (and already have been) hosted in this service format. First successful users started this format in having business lunches or seminars with key players from partner regions. Group meetings with decision makers, industry key players and leading researchers guarantee both a quick and deep overview on existing research competencies, market conditions and legislative regulations in partner regions. Participating companies benefit from this format by having the possibility to present themselves to many potentially interested partners at the same time not having the burden of contacting all potential partners one by one. Managerial help from the partner park network guarantees the matching quality of invited partners. Up to now visiting groups from Helsinki, Copenhagen, Stockholm, Malmö made use of this service.

Marketing Assistance at Conference and Expositions

Partners allow each other (on a mutual basis) privileged access to regional important conferences and exhibitions and trade fairs. They provide favourable financial conditions (reduced fees) to interested clients from Research or industry and/or offer improved visibility at regional events, give support in marketing of clients from partner regions (e.g. mailing support; match-making), giving the partner's company a better visibility. This particular measure was tested at several occasions in Helsinki and in Berlin (e.g. during Microsys 2007 and during Laser Optics Berlin 2006).

Financial Services

Partner will exchange audience during venture and seed capital markets. Sharing the markets leads to better volumes for both demanding SME and providing VC companies. Example: Euro Venture market.

Project Networks, Cluster Networks

The formation of joint R&D consortia; give better chances for successful participation in tendering and/or participation in research programs (e.g. FP7). As prominent example ScanBalt could be mentioned. ScanBalt BioRegion has been founded with the aim of ensuring that North European Life Science and Biotechnology realises its potential for global competitiveness. ScanBalt achieves this through the creation of a new 'metaregional' structure, which brings together regional and national expertise into one coherent, translational, organisation. ScanBalt members are networks between universities, biotech/life science industry, hospitals and other important actors in the biotech/life science arena.

Other activities are in the planning process, but by the short time period of the project, was a detailed development, description and implementation for the project partner not possible. To foster and focus the networking and development activities in the Baltic Sea region it needs time and continuity support of the growing structures. Only by this it will be possible to develop the future technology clusters.

5.3 Linking Clusters in the Baltic Metropoles Regions

As shown in the last chapter, inter-regional networking by means of linking science parks was the first step in linking clusters in the Baltic Sea region. Science parks facilitate selected networking between local organisations on both sides, but their networking ability is limited by their structure and scope.

The empirical analysis has shown that the structure of science parks in the Baltic Sea region differs. KISTA in Stockholm and Otaniemi in Helsinki have emerged around focal companies (Ericsson and Nokia) and are highly specialized on one technology sector, whereas Berlin-Adlershof for example includes a broad range of sectors. This structural bias in combination with the limited geographical scope of science parks requires the integration of a higher level of networking between the regions in order to max out their whole cooperation potential.

Many inter-regional innovation projects are coordinated by a dominant company (mainly OEMs), pure SME-projects are the exception rather than the rule. Many SMEs are unable to judge future market conditions due to insufficient information about activities in other countries/regions and therefore overestimate the risk of investment in certain R&D projects, especially regarding the implementation of ideas or interests by initiating project calls. Moreover SMEs are often unable to cope with the efforts for project coordination, resulting in a shortcoming of pure SME-projects. Since SMEs are the mayor driving force in most regions' clusters, sustainable development in the Baltic Sea Region requires the establishment of inter-regional support structures.

When reaching a certain development stage technology or innovation fields become clusters, which are usually managed on a regional level either by networks, political institutions or (partly) public financed organisations (NAOs). These institutions typically deal with strategic aspects of regional cluster development and often are the source of goal-oriented innovation initiatives. One of the mayor obstacles in inter-regional networking is the necessity of creating aligned strategic goals and initiatives on an inter-regional level.

An important step towards overcoming this obstacle is the formation of a true inter-regional cluster alliance. Such a cluster alliance can provide an improvement of resource alignment and knowledge utilization by establishing inter-regional strategic innovation councils which consist of experts from certain technology fields from different regional clusters. These experts can be representatives of companies, research organizations, technology parks, regional development agencies, city councils and so on. These councils can establish a strategic dialog between partner regions at different levels and with different thematic foci, for example about future development trends and goals in certain technology fields as well as facilitate the exchange of cluster development best practices in specific technology fields. They can map available knowledge and competencies to clusters along the value chain by pooling information about research activities, funding instruments, production capabilities and market conditions thus increasing inter-regional transparency. The mapping results can be provided in structured and easy accessible form as data bases, for example. This would provide a broad stock of codified knowledge and minimizes the efforts for information search, especially for SME. Moreover the councils could foster the bundling of complementary capabilities within the alliance in order to close determined resource gaps. For a proposed governance structure see figure 13.

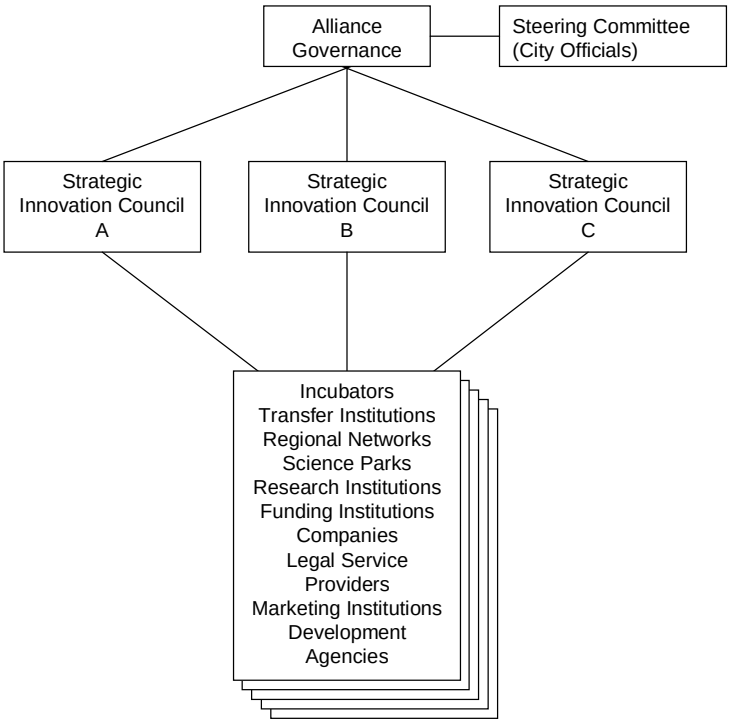

Fig. 13: Possible governance structure of an inter-regional cluster alliance

These activities would provide the basis for implementation of inter-regional R&D initiatives, e.g. matchmaking of companies and research institutions, development of project proposals and coordination of inter-regional cooperation projects.

On top of that, mapping results can serve as a basis to develop the alliance vision which can be broken down to the mission, values, strategic and operative goals, and measures on a more general level. An alliance governance can perform an intermediary function between policy on the one hand and science and economy on the other hand.

An important objective shall be to encourage communication and to strengthen interaction between members, other actors as well as supra-national institutions. The objective can target the improvement of internal as well as external communication. External communication can provide up-to-date information about alliance activities in easy-to-access format. Internally, information flows among the actors shall be coordinated to achieve better transparency of meta-regional activities. Joint publications, reports belong to the common communication tools. Round table discussions can be organized with the aim to identify potential partners and new actors.

Multiplier effects can be used to improve the dissemination of knowledge. For this reason, training-of-trainer courses and entrepreneurship education can be organized. The intense interaction by means of the described tools facilitates the exchange of ideas and helps to exploit the innovation potential and achieve synergies in the alliance.

Cluster alliances can minimize the costs of knowledge transfer through learning among organizational member. Appropriate measures shall target learning processes with the aim to increase the mobility of students, lecturers and researchers and to create critical mass in research and education. They might include shared curricula, courses, guest lecturing, projects, grants and rewards, also workshops and conferences. The information about all the activities shall be posted on a common web site. Knowledge networks might be established in cluster alliances in order to

improve the flows of tacit knowledge. The knowledge networks can specialize in professional issues, education, research and development, for example.

Activities of the alliance shall address the problem of developing relations and trust over distances through joint activities in the virtual space. One example is the creation of a “virtual” university, internet forums and work groups among other thing.

As the competitiveness depends on the availability of knowledge resources, a key objective must be the attraction of qualified human resources and firms. However, the alliance must provide appropriate infrastructure which is required for education, research, technology transfer and innovation. With regards to funding, the alliance can install practices to help its members to identify key stakeholders, to attract pilot project funding and assists in the preparation of funding applications.

Network development shall have high ranks in the alliance goal hierarchy. The central idea could be to build a dense network of contacts between representatives from different clusters in order to generate synergies and to ensure the best possible exploitation of common resources. This idea can be deployed in the formal scope of the alliance, or be implied in appropriate official documents.

Due to the fact that the alliance and its clusters are embedded in the social environment, it might be necessary to address the dialogue between the alliance and society in form of ethic work groups, for example.

Finally, dedicated activities must be established with the aim to improve the efficiency of the alliance organization, thus increasing the system competence of the alliance and its competitiveness at all level.

6 Summary

Work package 3 of the BaltMet Inno Project was started in 2005 with the aim to exchange ideas and knowledge of project partners on the development of clusters in order to improve the developmental process. In addition the aim was formulated to develop cluster tools and instruments that provide means for increased interaction and focused cooperation between clusters in the Baltic metropolitan regions.

This report gives a short introduction to relevant concepts. These included clusters, alliances, cluster alliances, and management of cluster alliances. The methodology section provides an overview of the steps taken to gather the necessary information for several analyses within the project. The main part of the report is mapping the three identified high potential technological fields or clusters in Berlin, Øresund, Helsinki, Stockholm, Riga and Tallinn to get a better understanding of the competencies and activities within the partner regions. Finally collaboration potential between clusters is identified – first with a special focus on science and technology parks followed by a more general discussion of such instruments and means at alternative levels.

At the science and technology park level these activities (which have partly already been implemented) include connecting science parks by organizing strategy seminars with park management members from different regions. It includes the exchange of best practice for building innovation infrastructure. In the educational sector networking of clusters can be organized by organizing technologically focused summer schools. Technology parks may also provide soft landing services for companies from partner regions or support cooperation and offer discounted rates for trade centres. Technology parks may also organize visiting, meeting and matchmaking programs. They provide marketing assistance at conferences and expositions as well as concrete financial services. Finally technology parks may offer a frame for the organization of interregional project networks.

However, alternative levels of cluster collaboration exist. Additional activities can be organized at and between these additional levels. These may include workshops (professional, EU FP7 competence, entrepreneurship); the installation of a black board information system which contain up-to-date information about funds, jobs, summer courses; info events at universities, company presentations in the region to increase awareness of the project; bachelor and master theses on selected regional topics; awards for student projects; shared curricula at universities; guest courses and lectures between universities; professional databases (know-how, best practices) – require current content and administration; Contact databases (yellow pages) containing info about regional players in the 3 sectors, investors, research institutions (triple helix). For organizing an inter-regional cluster alliance some kind of governance structure needs to be implemented. Part of such a structure could be a strategic steering committee as well as strategic innovation councils recruiting members from different partner regions and from different organizations.

These and other activities are currently in the planning process. Due to the short time period of the project, a detailed development, description and implementation for the project partner was not possible. The development of clusters and cluster alliances takes time. To foster and focus the networking and development activities in the Baltic Sea region time and continuing support from the project partners, the clusters, and political actors is needed.

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