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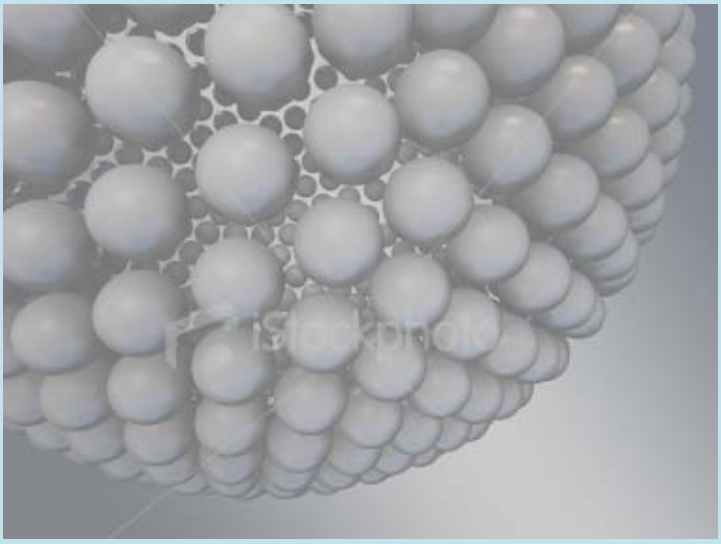

Regional Research Intensive Clusters and Science Parks

REPORT

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Contact: **Irmela BRACH**
European Commission
Office SDME 1/37
B-1049 Brussels
*E-mail**: Irmela.Brach@ec.europa.eu***
Fax (32-2) 295.77.29

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"Regional Research Intensive Clusters and Science Parks"

REPORT
prepared by an independent expert group:

Chairman:

Christian SAUBLENS – EURADA – Brussels - Belgium

Rapporteur:

George BONAS - General Secretariat for Research and Technology – Athens – Greece

Kai HUSSO – Science and Technology Policy Council– Helsinki– Finland

Pavel KOMÁREK – Ministry of Education, Youth and Sports – Prague - Czech Republic

Knut KOSCHATZKY – Fraunhofer Institute for Systems and Innovation Research ISI – Karlsruhe – Germany

Christine OUGHTON – Birbeck College, University of London – London - UK

Tiago SANTOS PEREIRA - CES, University of Coimbra – Coimbra – Portugal

Bernd THOMAS – AGIT - Aachen – Germany

Mark WATHEN – East of England Development Agency - Cambridge–UK

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Abbreviations list

BIC	Business and Innovation Centre
CIP	Competitiveness and Innovation Programme
DG	Directorate General of the European Commission
DSP	Digital Signal Processing
DTI	Department of Trade and Industry/UK
EBN	European BIC Network
EEDA	East of England Development Agency
GCP	Greater Cambridge Partnership
ERA	European Research Area
ERBI	Eastern Region Biotech Initiative (UK)
ERDF	European Regional Development Fund (Structural Funds)
ESF	European Social Fund (Structural Funds)
EU	European Union
FDI	Foreign Direct Investment
FP7	7th Framework Programme for Research and Development
NTBFs	New Technology-Based Firms
OECD	Organization of Economic Cooperation and Development
R&D	Research and Development
RDAs	Regional Development Agencies
RTDI	Research, Technological Development and Innovation
SP(s)	Science Park(s)
STI	Science, Technology and Innovation
UKSPA	UK Science Park Association
VC	Venture Capital

EXECUTIVE SUMMARY

1. In this report*, Research-intensive clusters* (RICs) are defined as clusters that predominantly rely on research and development (R&D) as a source of their innovativeness and competitiveness. Such clusters are often based on strong partnership and collaboration between enterprises and public research organisations, including universities. RICs are market driven but usually receive support from public or semi-public bodies. Due to their research intensity, RICs are evolving in the proximity of universities or R&D institutes enabling strong network relations that foster the exchange of knowledge and human resources. *Science parks* are largely regarded as key elements of the research based regional development policy and can be complementary to RICs.

2. The development of the knowledge-based economy puts an increasingly high emphasis on the need to produce, exploit, transfer and apply knowledge. In this context, there seems to be a general agreement about the need to develop and strengthen networking activities between the actors of the so-called **triple helix model**, i.e. the public sector, the business community and the higher education institutions. Intermediaries can facilitate the interaction between these three key groups and liaise with public and private R&D funding and venture capital organisations.

3. **Regions** are more and more generally identified as important players in the knowledge-based economy. However, regions don't always know how to exploit their potential. It is usual that even in regions that did not traditionally possesses a strong R&D base, both RICs and science parks have become very popular policy instruments and their number is constantly increasing. Nevertheless, they both have an important role to play in defining any science, technology and innovation (STI) policy at regional level. However, regions differ from each other in terms of resources (human, social, technological and financial capital) and other factors of competitiveness including those of cluster externalities, local knowledge spill-overs and other multiplicative effects. All these issues should be taken into account when policy mechanisms and actions are being designed and implemented. STI indeed need multi-level policy governance with intense co-operation and competition.

4. The report concentrates on the **multi-level policy governance** and its role in making policy interventions more efficient. For instance, the EU has raised the awareness of the importance of STI and provides incentives and supports investment in research, infrastructure and transfer of technology and knowledge. Efforts have to be made in the coming years in order to maximise the synergies between the EU instruments, such as the 7th Framework Programme for RTD, the CIP and the Structural Funds. The national level can focus on improving the framework conditions and capabilities by establishing a stable and predictable economic and political climate whilst regions should focus on the integration of R&D and innovation into regional development strategies. These strategies should help enterprises to absorb external knowledge.

5. Focussing more on RICs, the report highlights their **main characteristics**, which are based on science, entrepreneurship, people, access to investors and added value support services, networks and international contacts. RICs are represented schematically in the form of a value chain. This value chain has to be considered as an ideal model and therefore all its components may not be present in all existing RICs. The value chain is broken down in four parts: prerequisites and assets; RTD environment; RIC instruments; outputs. The outputs provide enterprises with a wide range of competitive advantages affecting their profits and growth (e.g. through more advanced products, processes and services, cost reductions and sales increase).

6. RICs are either spontaneous, **bottom-up** based informal networks of committed organisations, publicly supported **top-down** initiatives or a mix of these. RICs can also be classified from the point of view of their sectored focus, aims, openness or geographical coverage. Some recent RICs are created on a cross-border scale.

7. The typical **life cycle of RICs** has been described, showing that RICs need to be regularly reviewed to become or stay sustainable. RICs don't bring success per se; a lot of regional intangibles related to human capital, leadership, talent and people indeed make the difference between success and failure.

8. The implementation of a **RIC strategy** is often based on a shared vision and consensus building among the key stakeholders and a joint design of measures aiming at eliminating weaknesses, strengthening comparative advantages of the regional assets and fostering delivery mechanisms of public support. The critical issue within a RIC is the quality and intensity of the collaboration between RIC members and stakeholders.

9. Before developing a RIC, stakeholders should **analyse and benchmark** the regional capabilities and needs. Attention should be given to issues relevant to the RICs functioning, such as the drive behind their start and their initial organisation, their objectives and development path, types of activities, funding, sustainability, barriers to growth, the entrepreneurial dynamics and the issues in relation to transferability.

10. All the aforementioned issues are illustrated through a series of **case studies.** They show that successful RICs are complex eco-systems based on new ways to stimulate efficient forms of partnership and to design and implement an advanced set of tools that boost commercial application of research results or research absorption by existing enterprises. RICs are managed by a leader or a group of leaders able to create the right "alchemy" between all regional stakeholders.

11. A dedicated chapter in the report focuses on the role, characteristics and perspectives of **science parks**, showing their contribution to the strengthening of the local institutional infrastructure and the enhancement of social capital and institutional "thickness". Therefore, they often contribute to the development of a RIC. Science parks may indeed increase the visibility and attraction that paves the way for a wider strategy in the field of R&D and knowledge. They provide advanced infrastructure, complementary services and support to local firms and they usually enable or generate strong networking effects.

12. The first generation of science parks has been perceived as "**science push**" whilst the second generation has been seen as "**science pull**". Today, the third science park generation is based on **interactive local flows** located in a vibrant urban community". It is now indeed perceived as the soul of science-industry-government relations, increasingly involved with local, regional and even global innovation activities.

13. Finally, the report provides a series of **recommendations** and proposes measures to sustain successful RICs and science parks, or to develop new ones. These measures are addressing the three inter-linked policy levels, i.e. EU, national and regional.

A. INTRODUCTION

A.1 OVERALL OBJECTIVES

The main task of the expert group was to analyse and describe ways in which research-intensive clusters and science parks can most effectively contribute to the research and technological development (RTD) capacity of regions and the exploitation of their existing RTD potential.

For this purpose the expert group identified cases, and the underlying conditions thereof, where clusters of research actors, businesses and public administrations have been set-up around a research topic or an agenda and contributed in an important way to reinvigorating regional economies by exploiting the R&D results.

In the context of this report, a *research-intensive cluster* (RIC) was defined as a cluster that relies predominantly on research and development as a source of its innovativeness and competitiveness and relatively less on other sources. Such a cluster is expected to be most often based on a partnership and collaboration between businesses and public research organisations, frequently with a support role for public and semi-public bodies (RDAs, innovation centres / technology transfer centres, public and private venture capital funds, etc.) and is market-driven.

Because of their high research intensity, RICs frequently develop in the proximity of universities or other public research institutes, which foster the exchange of knowledge and human resources. The proximity to such research organisations that act as important sources of knowledge (through formal and informal processes) is particularly relevant in the case of science parks, where such proximity is a key characteristic. While science parks are not a necessary or sufficient condition for the emergence of RICs, their presence constitutes an additional asset for the development of clusters and for the exchange of knowledge that can sustain it. This is why science parks are also addressed in this report.

Science parks are largely regarded as one of the important elements in the successful design of research-based regional development policy and can be complementary to RICs. As such, they should also be paid particular attention but other arrangements and policy instruments should equally be considered if deemed important for the overall design of research-based regional development policies.

During this work, a number of case studies have been identified allowing comparisons across principal components that were considered as contributing to the successful development of RICs. The aforementioned case studies are also instrumental in the identification and characterisation of good practices across different fields and countries.

Subsequently, the expert group has proposed policy recommendations that may be supported at the European level in view of stimulating the development of RICs and, more broadly, research-based regional development across EU regions. These policy recommendations are justified and formulated in a way that can be relatively easily transformed into policy measures at national, regional and European levels.

A.2 POLITICAL CONTEXT AND RATIONALE

A.2.1 Background

The development of the knowledge-based economy puts an increasing emphasis on the need to produce and apply new knowledge. In recent years, the process through which new knowledge is produced and transferred has received a great deal of attention. The European research policy, the most visible instrument of which is the Framework programme for Research and Technological Development, but also the Competitiveness and Innovation Programme (CIP) as well as the Structural Funds should respond to the increasing need for creating knowledge for growth in the context of the Lisbon strategy.

Regions, or more generally, the sub-national level, have been identified as important players in the knowledge-based economy (European Commission 2003a; Cooke & Leydesdorff 2006). The need for regions to become more efficient in using their resources for investing in R&D was also identified in the 3 % Action Plan (European Commission 2003b). However, our knowledge of how exactly the potential of regions can best be put into use is still deficient. The lack of clear understanding is becoming even more visible in connection with the increasing importance attached to the regional dimension of the EU research policy that is to be implemented under the 7th Framework Programme for RTD, CIP and the Structural Funds.

There seems to be a general agreement about the need to develop and further strengthen collaboration between three key actors in the RTD domain: the public sector, the business community and higher education institutions. In addition, there is also an important group of intermediary actors that facilitate the interaction between these three key groups. Among others, RICs and science parks clearly display an important potential to stimulate RTD activities at the regional level and increase the competitiveness of regional economies. At the same time, they seem to be well suited to the task of an intermediary between public and private activities. Often, though not always, clusters and science parks represent organisations based on public-private partnerships at regional or local level and liaise intensively both with R&D organisations and the business community; in many cases, they also do so with other relevant regional stakeholders, such as regional administrations, development agencies, innovation centres, incubators, R&D funding and venture capital organisations, etc.

Both RICs and science parks have become popular policy instruments across the EU and their numbers are constantly increasing even in regions that did not traditionally possess a strong R&D base. They are by their nature regionally based and as such have clearly an important role to play in defining any science, technology and innovation (STI) policy at regional level. Nevertheless, it should not be forgotten that RICs display different characteristics than economic clusters, due to their focus on research and technological development. This makes them specific and dependent on a well-developed regional research base that not all regions possess in the necessary critical mass. Compared to RICs, science parks are a more appropriate tool for the enhancement of the regional research base, especially in cases where the research base needs further development. Both of these instruments seem to be well suited to the task of better integrating existing R&D-intensive activities based on public–private partnerships. In ideal cases, they can be advantageous for both academic and business communities and have the potential to improve the design and overall effectiveness of R&D and business development policies.

However, quite often the policy instruments in relation to RICs and science parks meet with suspicion from both sides – academics blame them for diverting money for research to other activities while local businesses often criticize them as being too ‘high-fly’, fashionable concepts that are detached from their problems and needs.

As such, both RICs and science parks raise a number of issues and concerns that often stem from a lack of communication and understanding between research and business communities. In addition, there seems to be still much conceptual ambiguity related to both of these concepts which often have different meanings in different countries and cultural contexts. Moreover, the development of regional STI activities – such as the enhancement of RICs – often requires simultaneous and well co-ordinated measures implemented by European, national and regional actors. Difficulties in co-ordination and division of work between different stakeholders make the development issues more challenging and fuzzy. For instance, on the one hand, it seems that regional authorities and other region-based actors can be effective mediators between the two communities. Thus, it's natural that the regions are willing to implement development measures of their own. But then, on the other hand, the question is also about team work: it is widely agreed that the enhancement of regional knowledge base and the capacity to innovate requires both trans-regional and international measures, such as those implemented by the European Commission, and various kinds of support that is provided by national and regional authorities and public and private intermediaries.

The ambition of this report is to contribute to the understanding of the concept of RICs, to analyse the relationships between RICs and science parks, and to provide suggestions for an optimal implementation of RICs and science parks. At the same time, the report also provide recommendations to regions that aim to get directly involved in the development of strategies based on knowledge and R&D, a challenging task in an environment characterised by a growing need of multi-level governance of STI issues.

A.2.2 Overview of EU policy instruments

The successive Framework Programmes of the European Community for research, technological development and demonstration activities (FP) are the key Community policy instruments for all European level STI activities. They aim at complementing the efforts carried out by the Member States and the European industry. The Sixth Framework Programme (FP6, 2002–2006) operated with a budget of €17.5 billion while the Seventh Framework Programme (FP7, 2007–2013), has a budget of €50.5 billion. FP7 partly builds on the achievements of its predecessor towards the creation of ERA. FP7 includes among others, special elements aimed at supporting R&D activities in regions and developing research-driven regional clusters. These actions also support R&D for the benefit of SMEs, enhance the research potential of European regions ('Regions of Knowledge' component), and stimulate the realisation of the full research potential of convergence and outermost regions ('Research potential' component) (Cordis 2006a, p.21; European Commission 2006b).

In the near future, an increasing part of regional policy funds will be used to promote STI. In 2000–2006, Structural Funds support in the field of RTD was directed at activities such as R&D projects carried out by universities and research institutes, innovation, technology transfer and setting-up of networks and partnerships between enterprises and/or R&D organisations and centres. In addition, the European Regional Development Fund has supported some 180 'Innovative actions programmes'. Over the period 2000–2006, it is estimated that investment in RDI channelled through the Structural Funds amounted to €10.2 billion, i.e. some 5.5% of total funding in the EU25 region. In the context of the re-launched Lisbon strategy, RDI is now placed higher in the policy agenda and considered as one of the priority areas for Europe. Consequently, in the new programming period of Structural Funds (2007–2013), out of the €308 billion that will be available to regional growth agendas, to the creation of more and better jobs and to further support the knowledge-economy related priorities of the Lisbon strategy, some €46.2bn (about 15%) of the funds will be made available to RDI (Research, Development and Innovation), sustainable development and other activities in the regions under the 'Regional competitiveness and employment' objective. In addition, €7.4bn (2.4%) will be available for cross-border, trans-national and

inter-regional co-operation under the 'European territorial cooperation' objective. A part of these funds will be invested in regional RDI. Hence, in order to enhance mainly regional and social cohesion in Europe and in the new EU Member States in particular, the volume of funding that will be channelled through Structural Funds into RDI is very significant (European Commission 2006a; Technopolis 2006).

The objective of the first Competitiveness and Innovation Framework Programme (CIP) (2007–2013) is to fortify European innovation capacity, through support to SMEs, innovation networks, the dissemination of good policy practices and R&D results, and transfer of technology and knowledge. In addition, the objective is to increase SMEs innovative capacity through an easier access to capital through loans, equity, venture capital and guarantees as well as technical assistance and grants. The programme will be built on three segments: promotion of entrepreneurship and innovation; environmental and energy-efficient technologies; a better use of ICT. Almost 60% of the total funds will be made available for the first segment. Through the Programme, it is estimated that some 350,000 SMEs will receive some €3.6 billion in EU support to invest in all forms of innovation and growth. With this funding the Commission expects to give positive incentive and signals for regions to take up their own initiatives and invest more in joint measures (e.g. European Commission 2006d). The volume of this investment is not too much compared to the ambitious plans for the CIP and the number of new initiatives. In addition to the objectives of the programme of its own, the CIP will complement other major actions, particularly those of cohesion, FP7 and lifelong learning.

Funding through FP7, Structural Funds and CIP all actually aim at improving knowledge and innovation for growth and well-being. The objectives of these programmes that are pretty close to each other are, for instance: 1) strengthening cooperation between businesses, R&D institutes and higher education institutions by supporting the creation of regional and trans-regional clusters; 2) supporting RDI activities in SMEs and enabling SMEs to access RDI services in publicly funded R&D institutions; 3) supporting regional cross-border and trans-national initiatives that aim at strengthening R&D collaboration and capacity building in priority areas of EU research policy; 4) strengthening R & D capacity building (incl. R&D infrastructure, human capital) (European Commission 2006a, 2006b, 2006c). The recommendations of this Report are addressing the same objectives and aim at an optimum exploitation of the main intervention tools (Programmes) available at EU level.

Since EU Member States' heads of state and government have decided to give high priority to the issues of R&D and innovation as means to tackle the challenges in relation to globalisation (e.g. at the Hampton Court Summit on October 2005), there could be more room for manoeuvre to make even larger changes in the allocation of the EU budget. As was suggested by Aho high-level expert group (set up by the EC and based on Hampton Court decisions), Structural Funds can be seen as a key means of giving all regions a stake in the knowledge economy. They recommend that the proportion of these funds given to R&D and innovation should be trebled from its current level to 20% (Aho Group 2006). Thus, they have recommended a higher share to be allocated to R&D and innovation than the current official EU plans.

As a good example of earlier efforts that are clearly in the interest of regions and that aim at enhancing (trans)-regional construction and interplay of RDI-intensive clusters is the recently completed PAXIS (Pilot Action of eXcellence on Innovative Start-ups) project, funded through FP6, which brought together 22 of Europe's most innovative regions to exchange best practice in innovation policy and practices. This initiative helped to confirm the importance of networking and innovative clusters and, crucially, proved that excellence can be learned (PAXIS 2006). On December 2006, the Commission launched a follow-up initiative called PRO INNO Europe. It aims to improve the coordination of national and sub-national innovation programmes and promote the cluster approach that has proved so successful across Europe's best performing regions. To reflect the increase in scope of the new initiative compared with PAXIS (budget of €29 million, 1999–2005), the Commission foresees a

budget of between €75–100million for PRO INNO Europe over the next seven years. This volume of funding is significant when compared to the fact that total EU investment on innovation-related activities stands at maximum at few per cents of what is spent on research (Cordis 2006b, p.19).

All in all, the growing role of regions in the favourable development of innovation-driven knowledge-based economy and society raises a number of issues that have an immediate relevance for policy making. It is especially important to improve our understanding of the cases where RICs and science parks interacted well with STI policies and worked in a way that allowed a fruitful cross-fertilisation of both research and business communities. The understanding of underlying causes of success or failure of research-driven clusters and science parks, with a due respect to their specific regional political, economic and cultural contexts, lies at the heart of any successful policy strategy.

B. GENERAL ISSUES RELEVANT TO THE INTEGRATION OF R&D AND INNOVATION INTO REGIONAL DEVELOPMENT

B.1 MULTI-LEVEL GOVERNANCE

The contribution of science, technological development and innovation (STI) on the welfare and competitiveness of nations and regions have attracted growing attention in Europe and OECD already since the latter part of the 1960s. However, during the past 10 years, this interest has reached completely new heights. Today, production of *technological innovations* and *social innovations*[1] has become increasingly based on the efficient use of knowledge, on the extensive utilisation of expertise and new technologies, and on the command of complex production processes. This trend is evident in the national and international reviews and statistics on R&D, technology and innovation, such as the European Innovation Scoreboard 2005 (European Commission 2005a) and the OECD Science, Technology and Industry Scoreboard (OECD 2005a).

It is widely agreed that a highly trained workforce and research and development (R&D) are among the key conditions for innovation and economic success of a country, a region or a cluster. Consequently, the roles of knowledge producers and businesses have taken on entirely new political and economic emphases; there is a growing demand for economic relevance of research, and R&D organisations are expected to contribute more directly and together with the business enterprise and public administration sectors to the regional and national economies and their innovation environments. At the same time, regions have taken a more and more central role as a basic spatial unit of socio-economic development within Europe and around the world. Regions act as facilitators of favourable developments through the implementation of supportive measures. Of course, technological and economic development in the regions depends not only on R&D but on a number of closely interrelated factors, such as the local industry's capacity for regeneration, the level of education and social capital, and the intellectual capacity to generate new business and to adapt to technological, economic and social changes (e.g. Temple 2000; Husso 2001; Sotarauta & Mustikkamäki 2001).

However, regions differ from each other in terms of resources (human, social, technological and financial capital) and other factors of competitiveness, including those of cluster externalities, and local knowledge spill-overs and their multiplicative effects. All these issues should be taken into account when policy mechanisms and actions are being designed and implemented. It is obvious that taking on board all these factors and their interdependences is a very challenging task for political decision-makers, policy-planners and experts in STI. However, due to the increasing importance of STI for the economy, employment and competitiveness, there are good reasons for regional policy interventions at all policy levels

[1] *Technological innovations* can be broken down in two groups: product innovations (incl. goods and services) and process innovations (mainly production processes). *Social innovation* is a form of innovation that can be linked to reforms in various societal structures, which improve the efficiency of the economy and society. Social innovation can change the society's, the community's or the individuals' way of acting, even though it may not be tangible in product and service markets. In addition, significant technological innovations always social processes – the question is about social shaping of technology, the intensification of producer–user relationships, the development of organisational structures, and new operating models and modes of behaviour. Social innovations are reforms and renewals that make these *social processes* more efficient, leading to new technological products or processes or more efficient human activities. Social innovation in itself is seldom the object of business activities alone. (STPC 2006).

(EU, Member States and regions, incl. clusters). Policies should aim at reducing barriers and giving incentives for all qualified players in the field of STI and, in order to control the on-going process of regional concentration and differentiation, encouraging regions to tackle the issues of competition and cohesion. However, the same policy objectives and support instruments are not useful and applicable to all regions. Thus, in order to respond to the challenges faced by regions more accurately, policy measures have to be increasingly tailored to the local needs and potential. The case studies included in Annex 3 of this report provide inside information on the ways clusters have been able to address those local needs. Indeed, most of them (e.g. Cambridge, Leuven) are good examples of bottom-up approaches. The Oulu case shows how local stakeholders can take benefit from national opportunities. This later case can be considered as an illustration of mixed "top-down" and "bottom-up" approaches.

There is an increasing demand for greater STI policy learning within and across all components of the governance structures set up to have an impact on the developments within regional, national and international innovation systems. At the same time, there is a growing need of new and more systemic 'good practises' and modes of governance for STI. This is due to a well-known configuration: innovation is a systemic, horizontal phenomenon caused by and influencing a broad spectrum of factors, while the focus/mandate of the related policy sectors and institutions is comparatively narrow. This situation leads to sector-based departmentalisation and fragmented and inefficient policy actions (e.g. Guy 2006). Thus, horizontally and systemically co-ordinated and more effective STI policies highlight the issue of multi-level governance. The developments described above are portrayed in Figure 1. These issues will be discussed next.

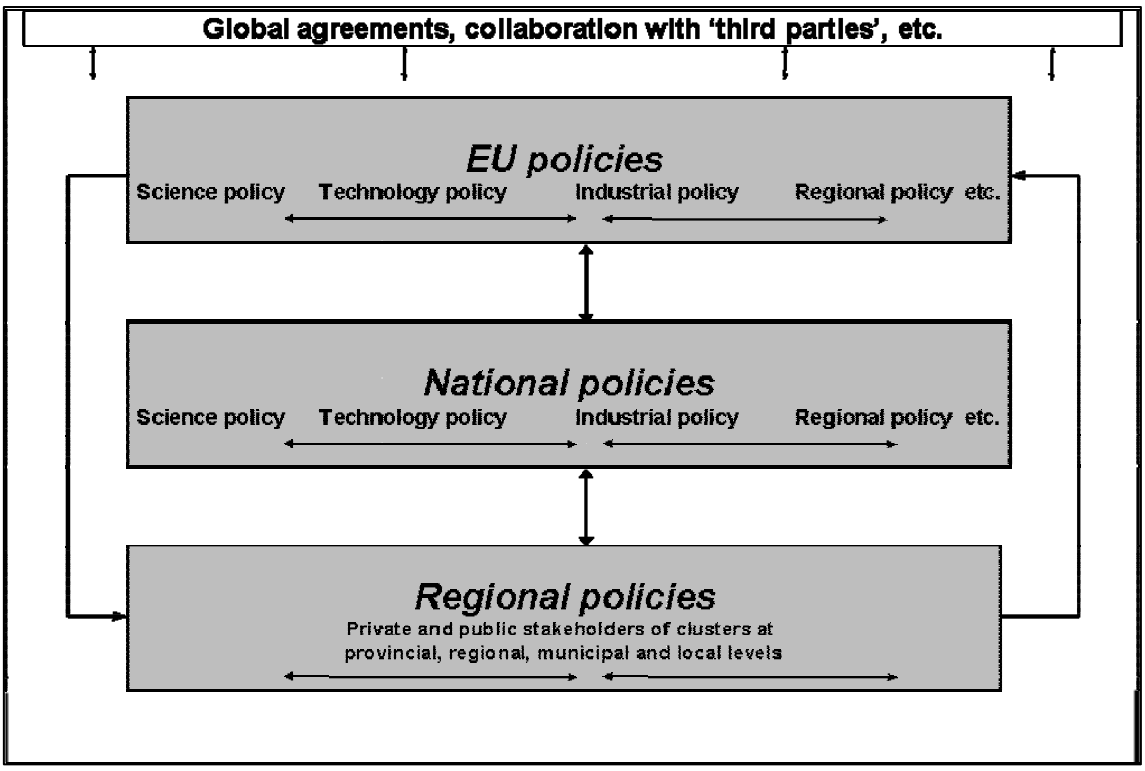


Figure 1. **Policies and measures at different levels**: the growing need of *vertical and horizontal (multi-level) policy governance* and more intense *co-operation and competition*.

B1.1 Policies at EU level

The growing importance of R&D for the economy, employment and well-being was recognised by the Lisbon European Council on March 2000, which sets for the EU a new, very ambitious strategic goal for the decade: to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion. In order to achieve this goal, a great emphasis was put on education, research and innovation, i.e. the triangle of knowledge. This new policy approach also underlined the importance of so-called *triple helix* actions, i.e. close interaction between universities, businesses and public authorities. Moreover, the rapprochement of these different stakeholders and their collaboration can be seen as a prerequisite for building up a well-functioning *RIC value chain* (see Part C, Figure 3). Alongside with the realisation of the Lisbon strategy, STI activities naturally were positioned as central elements of the development of the European Research Area (ERA). Regions play a core role in all these efforts: the regions themselves are best placed to initiate focused efforts, for example in the development of regional STI strategies, and with local level partnerships and clusters of related enterprises and researchers.

In this context, regionalisation of STI policies, i.e., policy approach to address region-specific conditions and prerequisites is a valid way to give a right stimulus to the market and to the key stakeholders responsible for economic development and other relevant activities in the regions. EU policies could raise the awareness of the importance of research, development and innovation activities and could provide incentives and support investments in research, infrastructures and transfer of technology and knowledge. However, although different EU policy sectors have become more region-conscious and regional measures have become increasingly STI-centred, the way policy sectors approach regions is different. For instance,

- DG Research is responsible for the research and technological development policy and focuses on excellence in R&D.
- DG Regional Policy is responsible for the regional and cohesion policies and focuses on balanced regional development and on issues related to economic, social and territorial cohesion.
- DG Enterprise and Industry is responsible for the enterprise, industrial and innovation policies and focuses on European competitiveness and innovativeness and more specifically to the development of knowledge-based small- and medium-sized enterprises (SMEs) and business and entrepreneur activities.

On the other hand, despite the obvious differences in their approaches, targets, instruments and funding criteria, these policy sectors also have common denominators, i.e., overlapping objectives and fields of action as well as a common policy base linked to the Lisbon strategy. Since one of the target areas not only of the EU regional policy but also of several other EU policies (e.g. research, industrial, enterprise and innovation policies) is 'region' (see section A.2), there are good reasons for all the aforementioned policy sectors to seek synergies and more efficient joint measures in order to strengthen their complementarities. The most obvious common view between these policy sectors is the interest in supporting (national and regional) economic and social development with a special emphasis on knowledge, R&D and innovation, including topics such as development of regional research-driven clusters and S&T centres and parks. In this situation, a better division of work and joint co-ordination of actions between the policy sectors and the programmes they develop would be advantageous. However, as is argued by Hölzl (2006), if all EU RTD and innovation policies were squeezed in the FP, this programme would be clearly overloaded.

Currently, the EU and its Member States are making conscious efforts to update and enhance their STI policy measures and also to integrate them more efficiently in other policy sectors, such as the industrial, regional and environmental policies. The EU and Member States have extended their policy instrument toolkit with a view to support development and innovation activities conducted by business companies, and promote co-operation between

companies, universities, and public research institutes. In order to support this line of development, EU Member States submitted in 2005 their national plans and ideas on advancing the EU's Lisbon reform agenda. The reason for this effort, which was related to the Spring Council meeting in March 2005, was the poor implementation of the Lisbon strategy. It should be noted that the implementation of research and innovation policies at EU-level is still comparatively fragmented. Initiatives are too often unconnected; interdependencies between various measures are not adequately recognised and synergy benefits are not reached. A more systematic and strategic approach should be developed to address these issues through common visions and target-settings.

The EU policy sectors have to deal more proactively with the challenge of building up cross-sectored linkages and enhancing the restructuring of current cross-sectored platforms. This is possible since the new major EU funding programmes on promotion of R&D, innovation, business and entrepreneurship all put more emphasis on the creation of knowledge-based growth and jobs. The programmes are far more STI–oriented and region-conscious than ever before. Since the programmes have convergent contents, objectives and instruments, there is room for manoeuvre and opportunities for joint actions and increasing synergies.

At the early stage of the current EU programming period (2007–2013), actions could be carried out to explore potential, horizontal joint initiatives and actions particularly with a view to intensify governance and co-ordination. In the beginning, these activities could take place in the form of joint foresight or benchmark project, for instance. Later on during the programming period, platforms, bodies or high level groups could be established with a genuine mandate to design and launch co-financed actions in the areas with clear links and potential synergies between different policy sectors. For instance, at least a small part of resources of each major EU funding programme could be (re-)allocated and made available to these initiatives. Figure 2 and Annex 2 show the different ways of intervention of the different EU funding programmes and the complementarities or synergies that could be developed among them.

B1.2 Policies and structures at the national and regional levels

Today, there are various on-going changes taking place in the operating environment that have significant and complex impacts on R&D and innovation policies and that highlight the needs to improve policy governance. Interdependency of countries, regions and players grows alongside the progress of globalisation. In these circumstances, competition and co-operation are concurrent phenomena. For regions and all the stakeholders of national innovation system, it is important to be able to enhance co-operation and interaction with both partners and competitors simultaneously. Success in this presupposes continuous renewal of the regional and national innovation environments and education and an ability to adapt to changes in a proactive manner. In addition to high-level competence, one needs social and cultural abilities and skills. In this context, the role of education system is crucial; economies must ensure that those entering work life have adequate capabilities for interacting at all levels, i.e. within and between regions and at international level.

All of the basic factors that facilitate successful R&D and innovation can be affected by efficient and well-directed STI policies carried out by the EU, its Member States and regions. It must be emphasised that most STI policy actions are defined, political decisions made and then implemented at national or regional level. It is anticipated that also in the future, the authority of the Member States in STI development issues is not to be weakened. However, by combining and networking STI resources of the Member States together with an additional stimulus (and co-ordination) from the EU, improved quality, productivity and competitiveness can be achieved across Europe. The undeniable fact is that EU Member States need to commit themselves more intensively into European decisions and joint efforts.

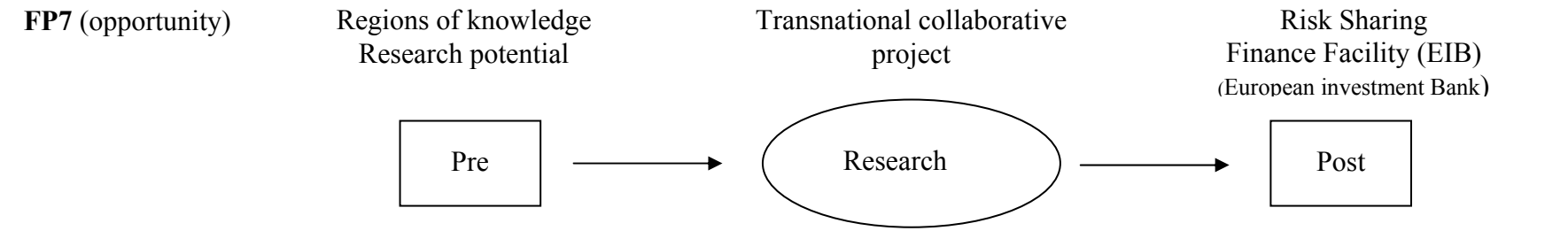


Figure 2: Synergies among FP7 – ERDF & ESF – CIP
(Source : EURADA, Eurada-News Nr 273, 5.2.07)

At the same time, the question is about more carefully planned and implemented measures by the European Commission, particularly with a view to complement the efforts carried out by the Member States. In general terms, national and regional policies should be better integrated at European level and together with the policies executed by the European Commission.

Systemic development of STI policies and national and regional innovation environments require updated knowledge on the effectiveness and functionality of the innovation system, especially on the issues with regard to governance and multilateral interactions between the relevant stakeholders of the innovation system. From the understanding of regional innovation systems, the conclusion arises that political influence can be exerted on regional development processes and on the question of the quality and competence of the regional R&D actors. Essential prerequisites for the successful governance of science and innovation and the consolidation of competences of policy actors are well-developed social capital and extensive exploitation of strategic intelligence in the entire policy cycle[2].

Continuing changes in economic and social structures – for instance, increasing globalisation and internationalisation of economic and social activities on all levels of the spatial system (local, region, national, international) – are taking place in the operating environment of STI. Furthermore, changes in the occupational structure and increasing demands of competence require raising the quality of education, improving the correspondence between education and working life. These changes have an impact on factors that shape innovation dynamics. More specifically, the developments that governments and regions need to take into account when designing and implementing policy actions include, for instance: new division of labour of knowledge production; replacement of the linear model of innovation with a model based on non-linear interaction between the different stages of the innovation process; new forms of public–private partnerships in STI. In this context, the question often is about the governance of the policy processes and multi-lateral RTD and innovation activities.

Currently, according to Smits & Kuhlmann (2002) and Edler *et al.* (2003), the governance of political and administrative systems in general and STI policies in particular in most EU countries is characterised by:

- Departmentalisation of the administration and sectoralisation of policy domains and development measures.
- Lack of inter-departmental exchange of knowledge and good practises and co-operation within the administration and between policy sectors.
- Dominance of the linear innovation model in thinking among policy-makers.
- Horizontal and systemic concepts, tools and operating models of STI policy-making are missing. The same holds true for learning and experimenting platforms.
- Institutional inertia within the government and its ministries.
- STI policies and the various, multi-facetted impacts of policy measures are understood in a too narrow manner.
- Lack of capability to construct a solid infrastructure for strategic intelligence (e.g. maintenance and integrated use of different sources of knowledge, including evaluations, foresight, benchmarking) and stakeholders' limited access to this intelligence.

While the picture of policy-making in Europe portrayed by these authors may be extreme, it highlights the great challenges faced by practitioners who aim to address the problems of

[2] The policy cycle is a manifold web of interactions, co-operation, co-ordination, and decision-making that takes place at different stages and levels of the policy process. The different stages of the policy cycle extend from policy agenda setting to design of strategies, (political) decision-making, implementation of policy measures, evaluation of the action, and policy learning processes. (OECD 2005b)

STI policy in a systemic way. In particular, it stresses the difficulty, and henceforth the need, to overcome existing barriers regarding horizontal or vertical communication and collaboration between different departments and actors. Such exchanges are of particular importance regarding the topic of our main concern, that of RICs and Science Parks. As has been noted, public policy initiatives in this area encompass different policy levels (regional, national or international) and different policy sectors, ranging from research policy to urban development. The success of such initiatives requires effective collaboration between these different levels, including also a variety of actors, which are essential conditions for the exchanges of knowledge and good practices on which the success of regional clusters rely. While the learning processes often result from the emergence of collaboration, different processes can contribute to a more effective interaction with different actors.

In order to consolidate policy-making and policy-learning processes in the STI regime, in many countries, national and regional authorities have executed different kinds of consultative exercises and RDI strategy processes. Furthermore, in order to be better equipped to define relevant policy targets and priorities, the authorities have recognised the importance of having all relevant stakeholders involved in the process of policy formulation. Strategy processes and vision-building are also used as a tool to intensify policy learning across a wide scope of interest groups, and to motivate the players to undertake joint actions and make investments for a more competitive and innovative economy.

In the course of European integration, which is linked to the retreat of the nation state and to the resulting growing significance of the regional and local identity, the political actions of governments have gained importance at the regional level. Therefore, the issue of striking the right balance between functions of individual stakeholders – national, regional, local – in a way that better serves the development of regions has become prominent. In this context and due to the resulting small-scale political activities at the regional level (top-down, but also bottom-up), the necessity for an intensified coordination within the regional governance arises (Fürst 2001). In other words, one could say that the regional governance draws its potential and opportunities mainly from the steering deficit of the state institutions, which is due to their planned or unplanned retreat.

Regional governance is aimed at complex and intermediary regulatory structures in regions (Benz & Fürst 2003, p.12) and can be understood as complementary to state, private sector or communal regulation (Fürst 2004). Resulting from the regional contexts, specific regional governing styles emerge, so that regional governance "... (is) not a standardisable form of self-government, but each region ... (develops) its own idiosyncratic form" (ibid). Thus the political regulatory competences of the regions are unequal and due to the connection to the inherent regional structures, also path-dependent (Fuchs & Wassermann 2005). Accordingly, different regions distinguish themselves by region-specific governance structures, which grew out of the respective economic, political and social environment and in the course of the individual history. Wiehler & Stumm (1995, p.244-245) differentiate the following governance types in Europe:

- regions with wide-ranging powers (e.g. German *Länder*)
- regions with advanced powers (e.g. Spanish autonomous communities)
- regions with limited powers (e.g. Dutch provinces)
- regions without power (e.g. Portuguese planning regions).

In general terms, in order to promote STI activities and increase their overall impact on the economy and society, one of the key policy objectives is the intensification of EU-, national- and regional-level interaction, and the consolidation of the functional entity formed by these levels. National and regional activities need to be better connected to an international operational environment and to EU actions – and vice versa. It also should be ensured that development activities at regional and local levels and the national policy are interactive and complementary to each other. The development of strategy processes supporting this aim

should proceed simultaneously in many different directions, and not in a centralised manner steered by only one responsible representative of the authorities or an interest group.

As a general principle, the regions should build on existing capacities rather than attempting to build their strategies by referring to undeveloped or inexistent technologies, critical mass or fields of industry or research. At the same time, in order to enhance their comparative advantages, regions need to increase their absorptive capacity and intensify networking between co-operative partners, knowledge producers and larger producer and user groups both within regions and between regions. The major objective is to enhance the regional knowledge-base and to find necessary complementary knowledge that conditions region's own development activities.

B1.3 Multi-level governance and the role of regions in STI policy

The theoretical discussion about the integration of R&D into regional development (in the context of regional innovation systems, RICs and science parks) is closely connected to the term *governance* (Cooke 2002a, 2002b; Cooke *et al.* 2004). From a political science viewpoint, governance refers to the balance of power in relationships and thus to collective action in different fields of activity (Fürst 2001, p.371). Governance "is the sum of the many ways individuals and institutions, public and private, manage their common affairs. It is a continuing process through which conflicting or diverse interests may be accommodated and cooperative action may be taken. It includes formal institutions and regimes empowered to enforce compliance, as well as informal arrangements that people and institutions either have agreed to or perceive to be in their interest" (CGG 1995, p.4).

Governance became so important since, on the one hand, the state is increasingly withdrawing from its prior broad involvement (e.g. by privatising state firms) and a new self-conception that is oriented towards the core functions of the state is building up (Fürst 2003). On the other hand, within the framework of European integration, original tasks of the nation states were delegated to the European Commission (Benz & Eberlein 1999), so that a new supra-nation state actor has stepped onto the political stage, whose political actions must be coordinated with the policies of the nation states (Schmitt-Egner 2005). This has important implications for regions and their involvement in STI policy and, more generally, for their effort to increase their competitive position.

The state, or national level, has been increasingly focusing on improving the framework conditions and capabilities of the economy and society, among other issues, by establishing a stable and predictable economic and political climate. This includes the framework conditions that encourage innovation and setting a challenging economic vision for a nation. At the same time, it is still predominantly the task of national public authorities to provide the basic prerequisites of R&D and innovation, i.e., to ensure that funding, legislative framework, infrastructure, education and research systems, etc., are of high quality and have the capacity to respond to economic challenges. In addition, governments can have a significant role in supporting STI as a demanding customer – e.g. by means of public procurements – as a regulator, and as a source of new knowledge (DTI 2002, p.82).

At the regional level there has been an increasing focus on the integration of research and innovation into regional development strategies. This is paralleled both at the analytical level and at the level of policy implementation. Different analytical, theoretical and conceptual frameworks, largely departing from the approaches of 'new industrial space', 'innovative milieus' and 'industrial districts' (see Annex 1 for more on these approaches), have emphasised the increasing importance of the local dynamics of knowledge production and exchange and of the learning capabilities of different regions.

The regional dimension and the understanding what "region" really means is a crucial aspect in the context of RICs and Science Parks. Region is not important because it has become a

popular catchword, but because of the role spatial and cultural proximity plays for the generation of tacit and codified knowledge, for knowledge exchange and for learning processes. This seedbed of spatially close ties and linkages is translated into a concept of spatial hierarchies, in which the region is something smaller than the nation, providing cultural and infrastructural frameworks which foster close personal communication, interaction and the spill-over of knowledge. Nevertheless, a common understanding about the concept of region does not exist. As a matter of fact, regions can be defined differently. They could be understood as an administrative, functional or homogenous spatial entity, usually at the sub-national level (Schätzl 2001, p.99), or as defined by Ohmae (1995), as an authentic community of interest. Regions can have different sizes and thus economic and research potentials. The 'regions' in England differ from small spatial entities called region like the Greek islands or a small province in Italy. For statistical analysis, the NUTS classification ('Nomenclature des Unités Territoriales Statistiques') provides a common ground, but also here the size of regions and their political status differ within the same NUTS classification. For example, the size measured by populations of the smallest level, the NUTS 3 region, can range from 150,000 to 800,000 inhabitants.

For all regional concepts and policy approaches, it is necessary to define the regional dimension which they are related to. RICs might even have no regional, but a local dimension. With regard to policy-making, the administrative character of regions plays a certain role, because this is the space for which regional policy-makers are responsible and for which they possess financial resources. Different policy objectives, financial resources and political powers in different, even neighbouring regions make interregional policy coordination a difficult task. This is especially a problem for clusters, for which administrative criteria cannot always be applied. Cooperative linkages in research and innovation are in most cases not confined to administrative boundaries, but follow the functional, cross-border and cross-sectored criteria of innovation processes and social networks. Labour markets play a more important role than regional borderlines. Clusters can thus be rooted in space in a way that they are part of different administrative regions, both within a national state and across national boundaries.

As already mentioned in the previous section, the involvement of regions in STI policy design and implementation varies a lot from country to country, depending on the degree of autonomy and competence they are given. It is also important to acknowledge that regions have very different research and technology profiles and capabilities. As such, not only their central activities are diverse, but also each region is characterised by a different local entrepreneurial culture and by the intensity of interactions between the different regional actors, which may require different policy responses.

According to Charles *et al.* (2004, p.13), three key roles are attributed to regional governments in respect of STI policy: 1) setting regional priorities for research on the basis of small units of excellence not necessarily recognised on the national scale; 2) negotiating with central actors to shape central policies for the benefits of their regions; 3) building linkages from all elements of the regional science system into innovation, commercialisation and technology transfer.

This short list of key responsibilities of regional authorities should not conceal the fact that there is indeed a very broad spectrum of policy lines that need to be tackled at the same time for regions that want to develop a successful STI policy. In other words, when looking at the issue from the other end, a regional STI strategy should not only focus on the scientific activity in the region, but more widely on the knowledge and learning capabilities across the regional system.

Policies to support knowledge-based regional development must comprise a classic view on the need to invest in infrastructural conditions (including land availability for science parks and other technology transfer mechanisms). They need to provide incentives for the production of new knowledge and for training of human resources, as well as instruments

that focus on the system and emphasise the need for co-ordination, reflecting the local technological structure and their prospective paths, or promoting learning processes ('learning regions').

Scientific literature indicates that the presence of a strong university is central to local economic development based on regional knowledge capabilities (e.g. Etzkowitz *et al.* 2000). Regions that intend to base their development strategy on research and innovation must be prepared for strong financial investments in order to maintain a favourable position of the main local knowledge producers, or to upgrade their capacity in order to produce high quality knowledge. The importance of main producers of knowledge such as universities derives not only from a potential first access to the new knowledge produced by them, but also from the provision of qualified human resources, the expertise needed for setting up new technology-based enterprises, as well as potential to attract financial investors.

It is clear that not all regions can have leading edge research universities, but it is important to note that the regional importance of the location of knowledge producing organisations does not derive solely from the new knowledge that is produced. Performing R&D also improves the capabilities to locally absorb knowledge that has been produced elsewhere, improving the 'absorptive capacity' of the organisation (Cohen & Levinthal 1989), or more broadly of the research system (Sharp & Pereira 2001).

A precondition for delivering a successful regional STI policy is also related to the balance between science and innovation support instruments. These need to take into account the existing local research and technological capabilities. In less technologically intensive regions, local investments in science are clearly of long-term nature, which can contribute to the strengthening of the absorptive capacity of the region. In these regions, more short-term policies must be the focus, with an emphasis on the supporting infrastructure for learning and for access to knowledge. The concept of absorptive capacity – that firms must have a certain knowledge capability internally (usually measured by human capital and R&D) – suggests that it is not possible for these regions to simply import knowledge. In leading knowledge regions, investment in science and in science infrastructure is paramount, contributing not only to the attraction of talent and new investments, but also to nurture the local knowledge networks and to exploit the knowledge produced locally.

For all types of regions the internal capabilities of firms must be strengthened if they should be in a position to absorb external knowledge, whether that knowledge was created locally, nationally or internationally. Hence strategies for the development of knowledge intensive industries and the application of knowledge to traditional sectors, must combine policies to develop firms' internal capabilities (in particular the skills and qualifications of their workforce) with policies to promote university-business links and policies to develop scientific infrastructure.

Regional authorities can have an important role in creating the settings for appropriate informal interactions to happen, for example by contributing to open channels between different institutional actors such as hospitals, firms, patient associations, and traditional laboratories etc., according to the specific local research profile. Florida (2002) goes further in arguing that the importance of successful knowledge-based regional economy extends to a wider set of creative and cultural activities, not only improving the attractiveness of a specific region (or city) to external talent, but also as an indicator of its openness (and tolerance), essential to the nurturing of novel ideas. It is less clear how the regions can create an atmosphere of openness and tolerance, but also this 'soft' aspect of policy making should be reflected in the strategic thinking of forward looking regions.

Last but not least, regional development processes are not steered at the regional level alone and regional actors have to come to terms with the multi-level governance - the complex inter-play of interventions from different hierarchical levels that eventually all have their spatial projection in individual regional settings. In this sense, the openness and the

exchange with the external environment represent essential criteria for a success of regional innovation systems. It is not only important how superior policy levels can contribute to regional development by triggering regional learning processes and by supporting the learning and innovation infrastructure, but also how regions can contribute to the strengthening of their national and even the supra-national (European) innovation system (European Commission 2005a, 2005b).

In other words, the regional dimension does not imply any inward-looking, autarchic approach and it is not at odds with increased internationalisation of innovative activities. While certain firms and industries seem to be increasingly globally networked, as part of the process of internationalisation of R&D, Storper (1995) argues that this often hides the importance of local contexts in their research activities. Hence, at the same time when domestic networks facilitate more efficient and successful R&D activity and strengthen local and regional innovation activities, it is a matter of great importance for regional fabrics to link themselves to international networks. Therefore, all (successful) regions have to find a fruitful balance between regional networking action (i.e. fortifying internal capacities and competitiveness), national network-based co-operation and building of international interactive links.

The main challenge which will be addressed in the remainder of this report is how should the regions best put in practice STI strategies that take into consideration the need to address all the diverse policy areas and levels of governance within one integrated policy framework. The concepts of RICs and science parks will be discussed at length as potentially fruitful approaches for organising public STI interventions at regional level.

B.2 TOWARDS RESEARCH-INTENSIVE CLUSTERS, SCIENCE PARKS AND THE TRIPLE HELIX APPROACH

When looking at the regional-level development that has taken place in Europe and around the world during the past few decades, it seems obvious that spatially uneven development is an unavoidable feature of the process of technological change and capital accumulation (Dicken 1992). Research and innovation-related activities play an important role in these processes. It has been shown that research, innovations inspired by R&D, and their various spin-off effects have a major beneficial effect on the regional economy (e.g. Florida & Smith 1993; Feldman & Florida 1994).

The concepts and models – such as techno-economic paradigms, national and regional systems of innovation, learning region, industrial clusters and triple helix – on the role of R&D, inter-active processes of innovation and education are discussed in detail in Annex 1. These more theoretical views have influenced both the EU and its Member States' approaches and decisions regarding how STI policies need to be developed. In most of the cases, the different approaches refer to the technological and social changes in industrial and service sectors over time and in different geographical scales. Currently, the focus is on knowledge-intensive business activities that specialise in ICT, biotechnology and nanotechnology, for instance, and on innovations particularly based on the introduction and application of R&D results, technologies and expertise of these fields.

From the point of view of regional development in Europe, a novel feature has been that new initiatives bringing together business and RTD institutions (with their own areas of specialisation and fields of strength) are mushrooming in all EU countries. These initiatives typically involve universities, public R&D institutes and industrial and service businesses that rely on new research results and technologies. In general, the changes in economic activities in regions and the co-operative relations within and between regions are partly the outcome of the dynamics of technological change. This all has highlighted the importance of localised learning. According to Malmberg & Maskell (2006, p.1), the concept of *localized learning*

outlines how local conditions and spatial proximity between actors enable the formation of distinctive cognitive repertoires and influence the generation and selection of skills, processes, and products within a field of knowledge or activity.

The concepts and models discussed in Annex 1 refer to a set of inter-related technological and social innovations that paves the way for an increase in productivity for regional and national economies. Among other issues, this development has opened up a new range of investment and profit opportunities to enhance well-being and to create more and better jobs. Such a change implies a new combination of technological and economic competitive edges for regions. However, we need to bear in mind that the total impact of the recent developments also goes far beyond R&D, innovations and the technological change itself. It brings with it a restructuring of the productive system and restructuring of the forms of co-operation between all the actors of the economy. The characteristics of the current era of development also include: a) new well-functioning, flat organisational structures and less hierarchies both in public and private entities; b) new skill requirements of the labour force; c) new patterns in the location and targets of investments, i.e., investments directed at facilitating the introduction of new products and processes and the dissemination and application of new knowledge and expertise widely in the economy and society.

From the point of view of build-up of clusters, it is important to keep in mind that the emergence of successful RICs often tends to be a market-induced and market-led process as it is also the case with science parks, with comparatively little governmental or other administrative interference. Why then should state and regional authorities have a role to play in strengthening or facilitating the emergence of clusters? In addition to reasons discussed above, several rationales for government action can be pointed out. These include (e.g. Held 1996; Boekholt & Thuriaux 1998; Hertog *et al.* 1999; Roelandt & Hertog 1999):

- Creating favourable framework conditions for the efficient and dynamic functioning of free markets and removing market imperfections.
- Stimulating interactions and knowledge exchange within RICs and among the various actors in innovation systems by acting as a facilitator and moderator, by raising awareness of the benefits that can be derived from these activities and by providing platforms for constructive dialogue.
- Removing informational deficiencies by providing strategic information through foresight studies, strategic cluster studies and evaluation and disseminating information with a view to avoiding duplication of R&D and services.
- Removing government regulations hindering the process of clustering, innovation and co-funded joint R&D.
- Sharing financial and other risks.
- Setting up competitive cluster development programmes and projects for collaborative R&D initiating joint industry–academia research centres or platforms based on public–private partnerships.
- Enhancing human resources and flows of knowledge: dissemination of expertise and intense flows of tacit knowledge is an essential feature of all successful RICs and science parks. Governments can introduce measures and incentives to support mobility between industry and academia, for instance.

As is stressed by Roelandt & Hertog (1999, p.11–12), “government should not try to take the direct lead or ownership in cluster initiatives, but basically should work as a *catalyst and broker* that brings actors together and supplies supporting structures and incentives to facilitate the clustering and innovation process”. Furthermore, they argue that clusters should not be created from “scratch” or based on declining markets and industries. Sometimes the notion of clusters is appropriated by policy makers and used as an excuse to continue traditional ways of defensive policy-making.

In general terms, it needs to be stressed that national and regional policies and measures have a pivotal effect also in globalised circumstances. Among the clearest manifestations of

globalisation are large multinational enterprises, which have a leading role in the world market. However, even if they are still connected to their location, their operations are based on local prerequisites, and they have special national and local characteristics. Therefore, domestic policy decisions, strategic choices, and development activities creating a competitive edge are important. A strong, forward-looking approach must be retained in responding to pressures for change. However, the current era of globalisation entails diverse, even contradictory development, which is difficult to control.

All in all, new knowledge and expertise have become a prized commodity and key factors of business and production. This has highlighted the importance of investment in R&D and innovation in business firms and research organisations. Given the key role of R&D and knowledge-intensive technologies and business activities as engines of national and regional economies and as key factors of formation of successful clusters, it is clear that public authorities have wanted to develop their political measures as well. Consequently, in recent years, public authorities have increasingly paid attention to policy objectives and measures that are relevant from the point of view of clusters. These include:

1) Enhancing knowledge base and specialised resources (incl. increasing investments in education, R&D and innovation, and receiving foreign direct investments);
2) Stimulating knowledge flows, mobility and public–private partnerships;
3) Refreshing local competition, co-operation and demand;
4) Revitalising entrepreneurial activity and general business atmosphere; and
5) Supporting creative innovation environments and platforms.

All these policy objectives are important from the point of view of supporting emerging and promising regional, sectored and functional RICs. But then, why clusters are important and why they can be considered as a useful policy approach and tool? There are numerous advantages that relate to clusters. For instance, cluster is a *dynamic system:* success often seems to accumulate around clusters. Cluster is also a useful policy mechanism, a *policy tool* that provides a platform for policy measures aiming at dealing with market failures, systemic failures and governance failures. Cluster approach can facilitate a better focus in, and better impact and efficiency of policy measures. Thus, cluster approach often opens up a new way to *prioritise, focus and organise policies and processes, leading to a better co-ordination of policies and actions.* Clusters provide a platform or a test-bed for advanced public-private partnerships. These partnerships can take various forms in different phases of the RIC value chain and depending on the objective of an activity in question (see Part C, Figure 3).

According to EU Innobarometer (2006), the most widespread cluster benefits are related to human resources and regular market information transfer within the cluster. In addition, almost 2/3 of those EU enterprises belonging to a cluster think that their cluster stimulates entrepreneurial spirit. Most of these companies also consider co-operating with other European clusters rather an opportunity than a threat. Furthermore, over two thirds of cluster company managers agree that public authorities have at least important if not fundamental roles in supporting the cluster. Clusters play a significant role also in attracting new resources in regions; almost 20% of enterprises considered the opportunity to belong in a cluster as a prime reason for choosing their current location.

Despite the obvious advantages of clusters, a large share of economic actors are not involved in cluster activities or/and are unaware of cluster-related benefits. On average, every fourth company works in a cluster-like environment. The EU figures are hiding a difference between the old Member States and the countries that joined the EU in 2004: the share of companies working in a cluster is notably lower in the new Member State zone. Company managers are generally aware of the relatively new concept of company clusters. While the awareness of the cluster concept is 62% on EU-25 level, only 41% of the managers form the new Member State zone claimed to be familiar with it. (Innobarometer 2006, p.11–13). Hence, awareness raising efforts need to be made throughout the EU to

efficiently disseminate information about the benefits of (research-intensive) cluster activities and the importance of intra-regional, trans-regional and cross-border collaboration and networking.

RICs consist of intense links between a wide variety of economic players, e.g. researchers, entrepreneurs and enterprise representatives, government administrations and agencies, investors and enabling organisations. These entities belong to three categories: the private sector, the public sector and intermediaries. Each entity of the three categories has a role to play in the RIC in developing sound management capacities and being committed to the goals and objectives. Due to the basic constellation of a RIC that consists of university–industry–government interactions, RICs can be considered as practical, real-life examples of a triple helix model (see also Annex 1). In an ideal situation:

- The public sector should be able to create the right type of environment allowing RICs to spring up, grow and mute. To achieve such objective, the public sector has to accept and recognize RIC leader(s), has to put the right type of governance into place and has to properly manage the institutional framework. It also has to foster or endorse the cluster vision and drive foresight exercises, contribute to the area attractiveness marketing and branding as well as to show its willingness to invest to meet RIC stakeholders' needs and expectations. It must be in a position to create a critical mass of talent and to stimulate the demand for research and innovation from enterprises. According to the type of RIC, the public sector can either be the initiator of a RIC or the engine helping enterprise initiatives to reach their maturity phase or to succeed in their transformation to face new challenges. The Oulu case study (presented in Annex 3) is a good example of such an involvement of the public sector.

- The private sector has to be the driving force. It has to introduce new innovative products and services into global markets. Potential entrepreneurs need to propose attractive projects to investors and existing enterprises have to be financially sound in order to invest in STI as well as in manufacturing and commercialising results of R&D. Successful RICs have in common a strong presence of serial entrepreneurs and business angels. The importance of the private sector is highlighted in the Oulu and Cambridge case studies but also in relatively less 'high tech' clusters as the ones described in the Sturian Autocluster and in the East Westphalia mechanical engineering cluster (Annex 3).

- Intermediaries, universities, R&D/innovation based organisations have to become enablers. To fulfil their task, they have to provide quality infrastructures and facilities, competences, and added value support services required by existing enterprises and start-ups. The Cambridge case study (Annex 3) is a good example of the important role the intermediaries have to play in the development of successful RICs.

In the knowledge and global economy, there is a wide agreement between experts and practitioners that nations and regions have to strengthen their RTD capabilities in order to maintain their comparative advantages and to help enterprises to remain competitive. To achieve these goals, it appears that nations and regions have to put in place a new type of governance based on interactions between three major stakeholders: public authorities, enterprises and knowledge centres. This type of governance often leads to create favourable framework conditions to develop competencies and innovation activities.

Regions are of course not similar to each other and have to cope with multilevel governance. Some regions can indeed rely upon a strong high technologically specialised eco-system whilst others have a lower technological profile. This explains why each region will have to design, develop and implement specific policies built on their own assets, existing capacities and critical mass.

Regions that have the aforementioned principles in place (spontaneously or thanks to visionary public policies) can be labelled as RICs. The ideal RIC models are indeed

characterised by strong RTD infrastructures, strong financial and social capitals and by their capacity to provide benefits for enterprises. Science parks are often an important element of a RIC. All these issues will be detailed in next chapters and are illustrated in the attached set of case studies showing the different RIC approaches and organization systems.

Talent, technology and capital are success factors that are increasingly supported and created by all EU countries and regions. However, economic and human resources are limited and scarce in many fields and regions. In this situation, competition on the key success factors is getting fiercer. Global competitors (outside the EU) and their own investments in education, R&D and manufacturing are whittling away the competitive advantages of EU regions. Thus, in order to remain at the forefront in the global knowledge economy, EU regions need to be able to collaborate with each other and with their competitors at a global scale. EU regions need to enable the creation or the support of new forms of linkages between the research base (universities, research centres) and business enterprises and start-ups. To this end, regions must invest more in science and education, in top class applied R&D and innovation infrastructures, in technology transfer and IPR protection, and should secure an enhanced access to seed and development finance.

Successful RICs can become one of the solutions regions have at their disposals to face this challenge. Most dynamic RICs rely on infrastructures such as science parks and incubators. In some cases, the science park leads to the creation of the RIC. In other cases, the science park has been built to support the development or the growth of the RIC. This is why the science park concept is analysed in a separate chapter of this report.

C. RESEARCH INTENSIVE CLUSTERS (RICs)

C.1 CHARACTERISTICS OF A RIC

RICs differ from classical clusters by the fact that they have a stronger science/research base and by their ability to generate a greater frequency of innovative enterprises which are able to commercialise and exploit research. In a RIC, higher education institutions and research centres play a key role.

An ideal RIC should have the 10 characteristics listed below (MLP 2006), even if in practice all RICs do not possess all of them. Although more numerous characteristics mean stronger RICs.

- **A strong science base**

  RICs have to rely on quality research infrastructure and laboratories as well as on high level talents and skills. Public and private fundings must be available to ensure optimal use of the infrastructure and to motivate or attract talents and skills. In order to be attractive for enterprises, RICs have to find ways to balance basic and applied research activities.

- **An above average entrepreneurial culture**

  RICs must help regions or countries to create growth and jobs. This can only be achieved if researchers and people have a strong entrepreneurial and innovation culture. That type of culture needs to find a favourable environment, good framework conditions and a strong public sector support for all types of entrepreneurial activities.

- **A capacity to generate fast growing start-ups (gazelles), spin outs/spin offs and to increase the RDTI absorption capacity of SMEs.**

  RICs are able to generate high growth / fast growing enterprises. Some of them can be considered as spin offs / spin outs of universities, some others from existing enterprises. Most of those gazelles such as in Cambridge or in Leuven have been created by serial entrepreneurs. This shows why an entrepreneurial culture is so important for RICs.

- **Attractive to talented people and students**

  New ideas often flourish in dynamic environments which attract and reward talent. Students are more and more interested in learning and developing their skills in the neighbourhood of talent. This form a virtuous cycle: talent develops new ideas which create an attractive environment to students who contribute to generate new ideas.

- **A skilled workforce**

  To help transform research results into new products and services, RICs need skilled workforce at each stage of the process, i.e. laboratory tests, prototype, production, etc.

- **Availability of finance, especially seed and venture capital**

  No successful RIC can be developed without a strong financial value chain. This chain needs to be composed of research funding mechanisms, repayable advanced tools to help the development of new ideas, proof of concept schemes, active business angels, seed capital funds, venture capitalists as well as banks and guarantee providers. Moreover, RICs have to help entrepreneurs improve their business plan proposal and avoid any misunderstanding due to asymmetric information and perception between them and investors. This can be done through business angel networks, investment readiness schemes and venture capital summits.

- **Availability of value added business support services**

  On top of the classical support services to enterprises such as information on how to create a new business, to write a business plan, how to incorporate it or to get production permits, RICs have to provide added value support services such as testing facilities, incubation spaces, mentoring, world economic intelligence, IPR protection advice and, as mentioned above, access to a wide range of funding tools.

- **A good location for research centres of large corporations**

  RICs are often attractive to the research centres of multinational enterprises because they are able to combine the science based environment with a good quality of life and good transport infrastructures. Science parks are often an asset to attract such enterprises.

- **Effective formal and informal networks**

  This is of course the essence of any clusters. As already mentioned, RIC's specificity is to allow a lot of interactions and cross-fertilisation of ideas between the players of the triple helix concept, i.e. the public sector, the private sector and the knowledge centres or intermediary organisations. Those networks often create a strong RIC identity among the stakeholders.

- **Provision of international co-operation framework**

  In today's economy, knowledge and market are global. To help all the stakeholders remain competitive, RICs have to be part of or to build transnational networks.

C.2 THE RIC VALUE CHAIN

A helpful tool for the analysis of the public policy delivery mechanisms in RICs, which allows the identification of the weaknesses or the missing links of the policies in place, is the 'Value Chain'. Such a chain is shown in Diagram Y and consists of three major parts, i.e. the RTD environment, the RIC instruments and the RIC outputs and is complemented by a series of pre-requisites or assets. It has to be noted however that the Value Chain (Figure 3) represents an ideal model and therefore all its components may not exist in all well established RICs.

C.2.1 Value Chain: *pre-requisites or assets*

A RIC is a highly dynamic system that evolves as key players change the underlying characteristics of the location and hence the relative competitiveness of a region will change with time. This dynamism is often the consequence of strong interactions amongst a wide range of actors and of a great sense of creativity of those actors.

The effectiveness of a regions' ability to manage and develop its knowledge is a function of:

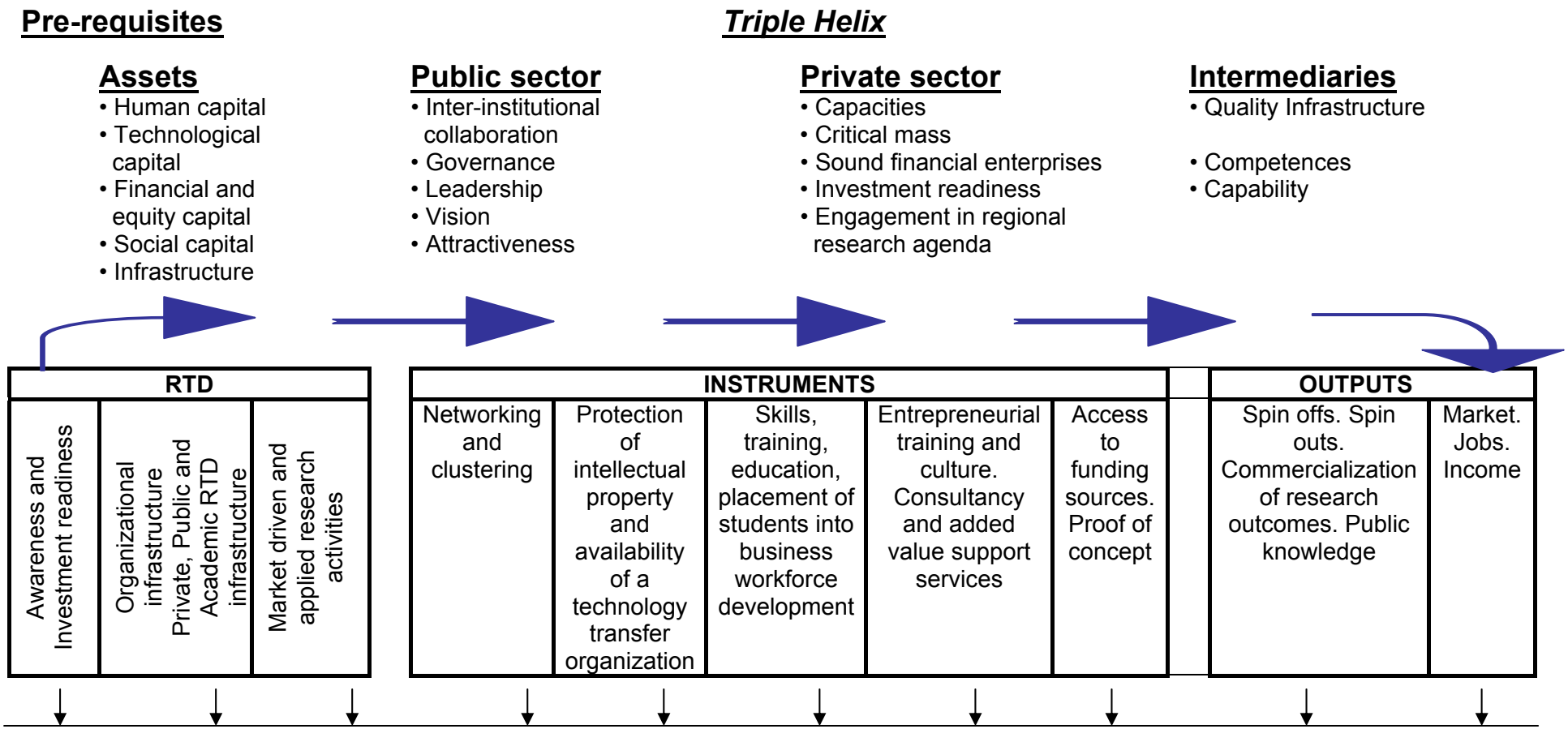
Social Capital: Creating a social environment that promotes and supports innovation and an awareness of an entrepreneurial culture which has experienced management and serial entrepreneurs. Social capital can later on become more formalised and driven by networks as the cluster matures. A pool of highly skilled talent exists possibly connected to a University and people who move freely between businesses in a cluster.

Human Capital: The key driver for entrepreneurship in a region. A region will need to acquire and maintain the ability to attract people with appropriate skills to develop and maintain an entrepreneurial culture through linkage with schools and other educational establishments as well as a strong focus on workforce development and vocational training

Infrastructure: The physical infrastructure - parameters such as transport, infrastructure, industrial attitudes in the region and the public agenda;

Financial Capital: Businesses require different forms of funding along their development lifecycle as well as investment readiness, preparedness and training. The success of a cluster in generating and growing new businesses will continue to attract the interest of VCs and other financiers, particularly where there is a proven pool of managerial talent and expertise and of having delivered results previously. The financiers themselves become well networked into the local cluster to know who the key 'movers and shakers' are who make things happen. Public sector funding complements private sector funding particularly at the proof of concept R and D stage known as seed finance. Government funding can also provide additional capacity for developing the infrastructure of particular themes of economic development.

Technological Capital: This is a measure of the combined industrial and academic knowledge generation capability and the research infrastructure and assets. It also includes the region's visibility in national and international projects. Technological Capital can be driven as much by the technology based companies and consultancies as it is by academics. Investment in Intellectual Capital for regional development can only be measured over decades.



Implementation

- Consensus building
- Strategy design to support research intensive firms and commercialization of research results
- Delivery mechanism of the strategy

Figure 3: Research Intensive Cluster Value Chain
(Source: EURADA Round Table of Practitioners in Economic Development. Adapted by the RIC Expert Group)

Knowledge economy companies are generally considered to conduct their business as networked enterprises rather than vertically integrated enterprises. Consequently, managed concentration based around regional infrastructure and the built environment is key to competitiveness. Cluster/sector-specific foci, hubs and science parks should maximise and consolidate local knowledge and importantly attract external knowledge rather than trying to generate their own from scratch.

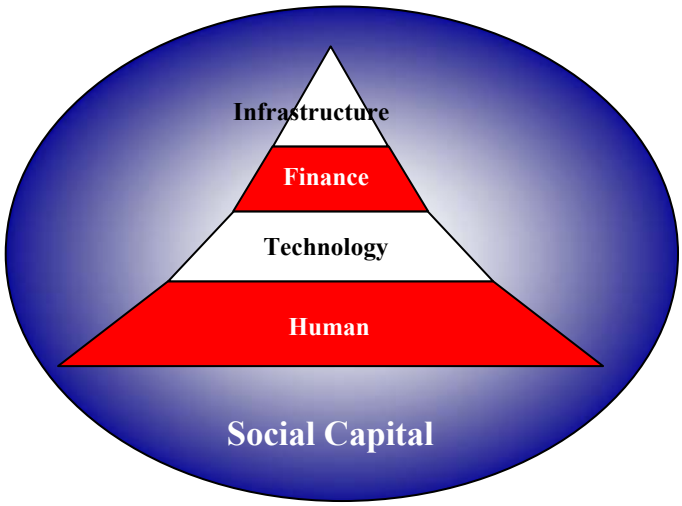


Figure 4. Foundations upon which regions of knowledge should base their approach to developing and sustaining a knowledge-based economy.

The model in Figure 4 is one way of illustrating the foundations upon which regions of knowledge should base their approach to developing and sustaining a knowledge based economy, particularly in respect of Research Intensive Clusters. Social and human capitals underpin the success of any exploitation of science technology and innovation for commercial purposes. Any additional funding thereafter expands the opportunities and capabilities to attract other forms of funding and the range and extent of activities in which the cluster and businesses can participate.

Funding which is directed to regions that don't have a developed social capital need to ensure that they have a strategy for developing such capital. This may mean establishing strategic relationships with RICs across Europe, thereby ensuring they might play a part in the value chain of significant European RICs. Regions which receive funding but don't develop experienced management or have limited technology pools, may not harness finance as effectively as more advanced knowledge regions, unless the gap is closed. There has to be a critical mass of networks and professional service providers for Research Intensive Clusters to succeed in generating wealth and perhaps some EU initiatives should be undertaken to benchmark this. Figure 5 is an attempt to depict a hypothetical region if it were to receive significant amount of structural funding with a lot of Government money going into the local economy. It represents more a public sector led 'top down' approach to develop the economy without having the resources in terms of social and human capital; it highlights how unstable such approach to economic development could be.

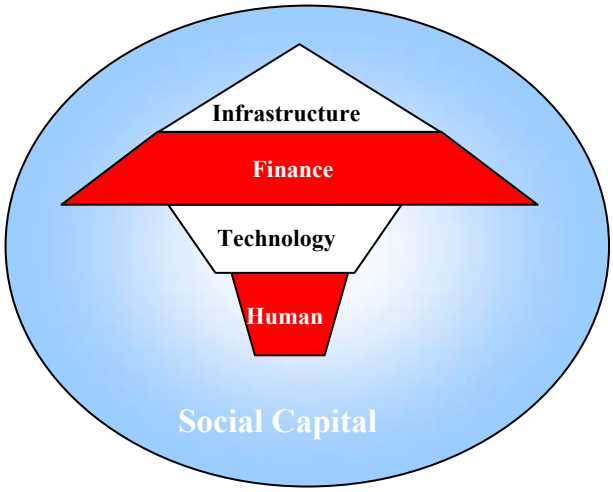


Figure 5. 'Top down' approach to develop the economy without having the resources in terms of social and human capital.

Such an approach is inherently unstable and potentially unsustainable in its own right. It lacks an embedded social capital infrastructure and needs therefore strengthening in this area in terms of experienced people, investment-ready technology opportunities and social networks.

The point is that several approaches need to be taken into account in the allocation of funding from FP7 which relate these different polarities and ensure that any funding/programmes are tightly developed to overcome the weaknesses of the particular RIC. Figures 4 and 5 are intended to highlight the fact that RICs at opposite ends of the spectrum have different needs for support. It is important to stress that providing support for the weaker RICs alone without support for successfully performing RICs might lead to a gradual erosion of the competitive advantage of the currently successfully performing RICs. This is due to the fact that successful RICs currently do not receive much support nationally, as the national governments tend to focus more on closing the gap between their country's regions by helping the more disadvantaged. It is important therefore that FP7 does indeed focus on supporting world class excellence to complement national government initiatives.

A strong recommendation is that the RICs and Science Parks across Europe need to create an interconnecting web that strengthens the EU's social capital and promotes the connectivity of the cross European value chain to overcome regional barriers to growth. The companies we are looking to nurture must address at least a national, more likely a global market place.

C.2.2 Value Chain: *The RTD environment*

The part of the value chain dealing with the RTD environment is often composed of actions in the fields of:

(i) Awareness and investment readiness. Researchers and university senior managers have indeed to be convinced of their ability to contribute to the creation of business and the commercialisation of research leading to the growth of regional RICs. Their contribution can for instance take several or all of the following forms :

- providing specialised training and workforce development opportunities,
- attracting and retaining talent,
- investing in entrepreneurship and innovation culture,
- addressing entrepreneurial RDT needs,
- providing assistance to start-ups (student placements, teachers, researchers) in order to technologically and commercially validate their business ideas and provide solutions to real needs,
- providing support to existing SMEs to enhance their RDTI absorption capacity
- building appropriate infrastructures from pre-incubators to science parks
- managing IPR and technology transfer and knowledge transfer interfaces or centres,
- taking stake in spin out or seed capital funds,
- integrating transnational partnerships.

Intermediary organisations have to fulfil an important task in helping research and university representatives to understand and speak the same language as the one used by businesses and to solve the asymmetric information gap between the long-term fundamental research expectations of researchers and universities and the short to medium term commercial imperatives of enterprises and the application of research. They also play an important role in creating an identity or a brand for the RICs.

(ii) Organisational infrastructure availability. Public, private and higher education institutions need to invest in RDT infrastructures and facilities. Due to the fact that investments in such assets are becoming increasingly expensive, RIC stakeholders have to consider new forms of Public-Private Partnerships and joint ventures.

(iii) Market driven and applied research activities - RICs aim at providing solutions to the RTD needs of enterprises. Those needs might be either outsourced TD/innovation activities, in house RTD/innovation activities supported by external researchers or student or risk shared RTD/innovation.

This issue can be tackled through support schemes aiming either at helping universities and research centres provide assistance to SMEs (direct support or student outplacements) or at helping enterprises procuring services or consultancy advice from research or academic institutions.

C.2.3 Value Chain: *The RIC instruments*

The central component of a RIC value chain includes 5 instruments facilitating the innovation process consisting of:

(i) The networking or clustering process through which the demand and offer for research/ innovation services are matched and through which pre-competitive and collaborative research projects and programmes are defined and implemented.

This process also helps promote regional innovativeness and dissemination of new technologies. It also secures better technology and market intelligence and commercial co-operation or partnering. Those networking activities will help enterprises to access technology and commercialisation intelligence and audit, prototyping and test or technological centres. They will support partnership and supply chain development, and interface opportunities with research centres and high education institutions.

(ii) Protection of IPR and promotion of incentives for scientists to protect their research results. Encouragement of technology transfer and quality management.

(iii) Promotion of skills, education, training and student placements in enterprises but also encouragement of companies engaging in developing their own work force. Those investments are essential in successful RICs as they provide the right type of human capital allowing enterprises and universities or research centres to strengthen their labour force without contributing to their overheads significantly.

(iv) Entrepreneurial training and culture. Those are RIC activities which allow RICs to bring research ideas and results to markets by boosting start-up creation and helping them develop their business and marketing skills and testing whether or not there are routes to market for their products and services and whether or not they are commercially viable. Special attention should be given to the use of external consultants and knowledge experts by SMEs as well and innovation management and leadership capabilities in SMEs.

(v) Access to funding sources (Business angels finance, Pre and seed capital, Venture capital, Repayable grants, Proof of concept funding, University / Research centre spin out / spin off fund, Mezzanine funding). The non availability of equity and other types of funding is often the major reason of a lower rate of high-growth SMEs (gazelle creation) in European RICs compared with the most dynamic RICs in the USA**.**

C.2.4 Value Chain: *The RIC Outputs*

The last part of the value chain deals with RIC outputs, i.e. spin off and spin out formation, commercialisation of research results in the form of new products or services or increased market shares. This part should provide the main performance indicators for the RICs.

RIC regions have or attract above average talented people, innovators, entrepreneurs and creative workforce. RICs also generate jobs, better wages, growth, public knowledge which can be used by all stakeholders and local enterprises. They are able to drive the regional research agenda on the basis of market needs.

Performant RICs provide enterprises with a range of competitive advantages, which impact their profits and growth through cost reduction and/or sales increase. Those advantages are related to research and innovation, access to funding sources and human capital as well as to sectored issues. In the field of research and innovation, a RIC will reduce the costs linked with those activities through cheaper (shared efforts), easier and quicker access to information, knowledge, infrastructure, capacities and capabilities (network and scale effects). RICs also enable enterprises to access human resources and attract talents and highly qualified skills (reputation, branding effects). The most dynamic RICs are able to attract different types of investors (business angels and venture capitalists), serial entrepreneurs and top class service providers. RICs create a good business environment which helps to reduce the risk related to the commercialisation of research results and market introduction of new products and services. They also improve the RDTI absorption capacity of existing SMEs. Being part of a RIC offers enterprises opportunities to avoid some

of the disadvantages they usually face (asymmetry of information, distrust of public procurement authorities, etc.) by bringing them close to the different stakeholders of the RIC value chain. Finally, enterprises can through the RICs improve the representation of their sectored interest (lobbying).

RICs have in fact to facilitate the "Research, Innovation, Market" process and in particular they have to speed up the "research idea to market" process and, vice –versa, the market needs into research projects.

C.3 RICs TYPOLOGIES

Two main RIC typologies can be identified:

a) Spontaneous "bottom up" ones. Those RICs have started from a few regional stakeholders wishing to address a well identified need or opportunity through sharing knowledge and experiences in a loose informal network of committed organisations.

b) Publicly supported ones. Those RICs were born thanks to a "top down" strategy initiated by ministries (industry, research, education, regional development) in order to facilitate or urge stakeholders to work together to improve their competitiveness. Clusters methodology serves as a public policy instrument through which grants are provided to networks of regional stakeholders.

RICs exhibit different degrees of formalised structure depending upon the maturity of the cluster, the degree of trust between actors and the complexity of what the cluster actors want to achieve and whether the cluster aligns and supports their own corporate objectives.

Other ways to classify RICs are according to:

a) Their sectored focus. Some RICs are very sectored focused, others are multi-sectored and/or technology focused.

b) Their aims. Some clusters can be built to strengthen the trade capacities of their members and others to create or exploit new knowledge. This can be achieved through collaboration and a renewed portfolio of activities such as market research, research activities, supply chain linking or integration of technologies in other product or process innovations.

c) Their openness. Clusters vary also according to the degree of openness and formal organisation. Some cluster have formal memberships based on fees or even have a status of clubs with restricted membership, others are much more loose with no defined boundaries and open to new partners and networks.

b) Their geographical coverage. Some clusters have a regional impact zone; others can be transregional or national.

A cluster however must not be seen as a 'regional' phenomenon. Depending on the understanding of a 'region' in national contexts, the spatial size of clusters can be much smaller. It can be a local activity within a municipal area or between a municipality and its suburbs. Usually, cluster borders are not confined to administrative boundaries. This holds true for clusters of all sizes. A local cluster can encompass different locations while a regional one extends over different administrative regions within a country or between more countries. However, transnational clusters do not rank at the first position of cluster organisation patterns, but are a possibility in regions bordering neighbouring countries.

Nevertheless, today, there are attempts to create transnational RICs supported by common transnational governance. Indeed, despite the fact that clusters are rooted spatially, clusters

may comprise different locations connected by research and production networks. The 'meta clusters' develop in scientific areas at the edge of scientific and technological development in which one location does not provide the necessary knowledge input for research and innovation activities. Research and even production is distributed over several locations within a country, a continent or even between continents and the challenge is to identify and integrate parts of it in the most productive way. Core drivers of these clusters are multinational companies which organise their research and production activities around subsidiaries located in different countries and contributing to a local cluster each.

As stated earlier, clusters have so far operated mainly at a regional or local level. Crossborder co-operation has only recently become a part of the operations, usually on a case by case basis. However, in the first meeting of a newly established High-Level Advisory Group on clusters in January 2007 the French senator Pierre Lafitte, the founder of Sophia Antipolis, pointed out that: "To remain competitive Europe must build more world-clusters. This calls for more transnational co-operation between the different cluster initiatives in the member states."
Furthermore, according to the recent Commission's communication on innovation, more and better transnational or crossborder European co-operation are essential in order to attain critical mass and improve strategic orientation. This new approach will give the chance to generate world-class European clusters. In the past we have seen that clusters at a regional or even national level often lack a wider view. Therefore it was essential to develop a new strategic orientation. Interregional or crossborder alliances will integrate regional efforts, will identify and contribute to the removal of barriers preventing closer co-operation between clusters and foster the development of common actions, technology projects and mutual learning among the regions. As an example of such interregional cluster, the case of the 'Eindhoven – Leuven – Aachen Triangle (ELAT)' is reported in Box 1.

To summarize, regional stakeholders have to carefully assess what is the real potential of the region for RICs before investing in them, as very few regions have a real potential to create world class high tech RICs and only a few can claim to become European or national champions. For those other RICs, they might focus their activity on upgrading their existing manufacturing base through greater support for innovation and through technology and knowledge transfer before aspiring to become RICs.

Box 1: The EINDHOVEN - LEUVEN - AACHEN TRIANGLE (ELAT)

In the Lisbon Strategy, the Union sets a new strategic goal for the next decade: to become the most competitive and dynamic knowledge-based economic in the world capable of sustainable economic growth with more and better jobs and greater social cohesion.

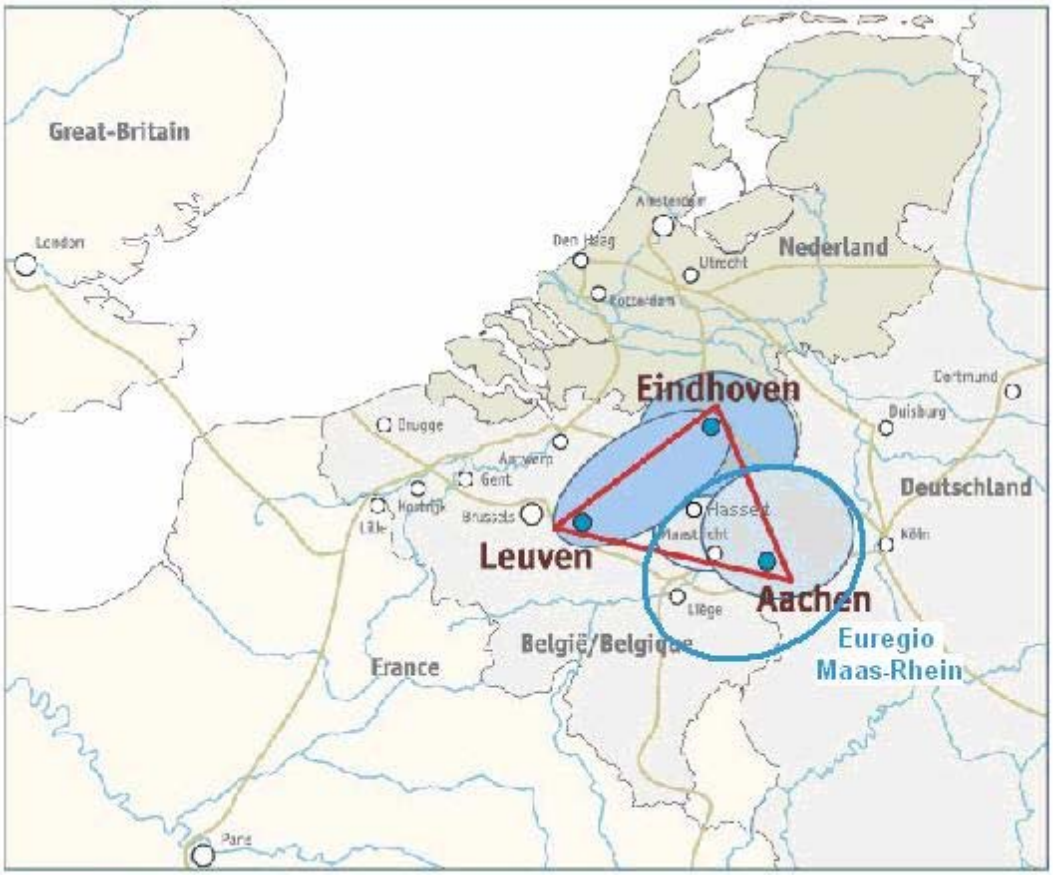
Achieving this goal requires an overall strategy aimed at (among others) preparing the transition to a knowledge-based economy and society by better policies for the information society and R&D. The ELAt project focuses on improving the access to the information society in order to facilitate the transition to a knowledge-based economy and society.

The partners in the ELAt project are three cities (Eindhoven, Leuven and Aachen), two regional public authorities and one university. The partners are all important key players in stimulating innovation and improving the access to information society in their region. All partners do this from a transnational point of view, and have experience in transnational and cross-border cooperation.

The three urban regions have common technology fields, but within these technology fields, Eindhoven, Leuven and Aachen have their own specialities. On these technology fields, cooperation between Eindhoven, Leuven and Aachen will result in synergy and added value. Instead of competition, the regions will cooperate to reach the joint ambition. Transnational cooperation will be fertile when technology, design and marketing are combined. These combinations offer new chances for economic and social profit: sustainable economic growth, employment, comfort, safety and care.

What is new is that transnational European regions join forces to implement a joint innovation strategy with the prosperity of the region and of the surroundings as point of departure. The ELAt project is really an initiative of the local partners in Eindhoven, Leuven and Aachen (bottom up), and fits remarkably well in the national and European policies.

The triangle Eindhoven, Leuven and Aachen (ELAt) is a transnational geographically concentrated area with the potential to become a European top technology region and constitutes an example of the improvement of the knowledge economy in Europe via cross border and interregional cooperation.



Source: e-Horizon, 2004

ELAt links up with new processes related to major changes in the production, exchange and use of knowledge, which can be identified within the triple helix model (business world, knowledge institutes and government). The ELAt project will create a new overlay of trilateral linkages, networks and organisations among the three helices, to institutionalise interfaces and stimulate organisational creativity and regional cohesiveness. The impact of the

activities of the ELAt initiative will not be limited to the three urban regions but it will also be beneficial to the surrounding areas and to the urban network of North-West Europe.

The partnership consists of six partners from three well doing innovative R&D regions. Today, each region scores very well on innovation, R&D, spin offs and start ups. But for the future, the regional and local authorities of Eindhoven, Leuven and Aachen realized that strategic cooperation is necessary to sustain the ambitions since none of these cities posses the critical mass to become an absolute top region in terms of technology, at European or world level. Only by joining forces the sum will be more than the individual parts ("1+1+1=4").

C.4 IMPLEMENTATION OF RIC STRATEGY

Whether they are of top-down or bottom-up type, RICs need to develop their activities by taking the three following principles into account:

a) Objectives, missions and actions have to be defined through consensus building among the key stakeholders. The RIC objectives should be industrially focused.

b) Designing the most appropriate strategy aiming at supporting research intensive firms and commercialising research results. The strategy should be able to eliminate weaknesses and bottlenecks and to strengthen the regional comparative advantage of each of the four capital/assets (human, technological, financial and social) of the area.
   This supposes that such strategies are built around clearly focused quantified objectives and evaluation mechanisms aiming at continuous improvement.

c) Clear delivery mechanism. When public authorities provide grants or any other type of financial support, they should carefully assess the delivery mechanisms to make their programme efficient, easy to understand and to apply.

When implementing a RIC strategy, stakeholders have to find the best way to optimise the cost of doing research, technology transfer or to develop new businesses. They should give particular attention to the reduction to the reduction of the operational costs of the major components of the value chain. They have also to improve regional operating conditions by focusing their efforts on the qualitative and operating factors of the RIC external environment (housing, transport infrastructures, amenities, culture etc). This environment can indeed bring success or may adversely affect the expected results of all investments made to support a RIC.

Additionally, RICs are characterised by a strong leadership based on a few people sharing in common a vision, their willingness to make change happen, their agenda and their enthusiasm. The challenges of leadership are visionary thinking, fundamental skills as well as capacity of staying within the field of the objectives of the stakeholders. In other words, RIC leaders are able to draw benefits from opportunities rather than to solve problems. This strong leadership often leads to a concentration of the RIC's objectives on a few key goals which have been identified through a capacity to analyse the situation (SWOT, internal transparency) and design the right strategy. RICs are driven by a will to build success and visible symbols. Leadership is often associated with a strong project management and delivery capability as well as with a good connectivity between major stakeholders.

In summary, the key challenge for the RIC is how to facilitate, strengthen or build synergies between enterprises, research centres, universities, intermediary organisations and public stakeholders in order to:

- create and/or exploit knowledge with strong market opportunities
- increase enterprise competitiveness and productivity
- help start-ups and existing regional medium-size enterprises to develop into fast growing enterprises (gazelles)
- strengthen the regional attractiveness for talented entrepreneurs and FDI
- foster growth and better paid jobs

RICs are actions and outputs driven geographical eco-innovation systems. Their establishment and strength will depend on the quality of the interactions between stakeholders and the presence of the prerequisites elements.

C.5 PRE-CONDITIONS FOR CLUSTER PROMOTION

Like many successful concepts and strategic approaches, also the cluster concept faces the problem of ubiquitous adaptation. Due to their popularity and easiness to grasp basic mechanisms, clusters are thought to be a concept which could solve all regional development problems. Looking at the policy agendas of many regions, the term cluster is always at front. Whenever first signs of a spatial concentration of economic or scientific activities appear, policy-makers call it cluster. Whenever a region wants to polish its image as technology or knowledge region, a cluster policy is thought to be the most appropriate tool. Clusters are too often only associated to the spatial concentration of firms operating in a given sector.

Spatial concentration of firms does not necessarily lead to the formation of a cluster. A cluster does indeed not only depend on the number of firms located at a certain place. Due to the synergies a cluster should generate, a minimum number of firms is nevertheless necessary. Whether these are 20, 30 or 50 companies depend on the sector and size composition of the firms and their relations with research institutes. Besides the size, the amount and character of value-added chains and of the internal networking intensities are also important. A spatial concentration of firms per se is not a cluster when these firms are not linked in value-added process chains. The existence of these chains is necessary in order to transform a spatial concentration into a cluster. For a first identification of clusters, measures like those summarised in Table A can be helpful.

What can be learned from cluster initiatives is that cluster development and cluster promotion takes time and that this approach is not a panacea for all regional economic development problems. A time span of five years is usually too short for observing the birth and growth of a cluster. According to empirical examples, seven to ten years are needed for the stabilisation of a cluster and its subsequent development path. Before setting up cluster promotion activities, a sound analysis of cluster potentials should be carried out. Although many and diverse examples of cluster policies exist, the prior identification and selection phase of clusters has been relatively little researched. A comparison of different cluster policies shows that the techniques with which the fundamental analyses are conducted vary greatly, not only in methodological strictness but also in complexity. The scope ranges from wide-ranging statistical analyses with complex input-output models up to studies based on qualitative interviews. Independent of the selected method, the results of such an analysis forms the necessary basis for developing specific cluster promotion measures.

Table A: Methods to identify and characterise clusters (Koschatzky & Lo 2007)

Dimension	Characteristic	Method/Indicator	
1. Cluster structure			
Critical mass and internal functional structure	*Critical mass*	Number and share of firms / employees in the sectors of the total number in the sectors (nation)	
		Patent and bibliometric indicators	
		National / world market share of the enterprises in cluster product / service area	
	Existence of crucial links of a value-added chain (core competences)	Sector input-output analysis	
		Expert surveys (e.g. research and educational institutions)	
	Completeness of the value-added chain	Benchmarking (comparison with as complete as possible, "ideal" value-added chain)	
Regional and supra-regional networking	*Quality of regional networking regarding intensity and effectiveness*	Network analysis	Network density
			Network cohesion
			Network centralisation
	Relationship of regional to supra-regional integration, support through complementary clusters, proximity to other agglomerations	Regional input-output analysis	
	Intra-regional information flows, joint utilisation of research results / technologies	Actor survey, patent and bibliometrical analysis	
	Dimensions of the cluster, geographical concentration	Localisation coefficients, variation coefficients	
2. Impacts and results			
International competitiveness	*Growth and growth potential*	Job and turnover growth in relation to regional / national level	
		Productivity, shares of value added	
		Trend analysis of future market development (market and branch trends)	
	Supra-regional competitive situation	Export specialisation, comparative advantages / disadvantages in foreign trade (RCA)	
		Market shares, international direct investments	
	Excellence in research	Regional patent analysis	
		Bibliometric analysis	
		Third party funding in universities	
		Share of international researchers male /female	
		Private and publicly funded R&D expenditures	
	Human capital	Ranking of universities and other educational institutions, faculties, numbers of students	
		Forecast of demographic development	

Every individual method reported in Table A has specific advantages and disadvantages. For this reason it is meaningful to combine different methods. A final assessment of the "critical mass" can only be carried out in each individual case against the background of the

specific sectoral and technological framework conditions and must include also qualitative analytical methods alongside quantitative ones in order to avoid a too "mechanistic" procedure. Which of these methods and indicators should be applied in the investigation of the development potential of a cluster depends on the respective question, the already existing knowledge base, the cluster structure as well as weighing the costs and benefits of such an analysis against each other. The decision in favour of an effective cluster promotion and the development of a cluster development strategy can only be meaningfully taken on the basis of a prior study. Even with such kind of analysis, cluster promotion and development is not an automatic process, but heavily depends on the specific actor configurations in the region.

It is also necessary to point out that according to some recent empirical studies (Buenstof & Klepper 2005), evidence exists that cluster dynamics do not stem from agglomeration economies per se, but specifically rely on spin-off activities. New firms spinning out of existing firms (and out of research institutes) are a major driving force for continuous competition and thus economic efficiency in a cluster. When developing successfully, these firms are an important engine of a cluster, not only by their own economic activity, but as success models by attracting new firms from outside the cluster. Besides the need to locate in close spatial proximity to crucial and strategic tacit knowledge, it is this aspect of agglomeration economies that contributes most to cluster development.

Although one could argue that it is unimportant which kind of agglomeration effects are the most relevant, it is indeed very important for policy makers (and cluster managers) to learn more about the real mechanisms of cluster development. A general notion of agglomeration economies could be too vague for being able to tailor specific measures for cluster support. Knowing more about the processes of firm birth and death in a cluster could open new opportunities for specific approaches and starting points for policy measures.

From the analysis of Table A, it becomes evident that barriers can be identified in relation to RIC development in the field of human capital, financial capital, intellectual property, innovation, business environment and infrastructure.

C.6 IMPORTANCE OF COLLABORATION WITHIN RICS

It is felt that organisational collaboration within the clusters is an important aspect of improving knowledge transfer and innovation. That business development is stronger when firms cluster together giving a critical mass of growth, collaboration, competition and opportunities of investment and knowledge. The report “Our Competitive Future – Building the Knowledge Driven Economy” (DTI, 1998) stated that “*many companies fail to recognise the benefits of collaboration. They are either unaware of firms with complementary skills, or are unwilling to collaborate with their competitors. A key role in facilitating the growth of a cluster is to encourage firms to take advantage of collaboration, and to demonstrate that by working together their performance will improve*”.

The key risks which need to be addressed and considered if a collaboration is to be successful include:

- ✓ Appropriate choice of partners to collaborate with to avoid people issues further down the line – collaborations tend to start with people or businesses who have worked with each other before in another capacity
- ✓ A clear and defined reason for collaboration needs to be identified and understood by all parties and what each brings to the party

- ✓ Most collaboration occurs with a specific goal in mind, namely a project or joint venture. However, it is best to dispel any assumptions at the outset as to how the collaboration will be managed
- ✓ A structured approach to collaboration needs to be adopted, where early on the aims and objectives of the group are identified and work allocation is split between all parties in an interactive and transparent manner.

Often the literature glosses over the 'how' of collaboration and, as Von Stamm (2004) identified, there are often very simple pitfalls to collaboration failures yet they occur time and time again within industry. It was felt that these failures were because there was not a clear structure or processes that organisations follow, which often led to a quick breakdown of relations.

Knowledge transfer and innovation
The main benefit cited is that of technological knowledge transfer / spillovers that occurs when firms have face-to-face interactions that collaboration enhances. This in turn can lead to the development of new ideas. Frequent interactions facilitate formal and informal knowledge transfer and encourage the formation of collaboration between institutions with complementary assets and skills. The type of knowledge that creates competitive advantage often requires proximity or regular face-to-face interactions and trust in order to be effectively communicated. Such collaboration increases an organisation's capacity for innovation by diffusing technological knowledge and innovations more rapidly. Empirical research has shown that there is a positive link between such spillovers and the proximity of innovative activity.

Economies of scope
A key reason for organisations to collaborate is to gain the benefits of economies of scope. Economies of scope occur when it is less costly to combine two or more products in one production system than to produce them separately. For example, drawing upon companies with complementary skills to bid for large pieces of work which each of the individual firms would have been unable to compete for alone.

Economies of scale
Collaboration can also allow firms to take advantage of economies of scale, by further specialising production within each firm, by the joint purchasing of common raw materials to attract bulk discounts, or by joint marketing. Companies can benefit from sharing knowledge about best practice and reduce costs by jointly sourcing services and suppliers.

What types of collaboration
There are many types of collaboration possible within industry, this is across organisational barriers (inter) or intra-organisational, all of which are important and have a common element - people.

- Strategic alliances

  Collaboration between two or more companies designed to achieve some corporate objective. This may include international licensing agreements, management contracts or joint ventures.

- Joint ventures
  When two or more businesses co-operate to run a project together - often a separate joint venture company will be established in which the various partners own a share. A joint venture is limited to one project while a partnership forms the basis for co-operation on many projects.

- Project based bids

When two or more organisations jointly work on a project tender, collaborating to supply a bid for a main contractor / client organisation. This is often run with a lead contracting partner who is in charge of the bid and who joins the bidding team.

- Supply chain partnering
  This is defined as collaboration between same industry organisations that collaborate to deliver a contract of work. This would be a one off collaboration for a particular piece of work and might involve competitors collaborating to deliver a product together, as they could not do it alone.

- Product development teams
  A common industrial collaboration, which is intra-organisational, and vital to an organisation's innovative success, is that of new product development teams. A facilitative process that enhances the working practices of this collaboration is of great benefit.

- University collaborations
  A common collaboration is that between university and industry, which often involves several project partners, e.g. European project teams. Frequently, if it is an international collaboration, the complexities of the venture increases when cultural and language issues are added to the mix.

- Non-competitive collaborations
  Collaborations can begin for a variety of reasons. Often these can be non-competitive, for example a special interest group of industry experts. Without the urgency of a competitive outcome these collaborations can dwindle yet are very important especially as knowledge sharing is a benefit of such collaborations.

- Regional

  Firms who are co-located have the added advantage of being able to meet face-to-face and an industry specific network or cluster group is a common example of a regional collaboration initiative.

- General project teams
  All people based group invariably have to collaborate, so some of the processes developed can also be applied to smaller groups and teams that are together over a period time or a period of a project.

C.7 DEVELOPMENT STAGES OF RICS

In reality, a typical lifecycle for the development of a RIC does not exist but there are some common observations which can be made. The analysis of different clusters highlights different approaches and trajectories for growth and collaboration. This refers to similar stage models like the product life cycle hypothesis (Vernon 1979) or the economic stages model of national economies (Rostow 1960). Based on different approaches in the cluster literature (Press 2006, Maggioni 2004), a six stages model can be developed for describing crucial steps in the development of RICs.

1. Pre-cluster and cluster emergence phase
According to the cluster literature, clusters do not emerge spontaneously, but rely on certain starting factors. This can be an economically driven process, e.g. in a way that economic and social assets (e.g. knowledge generated by scientific research) become important location factors for industry and research, or a policy driven process by which certain regional strengths are supported by network building and a parallel improvement in the infrastructure endowment. In this phase, pronounced agglomeration advantages and proximity effects do not yet exist.

2. Cluster set-up phase
In this phase, cluster structures develop in a form of first signs of a value added chain, and knowledge spill-over effects emerge which make it advantageous for outside firms to locate within the RIC. A specialist labour market is developing. With regard to RICs it becomes clear that not only cost rationales are the predominant motive for locating or expanding within the cluster, but the critical access to (knowledge) resources and the necessary interaction with public and private research units. Relevant knowledge is still tacit and sticky to the RIC. Due to positive external effects, generated by knowledge spillovers, agglomeration advantages gain more and more importance.

3. Subsequent cluster growth phase
In cases where agglomeration advantages dominate, subsequent cluster growth is triggered by many factors. Major internal factors are start-up and spin-out activities resulting from the economic success of the pioneering firms in the cluster. Other growth factors are related to cumulative causation effects like an increasing division of labour, the expansion of public support and of public infrastructure, the consolidation of industry and the development of a local milieu and identity. Major parts of new knowledge generated by the cluster actors is tacit and makes it attractive for external firms to locate closely to the knowledge producers and by this attracts (knowledge) resources from outside the RIC. External factors are a growing demand for products and services supplied by the cluster and the development of new markets or new market segments.

4. Cluster endurance
During the cluster endurance phase, agglomeration externalities exert a stabilising influence on the firms in the cluster by cost and knowledge advantages and a still increasing competitiveness. More and more parts of critical knowledge become codified and can be used without the necessity to be part of the cluster. As a matter of fact, some firms exceed their optimal degree of maturity and first signs of negative externalities (agglomeration disadvantages) limit the growth of those parts of the cluster which face competition by costs and not by knowledge advantages.

5. Cluster decline
Depending on the trade-off between positive and negative externalities, the roles of interactions and resources change in their importance for firms during this phase. The cluster and its firms are challenged by ongoing technological change, the emergence of new competitors and changes in external demand. Agglomeration advantages are slowly diminishing and former knowledge assets of the cluster become ubiquitous. Firms outside the cluster can produce products at lower costs and the knowledge advantages of research institutes which formerly fuelled the cluster growth diminish. Due to the former success of the cluster, first signs of a lock-in situation emerge and the milieu in the clusters becomes less dynamic. Market changes lead to stagnation and the start-up and spin-off activity decreases significantly with the result that the exit rate of firms exceeds the new entry rate. Negative cumulative causation processes prevail.

6. Cluster adaptation, mutation or exhaustion
In this last phase, several trajectories are possible depending on the responsiveness and openness of cluster actors for change. What can be observed are ongoing agglomeration diseconomies, e.g. by increased congestion costs, the emergence of internal inflexibilities and increased opportunistic behaviour, a diminishing value added chain and a further loss in knowledge advantages. Based on the openness of the economic system, the value of local (knowledge) assets, the realisation of cost advantages, e.g. due to changes in factor proportions of production, new technological opportunities in former competence fields, the chance for realising another first mover advantage is possible. This has to be supported by positive demand conditions for new products and competition advantages in price and quality. Whether the cluster exhausts or mutates to a new cluster (which can be a RIC) depends on the adaptive abilities of the cluster agents as response to internal and external challenges.
In all phases, industrial, science, technology and innovation policy can exert positive influences on cluster birth and evolution and on the interaction within the cluster.

Figure 6 developed after a diagram of the Glasgow Development Agency illustrates the cluster development process, which in many cases can last 20 to 25 years. It also shows the need to differentiate the stakeholders approach according to the cluster life cycle as well as the type of strategy to put in place.

If stakeholders are interested in short-term results, they can either strengthen a specific stage of development of an existing RIC or assist a RIC to become more international. A review of the RIC value chain in order to remove barriers due to missing links or bottlenecks can also contribute to the achievement of quicker results.

After having strengthened the links among the local stakeholders, a RIC according to its stage of development has to enhance its links with key stakeholders of other regions since they can become strategic external sources of know-how and expertise. As mentioned in C.1. ‘Characteristics of a RIC’, among the 10 main characteristics of successful RICs, two refer to "effective formal and informal networks" and "provision of international cooperation framework".

Some examples
The Silicon Valley cluster system born in the mid 1940s only started to produce a large number of innovative enterprises in the 1960s. The performance of the Silicon Valley eco-system is regularly reviewed by independent groups of stakeholders such as the "Silicon Valley Leadership Group" which assesses the future competitiveness of the Valley and the challenges to be faced to keep its position of global innovation area. In its 2006 report entitled "2007 Silicon Valley Projections: Tough Challenges – Hopeful Signs", the Silicon

Valley Leadership Group explains that its reports "provides a useful way to view the needs of companies at different levels of maturity and at macro level, offers insights into the overarching trends for industries clustered in the Valley". From a public policy perspective, it provides a unique insight to prioritise and gain perspective on how different levels of government can best respond.

In other regions such as Emilia Romagna where cluster-similar structures have been in existence since the 1970s, a major reform of that policy has been undertaken in 2004 in order to adapt the policy to the new assumption that clusters can further develop or sustain their competitiveness only if they are able to strengthen their knowledge and innovation base by improving the co-operation between universities or research centres with enterprises.

Those two examples show how the management of the cluster life cycle is important to sustain them or to support the development of new RICs inside a region. This shows that at each development stage measures have to be taken in order to maintain the cluster's dynamism and so to avoid its decline.

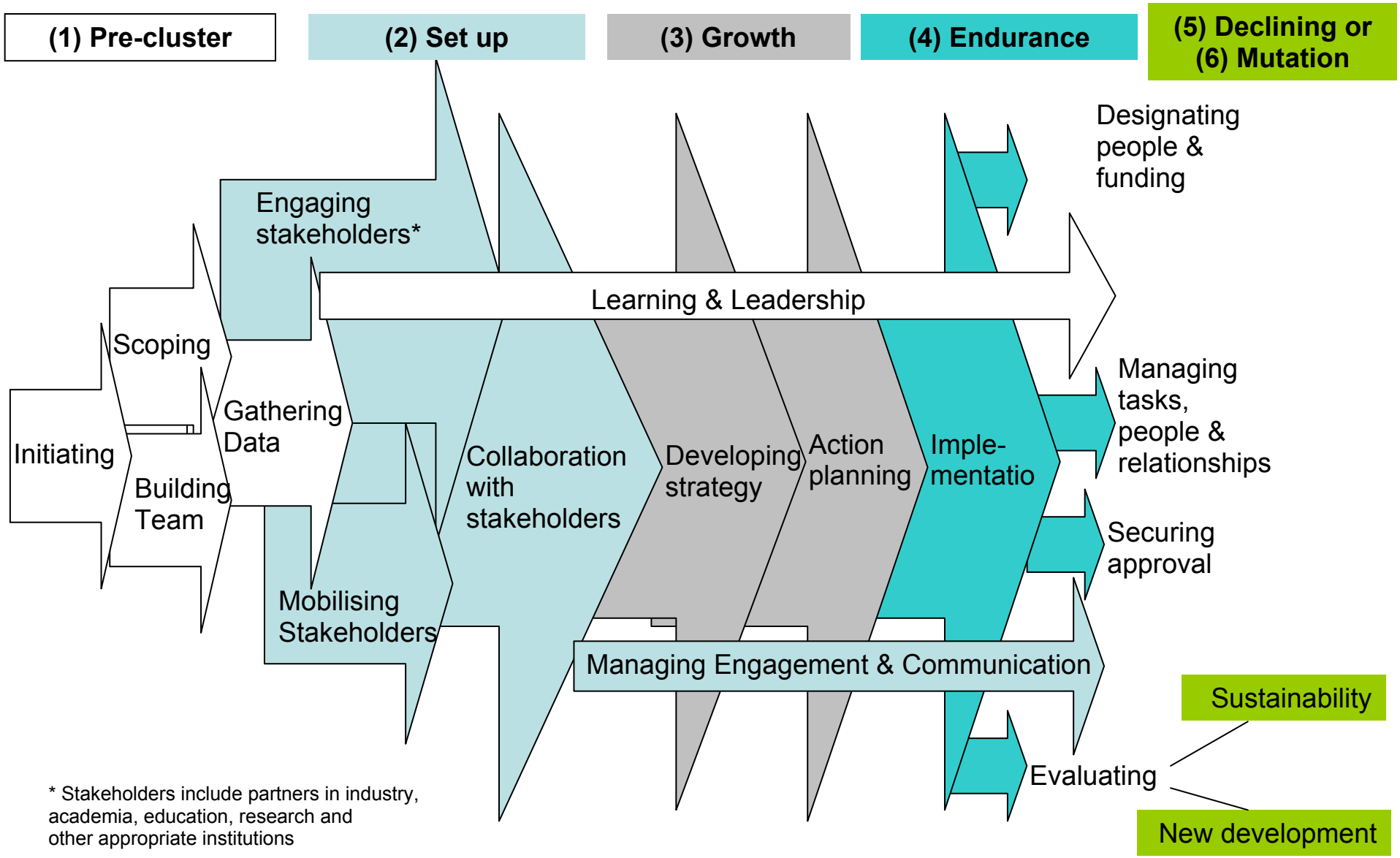


Figure 6: The Cluster Development Process (Source: Glasgow Development Agency & EURADA)

C.8 In Search of Excellent RICs

In recent years, many EU Member States and regions have developed policy instruments to support clusters in their search of regional excellence. However, tools *per se* don't bring successes.

As seen in previous points, there are a lot of regional intangibles (e.g. governance, social capital, leadership, people, etc.) that make the difference between a success and a failure.

In order to develop successful RICs, it is important to analyse and benchmark their performance and to look to the following issues relevant to their functioning:

1. *Which were and are the drivers behind the start of the RIC?*

   Before becoming a policy instrument, most clusters were spontaneous privately driven loose "bottom up" initiatives. Today, public stakeholders are trying to catalyse or drive clusters' agenda into more formal "top down" initiatives. Are "top down" approaches only leading to artificial clusters through a "run for the money attitude" of clusters initiators?

2. *How RICs were initially organised and how did they develop since their start to present days?*

   After a few years, loose informal organisational forms naturally tend to evolve into more formalised structures. It is useful to look which are the new players, how they were integrated as well as what type of functions remain in the hands of the founders and how the private sector acts in the new context, how the networking activities became stronger and enhance the collaboration between RIC stakeholders.

3. *Which are the objectives of the RIC?*

   Successful strategies often focus on a few clear shared objectives. This should not be different for the RIC. How the RICs' objectives are formally defined? How is knowledge shared? What delivery mechanisms are put in place? How are objectives reviewed and adjusted to a changing environment?

4. *What types of activities are undertaken by RIC members?*

   Efficient RICs are offering competitive advantages to their members. Which types of need analysis are undertaken? How do members benefit from being part of the RIC, what are the key services and joint activities launched? How do those services and activities match enterprise needs and expectations? Can those services be considered as added value ones? What types of outcomes are offered to the cluster members?
   However, several limitations exist that can reduce or even negate the advantages an enterprise could have through its participation to a cluster. Enterprises might be more interested in applicable results of research activities than in research activities themselves. Large RICs have to find a balance between expansion and focus on RTD activities. How can RIC managers keep the right product mix between these contradictory objectives?

5. *How are RICs funded?*

   Money is a critical factor for any activity. It is important to look how RICs' activities are supported and funded. What proportion of funding is generated from membership fees, public funding, etc.? Do RICs have to bid for funding or can they access grants? Does public funding impact the way RICs are spending money? What types of activities are funded under RICs' budgets (pre-competitive research, market intelligence, added value support services, etc.)?

6. How are RICs sustainable?

To remain attractive for their members, RICs have to regularly reinvent their activities and business model. In order to achieve this, which changes have to occur over the time, how does the change occur, how are members involved in such process, how to define the new key issues to be tackled ? How do RICs move to sustainability and what does self-sustainability mean? How can EU funding be helpful in this process?

7. Which are the barriers to RICs' continued growth and existence?

Cluster theory shows that clusters born, grow and die. How is clusters' sustainability addressed by its members and by public stakeholders? In the "top down" approach, what does happen when public authorities stop offering financial support? How RICs move to the state of self-sustainability and what we mean by that? What is the role of complementary funding and of Programmes of EU?

8. What are the best types of programme support helping RICs to be sustainable?

Globalisations, increased knowledge assets in all industrial sectors and rising of new competitors have a stronger and stronger impact on the regional economy including high-tech sectors. Which types of support, private and public, are better tailored to overcome new phenomena and any cluster vulnerability?

9. Transferability

It is not enough for a RIC to consolidate its own practices. In view of continuously improving its performance, it is important to be open and to learn from new practices developed elsewhere. How to learn from other existing RICs and transfer successful practices? How to adopt new ideas into the local context? What are the bottlenecks for such a move?

10. Entrepreneurship dynamism

Dynamic RICs are able to generate new firms and serial entrepreneurs or to increase the RDTI absorption capacity of existing regional SMEs. This can only happen if potential entrepreneurs are able to access equity. Which role are business angels, seed capital and venture capital investors playing in RICs? Are there spin out/off funds available? Who are the leading successful serial entrepreneurs? How does their "role model" impact the formation of new start-ups?

Concrete examples on how those issues have been addressed in selected regions across Europe can be found in the case studies presented in Annex 3.

C.9 RECOMMENDATIONS ARISING FROM THE ANALYSIS OF CASE STUDIES AND THEIR CONTEXT

RICs are complex eco-systems based on three elements:

- ✓ "A receipt": a new way to stimulate efficient forms of partnership between research, university and enterprises at regional level taking into account the contribution of the public sector and of the intermediary organisations. Such partnerships should provide support services to enterprises and entrepreneurs.
- ✓ "Ingredients" : a series of tools and implementing mechanisms aiming at boosting or strengthening the development of new innovative firms or products, services or processes accepted by global markets.
- ✓ "A cook" : a recognised leader or team of leaders being able to create the right "alchemy" between all the regional potential stakeholders and to design and deliver or sustain the right dynamic strategy and business environment. Therefore, it should be stressed that regions or countries having all the above listed individual ingredients in place will not automatically be able to transform their aspiration to create or develop a RIC into a success story since several key elements of the alchemy depend on human relations, cultural beliefs and attitudes, which are not directly transferable from one case to another.

Moreover, lots of attempts to create RICs fail because they lack of human, technological, financial and social capital or of critical mass of talent and funding mechanisms. RIC performance might also be affected by incoherence in public long-term support or vision which jeopardizes the trust of other stakeholders. In some cases, RIC policies can be seen as a "fashion public policy brand" rather than a true "investment willingness" initiative. In such cases, the implementation processes and tools developed by the public sector can be qualified as driven by a supply side approach instead of being based on a response to a demand or end users needs assessment.

D. SCIENCE PARKS

D.1 LINK/COMPLEMENTARITIES WITH RICS – SCIENCE PARKS AS ONE OF THE TOOLS FOR EXPLOITING RESEARCH RESULTS

While the concept of the Research Intensive Cluster is relatively recent and brings together, as discussed earlier, the notion of the cluster with new dynamic forces (i.e. high research intensity), some of the central conditions for the RIC emergence are related to other more long standing policy concepts as the agglomeration economies, industrial districts, or, more recent Triple Helix approach. As put forward by the aforementioned concept, RICs are strongly related to the intertwining of universities, business sector and government around research and innovation activities.

Universities often play a very strong role in the emergence of RICs, through indirect or more direct ways. Besides being a central source of new knowledge, universities provide a central resource for the well-functioning of a RIC, i.e. advanced human resources, central to the dynamics of RICs, and strong influence in the capacity of the RIC to attract new talent. Additionally, universities often contribute to a wider intellectual environment that favours the establishment of RICs.

But if these are essentially indirect modes of impact of universities on the emergence and dynamics of RICs, higher education institutes often have more direct interventions in this process. Besides the wider activities of technology transfer, the success of which is often at the centre of the capacity of RICs to establish themselves, the creation of science parks - directly by universities or through formal agreements with these by their promoters (in the business or governmental sector, typically at the regional level) - has a strong contribution to the visibility and attraction of research intensive firms and of new knowledge, to a given region.

As discussed earlier, RICs are most often based on a partnership and collaboration between businesses and public research organisations. Science parks provide particular conditions for the development of this partnership. Although they should not be considered as a precondition for the emergence of RICs, science parks are expected to favour their development. In most cases, a primary actor for the development of RICs are the universities' technology transfer offices (TTOs), which have the explicit aim of transferring knowledge to the private sector either through patenting, licensing or business partnering. Other instruments for the development of RICs include the university-industry cooperative research centres or incubators (typically also an important part of the infrastructure of science parks, but which can also exist independently). However, while some of these initiatives focus on the formal exchanges of knowledge, and as such have a limited number of target firms, the concept of the science park focuses instead on the development of informal links which are fostered by the physical proximity of producers and users of knowledge.

This has been, indeed, one of the main objects of debate on science parks: what impact has on the growth of new technology-based companies (NTBFs) their location in or outside a science park? The conclusions, however, have differed among different studies, with some finding little evidence of direct contribution to innovation from the location within the park (e.g. Felsenstein, 1994; Bakouros *et al*., 2002; Siegel *at al*., 2003) and others concluding the opposite (e.g. Ferguson and Olofsson, 2004; Lindelöf and Löfsten, 2004). Other studies have concluded that science parks do have a positive impact regarding the wider informal contacts that are fostered through the close proximity between NTBFs and universities or other research institutes.

It must be noted that the economic impact of basic research is more significant when the indirect impacts are also taken into consideration, while in practice, the direct impacts are often overemphasised. As Salter and Martin (2001) have reviewed, the direct impacts of research in the form of useable knowledge in the innovation process or resulting start-ups are only a part of the wider economic impacts of research. Other mostly indirect impacts include the training of skilled graduates, the support of scientific networks, the capacity to solve complex problems, skills for the use of new instrumentation and techniques, and the provision of social knowledge. It is precisely among these that the science parks are envisioned to have a larger impact. It is expected that the closer proximity between academics and private sector researchers, sometimes with on-campus facilities, contributes to the establishment of informal networks through which tacit knowledge is usually exchanged. Additionally, such proximity may facilitate access to students, as well as to specific equipment, instrumentation or new methodologies. The extent to which such benefits are fully exploited depends also on local conditions. Evidence suggests that in less developed innovation systems (e.g. Vedovello, 1999; Bakouros *et al*., 2002), the impact of science parks on effective interaction tends to be very limited. In these cases, the visibility effects of location tends to supersede the network effects meaning that the companies gain a greater benefit from the image given by the association with the park than from the actual learning and interaction with other partners located in the proximity.

In this way, science parks strengthen the local institutional infrastructure, to provide greater social capital and institutional 'thickness', therefore contributing for the main conditions of development for a RIC, i.e. the existence of strong institutional capabilities. Science parks, with their incubators and wider infrastructure, provide particularly favourable conditions for the establishment of NTBFs. Many firms also look for the image of quality and innovation that is associated with science parks. While this means that science parks are identified as 'centres of knowledge and innovation' it also reveals that they are often also understood as a property development, where firms look primarily for an external identification rather than for the effective close proximity with universities. The debates around the predominant nature of benefits of science park location are frequent, but usually inconclusive. This is largely due to the diversity of development models of science parks which makes it difficult to provide one, widely applicable characterisation of these infrastructures.

It must be noted that the impact of science parks in fostering the emergence of RICs should not be given too strong emphasis. As has been said, the impact of location within a science park is not always clear. A wider impact of the science parks, beyond the on-park firms, is therefore even less expected. However, at the local level, science parks do have an impact in the capability to attract the location of NTBFs and in guaranteeing the existence of quality infrastructure which is typically associated with these developments. On the other hand, with science parks becoming increasingly an image of high-tech regions, with many universities developing their own, RICs typically do not emerge in regions without science parks.

D.2 ROLE OF SCIENCE PARKS IN DEVELOPING/SUSTAINING THE RICS

While science parks, in their different models, often appear interlinked with the development of RICs, and RICs typically include a science park (or a similar infrastructure), their centrality in fostering the emergence of RICs should not be given too strong emphasis. If a science park may facilitate the development of a successful RIC, it is certainly not a necessary, nor a sufficient condition. Yet, science parks can have an important role mostly at four different levels:

- Science parks may provide the visibility and hence attraction to wider local strategies aiming at the creation of conditions for high-tech industries to prosper - cities and regions increasingly compete in seeking to become identified as the next 'region of knowledge', 'science region', 'creative region', and to attract value-added jobs, and are hence looking for distinctive features. It is clear that these features depend mostly on the 'right mix' of research excellence, entrepreneurial activity and public support strategies, but some elements such as science parks can contribute to their greater visibility. As such science parks can stimulate wider local strategies of support to high-tech industries and contribute to creating the conditions for the development of a RIC. Science parks can also influence the land use in the region, which is essential to the development of RICs, and often bear the name by which RICs are known.

- Science parks provide the advanced infrastructure on which research intensive enterprises rely, besides the location factor, being often in close proximity to a university. Science Parks are providing the necessary infrastructures for research, such as advanced ICTs, and are expected to create also proper conditions for informal exchanges between firms, creating a specific social milieu.

- Science Parks can provide complementary services and support to local firms. Spin-offs and SMEs can often find in science parks wider support services that allow them to better focus on their core business and on research for the development of innovations. At the same time they contribute to greater interactions between different actors. These can range from administrative matters (especially if the park includes an incubator), to management support, to technology brokering or to support on managing IPR. This is essential for a meaningful contribution to RICs which should go beyond simple property development business. The role of a science park is also in facilitating access to other firms located nearby and to their clients, in contributing to the strengthening of diverse institutions within the local innovation system, and in stressing the innovation process and the knowledge exchange.

- Science parks are usually associated with strong networking effects and high levels of social capital – as mentioned above. The impact of science parks is greater at the informal level and by contributing to the development of heterogeneous networks, including diverse actors (knowledge producers, users, disseminators), diverse disciplinary backgrounds or even industrial sectors. The social capital that may thus develop in science parks can facilitate the exchange of tacit knowledge, the formation of 'communities of practice', or the greater access to advanced human resources. Although these networks can emerge outside of the specific relationship with local universities or research institutes, the success of these relationships are of great importance to local knowledge networks that may emerge.

Although science parks can indeed have a strong impact on the development and sustainability of RICs, a number of conditions need to be in place for it to be successful and relevant for the development of a RIC. As previously mentioned in relation to RICs, science parks are not to emerge everywhere as a guaranteed recipe for success. Science parks must take into account the existing local research capabilities, as well as opportunities, the local industrial structure and the wider public strategies for the region.

D.3 CHARACTERISTICS OF SCIENCE PARKS

Innovation and innovativeness play the key role in national and regional economic growth and national and regional competitiveness. The knowledge based economy is developing more and more. In this type of economy the basic economic resources are not material, human resources or capital, but knowledge. This economy is global and interlinked. In this process, universities and research and development institutions as resources of knowledge fulfil a basic role. Knowledge creation through research and development (R&D) is the principle initiator in forming this new economy. That is why there is a strong need to combine knowledge theory and business practice, a strong need to strengthen the cooperation between two different environments: academic and business. Science parks are a widely accepted tool which is promoting this cooperation. The role of science parks in fostering local development has been object of a number of studies and analysis, including their role in forming research intensive clusters.

D.3.1 Definitions

There are a number of types of science parks in Europe and over the world. There is also not only one definition for the science park. One of the reasons is that in different countries different forms of science parks have been developed. Each country has a different history of science parks and has its own terms. For instance, “Science Park” is used in the United Kingdom, “Technopole” or “Technopolis” is used in France, “Technology Centre” and/or “Technology Park” is used in Germany, “Research Park” as a term is mainly used in the U.S.A. etc.

The lowest common denominator seems to be that such parks gather producers of high-technology products and services, and provide the opportunity for a degree of institutional co-operation between university and industry. The most commonly used definition for a Science Park in Europe is that of the UKSPA, the United Kingdom Science Parks Association with today approx. 60 members, also used by the International Association of Science Parks (IASP):

‘A Science Park is a business support and technology transfer initiative that:

a) encourages and supports the start up and incubation of innovation led, high growth, knowledge based businesses;

b) provides an environment where larger and international businesses can develop specific and close interactions with a particular centre of knowledge creation for their mutual benefit;

c) has formal and operational links with centres of knowledge creation such as universities, higher education institutes and research organisations’ (UKSPA).

According to this definition a Science Park necessarily has knowledge-based businesses and therefore each Science Park fulfilling this definition can be seen as industrially-based.

Besides the problem of defining a Science Park, there is the problem of the existence of other terms like Research parks, Innovation centres and Business centres. Sometimes it is said that those all refer to the same.

A SCIENCE/TECHNOLOGY/RESEARCH PARK is a business park where the primary activity of the majority of establishments is research and/or new product or process development-distinct from manufacturing, sales, headquarters, or other similar business functions.

A RESEARCH PARK differs from a Science Park in the sense that they prohibit all manufacture, except for the production of prototypes. Thus it can be seen as a special form of a Science Park, with a contractual and/or formal ownership or operational relationship with one or more universities or other institutions of higher education, and science research.
The Research Park helps to promote research and development by the university in partnership with industry, by assisting in the growth of new ventures, promoting economic development and supporting the transfer of technology and business skills between the university and industry tenants.

AN INNOVATION AND TECHNOLOGY CENTRE means in Germany a technology and start-up centre as well as a science and technology park.
The goals and tasks, which are realized by innovation centres, are decisive. The focus of the today approx. 165 centres is on the creation of favourable basic conditions for the concept, starting and first development phase of enterprises, in particular innovative and technology-oriented enterprises.

This happens predominantly in three main fields:

1. Consulting and support for founders and young enterprises, assistance to the enterprise's development, integration into the contact and communications network of the centre etc.
2. A differentiated offer of infrastructure for the enterprises within the most diverse ranges.
3. The development of innovation in the region, co-operation between researchers and industry, provision of information and technical and management training; and strengthening regional economic development through regional and international networks for information exchange and co-operation between firms. An innovation centre does not necessarily have operational links with a higher educational institution. So an innovation and/or a technology centre are not necessarily a Science Park.

Source: ADT - Bundesverband Deutscher Innovations-, Technologie- und Gründerzentren e.V.

A EUROPEAN COMMUNITY BUSINESS AND INNOVATION CENTRE (EC BIC) is a support organisation for innovative small and medium-sized businesses (SMEs) and entrepreneurs. The BICs are recognised by the European commission through a quality certification theme, which enables them to obtain the European "EC BIC" label. Operating in the public interest, they are set up by the principal economic operators in an area or region in order to offer a range of integrated guidance and support services for projects carried out by innovative SMEs, thereby contributing to regional and local development. The BICs are grouped together within the European BIC Network (EBN) with today approx. 160 BICs in 21 countries.

What is a BIC?

- Support organisation, public or private, for innovative small and medium sized businesses (SMEs) and entrepreneurs;
- Incubator/Business resource centre dedicated to Innovation, officially recognised by the European Commission through a certification scheme;
- Contributing to regional and local economic development through the creation of new innovative SMEs and innovative projects in existing SMEs;
- Offering a range of integrated strategic guidance for innovative projects;
- Grouped together within and benefiting from common services and tools provided by EBN (The Association representing the European BIC Network);

Source: EBN - The European BIC Network

Talking about science parks we must mention also another institution that plays an important role in regional development and which is very often partner or part of a science park, namely a business incubator. Its contribution to the regional development through the strengthening of the innovation process is significant. It offers the strategic guidance for innovation projects, complex services to innovative companies and sufficient infrastructure for new start-up companies. The business incubators are often nuclei of new science parks.

Incubators are an essential tool for economic development in which an increasing number of communities are starting to invest. In the EU there are currently around 900 business incubators operating that are making a significant contribution to job and wealth creation. Some 40,000 jobs are generated each year by incubators alone.

Incubators generate start-ups and serve as a driving force for new innovative companies through helping them to succeed on the market. The most effective incubators developed within Europe have formed part of broader political strategy to include university research activities, research institutes, and private industry within specific region. To this extent, the most successful incubation models are founded upon regional strengths and private-public-partnership.

Therefore the incubator tries to provide such professional and specialized services and defines his target market and admission criteria accordingly. Through specialization, therefore, we could expect higher levels of quality in the management and support services of the incubator that would assist firms throughout their development process, and until they establish secure market position.

A BUSINESS PARK is broadly defined as “a development which provides high quality accommodation in which a wider variety of activities such as manufacture, showrooms, distribution, etc. can take place’. Like an innovation centre the Business Park does not necessarily have operational links with a higher educational institution and therefore cannot be regarded as a Science Park.

Larger than a Science Park, a Technology Park or technopolis is a zone of economic activity composed of universities, research centres, industrial and tertiary units, which realise their activities based on research and technological development. Technology Parks are limited in geographic area but maintain network links to large firms and the public research infrastructure at both national and international levels. (PWC Consulting and Tsagaris Consult, 2002)

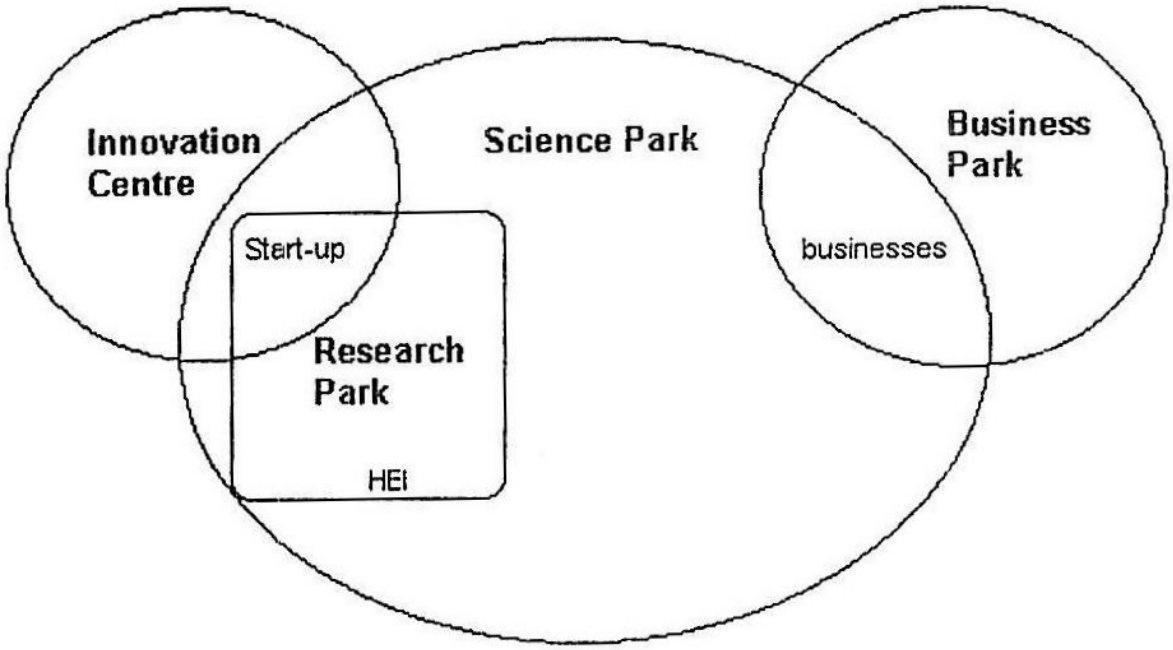


Figure 7: Relative positions and overlaps among Science Park, Innovation Centre, Business Park and Research Park (Source: Tsagaris Consult)

In several countries national associations of Science Parks exist and although most of them are members of the International Association of Science Parks (IASP) they do not use the same definition for a Science Park.

D.3.2 Typology of Science Parks

The differences in Science Parks mainly arise because of different actors that initiate the Science Parks. Those actors develop Science Parks for different purpose:

- *Government:* mostly set up science parks to increase the amount of applied research and in order to raise the level of technology transfer in a country.

- *Regions:* For a region the purpose mostly is to stimulate the regional economy by offering high-tech companies an attractive location. This attractiveness could be built by advancing to offer links to R&D institutions and excellent added value services available not only to companies but also to its citizens, tourists and other visitors. Attractiveness of the science parks is stimulating the attractiveness of region as a whole in the future.

- *Universities*: The reason for the universities to create or participate in the science park is commercialising their research results and therefore to make not only a profit but to create feet-back, too. Moreover they want also to establish good environment for their graduates and to attract more students by offering them the possibility to participate in solving interesting and actual projects, good employment foresight in the future, including possibility to create own company.

- *High-tech Companies:* are looking for the links which upgrade R&D with international linkage, good information system, qualified labour force, good location and excellent services with the aim to increase their future profit.

- *Investors/developers* are looking for the profit offering the premises and services.

As already mentioned, the traditional example of science parks are scientific campuses owned and managed by a single entity. These parks are very often affiliated with academic institutions, local or regional government and private sectors. On the other hand there are also science parks which are located in special prepared campuses rather far from the universities or these science parks are located within a growing urban community. According to Annerstedt (2006) and Haselmayer (2004) there are three generations of science parks[3]:

I. *First Generation Science parks: 'Science Push'*
A First Generation Science parks is an extension of a university into a dedicated neighbouring area that includes incubating facilities for start-up firms, related business services and, as importantly, pathways into new, research-based technology (and know-how) for potential investors and other business entities. Ideally, the park should operate as a science-based technology zone.
The typical mode of governance of a First Generation Science park is that of university-control through a foundation or limited company, created by the university or a related association. In Germany the legal position of the universities and/or R+D institutions did not allow till 2003 to be directly owner of a science park. Therefore a PPP model was established since 1983 including an indirect participation of the universities. The aim is to enforce wider economic goals and objectives for the university and energise the business community around it.
The innovation philosophy of a First Generation Science park is 'science push'. The many new ideas stemming from research and experimental development (R&D) should be channelled without difficulty to new firms established within or aggregated around or in the neighbourhood of the science park. It is a 'linear approach' to innovation, which sees scientific results as raw material for innovative activities among the business firms in the science park.

II. *Second Generation Science parks: 'Market Pull'*
The Second Generation Science parks are somewhat more recent institutions of science-economy interaction. In most cases, a Second Generation Science park or technopole remains an extension of a university (or other major R&D facility) into a dedicated high-tech zone. However, the park could also be a totally separate entity, even located relatively far away from a university. The drive and the decisive energy come from businesses, interested in the creation and growth of innovation-based companies.
Managers of Second Generation Science parks respond to such business needs by making available a mix of high-quality facilities in the Park, by streamlining the flow of technology and related knowledge, and by advancing and combining value-adding business services – from early incubation of newborn firms to a variety of spin-off and spin-on processes of technological significance to already established firms.
The typical mode of governance of a Second Generation Science park is that of a privately-owned company which manages the Park. Academic or other research representatives must be involved with local or regional policymakers in shaping rules and regulations for the park tenants and in setting the overall principles for the Park's operations.

The innovation philosophy of a Second Generation Science Park is 'demand pull'.

[3] For a definition of the "Three Generations of Science Parks" visit http://www.interlance-invent.com.

It is market-driven to a higher degree than the First Generation Science Park. A Second Generation Science Park is less concerned with the early exploitation of scientific results and capabilities than with the final stages of the innovation process. Research results and techno-scientific findings are regarded as 'raw materials' for the Park's innovating firms.

III. Third Generation Science parks: "Interactive" local flows

As already mentioned, among the current evolution of science (and technology) Park generations, a more comprehensive park set-up is being implemented. Called Third Generation Science park and located within a vibrant urban community, it is perceived as the quintessence of science-industry-government relations, increasingly functional and specialized along with its participation in local, regional and even global innovation activities. At the same time, this science park generation could become a contradiction in terms, as its management is striving to eradicate the fixed spatial boundaries of the park for it to become truly embedded the urban fabric as a catalyst for innovation.

Like its two predecessors, a well-functioning Third Generation Science park is an organization managed by professionals, experts on innovation support. The objective is to increase the wealth of the whole community that the Park serves by promoting science-industry-government relations in a number of ways. But it does not stop with that.

In addition, by its more central urban location, a fully-fledged Third Generation Science park is conditioned to offer more broadly-based and more comprehensive varieties of innovation-related services. If managed well, the Park is more able to create communicative linkages among a broader spectrum of entrepreneurial activities than the two other science park generations.

In such contexts, the Third Generation Science park could serve as a managing model to foster innovations throughout the economy. It becomes an urban catalyst for innovation that could influence also the broader culture of entrepreneurship in the city-region.

The typical mode of governance of a Third Generation Science Park is that of long-term public-private partnerships, where strategic decisions regarding the Park's operations are agreed through joint decisions, while the day-to-day operations could be carried out by a highly-specialized limited company. Various stakeholder groups, including neighbourhood representatives, could be involved in preparations for major investments.

The innovation philosophy of a Third Generation Science Park is cluster-oriented 'interactive innovation'. It is both 'science push' and 'market-pull'. It departs from an underlying 'linear model' of innovation, while making more effective use of the network overlay of communications in university-industry-government relations. In a Third Generation Science Park innovations tend to appear as outcomes of these functional interactions.

Annerstedt (2006) pointed out, that after two generations of primarily suburban Science & Technology Park developments, we now observe a tendency of such Innovation Environments to 'go urban', aiming for better competitiveness, more sustainable urban development, and higher attractiveness as catalysts in the knowledge society. In the light of ever more homogenous approaches, it has been realised that the best source of differentiation is the city itself.

First Generation Science Parks promote the Science Push from Universities into spin-off companies moving into surrounding dedicated industrial areas. Second Generation Science Parks were driven by industry's Science Pull, with major firms locating around leading research environments to extract scientific discoveries.

The emerging Third Generation Science Parks operate interactive models of innovation, embedded in diverse urban environments. In such areas, networks and systems of trust, the development of respective public, private or scientific partners, cultures of interpretation, degrees of public or institutional participation as well as the availability of financial/legal instruments all form an integral part of the innovation environment's global function. Location embeddedness is no longer just a feature, but a key success factor. (Haselmeyer 2004)

The traditional science park of the 1950s and 1960s was deliberately separated from the context of a city centre. Many of the parks were literally put into suburban areas or even further away from the economic centre of the city. They were designated to remain separate, even detached, from the urban fabric. In retrospect, the suburban high-tech zones seem effective for some types of innovation activity.

A major challenge is the on-going trend of urbanization of today's science park mode. Across Europe as well as on other continents, the trend is to integrate into the urban spatial setting some of the main functions of the science park and other managed innovation environments.

Graham & Marvin (2003) describe for example, a city's inherent openness and accessibility, its energy and drive, paired with a broader participation among stakeholders, may require inventive thinking by urban planners, industry policy makers, and private investors. Metropolitan cities in Europe try to exploit public-private partnerships and other modes of governance to the benefit of the new innovation environments and infrastructures which are integrated into the central parts of the cities.

Fostering effective innovation environments has emerged as a principal policy issue in connection with city development and under pressure from competing city-regions due to economic globalization. These processes might involve science park related developments such as accessibility of public services to high-tech businesses, management of clustering of competencies, real-estate asset values and the quality of the environment, urban morphology, and place branding and marketing.

This will probably call for new policies or new combinations of existing policies as well as new inter-disciplinary approaches among specialists. Park managers need to recognize the increasing involvement of new stakeholder groupings such as user pioneering groups.

Here, lessons from the "*Living Labs*" across Europe could be helpful tools for science park managers. By engaging user groups or at least by looking on innovations from the perspectives of user groups, the strengths and weaknesses of the science park could be identified and addressed. All three generations of science parks could benefit from a Living Lab perspective, but the easiest transfer of new approaches to innovation through user perspectives could be achieved by the management of a Third Generation Science Park.

In this context, a Living Lab is a city-area or other location, which is managed as a real-time laboratory and proving ground for prototyping and interactive testing of new technology applications. As a city-based innovation resource the Living lab projects are organized to be interactive innovation environments, directly involving users as well as producers of technology and applications.

Locally, the Living Lab is a user centric platform to enable innovation-focused collaboration of companies, public agencies and institutions, R&D centres and universities. In order to shape the new "Information Society" technologies, citizens, students, visitors and other user groups side with the innovation strategies of companies.

Each Living Lab is a consortium of stakeholders from the public and private sectors and from research, where innovative resources could be combined and synergies achieved. If functioning well, the Living Lab experiences should be exchanged across a European

network, creating highly visible showcases of innovation and identifying opportunities of learning and strategic collaboration.

Living Labs Europe is a pan-European organisation, currently coordinated by Interlace-Invent, a European research-based consultancy firm. Living Labs Europe is managed as a consortium of innovative city-based projects across the European continent, pioneering communications technology. Each Living Lab agrees to be a node in a European network and share information and experiences and, if possible, develop cross-border projects with other Living Labs.

The European Commission is endorsing Living Labs across Europe, as an important programme to support regional collaboration, to improve the European Research Area and to increase user-centric research and experimentation of information and communications technology as well as public awareness.

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High-tech companies in science parks in Europe are increasingly searching for opportunities to prototype innovative products and solutions in collaboration with their end-users within their normal setting. Science park managers have realized that cities increasingly become an interface in these efforts, because science parks in cities are placing the city's unique demographic, socio-economic, cultural and infrastructural resources at the disposal of innovative companies.

The United Kingdom Science Park Association (UKSPA) working in Partnership with the Small Business Service (SBS), commissioned ANGLE Technology to undertake research to identify the nature of the added-value the science park movement brings to the performance of knowledge-based firms located on Science Parks in the UK. This report presents the findings of this research and provides specific insights into the:

- performance of a representative sample of science park tenants compared with similar firms located off science parks; and
- influence of regional and/or sub-regional locations on the performance of science park developments.

The recommendations focus firmly on the future and concentrate on two important strategic issues:

a) stimulating the further development of successful, mature science parks; and
b) facilitating the fast track development of new science parks.

The company research programme involved surveying senior managers of 876 companies, 617 of whom were based on Science Parks. The remaining 259 surveys were conducted with a sample of companies not located on Science Parks. This sample was derived so as to provide proportional representation comparable to that of the UKSPA tenant population based on company size by employees and sector representation.

The results confirm that Science Parks play a positive role in supporting the growth of technology-related businesses, and hence wealth creation, in the UK as evidenced by the:

- steady growth of tenant companies, which, on average, have increased in size as measured by number of employees and floor area whilst maintaining their level of investment in R&D;
- enhanced growth in employment for science park based businesses compared with similar companies at other locations;
- higher proportion of qualified scientists and engineers employed by science park based companies;
- growing relative proportion of independent/single site companies.

However, the analysis also indicates that, contrary to the expectations of many of their founders, Science Parks are failing to perform as well as might be expected with regard to:

- the promotion of HEI/industry linkages;
- the transfer of technology form HEIs to Science Park firms.

This study demonstrates that clients perceive that the value that Science Parks currently deliver is based on the provision of distinctive property based solutions that meet the particular needs of knowledge-based businesses at the various stages of their evolution.

Globally there are approximately 3500 science parks and incubators worldwide. The numbers in North America and in Europe are estimated at about 1100 plus each, Asia has roughly 700 and the rest being balanced between South America, Africa and other countries. In Europe the majority of these institutions are in Germany (approx. 165), France (approx. 55) and United Kingdom (approx. 60).

D.4 SUCCESS FACTORS

As several authors have pointed out (e.g. Lugger and Goldstein, 1991) the science park ideas have experienced over half-a-century development. Comprehensive studies concerning science park operation/management appeared about two decades after the first park was established. Studies have been found from the U.S.A. and from Europe. They generate some science park key success factors into three categories relating to park location, park preparation, and park management team.

- **Park location:** This group of factors is suggested important in attracting knowledge-based firms and knowledge workers to a science park. They indicate that a beautiful landscape, although important, is not enough to attract knowledge-based firms and knowledge workers, and is far from a park's ultimate success. A park has to be located in a place with a pleasant, convenient and supportive living and working environment so that technological entrepreneurs will like the place, and are willing to work and develop their businesses in that place.

- **Park preparation:** Park preparation refers to the stage before park opening. Three factors are classified into this group. These are a flexible physical layout, sufficient financial resources, and familiarity with the market.

    - A flexible physical layout: The physical layout for both internal building structure and external landscape should allow maximum flexibility because the property requirements of technological firms change more rapidly than those of traditional and commercial users.
    - Sufficient financial resources: A science park should be regarded as a long-term investment for return, i.e. financial return, technology transfer, or job creation. Sufficient financial resources have to be available to assist park property development and/or tenants' knowledge-intensive activities.

- Familiarity with the market: A feasibility study should be conducted to identify the potential market segments of a park as well as factors attractive to potential tenants.

- **Park management team:** It is important to have a highly professional and fully committed management team in the fields concerned such as property management and marketing.

As several authors have pointed out (e.g. Zhang 2004; Plaeksakul 2006) the establishment of an increasing number of science parks since the 1980s have been motivated by the economic contributions of some high technology industrial clusters, both spontaneous and planned ones. It is necessary for science park initiators and managers to consider when those objectives should and could be achieved and how to achieve them within the shortest possible period of time. The investment in establishing a science park needs to be justified worthy.

Science park key success factors reflected by the literature focus mainly location factors, property management skills and a quality management team. This indicates that although both favourite location factors and firms' integration and interactions are important for the growth of a spontaneous high technology industrial cluster, these have not yet been fully applied in developing science parks. As a conclusion, there are the following three points that are expected to help a science park to achieve more economic benefits. These three points concern location factors, property management skills, and integration and interactions of clustering actors.

(1) **Location factors:** Favourite location factors do play an important role in attracting firms, therefore are critical for the initial growth of a science park. Identifying the needs of potential tenants beforehand is a good strategy, which can place a park at a good starting point. Science park managers do need to know what location factors can be helpful for their potential tenant firms.

(2) **Property management skills:** Science parks are property initiatives engaging in leasing land and offices spaces. Property management skills concerning physical layout and development and marketing are necessary to operate a park well. However, science parks and commercial properties are different in terms of objective.

Commercial properties normally target at making high profit. Science parks target at assisting economic development, the achievements of which can be indicated with increased employment and tax revenue through assisting technology commercialisation, enterprise creation, etc. Having a high occupancy rate can help both types of properties to achieve their objectives. However, as they cater different types of tenants with different needs, they need different strategies for their operations.

Good property management can lead a commercial property to a success, but is hardly enough for a science park to do so. Extra expertises needed for managing a science park are closely related to the objective of the park. For parks intending to increase the number of knowledge-intensive jobs or to create a certain knowledge-intensive industry by forming knowledge-based enterprises, expertises concerning enterprise formation and the specific type of knowledge of the industry concerned appear to be necessary.

(3) **The integration and interactions of clustering actors:** Science park managers should try to create the highest level of integration and interactions both inside and outside their parks. These include not only universities, research institutes, and government organizations, but any sector that may be related with tenant firms in any way. This can lead to easier knowledge transmissions, more innovation, and effective management, which can enhance firms' long-term competitiveness. The success of tenant firms represents the success of a science park. The dynamic environment thus formed may

attract more actors locating their businesses near the park. In such a way, an industrial cluster may emerge. A science park therefore creates the potential development for the region.

According to Seymour (2006) other relevant attributes of successful science parks exist, including the following:

- Single shareholders are generally more likely to achieve success than multiple owners.
- Successful science parks owners tend to have a higher education institution in their ownership structure, whether as joint partners, in consortia or standalone.
- Successful science parks effectively manage conflict by maintaining a clear separation between ownership and management, balancing competing interests and expectations and forging innovative ways of doing things between diverse parties (e.g. financing instruments).
- Higher education institution involvement is relatively high in successful science parks; however, collaboration does not appear to be a necessary or sufficient condition for success since unsuccessful science parks also enjoy significant collaboration with higher education institution.
- Successful science parks maintain comprehensive services portfolios and also appear to adapt their portfolios to sector composition and tenant lifecycle stage, when necessary.
- Successful science parks act on a clear vision and strategic intent, one indicator of which may be the mode of start; successful science parks have a 'fixed date' or 'rolling' start within a short period of time.

The best acting science parks are in the regions where there are strong network connections and links among the region's knowledge capital, innovation capacity, knowledge economy outputs and knowledge economy outcomes. Figure 8 provides an overview of the observed attributes of successful science parks.

Science parks are the perfect habitat for businesses and institutions of the global knowledge economy. They promote the economic development and competitiveness of regions and cities by:

1. creating new business opportunities and adding value to mature companies;
2. fostering entrepreneurship and incubating new innovative companies;
3. generating knowledge-based jobs;
4. building attractive spaces for the emerging knowledge workers;
5. enhancing the synergy between universities and companies;
6. building a skills base and associated innovation capacity;
7. creating regional innovation infrastructure supporting regional development;
8. promoting new technology oriented companies.

Certainly it is clear that the portfolio of functions depends on the business model and strategy of each science park.

D.5 LIFE CYCLE AND MARKETING

Science Park Managers are interested and motivated to demonstrate to new and existing tenants, as well as to their other stakeholders, that their park provides a dynamic and attractive environment for innovation. One of the tenants, a managing director of a solar energy company, mentioned that she didn't locate to the science park because of the low rents or good facilities, but because she had access to other companies that provide services

to what her company was doing. Being part of the network within that particular science park gave the company easy access to service and know how needed.

According to Vyakarnam *et al*. (2005) the nature of science parks can be described as a network environment, as it is build on collaboration, sharing of resources (both physical and mental). The “ingredients” of a networked environment include physical infrastructure, financial infrastructures, know-how infrastructure, value-added services (e. g. legal, venture fund management, design, consulting, etc.), and non-physical (intangible) such a access to know how, opportunities for relationship building for at various levels, e. g. providing access to the industry and university collaboration. The function of these networking activities is gaining access to local university resources, potential joint R & D project, as well as bridging academic and business research.

Ritter (2006) pointed out that some of the network activities are managed and controlled, others are not; sometimes it is a combination of both, meaning that a science park can actively influence the setting of a network, without being able to guarantee the outcome, e. g. the science park can formulate admission guidelines of potential tenants and mention, that priority is given to companies who are “contributing members of the fostering clusters”. If the newly attracted tenant really becomes a “contributing member” only becomes visible after some time, and it is often not continuously monitored by the science park management.

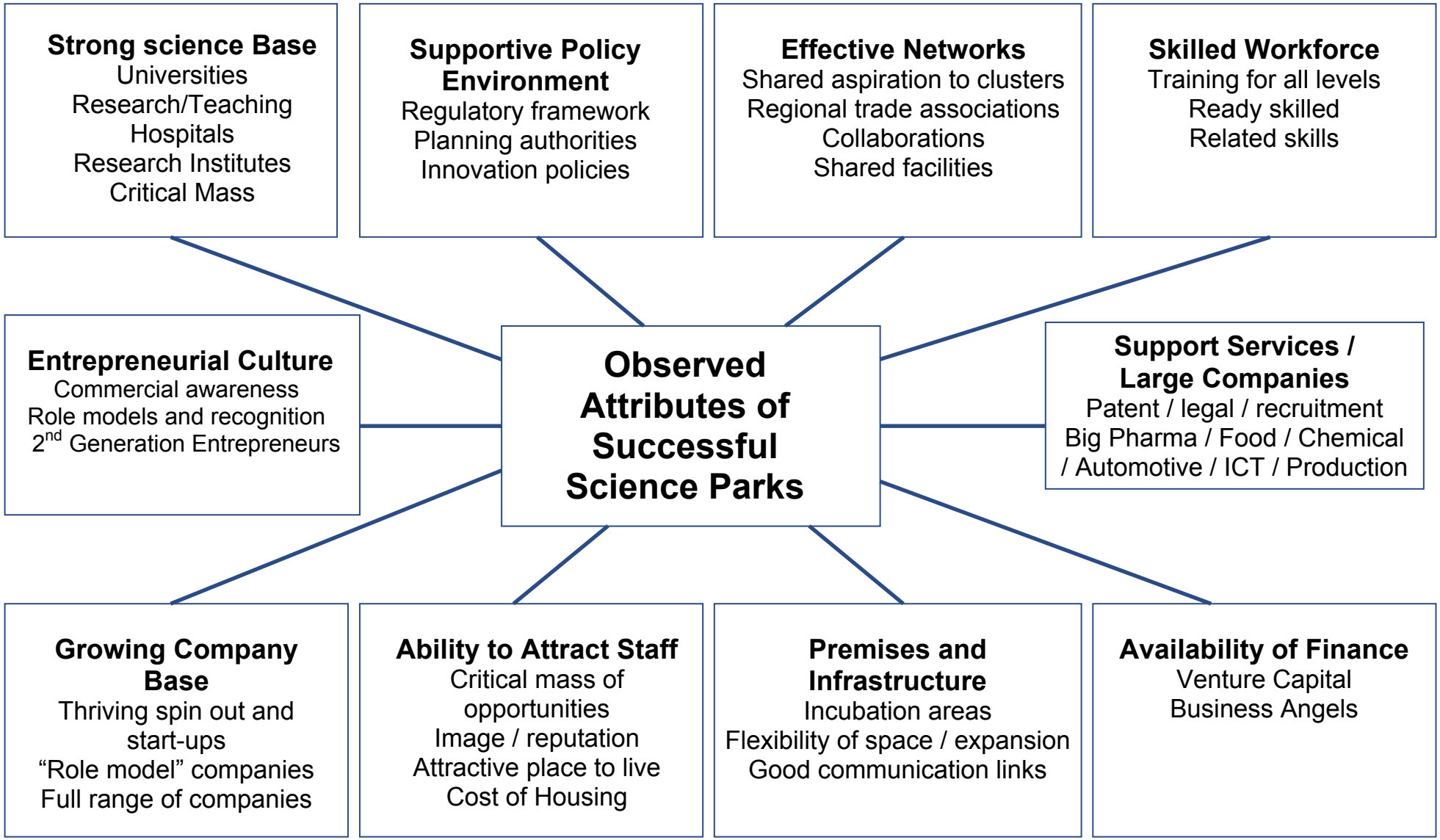

Figure 8: What makes a science park successful (Source: UKSPA)

Direct ways of stimulating and growing networks with a science park consist in connecting member companies to local and overseas industries, exchange and networking functions with professional organisations and overseas delegations as well as training and seminars. Some also include talent pool development and other human capital related activities.

The concept of “knowledge space” is still emerging and how it can be applied and put into context in a science park need to be further explored, but will certainly fall outside the scope of typical marketing and tenant relationship activities of a science park.

Science Parks like other businesses are created and managed in an environment in which they have to compete for both tenant companies and resources. to increase the chance of a park becoming a success it is important that this environment is fully understood; the park is what is wanted by the market; its place and price in this market is appropriate for its objectives and the way that it is promoted brings the park to the attention of the group or groups of users for which it is intended.

According to Parry & Roberts (2005) successful science parks have to deal with the contrast between serving a local market with 80 % of companies on parks being drawn from within their local regions and the remaining 20 % from a much wider area which includes some inward investment from overseas, while recognising that the main focus is on trying to support all these companies, which through innovation, can try to achieve their global potential and through this be considered as world class companies.

The ability to innovate is a key requirement for any company that is potentially going to occupy a world class market position.

The aforementioned paper explores how parks can enhance and promote their attraction to tenant companies through a number of factors that can help these occupiers to continue to innovate and in particular looks at the role of clusters in supporting this activity.

Currently available statistics (UNCTAD 2004) indicate there is likely that most business plans for science parks will have a section that describes the ambition of attracting foreign direct investment from a transnational company to their site. This ambition is usually not only stated within the business plan for parks but also spills over into regional and national plans because to achieve success at this level can result in a significant step forward in terms of economic development. However, because this ambition is shared by so many regions the competition for foreign direct investment is exceedingly fierce.

Governments do not create wealth and jobs it is businesses that do this and their work is driven by entrepreneurs who take risks in the face of uncertainty and open up new markets. However, where government does have a role is to create a stable economy and business environment, within which business can compete and win in world markets. There is no doubt that economic stability is the key to encouraging investment and longer term prosperity (UNCTAD 2005).

Experience suggests that beyond political stability the key themes that are likely to support FDI of whatever kind include:

- infrastructure, transport and communications
- supply chain development
- skills base, the capacity to innovate and business support
- marketing and market related issues

The presence of a science park may also help create a positive image for an area including its potential for building a technology cluster that can be reinforced in any marketing and promotion. Regions that become 'known' for certain clusters are more likely to attract inward investors that are related to that cluster than those that are not known. The development of a 'brand' or an image for an area can thus be a crucial part of any cluster development strategy and attracting FDI (DTI 2003).

According to Parry & Roberts (2005) the concept of creating real estate sites which focus on creating conditions to support technology transfer, driving technology up the value chain and by doing this encourage a culture of innovation and then brand this location as a science park was itself an innovative idea.

Today the brand image of science parks which has been built up over the last 50 years is well recognised and means that science parks are both trusted by their tenants as sites that stand for innovation and transfer to them the positive benefits of image and reputation.

Investment promotion agencies have access to a range of instruments as part of their inward investment strategies These include the provision of financial support, tailored training packages, the construction of suitable facilities and supporting infrastructure as well as more generic advice.

The science park concept, since it first emerged as a definite and unique property concept and more latterly as a service to support technology business, has differentiated itself from other forms of property development. In broad terms, science parks are more selective in the tenants they accept in terms of their tenants' business activities than traditional estates. This differentiation gives them the opportunity to promote themselves in a different way than purely as property initiatives.

If a marketing plan is effective it can lead to significant success for a park. However, it is important to set some benchmarks against which a park can be assessed. These measures might include those on a commercial level, those relating to technology transfer and company formation, and those that relate to wider benefits such as economic development. These benchmarks also provide a framework for considering marketing related decisions. For example, if one of the objectives for a park is to help raise the profile of the host university then any promotional activity should carry the host university's branding.

E. RECOMMENDATIONS

The development of interactions and synergies among several local actors such as the business sector, research institutions and regional authorities, constitute the RICs key players in the knowledge economy. Successful RICs stimulate innovation and exploitation of research results that generate jobs and wealth at regional level. To be successful, RICs should be considered and should act as a focal point for different policy interventions, which together can have greater impact. Science parks are often but not necessarily an important element of a RIC.

EU played a pedagogical role vis a vis National administrations and Regions, through the initiation of several activities that favoured the creation of the appropriate environment for the development of RICs. Among the activities that have been initiated by the EU we can mention the exchange of good practices, the launching of the open method of coordination (OMC) among the member states, mutual learning exercises, awareness activities and dissemination of information, benchmarking exercises, etc. This pedagogical role should continue and new initiatives should be planned for the near future.

The recommendations of this report aim to contribute to the development of new initiatives by the EU and beyond and therefore they are addressed to the different levels of governance (EU, National and Regional) that could design instruments and tools to implement it for the benefit of RICs and/or SPs.

E.1 INITIATIVES AND MEASURES TO IMPLEMENT AT EU LEVEL

1.1 Launching of horizontal exploratory actions to promote synergies among the different DGs and instruments

There are good grounds to launch horizontal exploratory actions to promote synergies among those programmes and instruments that aim at developing activities in RICs and science parks. At the early stage of the current EU programme period (2007–2013), DGs should undertake joint actions with a view to intensify governance and co-ordination between the different programmes. This should lead to the setting up of platforms, bodies or high level groups with a genuine mandate to remove barriers to the co-funding of activities from different programmes and to design and launch co-financed actions in the areas with a clear links and potential synergies between different policy sectors. For instance, a small part of resources of each programme could be re-allocated and/or pooled and made available to these initiatives.

1.2 Targeting EU funding for different development stages of RICs and for improving the performance of RICs

There needs to be a targeted approach in the allocation of EU funding that recognises the development stage and performance of RICs, therefore ensuring that any funding/programmes are tightly developed to overcome the weaknesses appropriate to the particular RIC. RICs at both ends of the spectrum have different needs and focus for intervention:

- Specific measures at the EU level (FP7, CIP) should aim at the sustainability and excellence of RICs, strengthening their global connectivity and allowing funding for collaboration at a global scale (Japan, USA, China, India, Brazil, etc.)
- National funding and Structural Funds could focus more on the development of new RICs, and on closing the gap between the regions and helping the more disadvantaged.

1.3 Creation of a RICs matrix across Europe
Mapping of RICs and SPs across Europe in the form of comprehensive database should be carried out. This would greatly facilitate collaborations among RICs and SPs creating an interconnecting matrix that strengthens the EU's social capital and promotes connectivity to overcome regional barriers to growth. Such matrix should be built on existing associations and initiatives. The approach of trans-national RIC should be developed further.

1.4 Launching of a specific mobility scheme for RIC and SP experts
The EU should help the transfer of knowledge between RICs/SPs and learning regions through an "outplacement" scheme of RIC and SP experts.

1.5 Increasing the mobility between industry and academia
The EU should further amplify the transfer of experts between industry and academia at international scale by contributing to the removal of all kind of barriers and by providing incentives, since such mobility is crucial to the favourable development of RICs and SPs.

E.2 INITIATIVES AND MEASURES THAT CAN BE IMPLEMENTED EITHER AT EU OR NATIONAL LEVEL

2.1 Development of links between the national and regional RDI programmes and FP elements
In order to promote RTD activities, such as those executed in RICs and science parks, and increase their overall impact on the economy and society, one of the key policy objectives in Europe is the intensification of inter-action between EU, national and regional levels. These three levels of action should be seen as one functional entity that needs to be consolidated. National and regional development measures have to be better connected to an international operating environment and to EU actions – and vice versa.

In this respect, it would be valuable for the Member States to link national and regional RDI programmes to FP elements, such as European Technology Platforms and Joint Technology Initiatives. Success in this demands close interplay and a clear division of labour between international and domestic parties.

2.2 Launching of SWOT analyses for emerging RICs and SPs
Any public support to RICs and SPs development should be based on evidence of a SWOT analysis in order to identify possible starting points for public intervention, to demonstrate its sustainability and appropriateness to local conditions and capabilities.

2.3 Continuing improvement and sustainable growth analyses for mature RICs and SPs
Support should be given to mature RICs and SPs for co-operation with other European or global partners, as well as support for external peer reviews at a global scale.

2.4 Launching of joint training actions for regional policy makers and RIC and SP managers
People make a difference. A RIC and SP needs to be driven and steered by well trained managers and should evolve in a robust governance system. Joint trainings should be implemented for managers and policy makers that would also contribute to the strengthening of the regional and RIC identity.

2.5 Launching of actions to improve the organization of networks (and other factors affecting the absorptive capacities of cluster actors).
In order to increase the absorptive capacity of RIC members and SP tenants, actions should be launched to improve social capital by creating conditions for informal networking, enhance creativity, e.g. through training on the organization and management of networks. Pre- or ongoing activities could be the involvement in the 'Regions of Knowledge' programme or other research and innovation-based funding activities of DG Research or DG Regio.

2.6 Incentives for intra-cluster and inter-regional network development and for industry-research collaboration.
Co-operation between industry and public research is a key to the development of RICs. A number of successful incentives stimulating this collaboration exists across Europe (e.g. like the recent research bonus programme *'Forschungsprämie'* in Germany; Centre of Expertise Programme in Finland). Such initiatives should be further enhanced and experience from them should be made available to other interested countries.

E.3 INITIATIVES AND MEASURES THAT CAN BE IMPLEMENTED EITHER AT NATIONAL OR REGIONAL LEVEL

3.1 Creation of strategy processes and policy platforms bringing together relevant policy making parties from the national and local levels
The growing importance of creative innovation environments and the success of RICs and SPs have activated regions to develop their competence and innovation activities through local-level decisions, on the basis of their regional competitive edges. However, in many EU Member States, the links between national and regional strategies and measures to the developments arising from the regions' own needs are as yet insufficient. A special challenge would be the *creation of strategy processes* and *policy platforms* that bring together all the relevant public and private parties involved in policy making and RTD at both national and regional level.

3.2 Development of synergies between the different EU and national instruments available at local level
Supporting RICs and SPs presumes the successful integration and exploitation of available EU and national instruments in the regional policy. In order to seek maximum benefits from EU programmes, regional stakeholders have to find new ways to develop synergies between the different instruments, namely Structural Funds, FP7 and CIP. Strategic alignment and leverage of different funding sources will increase their impact.

3.3 Developing measures for the identification and enhancement of strengths and capacities at the regional level
Regions should build on their fields of strength and existing capacities rather than attempting to build up expertise from scratch. Top-down policy approach, although it is often used in practice, is not enough in itself for successful RICs. That is why a bottom-up, demand-driven

approach is essential for a well-functioning RIC. Therefore stakeholders aiming to develop RICs should: identify strengths and key players in a region; enhance the regional knowledge-base and critical mass; find external complementary expertise; agree a vision and strategic STI agenda jointly designed and shared by all parties involved in a RIC.

3.4 Analysis of existing regional individual strategies and identification of the barriers for their effective integration.

A RIC is an integrated approach. Indeed, regions have often all the RIC ingredients in place, but in a fragmented environment. This situation leads to the fact that even if all the individual strategies and tools may be excellent, the region fails to fully success because the different stakeholders implement them as a separate agenda, loosing the synergy effects and benefits. Therefore, analyses should be carried out and measures should be implemented aiming at the removal of barriers and at the effective integration of the individual components of the RIC value chain.

3.5 Raising awareness of the benefits and challenges of RICs and SPs

Raising awareness is central to achieving the critical mass, which is a pre-requisite for a well-functioning RIC and SP. Promotion and training seminars and informative materials need to be organised and disseminated. Creating and enhancing RICs and SPs often also needs a new approach and mindset in policy design and implementation; policy design and implementation requires horizontal actions across the borders of different policy/administrative sectors. It is also important to make determined efforts to drive the RIC and SP agenda across the government and its administrative sectors. In this context, the need of strategic co-ordination between different players and between national and regional levels becomes evident.

3.6 Evaluation, foresight and benchmarking exercises

Evaluation and foresight should be intrinsic elements of RIC and SP-related policies and measures. In addition, policy actions can benefit a lot from benchmarking. Development of policies should be based on international ‘good practices’ that are tailored to national and regional contexts. This activity emphasises the importance of active learning and absorptive capacity of regions.

Evaluation activities in RICs and SPs are important because they provide knowledge on development needs and views on how to improve their focus and co-operation. The evaluations as well as foresight should focus on the entire RIC, not just individual organisations, instruments or sectors. Foresight activities are also important in that they provide information that supports STI priority setting and can enhance connectivity and efficiency of the RICs and SPs. Evaluation and foresight processes pave the way for shared awareness and views on trends, technologies or fields of expertise to be developed further.

3.7 Analysis of the RICs needs in terms of Infrastructure

Investments in the public research infrastructure are essential for the development of RICs. However, the optimization of such investments can only be achieved if they are preceded by an analysis that will demonstrate the adequacy between the planed infrastructure development and the scientific-technological profile and need of the cluster.

3.8 Initiatives on education, lifelong learning and entrepreneurship

Highly trained people are a key to success of both RICs and SPs. Further education and qualification of the regional or local labour force is necessary with respect to the scientific and technological needs of RICs and SPs.

RICs and SPs engagement with public sector research institutes is part of the journey to engage highly trained people effectively. It can demonstrate future resource needs of the future.

Universities have an important role to play as a source of potential entrepreneurs and therefore they should be encouraged to develop specific courses and activities adapted to the local needs and capabilities.

3.9 Setting-up of support schemes for innovation in corporate sector

Support for spin-offs from academia and industry is one important driver for development of RICs and SPs. However, often the support for existing companies is paid less attention than they deserve. The absorptive capacity of existing companies should also be increased and appropriate instruments should be put in place.

REFERENCES

Aho Group (2006). *Creating an Innovative Europe*. Report of the independent Aho Expert Group on R&D and innovation appointed following the Hampton Court Summit. EC, Brussels.

Annerstedt, J. (2006). *Science Parks and High-Tech clustering.* In International Handbook on Industrial Policy. Patrizio Bianchi & Sandrine Labory (eds.).

Bakouros, Y.L., D.C. Mardas & N.C. Varsakelis (2002). Science park, a high tech fantasy? An analysis of the science parks of Greece. *Technovation* 22(2), 123-128.

Benz A. & B. Eberlein (1999). The Europeanization of regional policies: patterns of multi-level governance, *Journal of European Public Policy* 6, 32–48.

Benz A. & D. Fürst (2003). Region – "regional governance" – regionalentwicklung. *In* Adamaschek B. & M. Pröhl (eds.): *Regionen erfolgreich steuern. Regional governance – von der kommunalen zur regionalen strategie,* 11–66. Bertelsmann, Gütersloh.

Boekholt, P. & B. Thuriaux (1998). *Overview of cluster policies in international perspective*. Report prepared for the Dutch Ministry of Economic Affairs. Technopolis, Amsterdam.

Buenstof, G. & Klepper, S. (2005). *Heritage and Agglomeration: The Akron Tire Cluster Revisited*. Papers on Economics and Evolution #0508. Jena: Max Planck Institute of Economics.

CGG [Commission on Global Governance] (1995). *Our Global Neighbourhood: The Report of the Commission on Global Governance*. Oxford University Press, Oxford.

Charles, D., B. Perry & P. Benneworth (2004; eds.). *Towards a Multi-Level Science Policy: Regional Science Policy in a European Context*. Regional Studies Association, Seaford.

Cohen, W. & D. Levinthal (1989). Innovation and learning: the two faces of R&D. *The Economic Journal* 99, 569–596.

Cooke, P. (2002a). *Knowledge economies. Clusters, learning and cooperative advantage*. Routledge, London.

Cooke, P. (2002b). Regional Innovation Systems: General Findings and Some New Evidence from Biotechnology Clusters, *Journal of Technology Transfer* 27, 133–145.

Cooke P., H.-J. Braczyk & M. Heidenreich (2004; eds.). *Regional innovation systems – the role of governances in a globalized world*. Second Edition. Routledge, London.

Cooke, P. & L. Leydesdorff (2006). Regional development in the knowledge-based economy: the construction of advantage. *Journal of Technology Transfer* 31: 1, 5–15.

Cordis (2006a). Regions of knowledge. *CORDIS focus Research Policy Supplement*, No 1, 21.

Cordis (2006b). David White reveals Commission's innovation funding fear. *CORDIS focus Newsletter* 265, 19.

Dicken, P. (1992). *Global shift*. Paul Chapman, London.

DTI [Department of Trade and Industry] (2002). *Innovation report. Competing in the global economy: the innovation challenge*. DTI, London.

DTI (2003). *A Practical guide to cluster Development*. A report to the Department of Trade and Industry and the English RDA, Ecotec Research and Consulting.

Edler, J., S. Kuhlmann & R. Smits (2003). New governance for innovation. The need for horizontal and systemic policy co-ordination. *Fraunhofer ISI Discussion Papers, Innovation System and Policy Analysis* 2/2003.

European Commission (2003a). *The role of the universities in the Europe of knowledge*. European Commission, COM(2003) 58, Brussels.

European Commission (2003b). *Investing in research. An action plan for Europe*. European Commission, COM(2003) 226, Brussels.

European Commission (2005a). *European Innovation Scoreboard 2005: Comparative analysis of innovation performance*. European Commission, Brussels.

European Commission (2005b). *Building the ERA of knowledge for growth*. European Commission, COM (2005) 118 final, Brussels.

European Commission (2006a). *Regions for economic growth: Innovating through EU regional policy*. European Commission, Brussels.

European Commission (2006b). Decision No 1982/2006/EC of the European Parliament and of the Council of 18 December 2006 concerning the Seventh Framework programme of the European Community for research, technological development and demonstration activities (2007–2013). *Official Journal of the European Union*, 30.12.2006, L412/1–41.

European Commission (2006c). Decision No 1639/2006/EC of the European Parliament and of the Council of 24 October 2006 establishing a Competitiveness and Innovation Framework Programme (2007–2013). *Official Journal of the European Union*, 9.11.2006, L310/15–40.

European Commission (2006d). Agreement on new € 3.6 billion “competitiveness and innovation programme”.
<http://ec.europa.eu/enterprise/enterprise_policy/cip/index_en.htm>.

Etzkowitz, H., A. Webster, C. Gebhardt & B. R. Cantisano Terra (2000). The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm. *Research Policy* 29, 313–330.

Feldman, M.P. & R. Florida (1994). The geographic sources of innovation: technological infrastructure and product innovation in the United States. *Annals of the Association of American Geographers* 84, 210–229.

Felsenstein, D. (1994). University-related Science Parks – ‘seedbeds‘ or enclaves of innovation? *Technovation* 14(2), 93-110.

Ferguson, R. & C. Olofsson (2004). Science Parks and the development of NTBFs – Location, Survival and Growth. *The Journal of Technology Transfer* 29(1), 5-17.

Florida, R. & D.F. Smith Jr. (1993). Venture capital formation, investment, and regional industrialization. *Annals of the Association of American Geographers* 83, 434–451.

Florida, R. (2002). *The rise of the creative class*. Basic Books, New York.

Fuchs G. & S. Wassermann (2005). Path dependency in Baden-Württemberg: lock-in or breakthrough? *In* Fuchs G. & P. Shapira (eds.): *Rethinking regional innovation: path dependency or regional breakthrough?* 223–248. Springer, New York.

Fürst, D. (2001). Regional governance – ein neues paradigma der regionalwissenschaften? *Raumforschung und Raumordnung* 59, 370–380.

Fürst, D. (2003). Steuerung auf regionaler ebene versus regional governance. *Informationen zur Raumentwicklung* 8/9, 370–380.

Fürst, D. (2004). Regional Governance. *In* Benz A. (ed.): *Governance - Regieren in komplexen regelsystemen. Eine einführung*, 45–64. Verlag für Sozialwissenschaften, Wiesbaden.

Graham, S. & S. Marvin (2003). *Splintering Urbanism*. Chapter: "The city as socio technical process". Routledge, London.

Guy, K. (2006). Innovation policy learning. Reflections on the Six Countries Programme workshop on innovation policy learning, 23–24 May 2006, Stockholm. <*http://www.6cp.net/*>

Haselmayer, S. (2004). Why science and technology parks go urban: Towards embedded innovation environments. *Urbanistica Informazioni*.

Held, J.R. (1996). Clusters as an economic development tool. Beyond the pitfalls. *Economic Development Quarterly* 10: 3, 249–261.

Hertog, P. den, J. Leyten, I. Limpens & J. Whalley (1999). *Approaches to cluster analysis and its rationale as a basis of policy*. Literature review for the RISE project, funded by the European Commission. An internal memo.

Husso, K. (2001). Universities and scientific research in the context of the national innovation system of Finland. *Fennia* 179: 1, 27–54.

Hölzl, W. (2006). *Cohesion and excellence. Two ways to a better Europe*. The Austrian Institute for Economic Research WIFO, Wien.

Innobarometer (2006). Innobarometer on cluster's role in facilitating innovation in Europe. European Commission, Brussels.

Koschatzky, K. & Lo, V. (2007). Methodological framework for cluster analyses. *Working Papers Firms and Region, R1/2007.* Karlsruhe: Fraunhofer Institute for Systems and Innovation Research.

Lindelöf, P. & H. Löfsten (2004) Proximity as a Resource Base for Competitive Advantage: University-Industry Links for Technology Transfer. *The Journal of Technology Transfer* 29(3-4), 311-326.

Luger, M. I., & Goldstein, H. A. (1991). *Technology in the garden*, Chapel Hill, UNC Press.

Maggioni, M. (2004). *The rise and fall of industrial clusters: Technology and the life cycle of region*. Institut d'Economia de Barcelona, Document de treball 2004/6. Barcelona.

Malmberg, A. & P. Maskell (2006). Localised learning revisited. *Growth and Change* 37: 1, 1–18.

MLP [Mutual Learning Platform – Regional Profiles Report] (October 2006). *How to make Regional Growth Poles Work*. Published by IRE Innovation Network.

OECD (2005a). Science, technology and industry scoreboard. OECD, Paris.

OECD (2005b). Proposal for TIP project on 'Innovation policy governance: learning from good practices'. A proposal prepared by the Finnish Ministry of Trade and Industry for the OECD/TIP. OECD document DSTI/STP/TIP(2005)11.

Ohmae, K. (1995). *The end of the nation state: the rise of regional economics*. The Free Press, New York.

O'Mara, M. Pugh (2005). *Cities of Knowledge: Cold War Science and the Search for the Next Silicon Valley*. Princeton University Press, Princeton, NJ.

Parry, M. & E. Roberts (2005). *The performance of Science Parks as part of the framework of regional development and regional innovation and science strategies in the United Kingdom*. XX11 IASP World Conference on Science and Technology Parks.

PAXIS (2006). *The PAXIS manual for innovation policy makers and practitioners. Analysis and* transfer of innovation tools, methodologies and policy. European Commission, Brussels.

Plaeksakul, A. (2006). *Transferring the growth engine of spontaneous industrial clusters into the management of science parks*. IASP XXIII, Helsinki.

Press, K. (2006). *A Life Cycle for Clusters? The Dynamics of Agglomeration, Change, and Adaptation*. Heidelberg, New York: Physica.

PWC Consulting and Tsagaris Consult (2002): *Involving regions in the European Research Area*, Final Report to the European Commission, EUR20477/3.

Ritter, W. (2006). *Knowledge Exchange and Networks in Science Park.* IASP XXIII; Helsinki.

Roelandt, T.J.A. & P. den Hertog (1999). Summary report of the Focus Group on Clusters. Paper prepared for the OECD.
<*http://www.oecd.org/dataoecd/56/47/2369025.pdf*>

Rostow, W.W. (1960). *The Stages of Economic Growth. A Non-Communist Manifesto*. Cambridge/Mass.

Salter, A. & B. Martin (2001). The economic benefits of publicly funded basic research: a critical review. *Research Policy* 30(3), 509-532.

Schmitt-Egner, P. (2005). *Handbuch zur Europäischen regionalismusforschung*. Verlag für Sozialwissenschaften, Wiesbaden.

Schätzl, L. (2001). *Wirtschaftsgeographie 1. Theorie*. *8. Auflage*. Ferdinand Schöningh, Paderborn.

Seymour, S. (2006). *Micro Agglomerations of Technology: A Typology of Ownership and Implications of Success.* IASP XXIII, Helsinki.

Sharp, M. & T. Pereira (2001). Research and technological development. *In* Hall, R., A. Smith, L. Tsoukalis (eds.): *Competitiveness and cohesion in EU policies*. Oxford University Press, Oxford.

Siegel, D.S., P. Westhead, P. & M. Wright (2003). Science Parks and the performance of New Technology Based-Firms: A review of recent U.K. evidence and an agenda for future research. *Small Business Economics* 20, 177-184.

Smits, R. & S. Kuhlmann (2002). Strengthening interfaces in innovation systems: rationale, concepts and (new) instruments. *In* European Commission (ed.): *Science & Technology policies in Europe: new challenges and new responses. Proceedings of the STRATA consolidating workshop*, Brussels, April 2002. European Commission, Luxembourg.

Sotarauta, M. & N. Mustikkamäki (2001; eds.). The eight elements of regional competitiveness. *Suomen Kuntaliitto, ACTA* 137.

Storper, M. (1995). The resurgence of regional economies, ten years later. The region as a nexus of untraded interdependencies. *European Urban and Regional Studies* 2, 191–221.

STPC [Science and Technology Policy Council of Finland] (2006). *Science, technology, innovation*. Science and Technology Policy Council of Finland, Helsinki.

Technopolis (2006). *Strategic evaluation on innovation and the knowledge-based economy in relation to the Structural and Cohesion Funds, for the programming period 2007–2013*. A report to the European Commission. Technopolis Consulting Group, Brussels.

Temple, J. (2000). Growth effects of education and social capital in the OECD countries. *OECD, Economics Department, Working Papers* 263.

UNCTAD 2005 (United Nations Conference on Trade and Investment 2005) - *Prospects for Foreign direct Investment and the Strategies of Transnational Corporations*, 2005-2008, UNCTAD/ITE/IIT/2005/7 ISBN 92-1-112691-6 - page 32.

Vedovello, C. (1999). Parques de ciência e tecnologia e interacção universidade-indústria: uma análise comparativa entre as experiências inglesa e portuguesa. *In* M.M. Godinho & J.M.G. Caraça (eds.): *O Futuro Tecnológico: Perspectivas para a inovação em Portugal*, 163-177. Celta, Oeiras.

Vernon, R. (1979). The product cycle hypothesis in a new international environment, *Oxford Bulletin of Economics and Statistics*, 41, 255-267.

Vyakarnam, S., Y.M. Myint & L. Marino (2005). *Research parks and incubators: re-defining the role of the incubator*. In Advancing innovation and entrepreneurship, Technology Transfer Society Annual Conference, 28-30 September 2005, Kaufmann Foundation. Kansas, MO.

Wiehler F. & T. Stumm (1995). The powers of regional and local authorities and their role in the European Union. *European Planning Studies* 3, 227–250.

Zhang, Y. (2004). Critical factors for science park management: The North American and European experience. *Int. J. of Entrepreneurship and Innovation Management, Vol4, No.6, 575-586.*

ANNEX 1: R&D, innovation and regional economic development - Theoretical approaches

R&D, innovation and regional economic development: theoretical approaches

When one looks at the history of regional development in Europe during the past few decades, it becomes clear that spatially uneven development has been a typical and in most of the cases an unavoidable feature of the process of technological change and capital accumulation (Dicken 1992). Today, R&D and innovation-related activities play an important role in these processes. A vast bulk of recent scientific studies has indicated that research, innovations inspired by R&D, and their various spin-off effects have a major positive impact on the regional economy (e.g. Florida & Smith 1993; Feldman & Florida 1994).

Techno-economic development is dependent on level of education, R&D, innovativeness, capacity for regeneration and a wide array of other interrelated factors. However, the interplay between different factors involved is highly complex and difficult to demonstrate. The theoretical approaches and models adopted in the fields of economics and geography on the regional economics, R&D, innovation, agglomeration tendency, clusters and local milieus have been a widely discussed topic both among policy-makers and within the academic community.

The role of R&D, advanced technologies and innovations in national and regional economic development – as well as in formation of STI-intensive clusters in general – has been studied through numerous, partially overlapping and inter-related theories, concepts and schools of thought. These different approaches can be divided into two subgroups – general macro-level perspective and regional perspective. The approaches, their basic rationales and their main arguments and findings are discussed next.

I. General theories and macro-level perspective

Techno-economic paradigms: The paradigms are constructed and diffused on three inter-related levels: a) as a set of real new technology systems which grow and diffuse in the productive sphere (today, these would be the microelectronics, software and computer related industries, plus modern telecommunications and all the services connected with them); b) as a new "best practice" model adapted to the new technologies and capable of taking best advantage of them. This model diffuses across all industries and productive activities, modernizing them and establishing the emerging managerial common sense for investment and innovation (at present, this refers to the flexible organizational model fused with the consistent application of information technology); c) as a more general set of "common sense" principles for organizational and institutional design (this involves general principles such as decentralization, networking, interaction between the organization and its users or beneficiaries continuous improvement, participation, consensus building, etc.). These principles can be said to conform a techno-organizational paradigm. (Perez 2004; see also e.g. Freeman 1987, 1992; Dosi *et. al.* 1988).

New growth theory: The classic factors of production – labour and capital – do not explain the economic growth and its processes well enough in the globalised world characterized by the importance of knowledge and creativity. Furthermore, the law of diminishing returns of the classic theory is not as useful approach to study growth today as it was before. The new theory emphasises the process of accumulation of knowledge that results from investment in new technologies and human capital. This, in turn, influences the growth of profits and other benefits. In other words, economic growth is based on the increasing returns associated with knowledge. Consequently, growing attention should be paid to all the factors and policies/policy instruments that support and provide incentives for the creation, transfer, introduction and application of knowledge.

Evolutionary and industrial economists basic argument is that the accumulation of knowledge is a 'path dependent' (i.e., it follows ordered paths or technological trajectories directed by the technical properties, the problem-solving heuristics and the expertise embodied in techno-economic paradigms) and non-linear process (i.e., it does not follow the linear model of innovation but involves multi-facetted interactions between the different phases of innovation process and between different players involved in STI). Interaction between organisations, social norms, and regulatory framework condition this process. According to Boschma & Lambooy (1999: 411), evolutionary approach may be useful to explore the process of collective learning in a regional context, the adjustment problems regions may face in a world of increasing variation, and the spatial development of emerging industries as an evolutionary process, in which increasing returns in spatial terms (i.e., agglomeration economies) may lead to a spatial lock-in.

Institutional economists' approach emphasises the importance of institutions in designing and implementing policy reforms. Controlling the complex interplay between organisations involved in STI requires new modes of action. The significance of governance and new mechanisms and modes of action grows as the division of labour and specialisation among participants in STI processes increase. According to Boschma & Frenken (2006), institutional approaches argue that differences in economic behaviour are primarily related to differences in institutions. These differences can be present among firms (in terms of organisational routines and business cultural) and among territories (in terms of legal frameworks, informal rules, policies, values and norms).

National system of innovation: The system approach – which is more of a conceptual framework – draws primarily from the subfields of economics, mainly from theories of interactive learning and evolutionary theories of technological change, and from new research findings concerning the innovation process and its impacts on economic growth. The innovation system approach holds that economic and innovation activities are based primarily on learning and a systematic search for knowledge. These are social processes that depend on economic and political institutions, their values, and each society's/region's norms. From the point of view of policies and policy-making, innovation system is a set of "distinct institutions which jointly and individually contributes to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and

artefacts which define new technologies" (Metcalfe 1995; for more on definitions, see Niosi 2002 and Martin & Sunley 2003).

Innovation systems consist of four basic elements (cf. Nelson 1993: 517–520; Patel & Pavitt 1994): 1) the *institutional structures* (they are formed by the enterprises, universities, research and educational organisations, standards, routines, networks, finance organisations and public policy to promote and regulate technological change); 2) the *incentive system* (this category consists of incentive systems for innovation, technology transfer, learning and qualification, for firm formation as well as professional mobility in and between organisations); 3) the abilities and *creativity of the innovation and economic actors* (there are great differences, not only among countries but also among the enterprises of a country, regarding the diversity and quality of products and services, as well as the possibilities to tread new development paths); 4) the *cultural particularities*: these can be reflected for instance in different acceptance and understanding of possible utilisations of technology.

Alongside with the concepts of techno-economic paradigms and national systems of innovation, the idea of **technological trajectories** has emerged. The notion of technological trajectories is related to the path of development within a given technological field (Dosi 1982, 1984). Trajectories differ in the direction and also in their advances. These differences in the advance, or rate of development of a given technology is determined by the underlying technological regime related to it. Malerba and Orsenigo (1993) have proposed that the technological regime is determined by the opportunity conditions (level of difficulty in the development of technology), in the appropriate conditions (IPR and protection issues), by the cumulativeness (today's innovation is the breeding-ground of tomorrow's innovations) and by the nature of the knowledge base (tacit and locally embedded knowledge vs. codified and universally available knowledge). (Kristensen 1998: 17)

II. *Regional perspective*

Regional perspective deals more closely with the issues, such as geographical proximity, a capacity to generate and enhance social capital, a capacity to accumulate and exchange knowledge and expertise (i.e. codified and tacit knowledge), and other prerequisites that are relevant for the development of regional clusters and key factors of successful STI activities.

New industrial spaces: The concept used in explaining regional economic development and the changing structure of industrial production systems particularly with a view to flexible production organization and high-technology. In addition, emphasis has been put on the transactional approaches to understand industrial organisations and location, the shifting boundary between internalising the operations of a firm and providing necessary products and services through sub-contracting and market relations between firms, and the restructuring of the social division of labour (starting from the work by Scott 1986, 1988).

Learning regions: Learning capacity and absorptive capacity are central features of a successful firm, region and country. Learning ability conditions the innovative capacity of an entity. Emphasis has also been put on the roles of codified and tacit

knowledge, the accumulation of knowledge, and lifelong education and training. Collective interactive learning is a socially embedded process that is the fundamental element of the process of innovation (Lundvall 1992; Lundvall & Johnson 1994). Hence, this approach entails a broader view on innovation as a set of concurrent technical and social processes and as a non-linear process that involves various other activities in addition to R&D and multi-faceted processes of interaction between all the entities involved in innovation activities. Asheim (1998: 3) defines a 'learning region' as 'representing the territorial and institutional embeddedness of learning organisations and interactive learning' and argues that in such innovation-supportive regions the inter-linking of co-operative partnerships – understood as 'regional development coalitions' – are of strategic importance[4].

Basic prerequisite for a well-functioning learning region is the existence of so-called learning organisations. In this context, the question is about organisational innovations (e.g. implementation of non-hierarchic, flat and flexible organisational structures) implemented both at an intra- and inter-organisation level and at a regional level. In addition, learning region and its production capacity is dependent on three forms of capital – i.e., human capital (individual know-how), structural capital (organisational know-how) and social capital (know-how embedded in the region/community) – transfer of knowledge and human capital (e.g. in the form of high mobility rate) and efficient transfer of R&D results and human capital into practise (OECD 2001).

Furthermore, innovative capacity and the regional learning ability associated with it are shaped by the density and quality of networking within the regional productive system. Inter-firm and public–private co-operation (particularly between research organisations, government and industry through complementary investment in R&D and innovation-related activity) and the institutional framework within which these relationships take place are assumed to be key sources of regional innovation. Innovation is viewed as the 'end-product' with regional learning dependent on the quality and density of the above relationships, being viewed as the 'process' (see Lundvall & Borras 1999). The ability of a firm or region to learn is also shaped by its absorptive capacity, which may be defined as the ability of a firm or region to assimilate and utilise knowledge. Absorptive capacity depends on the internal capabilities of a firm and region and existing stocks of knowledge. Thus, absorptive capacity results in cumulative causation in learning and innovation.

In the literature, industrial districts, industrial clusters and innovative milieus have been often seen as learning regions. **Industrial district** can be defined as "localized network of producers bound together in a social division of labour, in necessary association with a local labour market (Scott 1992: 266). Some authors emphasize the small-firm characteristics of the industrial districts, i.e., regional system of SMEs, others the fact that research and innovation activities of industrial districts shifts the emphasis from the characteristics of the single firm to those of the local or regional system of which the firm is a part (e.g. works by Asheim 1996, 1998; Hayter 1997).

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4 For more on learning economies and learning regions, see Lundvall & Johnson (1994), Morgan 1997, Asheim (1998), Lundvall & Borras (1999), Henderson & Morgan (1999), Keeble & Wilkinson (1999), Landabaso *et al.* (2001, 2003), Oughton *et al.* (2002).

The concept of **industrial clusters** started to gain ground as a practical tool in both policy-making and research after Porter (1990) introduced his very generic views on the development of clusters and arguments for the importance of clusters. He modelled the effect of the local business environment on competition in terms of: demand conditions; factor input conditions; firm strategy and rivalry; and related and supporting industries. This so-called diamond theory stresses how these elements combine to produce a dynamic, stimulating and intensely competitive business environment.

Later on, Porter (1999: 78) defined clusters as: “geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition. They include, for example, suppliers of specialized inputs such as components, machinery, and services, and providers of specialized infrastructure. Clusters also often extend downstream to channels and customers and laterally to manufacturers of complementary products and to companies in industries related by skills, technologies, or common inputs. Finally, many clusters include governmental and other institutions – such as universities, standards-setting agencies, think tanks, vocational training providers, and trade associations - that provide specialized training, education, information, research, and technical support.” Porter’s definition of clusters has been criticised especially for the lack of clear industrial boundaries (core fields and complementing/related fields) and geographical boundaries (spatial scale), and difficulties and pitfalls in bringing the cluster concept into a policy context in an effective way (Martin & Sunley 2003: 5, 10). In recent years, numerous terms has been used to describe different of types of clusters or districts (e.g. ‘sticky places’, ‘hub-and-spoke districts’, ‘satellite industrial platforms’, ‘state-anchored industrial districts’, ‘multi-clusters’). For instance, multi-clusters by Simmie & Sennett (1999) are linked with cities that are at the top of their national urban hierarchies. They are often international commercial centres and cities with multi-clusters of different innovative sectors. (Collis *et al.* 2005: 1–2). The cluster issues are discussed thoroughly and in more detail in Chapter C.

Innovative milieus: The approach focuses on region as a major element in economic development, a playing field for innovation. A region is an innovative milieu because it mobilizes three internal properties: universities, financial institutions, and geographic relationship to markets. Innovative milieu is a complex regional network of principally informal social relationships characterised by a strong sense of belonging (Camagni 1991: 3). Creativity and continuous innovation is considered to be a result of "a collective learning process, fed by such social phenomena as intergenerational transfer of know-how, imitation of successful managerial practices and technological innovations, interpersonal face-to-face contacts, formal or informal cooperation between firms, tacit circulation of commercial, financial or technological information" (Camagni 1991: 1). Camagni (1991: 8) – in line with Lundvall’s view on learning regions and economies – considers technological innovation to be increasingly a product of social innovation, i.e., a process that takes place both at the intra-regional level in the form of collective learning processes, and through inter-regional linkages facilitating the firm’s access to different, though localised, innovation capabilities.

Industrial and technology systems and knowledge structures of a particular region (or a country or a cluster) has been studied frequently by exploiting the concept of '**regional innovation systems**'. Regional innovation systems (RSI) are understood as "...geographical distinctive, interlinked organizations supporting innovation and those conducting it, mainly firms" (Cooke *et al.* 1996: 12). The concept therefore assumes that the region and its spatial environment play a role in the innovation and development process of enterprises as well as of other innovation actors. The region should exhibit so much own responsibility and freedom of governance that it is capable of policy implementation and can create framework conditions using public funds which contribute towards stimulating innovation. In a (regional) innovation system organisations act and influence it through their mutual interactions as well as their interconnections with other innovation systems. Central elements of an innovation system are universities, non-university research organisations, technology transfer agencies, consultants, further education institutions, public and private financing institutes, small, medium-sized and large enterprises as well as other organisations which are integrated into the innovation processes. Regional innovation systems are thus very complex and consist of a diverse set of institutions, organisations and incentive systems.

The importance of inter-firm networking and of inter-organizational relationships that cut across the government, business and education sectors has been stressed by the regional innovation systems literature (e.g. Asheim 1998; Cooke 1998) and by the related concept of the *triple helix* model of innovation (see below), which emphasises government-industry-university relationships and complementarities between public and private sector investment in R&D.

Although the RSI concept provides a general framework for the regional level, it should not be forgotten that regions are very heterogeneous in their economic structure, their technology profile, their creativity, scientific and innovation-related infrastructure and their economic performance. Usually R&D expenditures or R&D personnel (as two input indicators) are highly concentrated in a few regions per country. In UK, about 40 per cent of the nation-wide R&D employees have their workplace in the London region (southeast); in France, the respective figure for the Île de France is 48 per cent, and in Italy for Milan (Lombardy) 32 per cent (Koschatzky 2005: 304). This makes it clear that regional innovation systems show a great variety (for different examples, see Cooke *et al.* 2004). The spectrum varies from international centres of scientific and technological excellence, to less innovative agricultural regions, and up to regions where the fundamental prerequisites of innovation (e.g. networks, research activities, innovative companies) are missing.

Triple helix models: This approach analyses the interaction between university, business and government from the point of view of three models. In Triple Helix I, the three spheres are three independent institutions that interact across their institutional borders. Interaction is facilitated by intermediaries such as industrial liaison, technology transfer, and contract offices. In Triple Helix II, the helices are defined as different communication systems consisting of the operation of markets, technological innovations, and control at the interfaces (Leydesdorff 1997). The interfaces among these different functions operate in a distributed mode that produce potentially new forms of communication as in a sustained technology

transfer interface or in the case of patent legislation. In Triple Helix III, the institutional spheres of university, industry, and government, in addition to performing their traditional functions, each assume the roles of the others (f. ex. the emergence of the 'entrepreneurial university'). The different versions of the Tripe Helix posit different types of intersections among the institutional spheres with significant implications for both theory and practice. Knowledge flows that take place within and between the spheres are not considered as linear processes from an origin to an application. In general terms, all models emphasise the importance of university–industry–government interactions in improving the conditions for innovation in a knowledge-based economy and society. (Etzkowitz & Leydesdorff 1997, 2000; Leydesdorff & Etzkowitz 1998: 197–198; Leydesdorff 2000; Etzkowitz 2003).

III. *Concluding remarks*

In a nutshell, the literature on the geography of innovation explains why R&D activity, knowledge transfer and innovation tend to be spatially concentrated in research intensive clusters. These clusters are often located around universities and research organisations. However, it does not provide us with full explanations for what triggers the initial investment in R&D and the other positive processes that later on enhance the accumulation and transfer of knowledge and the various spill-over effects. In addition, as argued by Asheim (1995: 15) on the innovative milieu approach, the basic problem is the incapacity to identify the mechanisms and processes which promote innovation more successfully in some regions than in others, i.e. "why localization and territorial specificity should make technological and organizational dynamics better" (Storper 1993: 14). Furthermore, despite a vast number of studies on regional economic development and their righteous focus on knowledge and learning as crucial prerequisites for growth, a large part of the studies fail to support the arguments with a set of convincing comprehensive and comparable empirical data.

Further analysis needs to be carried out on the importance of larger, regionally extramural networks and structures. The same holds true for the critical view on the definitive role of spatial proximity in explaining industrial success of capacity to innovate or conduct R&D (e.g. Larsson & Malmberg 1999; Boschma 2005; Boschma & Kloosterman 2005). This could be the case despite the widely adopted fact that proximity makes the processes of knowledge and technology transfer, mobility of experts and collective learning easier. In the operating environment of continuing globalisation and increasing internationalisation of STI, the literature (though containing mixed views) indicates that there is a close national and local association between research and its exploitation. It seems that especially the transfer of tacit knowledge requires geographical proximity and personal face-to-face contacts that makes it possible to build up social capital and cohesion.

References (for Annex 1)

Asheim, B. T. (1995). Regionale innovasjonssystem – en sosialt og territorielt forankret teknologipolitikk. *Nordisk Samhällsgeografisk Tidskrift* 20, 17–34.

Asheim, B. T. (1996). Industrial districts as 'learning regions': a condition for prosperity? *European Planning Studies* 4: 4, 379–400.

Asheim, B. T. (1998). Territoriality and economics: on the substantial contribution of economic geography. *In* Jonsson, O. & O.-L. Olander (eds.): *Economic Geography in Transitions, the Swedish Geographical Yearbook* 74: 98–109.

Boschma, R.A. (2005). Proximity and innovation. A critical assessment. *Regional Studies* 39, 61–74.

Boschma, R.A. & K. Frenken (2006). Why is economic geography not an evolutionary science? Towards an evolutionary economic geography. *Journal of Economic Geography* 6, 273–302.

Boschma, R.A. & R. Kloosterman (2005). Clustering, learning and regional development. *In* Boschma, R.A. & R.C. Kloosterman (eds.): *Learning from clusters. A critical assessment from an economic-geographical perspective*, 1–15. Springer Verlag, Dordrecht.

Boschma, R.A. & J.G. Lambooy (1999). Evolutionary economics and economic geography. *Journal of Evolutionary Economics* 9, 411–429.

Camagni, R. (1991; ed.). Innovation networks. Spatial perspectives. Belhaven Press, London.

Collis, C., T. Donnelly & M. Hyry (2005). Sectoral Change and Regional Economic Development in the Oulu Region of Northern Finland: the role of the High-Tech Industrial Cluster by the Arctic Circle. A paper presented at the Regional Studies Association's international conference on 'Regional growth agendas', 28.–31.5.2005, University of Aalborg, Denmark.

Cooke, P. (1998). Global clustering and regional innovation: systemic integration in Wales. *In* Braczyk, H.-J., P. Cooke & M. Heidenreich (eds): *Regional innovation systems: the role of governances in a globalized world,* 245–262. UCL Press, London.

Cooke, P., P. Boekholt, N. Schall & G. Schienstock (1996). Regional innovation systems: Concepts, analysis and typology. Paper presented at EU-RESTPOR Conference "Global Comparison of Regional RTD and Innovation Strategies for Development and Cohesion", Brussels 19.–21.9.1996. Cardiff University, Cardiff.

Cooke P., H.-J. Braczyk & M. Heidenreich (2004; eds.). *Regional innovation systems – the role of governances in a globalized world*. Second Edition. Routledge, London.

Dicken, P. (1992). *Global shift*. Paul Chapman, London.

Dosi, G. (1982). Technological paradigms and technological trajectories. *Research Policy* 11, 147–162.

Dosi, G. (1984). *Technical change and industrial transformation*. Macmillan, London.

Dosi, G., C. Freeman, R. Nelson, G. Silverberg & L. Soete (1988; eds.). *Technical change and economic theory*. Frances Pinter, London.

Etzkowitz, H. (2003). Research groups as 'quasi-firms: the invention of the entrepreneurial university. *Research Policy* 32, 109–121.

Etzkowitz, H. & L. Leydesdorff (1997). *Universities in the global economy: a triple helix of government–industry–government relations*. Cassell Academic, London.

Etzkowitz, H. & L. Leydesdorff (2000). The dynamics of innovation: from national systems and "Mode 2" to a triple helix of university–industry–government relations. *Research Policy* 29, 109–123.

Feldman, M.P. & R. Florida (1994). The geographic sources of innovation: technological infrastructure and product innovation in the United States. *Annals of the Association of American Geographers* 84, 210–229.

Florida, R. & D.F. Smith Jr. (1993). Venture capital formation, investment, and regional industrialization. *Annals of the Association of American Geographers* 83, 434–451.

Freeman, C. (1987). *Technology policy and economic performance. Lessons from Japan*. Frances Pinter, London.

Freeman, C. (1992). *The economics of hope. Essays on technical change, economic growth and the environment*. Frances Pinter, London.

Hayter, R. (1997). *The dynamics of industrial location. The factory, the firm and the production system*. Wiley, Chichester.

Henderson, D. & K. Morgan (1999). Regions as laboratories: the rise of the regional experimentalism in Europe. *In* Wolfe, D. & M. Gertler (eds): *Innovation and social learning*. Macmillan and St Martin's Press, New York.

Keeble, D. & F. Wilkinson (1999). Collective learning and knowledge development in the evolution of regional clusters of high technology SMEs in Europe. *Regional Studies*, 34, 295–303.

Koschatzky, K. (2005). The regionalization of innovation policy: new options for regional change? *In* Fuchs, G. & P. Shapira (eds.): *Rethinking regional innovation: path dependency or regional breakthrough?* 223–248. Springer, New York.

Kristensen, F. S. (1998). Understanding learning in technological trajectories: combining organizational integration and industrial dynamics. Paper presented at 1998 DRUID summer conference on 'Competence, governance and entrepreneurship', 9.–11.6.1998, Bornholm, Denmark. <*http://www.druid.dk/uploads/tx_picturedb/ds1998-21.pdf*>

Landabaso, M., C. Oughton & K. Morgan (2001). Innovation networks and regional policy in Europe. *In* Koschatzy, K., M. Kulicke & A. Zenker (eds.): *Innovation networks: concepts and challenges in the European perspective*. Physica-Verlag, Heidelberg.

Landabaso, M., C. Oughton & K. Morgan (2003). Learning regions in Europe: theory, policy and practice through the RIS experience. *In* Gibson, D., C. Stolp, P. Conceição & M. Heitor (eds.): *Systems and policies for the global learning economy*. Praeger, London.

Larsson, S. & A. Malmberg (1999). Innovations, competitiveness and local embeddedness: a study of machinery producers in Sweden. *Geografiska Annaler B* 81: 1, 1–18.

Leydesdorff, L. (1997). The new communication regime of university–industry–government relations. *In* Etzkowtiz, H. & L. Leydesdorff (eds.): *Universities in the global economy: a triple helix of government–industry–government relations*, 106–117. Cassell Academic, London.

Leydesdorff, L. (2000). The triple helix: an evolutionary model of innovations. *Research Policy* 29, 243–255.

Leydesdorff, L. & H. Etzkowitz (1998). The triple helix as a model for innovation studies. *Science & Public Policy* 25, 195–203.

Lundvall, B.-Å. (1992; ed.). *National systems of innovation*. Pinter, London.

Lundvall, B.-Å. & S. Borras (1999). *The globalising learning economy: implication for innovation policy*. DGXII-TSER report. European Commission, Brussels.

Lundvall, B.-Å. & B. Johnson (1994). The learning economy. *Journal of Industry Studies* 2, 23–42.

Malerba, F. & L. Orsenigo (1993). Technological regimes and firm behaviour. Industrial and Corporate Change 2, 45–71.

Martin, R. & P. Sunley (2003). Deconstructing clusters: chaotic concept or policy panacea? *Journal of Economic Geography* 3: 1, 5–35.

Metcalfe, J. (1995). The economic foundations of technology policy: equilibrium and evolutionary perspectives. *In* Stoneman, P. (ed.): *Handbook of economics of innovation and technology change*. Blackwell, Oxford.

Nelson, R. R. (1993). A retrospective. *In* Nelson, R.R. (ed.): National innovation systems. A comparative analysis, 505–523. Oxford University Press, New York.

Niosi, J. (2002). National systems of innovations are “x-efficient” (and x-effective). Why some are slow learners. *Research Policy* 31, 291–302.

OECD (2001). *Cities and regions in the new learning economy*. OECD, Paris.

Oughton, C., M. Landabaso & K. Morgan (2002). The regional innovation paradox: innovation policy and industrial policy. *The Journal of Technology Transfer* 27, 97–110.

Patel, P. & K. Pavitt (1994). The nature and economic importance of national innovation systems. *OECD, STI Review* 14, 9–32.

Perez, C. (2004). Technological revolutions, paradigm shifts and socio-institutional change. *In* Reinert, E. (ed.): *Globalization, economic development and inequality: an alternative perspective*, 217–242. Edward Elgar, Cheltenham.

Porter, M. E. (1990). *The competitive advantage of nations*. Free Press, New York.

Porter, M. E. (1999). Clusters and the new economics of competition. *Harvard Business Review*, November–December, 77–90.

Scott, A. J. (1986). Industrial organization and location: division of labour, the firm and spatial process. *Economic Geography* 62, 215–231.

Scott, A. J. (1988). *New industrial spaces: flexible production organization and regional development in North America and Europe*. Pion, London.

Scott, A. J. (1992). The role of large producers in industrial districts: a case study of high technology systems houses in Southern California. *Regional Studies* 26, 265–275.

Simmie, J. & J. Sennett (1999). Innovative clusters: global or local linkages? *National Institute Economic Review* 170, 87–98.

Storper, M. (1993). Regional “World” of production: learning and innovation in the technology districts of France, Italy and the USA. *Regional Studies* 27, 433–455.

ANNEX 2: 2007 – 2013 COMMUNITY SUPPORT AT A GLANCE

TABLE B: 2007 – 2013 COMMUNITY SUPPORT AT A GLANCE

Instrument / Topic	ERDF Convergence (1)	ERDF Growth and Employment (1)	ERDF Territorial Cooperation (1)	ESF (2)	CIP (3)	EAFRD (4)	EFF (5)	FP7 (6)
Access to finance	Article 4.1	Article 5.1 d	Article 6.2 a		Article 11 Article 17.2 Article 18 Article 19 Article 20			RSFF (*) Capacities
Networks and clustering	Article 4.1	Article 5.1 a Article 5.1 b	Article 6.2 a	Article 3.1 d ii	Article 12			Capacities
Supply of SME support services	Article 4.1 Article 4.2 Article 4.4	Article 5.1 b Article 5.3 b			Article 12 Article 21			Capacities SME support action
Entrepreneurship	Article 4.1	Article 5.1 c	Article 6.1. a	Article 3.1 a i	Article 10 Article 15	Article 49 a		
Support to innovation	Article 4.1	Article 5.1 Article 5.1	Article 6.2 a	Article 3.1 d i	Article 13 Article 14 Article 21 Article 22			Capacities
R T D	Article 4.1	Article 5.1	Article 6.2 a	Article 3.2 a iii			Article 37 j	Capacities
Human capital	Article 4.10		Article 6.1 d	Article 3.1 a i				Capacities
Investment	Article 3 Article 4.2	Article 3			Article 28.2 b	Article 49 a	Article 34	Capacities

(*) Risk Sharing Financial Facility through EIB loans

(1) ERDF Regulation N° 1080/2006 published in O.J. L 210, 31.7.06
(2) ESF Regulation N° 1083/2006 published in O.J. L 210, 31.7.06
(3) CIP Decision N° 1639/2006 published in O.J. L 310, 9.11.06
(4) EAFRD Regulation N° 1698/2005 published in O.J. L 277, 21.10.05
(5) EFF Regulation N° 1198/2006 published in O.J. L 223, 15.8.06
(6) FP7 Decision N° 1982/2006 published in O.J. L 412, 30.12.06

Source: EURADA, Putting EU Policies in Favour of Innovation and Entrepreneurship into Practice at Regional Level, January 2007

NETWORKING AND CLUSTERING

Introduction

In the last decades, competitive advantage can be created through formal and informal networks and by clusters.

Four main EU policies/instruments provide financial assistance for the creation, development or improvement of networks and clusters. They are:

- → ERDF European Regional Development Fund;
- → CIP Competitiveness and Innovation Programme;
- → 7th RTD Framework Programme;
- → ESF European Social Fund;

By networks we understand measures such a:

- ✓ Business networks/clubs;
- ✓ Clusters;
- ✓ Links between SMEs and universities or research and technology centres;
- ✓ Groups of SMEs;
- ✓ Inter-firms cooperation;
- ✓ Twinning between research groups.

1. LEGAL BASIS

1.1 ERDF – European Regional Development Fund

The ERDF will provide opportunities for the following supports to networks and clusters according to the eligibility of the region where they are established.

- ERDF – Article 4 – Point 1 provides that convergence regions can use the ERDF for:
  - improvement of links between SMEs and universities and research and technology centres;
  - development of business networks, public-private partnerships and clusters;
  - support for the provision of business and technology services to groups of SMEs
- ERDF – Article 5 – Points 1(a) and 1(b) provide for that through the regional competitiveness and employment objective, ERDF can be used for:
  - inter-firms cooperation;
  - promoting cooperation networks between enterprises and appropriate tertiary education and research institutions;
  - supporting business networks and clusters.
- ERDF – Article 6 – Point 2(a) provides that under the "European territorial cooperation" strand, ERDF money can be used for:
  - the creation of scientific and technological networks contributing to the balanced development of transnational areas including networks between universities and links for accessing scientific knowledge;
  - the establishment of networks between appropriate tertiary education and research institutions and SMEs;
  - twinning of technology transfer institutions.

In the explanatory memorandum of the Council decision on Community strategic guidelines on cohesion, one can read on page 19 that "*while direct grants remain important, notably in convergence regions, there is a need to focus on the provision of collective business and*

technology services to groups of firms, in order to help them improve their innovative activity."

1.2 7th Framework Programme for RTD

- FP7 RTD – Strand "Capability" – Point 2 Research for the benefit of SMEs foresees SME support for "strengthening the innovation capacity of European SMEs by extending their networks or by internationalising their knowledge networks".
- FP7 RTD – Strand "Capability" – Point 3 Regions of knowledge provides that EU money is available for "the promotion and the strengthening of cooperation between clusters, the sustainable development of existing R&D driven clusters as well as the fostering of the creation of new ones".
- FP7 RTD – Strand "Capability" – Point 4 Research potential provides funding opportunities for "strategic partnerships, including twinning between research groups both from the public and private sector".

1.3 CIP – Competitiveness and Innovation Programme

- CIP – Article 12 – Points (b) & (c) – provides for a framework for SME co-operation through "measures helping SMEs to cooperate with other enterprises across borders and the promotion of international business co-operation" and "international business cooperation, including at regional level and through SME networks favouring the coordination and development of their economic and industrial activities".
- CIP – Article 13 – Point (a) – provides for that EU funding is available for "fostering sector-specific innovation, clusters, innovation networks, public-private innovation partnerships and co-operation with relevant international organisations".

1.4 ESF – European Social Fund

- ESF – Article 3 – Point 1 (d) (ii) provides for that the ESF can support "networking activities between higher education institutions, research and technological centres and enterprises".

2. ECONOMIC DEVELOPMENT ORGANISATIONS' (EDO) CONCERNS

- How to build synergies between the supports provided by the different DGs?
- To foster partnership between universities and SMEs, EDOs have to invest in awareness raising of the mutual benefits and build trust between the two communities. This can only be achieved if the asymmetry of information between the entrepreneurs and the academics is overcome and if enterprises are made investment ready to invest in such partnership.
- Clusters can be a fashion or a political tool. It should be reminded that to be successful, a cluster needs to be endorsed by the private sector and provide real pre-competitive advantages for clusters' members. It should also be noted that the typical horizontal Michael Porter's cluster type becomes obsolete and is replaced by a sectarian vertical value chain model aiming at bringing knowledge to market. Are the EU fundings adapted to this new trend?

3. HOW TO TAKE BEST BENEFIT FROM THE EU SCHEMES

Regions should invest in stakeholders clubs, informal and formal networks aiming at:

- ✓ Analysing and answering the needs of the public intervention's end users in an approach combining demand and supply elements;
- ✓ Increasing public-private partnership (PPP) both at the strategic planning phase and in the implementation phase through private money leveraging mechanisms;
- ✓ Investing in awareness campaigns in order to better inform all the potential beneficiaries of the competitive advantages resulting from networking and clustering activities;
- ✓ Making coaching and investment readiness schemes available in order to ensure that any beneficiary of the support has developed the management capacity allowing him/her to efficiently use the support granted.

ANNEX 3: CASE STUDIES

CASE STUDIES

1. **Cambridge (biotech)** – bottom-up, typical.

2. **Oulu (ICT and telecoms)** – mixed, public research infrastructure driven at the beginning.

3. **Leuven (microelectronics and biotech)** – centred around university infrastructure.

4. **Scotland (horizontal – cross-cutting)** – PPP, public sector driven.

5. **Mechanical engineering cluster (East Westphalia)** – bottom-up, business driven, lacks local research infrastructure.

6. **Clusters in Austria:**
    a. **Styria (automotive)** – centred around Magna – large MNC.

    b. **Upper Austria (wood)** – top-down, turning into business-led.

7. '**Agency for Innovation and Development of Andalusia**' plus '**The wood furniture cluster'**

Table C: Case studies overview

	1	2	3	4	5	6a	6b	7
	Cambridge	**Oulu**	**DSP Leuven**	**Scotland**	**Mec. Eng.**	**Styrian Autocluster**	**Wood Saltzburg**	**Wood Andalusia**
Genesis	Bottom-up	Mixed	Bottom-up	Mixed	Bottom-up	Top down	Top down	Mixed
Formal Management Structure?	Indirect	No	Yes	Indirect	Yes	Yes	Yes	Indirect
Financing	No	No	Fee/ mixed	Government + projects	Contrib. + sponsors	Fee	Government + projects	No
Link to University	Yes	Yes	Yes	Not specific	No		No	No
High Tech. character?	Yes	Yes	Yes	Yes	No	Limited	No	No
Cross-border expansion?	No	Yes	Yes	No	Foresee			No
Specific activities			Networking meetings: find talented people	Develop-ment of Specific Programmers		Training, information manage-ment	Project manage-ment; sales abroad	

Research Intensive Cluster Case Study

1. Cambridge Cluster

Pre-face

The Cambridge cluster started out as a 'spontaneous' bottom up cluster which was informally organised. It has critical mass, is connected globally and has a good base of social and human capital with research strengths due to the proximity of the University of Cambridge in Lifesciences and ICT.

It is beginning to face agglomeration diseconomies such as increased congestion costs and infrastructural growth constraints. However, it continues to be a hot spot for new emerging technologies with possible 'first mover' advantage. However, it struggles with commercialising research into the new big gorilla or gazelle on a purely regional basis and therefore needs to co-operate and collaborate internationally. It also has a strong concentration of research intensive institutes and the University in the life sciences research intensive cluster.

Key issues are more seed corn funding and assistance in investment readiness and entrepreneurial training and support for larger scale prototyping and demonstrator technologies closer to market. These are areas where support from the Framework 7 could focus.

1. What were and are the Drivers behind the start of the cluster?

Genesis

The Cambridge cluster has been very much a bottom up initiative with support latterly provided by EEDA and its enterprise hub initiative. It exists because of the research base amongst the business community, not solely the University as is the perception.

It started as a result of informal networking and establishment of a club facilitated by Barclays. It subsequently grew with dedicated resource to assist with the writing of business plans and securing of finance and co-ordinated all such activity. It grew in the right political and economic environment and at the right time in the technology development loop, where significant breakthroughs were just beginning. It was also happening at the time of the Thatcher era and the Conservative Government where the 'individual' was encouraged to develop their own opportunities and roll back state intervention and when state subsidised monopolies such as BT etc were beginning to be broken down. More innovations also began to be commercialised at this time – microchip – it was the right time and right position along the technology lifecycle.

Barclays disengaged after 1986 when it considered it had done its job and it was time to hand over the reins to a suitable successor which turned out to be St John's Innovation Centre, originally conceived as a property letting centre but which has evolve to form a key focal point of all sub-regional business support services

High profile entrepreneurs emerged with successful businesses such as Hermann Hauser which led to the formation of the Cambridge Network and latter in the 90s to the formation of ERBI encouraged by GO.

The University only really engaged since 1996 when it began to engage in technology commercialisation and transfer. This was further encouraged through DTI programme of entrepreneurship being encouraged- led to establishment of Cambridge Enterprise in 1998 to encourage further the commercialisation of technology.

The cluster is unusual in European terms in that it is based on a University town or international village rather than a large conurbation or capital city. It is often perceived that the cluster is almost exclusively derived from and dependent upon the University because of its location. However, although the University is an intellectual powerhouse its role in local technology transfer is not as significant as it is perceived to be.

The University has directly and indirectly contributed to the growth of the cluster. The word 'Cambridge' is associated with quality is a strong brand with credibility and reputation for quality. Graduates form a highly skilled diverse labour force and a considerable local talent pool and the colleges themselves have been involved in the creation of science parks. The University has placed 500 students in over 150 companies within the cluster to-date.

Recently Cambridge has been recognised as one of the world's leading high-technology business clusters by Time, Fortune and Wired. Time assessed the top 50 'hottest' high tech businesses in Europe, 9 of which are in Cambridge. It has became the heart of a vibrant international technology consultancy cluster that applies leading scientific and technological 'know-how' to commercial needs.

It has played a leading part in the growth of new industry sectors such as industrial ink jet printing and a range of applications of wireless information and communication technologies.

Library House research in 2004 showed that businesses within the Cambridge Technopole secured 25% of all UK venture capital investments and 8% of European VC investments by value.

Cambridge is one of a handful of regions to be consistently ranked by the EU as 'excellent in its support of innovative start-ups'.

The University of Cambridge has spun out 300 new high tech ventures in the past 10 years, some of which now lead in their industry sectors.

2. Organisation

'Creative chaos becoming more organised'

The sub-region is a geographic area of intense high-technology activity encompassing the City of Cambridge and its hinterland approximately 25 miles in radius. The City has a population of 106,000 and the travel to work area about 500,000.

In 1978 there were around 20 high-tech businesses in the area. One of the leading UK clearing banks, Barclays plc, recognised that they could form the heart of a 'mini-cluster' and as a result they formed the Cambridge Computer Group and made one of the bank's employees available to assist start-ups with business advice and help in raising finance.

By 1985, the number of high technology businesses had increased to 360 when the significance of what was happening in Cambridge was identified by the publication of the 'Cambridge Phenomenon' report authored by Sega Quince Wicksteed (SQW) which provided an overview of the cluster's evolution.

Today the cluster is home to around 1,000 – 1,500 high technology ventures employing 40,000 people, although there are debates about the absolute number based on differing definitions. St John's Innovation Centre definition which plays a central role in the cluster defines a high tech business as 'an organisation which is seeking to exploit the science/research base for profit'. There are about 200 biotech companies included within this number.

In 1990 there was only one company listed on the UK stock market, namely Domino, but now there are 70 according to Library House.

It can be argued that Cambridge University only really began to focus on the commercialisation of research with the advent of the Vice Chancellor Sir Alec Broers in 1996. Furthermore, until 2001, academics owned most of the intellectual property and the rules were only changed in 2001 when the IP of academics funded by research grants became the property of the University. There is now considerable support for technology transfer.

The Cambridge Technopole Group was established 5 years ago in 2001 as an informal network of business support organisations operating in the greater Cambridge sub-region.

Informal but all relevant players and network of networks – simple access and staged gateway to more in depth services with proven track record leading to trust and integrity – client still felt as though individually treated.

3. Objectives

The cluster is an 'incubation cluster' for all intents and purposes and yet still has 70 Public Limited Companies (PLCs) listed on the stock market.

There is a view emerging that there needs to be a more robust action plan having identified gaps in support as to how these can be dealt with effectively overseen by EEDA/GCP and annual reviews to check progress and health of the cluster which should lead to a short business plan for the cluster.

Technopole's objectives

Mission

To improve the range and quality of the business support services available in the sub-region, particularly for companies based on technology.

Objectives

- To encourage the flow of information on new projects and initiatives between the members of the Group and to work together for the benefit of business customers
- To identify the key organisations involved in business support in the Greater Cambridge sub-region for the purposes of accurately signposting business customers
- To publicise and explain the origins and growth of the 'Cambridge Phenomenon' in order to attract and retain appropriate new businesses to the sub-region
- To identify gaps in the provision of support for businesses and to lobby for resources to fill such gaps

Organisations

Addenbrooke's and Health Enterprise East (HEE);
Cluster networks - Cambridge Network and Eastern Region Biotech Initiative;
Business support organisations - Chamber of Commerce;
Cambridgeshire Enterprise Services;
Science Parks - Cambridge Science Park, Colworth Park (Unilever);
Government – EEDA, Greater Cambridgeshire Partnership (GCP);
Finance/Angels – Great Eastern Investment Forum;
I10 – University network;
Hubs – SJIC, Babaraham Institute;
Cambridge University departments – Judge Business School, Institute for Manufacturing, Cambridge Enterprise.

The stakeholders want to move to develop annual framework for development and improvement and a review of the state of the cluster and work has just begun in this area.

4. Activities

- Entrepreneurship and skills training;
- Business plan competitions;
- Innovation support and guidance;
- Investment readiness training;
- Seed corn financing;
- Angels and VC networks;
- Sector support;
- Knowledge transfer activities;
- International trade support.

5. Financing

There is a mix of funding with the Government investing in collaborative R and D programmes for which the Cambridge cluster has to compete in open competition and in physical infrastructure as well as support the capacity development of knowledge intensive sector networks and skills training initiatives. Regional funds to support R and D and Proof of Concept are available to support individual businesses through an individual grant but with pre-qualifying conditions.

6. How has the cluster and its activities reinvented itself to make itself relevant today and what have been the major successes?

Cambridge is a relatively mature cluster. Mary Ann Feldman produced a paper in 2005 which identifies three stages of cluster development, the third stage of which is *'characterised by the emergence of serial entrepreneurs who having previously started up companies continue to engage in the community acting as business angels or continuing to initiate companies. The success of at least some of the initial companies creates synergies explored by new start ups. In this stage previously informal networks formalise and are joined by policymakers and established companies seeking opportunities. Venture Capital is moving into the area signifying that the cluster has succeeded.'*

There is a great degree of trust amongst players within the cluster which reinforces the impartiality of advice which people within the cluster can give to each other. There is also significant expertise within the cluster of people who have run businesses and are able to effectively mentor others setting out on the journey. There is a lot of common sharing of knowledge through informal but robust and reliable networks connected into the international arena. Expertise and guidance can immediately focus on the issue facing a knowledge based enterprise and know where to direct them to the appropriate support gained from first hand experience.

There is a collective sense of cohesion and community and people with a similar cultural and educational background; all within the cluster understanding what that community is and how to make things happen.

7. What are the barriers to the clusters continued growth and existence and how are these being addressed?

Recently there has been a perceived downturn in high tech start up activity which mirrors what is happening in the rest of the UK and Europe, but Cambridge would not seem to be as badly affected as elsewhere.

The question of whether Cambridge should be part of a supercluster including London and Oxford (so called Golden Triangle) has been posited as a key to its future growth and international reputation. As such it could take its place alongside Silicon Valley and Shanghai.

More emphasis given in promoting Cambridge as a place whose 'ideas change the world', possibly supported through convening a regular 'World Scientific Forum'.

<u>Tension between different viewpoints</u>
There is a continuing interaction of two opposing forces – those wishing to maintain a 'market town character' and those who want to build a leading international 'technology cluster'.

Cambridge has also developed into an innovation output of London with Oxford and Reading being two other significant outposts.

<u>Infrastructure deficit</u>
Cambridge in isolation is unlikely to create the next generation of 'big gorillas' (next generation of significant medium – large corporations) as the physical infrastructure is not in place to cater for employees of global corporations into the thousands.

<u>Failure to reach growth potential</u>
What Cambridge lacks is the indigenous development of any major high tech companies judged by large number of employees – those Cambridge firms that do grow tend to sell to bigger players internationally.

As the Cambridge Innovation Research Study 'Monitoring the High Tech Cluster in the Greater Cambridge Area' in 2006 pointed out ' if we took the entire cluster and re-organised it into one technology company it would have a very impressive R and D spend but it would still not make the top thirty global companies'.

Reasons include:

- It takes time to create a global company;

- Cambridge businesses are consequences of their environment focusing on exploitation of technology rather than growth of business;
- If companies are to grow rapidly and substantially the barrier is securing VC funding.

Recommendations to support RICs include:

- Strengthen business planning competition;
- Support for mentoring teams of graduates to explore commercialisation routes for new technologies emerging from university research;
- Support for entrepreneurs in residence at Universities;
- Fostering and supporting of networks of links to ensure continued contact with overseas students going back to China and India;
- Greater support for entrepreneurial learning;
- More finance to support funding gaps – seed funding for start ups in the biotech sector especially and grow on funding requiring 200k-5m;
- There is a great need for seed finance and to enable Governments to adopt a procurement policy for innovative products.

A major weakness around Cambridge is the current road infrastructure of the A14 and more recognition by our national Government needs to be given to 'supporting success', as a result of this, Cambridge does not receive significant national attention as to what is needed to support its international success.

8. What types of programme of support is needed to ensure the cluster overcomes any current barriers to growth and existence?

The issues facing the cluster don't change, rather a continuum of consistent support is needed which the EU can help bridge with its seven year programme. Emphasis should be given to the Framework supporting:

- Improving entrepreneurial climate and stimulation of growth;
- Helping support the placement of students to give them practical experience of applying knowledge and providing businesses with additional skilled resource, which is critical for SMEs who have short term needs;
- Small business research programme involving public sector procurement to stimulate innovation in healthcare, energy, transport and environment;
- Support for validation of new technologies which reduces time to market by facilitating early development and trials with lead customers;
- Support for helping global private investors interface with universities;
- The creation of a financial vehicle whereby long term capital is provided without the need for an early exit e.g. a long term loan with a higher than normal rate of return and an 'equity kicker' to compensate for the risk – this loan could be in the form of grants;
- Education – better stimulation of entrepreneurship in schools;
- More support and mechanisms for mentoring KBEs.

2. The case of Oulu[5]

The case study of Oulu region is about region that has undergone a dramatic economic transformation during the past five decades. The "Oulu Phenomenon" was based on a paradigm shift in the economy of the province of Ostrobothnia (where Oulu locates) of Northern Finland. It involved a move away from industries based on natural resources to those based on the knowledge economy, R&D and innovation. It ended up being an internationally renowned high-tech industrial cluster located in and around Oulu, a city only some 200 km south of the Arctic Circle and 600 km north of Finland's capital city, Helsinki, and with a population of some 200,000 in the region. Thus, despite its unfavourable geographic position, Oulu's development did not emerge in isolation, but was part of a much wider change in the global economy. Compared to the situation in the beginning of the ICT era, the change has been outstanding. In 1983, there were 27 high-tech firms in the Oulu region (employing 2,620). Today, there are about 850 high-tech companies based in the Oulu area, employing 18,500 people, with a total turnover €5 billion in 2005. (Collis *et al.* 2005; Morris *et al.* 2005; Virtanen 2006).

Evolution of the region towards high-tech cluster

Early stages of growth were based on the exploitation of natural resources. In the latter half of the 19th century, the tar trade was the major field of economic activity. Mechanical wood processing in sawmills located in the riverfront was the next field to emerge. By 1960, pulp and paper production had become the region's leading field. It remained the key sector until the next – rather unexpected – stage in regional economic development took place, i.e. the emergence of the electronics and electro-technical sector. By the late 1980s, the ICT sector was the major industrial employer in the region. Since then, this sector has been the cornerstone of the region's industrial base and economic prosperity.

The key events in the process of development of Oulu's high-tech cluster are as follows:

- The setting up of a teacher education unit in 1956 as part of central government education policy with the aim to alleviate shortages in the supply of teachers and improve educational standards in the entire area of North Finland.
- The establishment of the University in Oulu in 1958. As a deliberate action taken by the government and a core issue of the regional policy, the goal was to develop Northern Finland by means of providing high-grade technical education and to carry out research in fields considered important to the regional economy. In 1965, the department of electrical engineering was established. The department was fundamental to long term development; it "became a critical element in the chain of events contributing to the Oulu Phenomenon via subsequent growth of the early electronics industry" (Hyry 2004: 102). Furthermore, the department of information processing science was created in 1969. With the lead of long-sighted persons from industry and the academic community, R&D and teaching priorities were shifted towards electronics.
- The first company to respond was Kajaani PLC, a pulp and paper mill company, which set up Kajaani Electronics in Oulu in 1970. Then Nokia comes in the picture[6]: it

[5] Bibliographic references for the Oulu case study are reported at the end of this section.

opened Nokia Electronics in Oulu in 1972. At that time, Nokia received an order from the Finnish army for the production of military radio equipment based on an American licence, and, by the mid-70s, the production and development of radio telephone networks for civilian use began in Oulu. In the beginning, the main reason for Nokia locating telecommunications in Oulu was not that much the university but the high turnover of workers and lack of premises in Helsinki combined with a stable workforce, lower wages and the availability of premises in Oulu, and government subsidiaries available (Collis *et al.* 2005; Oinas-Kukkonen *et. al.* 2006). Later on, the importance of the university has become obvious and undeniable. In the late 1980's Oulu was given the responsibility for the development of base stations for the new second generation digital mobile phones. The rapid increase in demand for base stations could not be met in Oulu alone, so Nokia also set up base station manufacturing facilities abroad, including two facilities in China. In Oulu, base station work was not only on manufacturing but increasingly on development work. With respect to mobile phones, jobs in Oulu were all in development activities. At the beginning of the 21st century, both parts of the industry (base stations and mobile phones) were of equal size, each employing about 2,000 people. In sum, in the early stages of the development of the high-tech cluster, it was the big firms that played a key role. Later on, the role of the smaller firms has become equally important. A significant share of these firms was spin-offs from the university and VTT or established by former students of the University of Oulu. (Oinas-Kukkonen *et. al.* 2006)

- In the beginning of the 1970's, central administration, namely the Ministry of Trade and Industry and the Ministry of Labour, had offices in the provinces. These offices were responsible for allocating funds to public and private sector organizations for regional development activities and for industrial training. The primary aim was to tackle employment problems and population loss through improvements in infrastructure. These branch offices of the central government started to fund public and private research laboratories in Oulu by the mid-70s. Alongside these branch offices were a series of specific planning committees. Their role was to take initiatives on behalf of central government. In the early 1970s, the Lapland–Oulu committee focused on education issues and on how to encourage the developing electronics industry in Finland to invest in northern Finland. With the help of Oulu University, the committee organized three high-level seminars on the electronics industry. These seminars served as a platform for sharing opinions on the electronics industry, its future prospects, its demands on education and research, and the local factors and prerequisites relevant for this kind of industry. Some 30 years after these seminars, they are still referred to as golden moments that paved the way towards the formation of a successful ICT cluster. (Hyry 2004).
- In 1974, two laboratories (electronics; construction technology) of the state-owned Technical Research Centre of Finland (VTT, the largest government R&D institute in the Nordic Countries and locating mostly in the Greater Helsinki area) were located in Oulu. These were followed by a computer technology laboratory in 1982. The institute developed close relations with the University of Oulu and with local firms, thereby contributing to the process of sector change and regional development in Oulu.
- In 1982, Oulun Teknologiakylä Oy (Oulu Technology Park Ltd), later Technopolis Plc – the first science park in the Nordic Countries and today one of the largest and best-known technology centres in Europe – was established. The regional plan for Northern Ostrobothnia (1981) proposed the founding of a high tech area in Oulu near

[6] The genesis of Nokia's activities in radiotelephone-related activities dates back to 1960, when it established a small department of electronics in Helsinki. In this site, the development of industrial and radio electronics started in 1962.

the University and the VTT laboratories. In 1981, the Oulu City Council set up a committee to launch the technology park project. The tech park company was formed in 1982 and the first partners were the City of Oulu, the University of Oulu, KERA (the Regional Development Funding Agency) and 19 privately owned firms. In 1983 the city authorities declared Oulu to be a 'City of Technology' in an effort to create and build up its technology image. This effort became particularly important later on in the 1980's when plant closures in the traditional industries occurred. (e.g. Collis *et al.* 2005)

- Due to the apparent and growing importance of technology issues in industrial policy, Tekes – Finnish Funding Agency for Technology and Innovation – was established in 1982. The Oulu region became one of the biggest beneficiaries of this funding. The region's share of R&D expenditure (per capita) was 3.2 times more than the average in Finland in 2005.
- The role of technology programmes initiated by Tekes and research programmes set up by the Academy of Finland has been essential as promoters of (regional) multilateral networking and as platforms for more intense, long-term R&D co-operation between business enterprises, universities and government R&D institutes. Thus, public STI financing agencies that also act as expert organisations on policy issues can play a big role as facilitators of multilateral collaboration, in raising the quality of STI, and in reaching a better match between supply and demand/needs. Actually, one of the key success factors of the Finnish innovation system has been the well-functioning middle-/meso-level of the system, i.e. policy and funding organisations operating between the government-level and the actual research organisations (enterprises, universities, polytechnics, R&D institutes, etc.).

Explaining the success

The importance of the university in the region has been demonstrated in various ways. Important contributions made by the university include the provision of graduate and post graduate courses in, for example, telecommunications and business, in particular tailored courses to provide skilled labour and develop courses to meet the needs of local industry (Donnelly & Hyry 2004: 147). For instance, in 1982–1992, more than half of business start-ups in Oulu were by graduates of the university. The University's research relevant to local business has been an important part of its activities and has led to a number of small firm spin offs. The University has enhanced the local learning environment by acting as a host to the Northern Lights Association, a network of local business people and regional administrators who meet regularly to discuss new initiatives to develop the local business environment.

In a nutshell, the economic transformation was partly the result of the foresight of senior academics at Oulu University and partly due to the effective interaction between the local civic authorities, the University, local entrepreneurs, VTT, and ultimately of Nokia Corporation. Social and business networking has played a crucial role in the development of Oulu's regional economy. In many cases, successful operations depend on personal relationships more than organizations. For instance, there are many people working at the premises of Technopolis who know each other from their student days; these networks will remain throughout their entire life (Virtanen 2001: 29). Hyry (2001: 151) stresses that proximity and personal relations have facilitated the relations between firms in the areas of outsourcing and subcontracting which in turn have been reinforced by informal networking among firms. The combined roles of the University, VTT and Technopolis and their collective activities with the City of Oulu should not be underestimated as a central factor in the growth and development of co-operation and networking. In addition, the role of an anchor firm, Nokia, and of small high-tech enterprises in the later stages of the evolution of the cluster has been essential. Most firms of the cluster were initially small and self-funded and had only

few employees. The funds for growth came primarily from retained profits rather than from external sources of funds. The failure rate of small firms has been low, the majority surviving for 10 years or more. Many of the surviving firms have shifted their field of expertise over time in response to the rapid pace of technological development.

There are several factors and incidents that at least partially explain the success of Oulu ICT cluster. One interpretation of Oulu's factors of success is as follows (Oinas-Kukkonen *et al.* 2006: 30–31): 1) Leading-edge academic research on a diverse portfolio of industry-relevant topics and dissemination of research results to the industry; 2) Academic researchers becoming entrepreneurs and bringing their innovations to existing companies or new start up companies; 3) Industrial cluster capable of renewal and willingness to expand and diversify its product portfolio using new opportunities provided by innovations coming within the industry and from academic research; 4) Restructuring of industry where new products or product lines are spun-off from the mother company; 5) Fast growing companies form a cluster that becomes a new industrial base for diversification; 6) Sufficient availability of well-educated workforce, and existence of critical mass of infrastructure, industrial base and relevant STI support services. Furthermore, it also needs to be emphasised that the co-operation culture in the region has evolved, deepened and diversified since the 1980s. For instance, as described by Ali-Yrkkö (2001), Nokia's co-operative relations in the 1980s were based on subcontracting in manufacturing. Then in the early 1990s, more deep and versatile partnerships in manufacturing were created. In the field of R&D, from the late 1990s to 2000s, collaborative relations developed from R&D subcontracting-based activity to building up long-term partnerships.

The future of the cluster: importance of proactive measures

Today, Technopolis offers corporate customers both modern facilities and comprehensive, high-quality services with the objective to support the growth and success of the companies. Technopolis has developed its concept with technology companies in mind, and the service companies that support them. It continues to refine this concept on the basis of feedback from customers. Technopolis is already a major player in almost all of the important high-tech communities in Finland; currently, it runs technology centres not only in Oulu but also in the Helsinki metropolitan area and in towns of Lappeenranta, Jyväskylä and Tampere. It is, however, still seeking to expand both in its present locations and elsewhere. There is particular interest in the markets in Russia and the Baltic States. In 2007, Technopolis will open up a technology centre in St Petersburg. This is intended for both Finnish and foreign companies, and it is to be one of the first technology centres in Russia running advanced, modern principles. Hence, despite Technopolis starting with a strong local perspective, it has become a facilitator and a hub for global activities. In all, the units of Technopolis house 930 customer companies, which employ a total of 12,000 people. In Oulu alone, Technopolis is a cluster of some 4,000 experts, with almost 200 companies working closely together. The customers represent a wide range of high-tech fields plus service and specialist companies and branches of research and training institutions. There are also various testing and product development environments. (Arokylä 2006)

What about the future of the Oulu ICT cluster? Currently, as a response to (global) challenges, there are several national and regional policies and public and private support measures that aim at enhancing RIC and science park related activities. From the point of view of Oulu, the major objective is that regional economy in general and the RIC in particular will be successful and overcome possible barriers to growth. The major policies and actions include: 1) Centre of Expertise Programme, which is a tool to pool local and regional resources and link these with other relevant resources located elsewhere; 2) regional innovation strategies and strategy processes developed, adopted and implemented in Oulu region; 3) continuous development of Technopolis Science Park, public and private

development companies and other intermediaries; 4) national and regional R&D and technology programmes as a vehicle for the development of RICs and science parks.

Finnish regional innovation policy is implemented through *the Centre of Expertise Programme* in particular. The Ministry of Interior runs the programme, which is actually a joint action by five ministries, the Science Park Association and other stakeholders. The national programme supports regional strengths and specialisation. It also aims at enhancing co-operation between the different centres of expertise (in the programme period 2000–2006, there were a total of 22 centres of expertise, and they represented 45 different fields of expertise). The centres appointed by the Government implemented the programme at local level. A new six-year programme that is managed by the Ministry of Trade and Industry and the Ministry of Interior together was launched in January 2007. The centres of expertise launch co-operation projects between the research sector, educational institutions and enterprises. The goal is to boost the competitiveness of companies, strengthen regional expertise, create new businesses and promote the creation of new innovation environments. (See MoI 2006)

The role of *research and technology programmes* launched by Tekes and the Academy of Finland has been significant in many respects. For instance, the impacts of Tekes' electronics and telecommunications technology programmes have been essential in promoting multi-lateral networking between partners in Oulu. In addition to considerable impacts on business, development of technology, risk-taking capacity and innovation, the role of technology programmes especially in networking and cluster formation has been significant. Although ICT cluster in Oulu is very self-sustaining, there have been participants from around the country in the Oulu-driven development programmes. During this decade, in two Tekes' ICT-related programmes (total budget of some €300 million with Tekes funding of some €140 million), there has been altogether some 420 enterprises and 110 R&D units collaborating with each other in these programmes. A relatively large share of these enterprises and research units were either from Oulu region or linked closely to the Oulu ICT cluster. Currently, similar kinds of new programmes are running.

With the stimulation of funding from the EU Structural Funds, a major effort has been carried out to integrate separate initiatives, actions and programmes in the Oulu region within the framework of the so-called *Oulu Growth agreement*. The agreement is orchestrated by Oulu Innovation Ltd., which is also responsible for steering Oulu region Centre of Expertise activities. The agreement focuses on five clusters, ICT being one of them. Industry forums that bring together some 150 enterprises are the core feature of the cluster development programmes of the agreement. *The Mobile Forum* is supporting R&D and business development for mobile products and services and the exploitation of the spearhead initiative *Octopus* network, which is an open innovation and testing environment for mobile technologies. Octopus also provides education in mobile technology related fields. As funded by the EU in 2002–2004, Octopus has partnered with Nokia and some 60 other companies, City of Oulu and HEIs of the region. The annual budget of Octopus has been above €5 million. (OECD 2005: 100–102)

Moreover, in order to form a more coherent and consistent supra-regional vision of the globalising operating environment and to anchor joint strategies and actions in this environment, the *Multipolis network* has been launched by Technopolis. This network covers northern Finland and is linked to other centres in northern Sweden and northern Norway. Themes of specialisation of the Multipolis network are telecommunications, wellness technologies and cold climate expertise. Close co-operation combines the know-how of regionally operating centres of expertise, thus fostering the capacity for innovation and enhancing competitiveness of the participants of the network. (See OECD 2005)

Research Intensive Cluster Case Study template: Oulu ICT cluster

1. What were and are the drivers behind the start of the cluster?

The development of education and R&D system took place first between the 1950s and 1970s. This was mainly based on top-down activities, i.e. actions were carried out by public authorities at both national and regional/provincial level. Bottom-up approach with a clear vision of Oulu as a high-tech city originates to events in the turn of the 1970s and 1980s, when municipal authorities, the business sector and representatives of the university of Oulu jointly started to prepare an ambitious plan aiming at realising this vision. As a first concrete move, a technology centre/science park – which is currently a central player and key organiser of the Oulu cluster – was established. Later on, since the mid 1990s, Oulu's development has clearly been based on a very strong bottom-up approach, i.e. activities designed and carried out by business enterprises together with far-sighted individuals (from business life and academia) and with the help of public support. This support combined with private investments is allocated to the formation of multilateral co-operative networks and other inter-active instruments, and modes of action (especially R&D and innovation activities) based on public–private partnerships.

2. Organisation

The activities of the Oulu cluster is build upon numerous individual private and public organisations. These organisations work together in a very close co-operation and carry out (private and public) regional and national R&D and other development projects and programmes. Since the volume of activities is high and several projects are going on at the same time, the cluster needs someone to keep all this together and coherent. The cluster is mainly orchestrated by Technopolis Plc science park company.

3. Objectives

Oulu cluster, in general: the common good; increase citizens' well-being; more and better jobs; creation and exploitation of such knowledge and expertise that are of critical importance for the economy and society.

Science Park/IT cluster, in particular: different players – university, VTT, enterprises, Technopolis Ltd., regional and national authorities – have naturally different objectives. But the goals are also partially parallel with each other. This enables fruitful collaboration and ensures that different stakeholders of the cluster share similar visions, interests and goals.

4. Activities

Numerous activities include: regional and inter-regional development plans prepared by regional authorities together with other stakeholders of the Oulu cluster; strategies on collective actions and division of labour jointly designed by HEIs of the region; development programmes implemented by Technopolis and/or other intermediaries; business plans designed and implemented by groups of enterprises having mutual views and interests; tailored development projects that respond to the needs of starting companies, SMEs and other economic players (needs can vary from demand of business information to services helping companies to enter international markets).

5. Financing

Since the Oulu ICT cluster is not a project, single programme or financed/steered by a single organisation, it is extremely difficult to estimate the volume of total funding of STI and other development activities in the cluster. However, one option is to study the volume of R&D expenditure in the region. In 2005, the volume of R&D expenditure in the Oulu region was €688 million (i.e. some €3.400 per capita, which presumably is one of the highest figures in the EU). Enterprises account a lion's share of these expenditures; €85 million is spent in the university (Statistics Finland 2007). The volume of public sector's (incl. VTT) expenditure in R&D is approximately between €30–40 million. Moreover, in 2005, Finnish private equity

companies made investments worth of some €35 million to both in new and established companies located in Northern Finland (Yearbook 2006). As a major player in the province, it is evident that Oulu was the main receiver of these investments. Unfortunately, reliable and comprehensive statistics on all (regional) STI related activities does not exist.

6. *How has the cluster and its activities reinvented itself to make itself relevant today and what have been the major successes?*

The last 6 paragraphs of the short story on Oulu give examples of public–private partnerships and other (policy) activities that aim at reinventing the ICT cluster and keeping it successful also in the future.

In general terms, special attention should be paid at keeping social culture as open and transparent as possible. At least up to now, this innovation-friendly culture has facilitated the creation of shared visions and mental models and increased willingness to build up networks, to collaborate and to share knowledge and expertise. This valuable, intangible success factor – social capital – has kept *the triple helix of Oulu cluster* (university, VTT, enterprises, intermediaries, City of Oulu) tightly together, intensified multi-lateral inter-action and maintained the dynamic relations between all the stakeholders.

7. *What are the barriers to the clusters continued growth and existence and how are these being addressed?*

- Further financing needs to be allocated to STI; short supply of venture capital could be a barrier to knowledge-intensive start-ups and young companies.
- More foreign direct investments and foreign experts, researchers and other talents should be attracted to the region.
- Fragmented system of public and private STI support organisations/agencies may lead to inefficiencies, market failures and systemic failures (f. ex. overlapping support actions, and funding and other support gabs in the services of intermediaries).
- There should be a better ability to exploit R&D results and translate them into innovations (practical appliances, goods, processes and services).
- Entrepreneurial atmosphere needs to be strengthened.
- Sufficient availability of well-educated workforce and supply of qualified scientists needs to be ensured by joint activities carried out by private and public sectors.
- How to maintain and stimulate the growth of high-tech activities in general and knowledge-intensive start-up activities in particular is one of the key future challenges. As economic history has taught to all of us, successful regions of one economic era have turned to be less successful in the next era, and players in Oulu cluster are aware of this. The central feature is to maintain the capacity for renewal, avoid institutional rigidities and cope with the risks involved in STI work and sunk costs related to previous infrastructures.

8. *What types of programme of support is needed to ensure the cluster overcomes any current barriers to growth and existence?*

See point 6.

<u>The Oulu story is based on the following studies:</u>

Ali-Yrkkö, J. (2001). Nokia's networking. Gaining competitiveness from co-operation. *ETLA B* 174.

Arokylä, K. (2006). Technopolis Plc – a big, successful European technology centre. <*http://virtual.finland.fi/netcomm/news/showarticle.asp?intNWSAID=54541*>.

Collis, C., T. Donnelly & M. Hyry (2005). Sectoral Change and Regional Economic Development in the Oulu Region of Northern Finland: the role of the High-Tech Industrial Cluster by the Arctic Circle. A paper presented at the Regional Studies Association's international conference on 'Regional growth agendas', 28.–31.5.2005, University of Aalborg, Denmark.

Donnelly, T. & M. Hyry (2004). Urban and regional high technologies: the case of Oulu. *Local Economy* 19: 2, 134–149.

Hyry, M. (2004). Industrial growth and development in Northern Finland: the case of Oulu 1970–2002. Unpublished PhD thesis.

MoI [Ministry of the Interior] (2006). Regional innovation policy and the Centre of Expertise Programme. <*http://www.intermin.fi/intermin/home.nsf/pages/index_eng*>.

Morris, D., T. Donnelly & M. Hyry (2005). The Oulu Phenomenon. Paper presented at "Balestrand Conference: Towards a New Nordic Regionalism?", the conference for policy-makers and researchers organised by the Nordic Network of the Regional Studies Association, 4.–5.5.2006.

OECD (2005). *Territorial reviews, Finland*. OECD, Paris.

Oinas-Kukkonen, H., J. Similä & P. Pulli (2006). Main trends of ICT innovation in Oulu in 1960–1990. Paper presented at the XIV International Economic History Congress, 21.–25.8.2006, Helsinki, Finland.

Statistics Finland (2007). *Tutkimus- ja kehittämistoiminta 2005*. Statistics Finland, Helsinki.

Virtanen, H. (2001). Oulu – Silicon Valley of the North. *Business Finland* 2001, 26–30.

Yearbook 2006 (2006). The Finnish Venture Capital Association, Helsinki.

3. Leuven – A region for high tech entrepreneurship

Centrally located in Flanders/Belgium, the Leuven region, with its renowned knowledge institutes, its science parks and its presence of venture capitalists, provides a fertile breeding-ground for spin-off companies as well as for international research-intensive businesses. Knowledge institutes like the K.U. Leuven, the Gasthuisberg University Hospital and the Inter-university Micro-Electronics Centre (IMEC) generate a huge inflow of state-of-the-art knowledge that may bring about innovative ideas for new as well as existing companies.

The City of Leuven, in close co-operation with K. U. Leuven, has created a favourable business climate for high-tech entrepreneurship. They are active partners in the setting up of a number of networking initiatives and technology clusters, like:

- LEUVEN INC - L-SEC - DSP Valley

As well as in the planning, setting up and exploitation of incubators, science parks and business centres in the Leuven region, like:

- Haasrode Science Park - Arenberg Science Park

DSP Valley Leuven

Mission statement
DSP Valley is a technology network organisation, focusing on the design of hardware and software technology for digital signal processing systems. DSP Valley groups members of different kinds: universities, research institutes and industrial companies (from small start-ups to large international groups).

1. What were and are the drivers behind the start of the cluster?

At the start of the cluster, there were mainly 3 godfathers: K. U. Leuven, Philips in Leuven and IMEC. Each of them had their own arguments for starting the cluster:

- K. U. Leuven (Leuven University) wanted to participate in more EU-framework projects, and hoped to achieve this goal by better networking with industry;
- Philips Leuven wanted to secure their activities in the region, against the thread of globalization and against the pressure of the not-too-far-away R&D headquarters of Philips in Eindhoven. They wanted to prove the need for the presence in Leuven, by proving that they create a lot of added value for Philips through local cooperation with other (local) cluster partners.
- IMEC wanted to prove to the regional Flemish government, that their yearly grant results in a return-on-investment through a spill-over to the local environment, by creating a local eco-system with spin-offs and start-ups making use of technologies developed at IMEC. The existence of a cluster was a good proof for that local eco-system.

2. Organization

Initially, the cluster was shaped by some like-minded individuals, coming together on a monthly basis for exchanging ideas, on an informal base.

Very soon (in December 1996), a formal legal entity "DSP VALLEY vzw" was founded: it was chosen to create a not-for-profit (= vzw) networking organization, headquartered in Leuven, Belgium. In its first days, this legal entity was managed by a free-lance consultant, being remunerated by commissions on certain achievements and results. This construction has been replaced very soon by a permanent management, employed by the legal entity. Since December 1998, DSP Valley has its full-time managing director, joined 1 year later by a logistics and administrative support staff. The team further expanded to 4 people.

In April 2005, the organization was further expanded with a subsidiary in Eindhoven, the Netherlands. Today, the Dutch branch of DSP Valley also has its own director. In this case, this person is contracted from Philips.

At the time of its formal creation, the DSP Valley legal entity has been co-founded by 8 organizations (3 universities, 1 research institute, 2 multi-national companies and 2 SME's). It has grown to a membership-based organization with over 50 members today (membership is always a corporate membership). About 1/3 of the members comes from the academic world, about 1/3 is a multi-national company represented by its local design and development centre, about 1/3 is a locally grown SME or spin-off or start-up, resulting in a very balanced mix of participants.

Key players are IMEC, Philips (now partially split-up into Philips and NXP Semiconductors) and the K. U. Leuven (Leuven University). They were also the 3 godfathers behind the creation of the cluster.

3. Objectives

The primary objective of the cluster is to stimulate new innovative partnerships by the cluster participants, exploiting complementarities in technologies and know-how, and mutually strengthening the competitive position of each partner. "Partnerships" can happen in many ways: traditional client-vendor relationships, joint partnering in subsidized programs (e.g. by the EU's 7th FWP or by the regional government), research cooperation between industry and academia, teaming up in a partnership for joint development for a 3rd party…

In order to realize this primary objective, the cluster organizes a platform where the cluster participants can meet each other in many different ways, where they can create a better exposure for their offering, and where they can learn more about each other's competencies.

A secondary objective of the cluster is to attract new investors to the region. By doing so, new opportunities for cooperation and partnerships are being offered to the already present cluster participants.

4. Activities

The primary activities of the cluster are networking meetings with the members of the DSP Valley network. The objective of these meetings has been explained above: creating a better

exposure for the available technologies and competencies, and better knowing each other. These networking events include different types:

- Member meetings with company presentations and visits;
- Technology seminars;
- Business-to-business matchmaking and brokerage events;
- A university-to-business matchmaking event;
- Social events;
- An international symposium.

On the other hand, the cluster also participates, together with network members, in internationals events, like exhibitions and trade fairs.

The cluster also participates in student information days and job fairs, again representing its members (SME's in particular). More in general, the clusters supports the participating organizations in finding the needed talented people, e.g. with the announcement of vacancies via the thematically focused DSP Valley website.

5. Financing

Financing is achieved through a mixed private-public financing. Main financing sources are:

- Membership contributions (= private financing; about 25% of yearly income) by industry and by academic organizations.
- Project subsidies, for innovation stimulation projects by facilitating support organizations (= public financing, about 35%) by the regional Flemish government.
- Project subsidies, for stimulation of cross-boundary cooperation (= public financing, about 20%) by the European Interreg program. This financing is being used for the cluster and network extension across the Flemish-Dutch border.
- Participation fees for technical seminars, workshops and symposia (= private financing, about 10%), mainly from non-members.
- Subsidies for international trade initiatives, such as participation in international trade fairs (= public financing, about 5%) by the Flemish agency for international trade, combined with a financial contribution (= private financing, about 5%) by the industrial participants in the DSP Valley initiatives.

The total annual budget for the DSP Valley network is about 800k €.

None of the financing resources can be considered as a "free lunch". For the membership contributions, the members expect to create a return-on-investment (through new partnerships, recruitment of specialized staff, acquisition of necessary information, acquisition of business leads at international trade fairs…).

The main stream of public financing is on a project-base. That means that a project proposal or project plan is available, including measurable deliverables and milestones. At the lowest level, deliverables are expressed as: number of member meeting, number of technology seminars, number of people and organizations attending the events, percentage of SME's involved in the participants, number of published newsletters… In fact this represents a measurement of the used resources. On the other hand, the project evaluation is changing to a measurement of results: number of newly created or stimulated partnerships, number of companies starting to use new technologies available from the cluster participants…

However, this is a difficult exercise, since the cluster (or the network) has neither direct control nor decision power in this process. The cluster has only influencing power and can only distribute relevant information (in so far that this information is not confidential).

Even in the case of a clearly proven impact of the networking and clustering on a newly formed partnership, it remains a problem to quantify the value. That means that return-on-investment for the participants is more a question of perception than a question of numbers. E.g. it is difficult to quantify what is the (added) value created by the network in a new partnership: is it the total value of the project? Is it the created margin? Or only a percentage of it?

6. How has the cluster and its activities reinvented itself to make itself relevant today and what have been the major successes?

Since the start, the activities of the cluster did not change dramatically. Nevertheless, it remains a constant challenge for the cluster management to keep the activities attractive to the participants, by introducing new concepts (e.g. the B2B matchmaking) or external speakers. The organization of cluster or networking activities shall not degrade to a routine job, with always exactly the same type of agenda (although it remains the main objective that participants should be able to learn about each other's offerings).

Major successes are found in the establishment of new partnerships. Today it is a fact that ALL participants of the DSP Valley networking activities have strategic and long-term partnerships with at least 3 other network-participants. Although DSP Valley does not claim that all these partnerships have been established exclusively through the networking, a representative number of these partnerships can be traced with 100% certainty to a contact created at one of the networking activities or event organized by DSP Valley.

By establishing these new partnerships, the participants create a return-on-investment for the payment of their membership contribution (which can be as high as 20.000 EUR / year). It is a permanent challenge for the DSP Valley cluster management that return-on-investment is realized for all cluster participants. If not, they will loose interest, and they will not longer participate actively.

DSP Valley has reinvented itself by expanding geographically from Leuven to Eindhoven. Through this geographic expansion, the interest of the cluster participants increased, because of the new partnership opportunities created by the new members. Moreover, for some smaller companies, this was also an excellent chance for expanding their market, with the support of the cluster. The renewed and increased interest for the networking is illustrated by the doubling of the growth rate of the number of members.

7. What are the barriers to the clusters' continued growth and existence and how are these being addressed?

Growth of the cluster (larger number of members) may also results in a lower active participation percentage, because of the lesser intensive personal contacts between the member representatives. It is a challenge for the cluster management that all member representatives do know each other personally.

On the other hand, the geographic expansion also introduced more important travelling. Where most member activities were taking place in the Leuven region before the expansion (resulting in maximum travelling time of 30'), the member events are now alternatively being

organized in the Leuven and the Eindhoven region, which may result in travelling time up to 1h30 (x2 for the return journey).

DSP Valley intends to address this growth problem by offering local member events either for the Leuven community or for the Eindhoven community, with common meeting and contact moments in addition. The (yearly) B2B matchmaking event is a good example of member event that will remain common for the whole cluster community.

8. What types of programs of support are needed to ensure the cluster overcomes any current barriers to growth and existence?

At least in Flanders, a well-adapted support program for “innovation stimulation” is available, typically addressing intermediate organizations or facilitators. The problem may be that more and more clusters are proposing activities within a rather constant budgetary envelope, reducing the financial support per individual initiative: the same budget has to be shared by more players in the field. This problem can be solved (partially) by a consolidation of the existing clusters and networks. Mergers should be stimulated, such that the individual initiatives gain critical mass and competitive strength. On the other hand, the financial support needed to run and manage a successful cluster is not unlimited. A well focused cluster management can create a lot of successes with a limited team of +/- 5 people (an increasing number of cluster participants do not require an increasing number of events: the agenda of the participants has constraints any way…).

At European level, DSP Valley only has experience with the Interreg support program. Although the scope of this program is fully in line with the objectives of the DSP Valley cluster, the administrative part of the European project is very heavy compared with the local Flemish administrative requirements. Especially for a small organization as DSP Valley is, the administration should be reduced and should be made easier than it is today.

Probably other European financing instruments exist for cluster organizations, but they are not known to DSP Valley, which is and remains a private SME without the resources for permanent lobbying at the European institutions.

4. Scottish Enterprise

Clusters & Industries Strategy
1993-2007

Executive Summary

The clusters' strategy adopted by Scottish Enterprise during the last decade has helped to boost Scottish economic activity and deliver on a policy built on strengthening Scotland's competitive capability as it was transformed from a traditional to a "knowledge-based" economy.

The strategy, developed originally on the "Porter" model and praised as a policy initiative which led economic development thinking in Europe, has evolved into a key means of focused support to key "priority industries", embracing Electronic Markets, Food and Drink, Energy, Life Sciences, Tourism and Financial Services.

The strategy has led, amongst other things, to the creation of three Intermediary Technology Institutes (ITIs) for Life Sciences, TechMedia and Energy. These are currently in the third year of a 10-year funded plan and their remit is to source and discover protectable Intellectual Property and match it to market opportunities. (www.itiscotland.com)

The concentration of activity behind priority industries recognises that these industries are currently in a high growth-curve across global markets, and offer the greatest potential to provide future sustainable corporate, SME and employment growth in Scotland.

For example, Financial Services is worth £5bn to the Scottish economy and sustains more than 100,000 jobs. Tourism is worth £4.2bn and sustains 200,000 jobs. Significant economic contribution is made in the energy sector, principally through the offshore oil and gas industry, but increasingly in renewable energy sources.

Scotland's world-renowned strengths in academic and institutional research, especially strong in the Life Sciences and Design Electronics sectors, are actively supported by the clusters / priority industries sector.

This case study details the history of the strategy, how it has evolved and plans for its future development.

About Scottish Enterprise

Scottish Enterprise is the main economic development agency for Scotland, covering 93 per cent of the population, from Grampian to the Borders. The Scottish Enterprise Network consists of Scottish Enterprise and 12 Local Enterprise Companies. Working in partnership with the private and public sectors the Network aims to build more and better businesses, to develop the skills and knowledge of Scottish people, and to encourage innovation, to make Scottish business internationally competitive. More information is available at www.scottish-enterprise.com

Key successes

Scottish Enterprise's strategy has been rooted firmly in working with the private sector and areas of academic research to address market gaps and opportunities, build on Scotland's existing strengths, and exploit areas where Scotland has potential strengths.

This strategy has worked across a range of priority industries, selected after careful research and evaluation. Key support initiatives have included the Proof of Concept (PoC) Programme, which provides finance to enable researchers to spend additional time bringing an idea or technological breakthrough into the commercial field.

Independent evaluation completed in 2006 found that the PoC programme will generate gross value added (GVA) of £125 million for the Scottish economy, at an initial investment cost of £28 million.

The research, conducted by Pricewaterhousecoopers LLP, examined the economic and wider impacts of six rounds of funding between 2000 and 2006, and concluded that 80 per cent of projects would not have achieved commercial success without the Programme, which currently supports 184 projects providing 500 jobs.

While for some industries such as Life Sciences the key role of Scottish Enterprise has been to encourage greater collaboration between research and the private sector, or to facilitate world-class research that leverage's existing strengths, the strategy has also embraced the "softer skills" such as training and development.

In Financial Services, an immensely buoyant industry, support has provided a focus on infrastructure and skills, with 3,000 people trained for jobs in the sector. Productivity output has risen in Tourism, thanks to joint initiatives with the industry.

Across all sectors, an emphasis on helping business start—ups, improving management and identifying potential companies of scale have combined to ensure more sustainable companies and cemented Scotland's position in the global competitive environment.

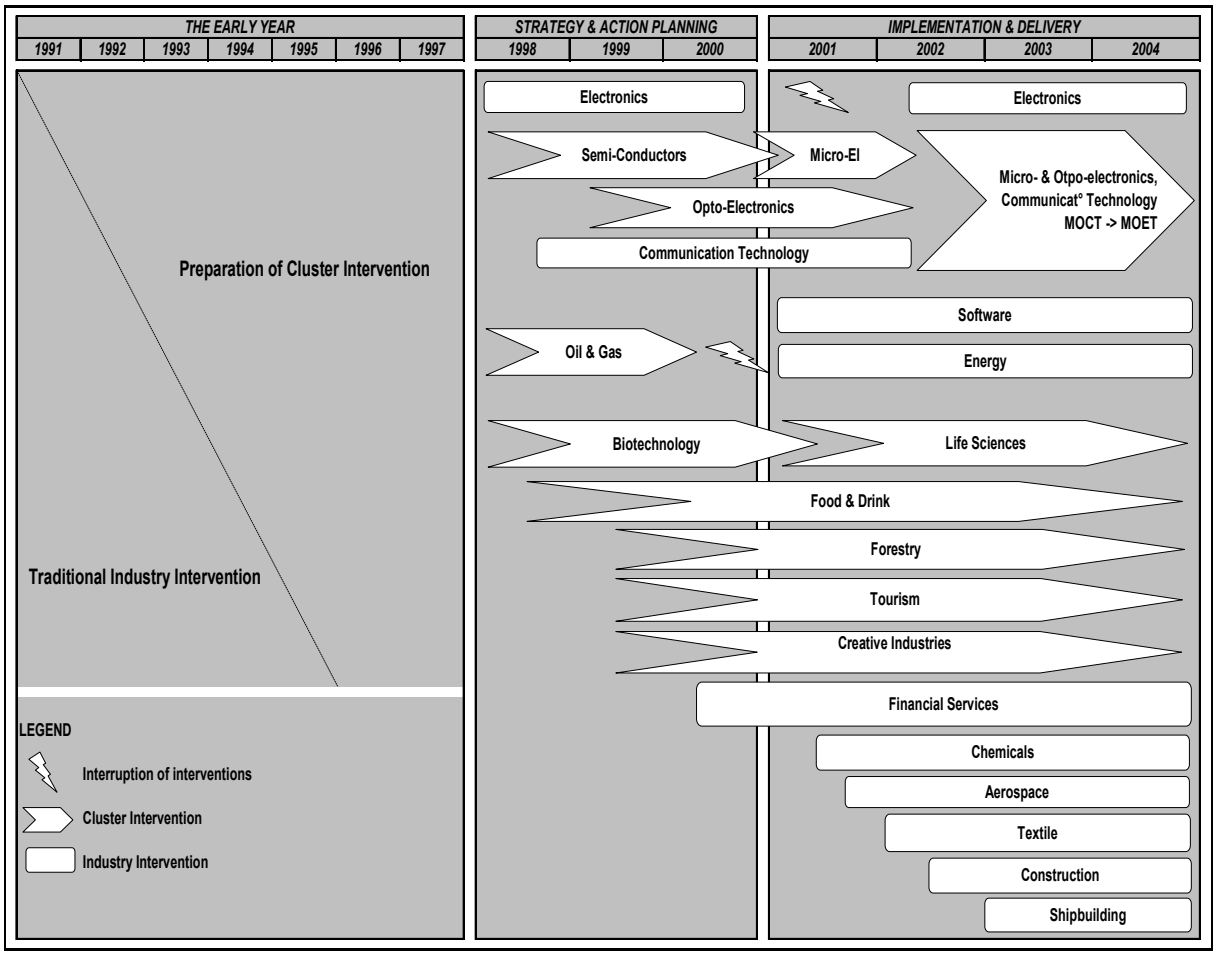
This is about a long-term strategy which builds and sustains a pipeline of new and existing businesses, capable of significant growth. It operates in the context of a priority industries' strategy that includes a High-Growth Start-up Unit, and investment and support in skills and workforce development, business infrastructure, international activity and encouraging the development of an investment community that supports each state of company growth.

History

Scottish Enterprise first embraced a "clusters" strategy following considerable research undertaken with the international consultancy Monitor Group during 1991-93. The intention was to establish Scotland's strengths in key industries, using criteria including the share of world markets, export volume, share of employment, value-added, growth rates, research and development (R&D) capability and the reputation of leading firms.

The initial research, and the various developments witnessed during most of the 1990s, was driven by the work of Michael Porter and Monitor, based on Porter's study, ***The Competitive Advantage of Nations (1990)***. The work undertaken in Scotland was amongst the first such approach to be taken in Europe, and was perceived to be pioneering both in the UK and within the European Union (EU).

General chronology of Scottish Enterprise's cluster and industry policy interventions over time.



Source: ECOTEC, 2005

Key drivers behind the cluster strategy

Initially the research work into a "cluster strategy" for Scotland was driven by the decline of traditional source of major economic activity and employment, and the development of newer industries, or the continued strength of industries where Scotland had a particular strength related to natural resources, environment, academic research or the skills base of its labour force.

These drivers were augmented by key developments in the global market environment which meant that Scotland had a strong position, or where it was agreed that a strong position might be achieved with appropriate intervention.

The implementation of clusters strategy has been influenced strongly by developing international market trends, opportunities arising from particular research strengths, and the views of the participating industries.

This has led to creation of six "national clusters" addressed specifically by dedicated teams within Scottish Enterprise, with recognition and support for and additional six regional

industries where Scotland has particular strengths or potential. These "clusters" are now described by Scottish Enterprise as "Priority Industries".

Scottish political devolution and the creation of the Parliament in 1999 led to a more "locally-led" policy approach to economic development, and the creation of an overall strategy, "***Smart, Successful Scotland***". That initiative, and its "refresh" in 2005, embraced the cluster-based approach initiated by Scottish Enterprise during the previous decade.

Global market changes have influenced cluster strategy throughout its development in Scotland. For example, a dependence on the electronics industry (and particularly hardware manufacture) gave way to greater emphasis on knowledge-led activity in this sector. Where previously support was given to creative industries, communications technologies and digital media, convergence has influenced the creation of a team supporting the broader activity of "Electronic Markets".

The decision to focus on priority industries was a recognition that these areas either present a global opportunity for their industry, or are where Scotland already has a global competency. The prioritisation looked at areas such as growth potential, their importance to the economy and their disproportionate impact for Scotland.

This is an industry demand-led approach. In each case the active participation of companies and organisations within the relevant sector has been vital. It is also important that the approach to clusters is not static, but more fluid, responsive and dynamic. This is borne out by Scottish Enterprise's willingness to review and adjust priorities over the years since it first embraced the clusters idea.

Organisation

Normally each "cluster" has been supported by a specialist team of Scottish Enterprise personnel, supported by individuals or expert groups from the private sector (usually specific to the industry). The team has been based normally at Scottish Enterprise headquarters, although individuals may be based within "local enterprise company" offices according to the location of expertise, or of the industry.

In the case where regional-level support was provided to industries with specific local presence (for example, Aerospace in Ayrshire or Financial Services in Edinburgh), this has been provided directly in the relevant regions.

Cluster teams are encouraged to work closely together, taking a cross-disciplinary approach wherever possible. This has been driven by the convergence of activities across markets, for example in bio-medical research (which draws Information Technology and Life Sciences expertise together) or in Digital Media, where games development and communications technology are two parts of a larger proposition.

Many cluster/priority industry strategies are driven by industry-led steering groups, ensuring that economic development delivers what the industry needs.

Objectives

The key objectives of the Clusters / Priority Industries strategy, and its delivery, are:

1. To support key industries in Scotland in line with policy and strategic objectives set out by the Scottish Parliament, Executive and the Scottish Enterprise Board;
2. To identify industries and activities where Scotland has a particular strength, or potential strength, and to maximise the capability of exploiting those strengths to genuine economic effect;
3. To address clear “market gaps” where industries could improve their activities and competitiveness in Scotland, where it is judged that such an intervention may be successful;
4. To employ the specialist economic development skills retained by Scottish Enterprise to support and enhance the selected industries
5. To work with each industry and its research and supply bases to improve its prospects in Scotland and to retain and enhance its presence in Scotland;
6. To help the significant development of each industry’s real and potential contribution to the Scottish economy, measured by Gross Value Added (GVA) and other appropriate instruments;
7. To achieve value for money, efficiency and effectiveness from the efforts of Scottish Enterprise in each industry area.

Activities

Scottish Enterprise’s intervention via its clusters strategy is known to have made a distinct and positive impact on the Scottish economy, whether that be in the introduction of specific programmes aimed at encouraging innovation and strengthening Scotland’s business base, or in individual “added value” projects.

Universal programs

Proofs of Concept, Enterprise Fellowships and Intermediary Technology Institutes have made significant contributions to improving the commercialization of expertise and technologies from Scotland's universities out into the business community.

Specific Programs

Optocap
A leading-edge design centre that provides a critical link in the commercialization of Scottish micro and optoelectronic research. The centre works with university spin-outs, researchers, start-ups and established companies who access its facilities and services to develop and test their research to market-ready status.

It specializes in the development of processes to arrange delicate circuitry in the protective packaging that allows optoelectronic devices to interface and connect to external networks via optical fibers and electronic connections.

Optocap develops these solutions for devices used in the communications, consumer, industrial and automotive sectors. It also creates packaging solutions for emerging technologies such as life sciences where the biochip will play an increasingly important role in the diagnosis of illness and the management of its treatment.

Intellectual asset centre
The centre aims to 'assist Scottish businesses to maximise the economic potential of their intellectual assets'. It is the first in Europe and the world. It aims to:

- raise awareness and understanding of intellectual assets, their value, identification, protection, management and exploitation for business benefit;

- demonstrate how intellectual assets impact upon all aspects of business (strategy, products, services, markets, etc);

- provide tools to help our companies identify, assess, record, manage and exploit their IA; and

- guide and signpost companies to suppliers of IA management services.

Scottish Fuel Cell Consortium
The development of a hybrid battery fuel cell - which brought together two universities and 5 companies and has acted as a catalyst for more joint academic/industry joint ventures.

Scottish Health Innovation Ltd (SHIL)
SHIL supports technology transfer from the National Health Service (NHS) in Scotland. The key aims of the project are to:

- Capture NHS intellectual property

- Provide dedicated funds for intellectual property exploitation

- Grant NHS staff access to expert advice and assistance on taking new innovations to market

- Provide specialist support to promote and optimize the potential economic return for NHS Scotland innovations and technologies, from research or for day to day work.

Biocampus
Biocampus is Scotland's first dedicated national bio-manufacturing campus, custom designed to meet the needs of companies involved in the specialist manufacture of next generation biotechnology related products.
Already home to hundreds of life science companies, Scotland has a thriving bio-manufacturing community and Biocampus provides an integrated environment that's fully equipped for advanced biomanufacturing.
It adjoins three research parks each offering access to specialized scientific facilities and the university departments of Heriot Watt, Strathclyde and Edinburgh are involved in applied bio-processing related research.

Centre for Biomedical Research
The Centre for Biomedical Research is located next to Edinburgh's new Royal Infirmary. The centre, created to position Edinburgh as one of the world's top 10 centres for biomedical investment, will also seek to entice world-class life science companies and act as a magnet to attract and retain scientists and researchers.

The centre will have more than 500,000 sq ft of academic research space and 900,000 sq ft for commercial research based companies. A range of laboratory and office space will be available, from start-up incubator units to flexible multi-user spaces and strategic sites for single biomedical companies. A range of facilities will be shared between commercial, academic and health service related research organizations.

Roslin BioCentre
Roslin BioCentre is a centre of excellence for life sciences, with world-ranking expertise in stem cells, genetics, genomics and bioinformatics. The park was formed around the famous Roslin Institute, known globally as the birth place of Dolly, the first mammal cloned from a cell taken from an adult animal. And now, many world-leading research and development

organisations share Roslin's site facilities, making collaboration and networking a very real option.

Financing

Scottish Enterprise has funded the priority industries strategy from internal resources (i.e. its annual budget). Certain projects have attracted additional funding from the private sector or other public sector sources in Scotland, UK or Europe.

The ITI strategy has been supported by an annual budget of around £45m, split between the three ITI sectors, with provision for a 10-year project lifespan.

Updating to reflect changing market environments and major success

As the history of the cluster strategy has shown, since its first inception during the early 1990s, the choice of industry clusters has been adjusted to reflect key changes in the market environment. The principal drivers have been:

- Market environment: where changes in demand and the introduction of new products and services have led to a significant change in the key drivers within any market (for example, electronics);
- Convergence and technological advance: where new technologies have had a radical effect on services and products and the way they are produced and used;
- External market environments: including the emergence of new low-cost labour markets which have attracted mass manufacturing activities away from mature economies such as Scotland (and towards eastern Europe and parts of Asia)
- Research strengths: where specific research in Scotland has led to the creation of new industries in Scotland (both indigenous and as a result of foreign direct investment), for example in Life Sciences and Opto-electronics.

Key elements of the evolving strategy are predicated on a broad understanding of key external factors in each priority area. These are:

- Money (financial capital)
- People (human capital)
- Things (physical capital)
- Know-how (intellectual capital)
- Global positioning (market capital)
- Growth of networks (social capital)

Priority industry support is adjusted on a regular basis according to these criteria.

Conclusion

Scottish Enterprise strategy for priority industries has played an important role in both shaping and reflecting policy. It led economic development thinking in Europe for several years, and brought more closely together the research work undertaken at Scotland's 13 universities and numerous colleges and research institutions with that of the private sector (both indigenous and foreign-owned).

The strategy has been flexible, so that it can adapt to reflect changing market conditions both at home and worldwide. A key element to the strategy is to bring together private and public

sectors and to intervene only where such intervention can be demonstrated to add real value-add.

5. Mechanical Engineering Cluster – East Westphalia (OWL - OstWestfalenLippe)

Since the beginning of the 1990s, North Rhine-Westphalia/Germany too has been staking its bets on cluster policy, if under a different name. In the framework of the new orientation of regionalised structural policy with the NRW-EU Objective 2 Programme since 1999, a stronger focus on regional sectors and/or technology priorities became evident. This approach is currently experiencing a new shift in focus.

The topic of clusters has undergone a rapid development process at EU level too. Both in the Framework Programmes as well as in EU structural support measures, the cluster concept today plays a decisive role. At the same time however, it must be noted that both from an international as well as from an NRW viewpoint cluster policy does not represent a panacea and that no “miracles” can be expected either.

The objective is to analyse the opportunities and risks, feasibility and myth of a cluster-based technology and innovation policy in order to derive promising policy concepts for North Rhine-Westphalia as a region of innovation.

The development potential of a region (of a country) from this perspective is based on the innovation strength of networks which are characterised by self-steered processes, co-operative exchange structures and dynamism. The support of networks of enterprises, of clusters or of fields of competence (NRW approach) therefore promises to be an adequate and efficient instrument in terms of structural, SME-oriented and innovation policy. Nevertheless the skill of identifying and initiating clusters which promise success as well as of motivating enterprises, meso institutions, public players and possibly research organisations to work together must often first be developed by those responsible for clusters.

Therefore, the aim in future is to strengthen the personal initiative and responsibility of all players and to lead the partnerships found in clusters into a self-supporting process.

In the framework of an analysis of the value and importance of individual economic sectors for NRW in 2000 attention fell to the production technology, among others.

The background to this was the awareness that mechanical engineering - and in conjunction with this production technology - is of major significance for NRW.

It is the dynamism of this industry which makes it possible to achieve value added. Thus, for example, Aachen University of Technology drives innovation through PROTECA and East Westphalia-Lippe absorbs innovation, and has supported for a long time OWL Mechanical Engineering.

The level of organisation in the OWL region is high. Production technology / mechanical engineering is certainly one of the operatively most stable regional clusters, with in part a high degree of regional self-confidence and regional independence.

1. What were and are the drivers behind the start of the cluster?

The most important driver has probably been the increasing pressure because of the globalisation, which includes the tight international competition and new chances on the growing markets in Eastern Europe and Asia. Another driver lies in the accelerating technological changes in products and processes. At the time when the association ("Verein") has been founded within the company GILDEMEISTER AG in Bielefeld (one of the world market leaders for machine tools) in October 2003, the 13 companies, scientific institutions and RDAs (regional development agencies) expected to find the cooperation potential and synergies in the fields of benchmarking, science transfer, human resource management, location marketing and cooperation rather on an international than on a national scale. Until today the key actors are small or medium-sized, family-led companies such as MIELE, CLAAS, BOGE and KANNEGIESSER, which are also world market leaders in their niches. The BERTELSMANN STIFTUNG (Bertelsmann Foundation) is also actively involved in the board of the association. The coordination of the network has been taken over by the WEGE Wirtschaftsentwicklungsgesellschaft Bielefeld (Economic Development Agency Bielefeld). The declared strategic goal of this institution is to keep the respective company headquarters in the region of OstWestfalenLippe (OWL).

2. Organisation

The OWL Maschinenbau (Mechanical engineering, www.owl-maschinenbau.de) cluster is organised as a specific type of association (VEREIN). Right now the association has 160 members (companies, scientific institutions and other partners). By their financial contributions the members finance a certain amount of the daily workload of the association. Specific projects are financed through sponsoring and technology transfer funding programmes. Small and medium-sized companies (from the field of mechanical engineering) and their suppliers dominate the member structure. Additionally specific working groups have been established, which lead the activities in key future topics.

3. Objectives

Approximately 300 mechanical engineering companies with around 40.000 employees are active in the region of OstWestfalenLippe (OWL). They all have an annual turnover of app. 7,3 billion Euros (app. 5% of the total German turnover of mechanical engineering companies). If you add the suppliers to this figure, the turnover sums up to app. 10 billion Euros per year. Most of those located companies are medium-sized and technology-champions in their respective market niche, which develop and produce high-tech solutions for their costumers worldwide. The activities of the association are spread in the following six segments: experience transfer, cooperation support, innovation management, human resources management, internationalisation and location marketing.

4. Activities

In every activity segment periodical benchmarking events and a yearly congress takes place in the member companies. There are also university-transfer projects in every segment to accelerate product and process innovation in every company. The network also moderates cooperation for their members (for instance regarding purchase, distribution, service and maintenance issues). Experiences, e.g. in issues of entering foreign markets are also shared between the members

5. Financing

The financing is guaranteed through the yearly contributions of the members and sponsoring. Public funding is usually used for the start-up financing of certain activities, such as the "Competence Centre for Virtual Prototyping & Simulation" in 2006.

6. How has the cluster and its activities reinvented itself to make itself relevant today and what has been the major success?

Since the start of the initiative in 2003 the main “capital of the initiative” has been to build up and encourage the trust between the members and to develop a corporate identity for the involved partners. Today the OWL region is renowned and regarded as a leading mechanical engineering cluster both on a German and on a European level. The joint participation at the HMI (Hannover Messe Industrie) with a 500 m² booth has enlarged the self-confidence of the companies. A common vision has been developed to strengthen the region as a “High-performance region for mechanical engineering” systematically.
Parallel to that the R&D landscape is also successively expanded into a research-cluster.

7. What are the barriers to the clusters continued growth and existence and how are these being addressed?

The growth limits are the app. 600 mechanical engineering companies and their suppliers. The network management surely also has to grow parallel to its number of members in order to match the expected added value in the international competition of every new company in the network. This can only be realised on a long-term base with the use of modern management techniques, such as a balanced scoreboard for the network. Staff continuity in the board of the association has been a key factor of success in the implementation phase of the network. Now in the upcoming years this high quality level has to be kept with changing boards and managing directors.

8. What types of support programmes are needed to ensure that the cluster overcomes any current barriers to growth and existence?

Benchmarking and cooperation between branch initiatives and competence networks are a key factor of success on a European level. Right now there are already intensive contacts and dialogues as well as research-transfer projects with the region of Aachen and Stuttgart. The next step will be to intensify the interaction with European clusters in Italy, France, Slovak Republic, etc. to create synergies and know-how advantages in key technologies for European, medium-sized companies, active in the field of mechanical engineering.

6. Regional Clusters in Austria

In Austria the cluster development brought without any doubt an important structure-political success since beginning of the 90's. By the example of the "Automotive Cluster Steiermark" it has been proved that also a medium-size structured economy with the network of multinational companies can respond to a quite meaningful and competitive division of labour.

Already before cooperation of companies were called cluster, there were cluster-similar initiatives. An example for this is the in 1990 founded Pro Wood Initiative, which can also be called the start of today's wood cluster. Moreover, with AOEM a cluster-similar network has been established in the automobile supporting industry.

In Austria appears a different cluster development.

- Regional Cluster (e.g. the Automotive Cluster in Steiermark and the Wood Cluster in Salzburg
- Nationwide Cluster (export related clusters)
- Centres of competence

For the first time an institutionalized cluster has been developed in 1996 with the automotive cluster in the Steiermark. After an analysis of the strength fields in the Steiermark the federal state government seized the initiative for the establishment of this cluster.

Since the foundation of the automotive cluster the technology and marketing company of Austria established altogether six clusters (automotive cluster, diesel-technology cluster, plastic cluster, renewable energy cluster, wood cluster and food cluster).

At present, more than 1,500 companies, R&D bodies and educational institutes are partners in the eight inter-branch networks. This presents clear evidence of the fact that the local business community has recognised the necessity for close co-operation between companies and a co-ordinated approach to the world at large. Today, regional competitiveness is not determined by the strengths of individual companies, but to an ever-increasing extent by the innovativeness of complete industries and branch complexes, as exemplified by the Austrian cluster initiatives. Teamwork is the key to success, as it not only strengthens each of the companies involved, but also the entire economic structure of a region in a far-reaching and sustained manner.

So one major aspect of this programme is a systematic expansion of the existing areas of economic and technological strength in Austria, which is aimed at enhancing the innovative capacity of companies, in particular through networked co-operation.

First evaluations to the Austrian cluster brought absolute positive results. In most industries a clear improvement of employment, productivity, volume of exports and R&D expenditures can be determined. Above all SMEs profit from such a co-operation. In the Steiermark an increase of the employment rate within the automotive industry rose between 1995 and 1997 by 25 per cent, whereas in Austria only by eight per cent.

The evaluation of the export cluster results in the advantage of an improved information exchange and in the easier market entrance.

6.a Styrian Autocluster

Styria is one province in Austria that was particularly hard hit by economic structural change and the decline of the state-owned metal industry. A high level of expertise in the automotive sector and renowned firms like Steyr-Daimler-Puch (today: Magna Steyr) slowly reversed this trend in the 1990s, especially in the automotive industry. To muster the regions' strengths even more effectively, the ACStyria Automobile Cluster was launched in 1995. This was the first cluster to be created in Austria and has since served as a model worldwide for cluster formation. Once a crisis region, Styria is now often called the "Detroit of the Alps". It is a globally successful car and engine manufacturing region with potent lead enterprises such as AVL List and Magna Steyr. The formula for success was simple. "Carefully plan the linkage between business, research and public institutions and determine and promote the strengths and synergies involved." The major drivers in this process were lead enterprises strong in research and willing to cooperate.

1) What were and are the Drivers behind the start of the cluster?

The Styrian Autocluster was founded in 1995 as a project of the Styrian Business Promotion Agency and the Federation of Austrian Industry, launched by the idea of a cluster in Styria specifically for the needs of the automobile sector.
Herbert Paierl, at this time member of the provincial government - responsible for economic affairs - took the opportunity, to sustain the Styrian economic policy. Supported by the Styrian Business Promotion Agency (SFG) and the Styrian automotive and supplying industry, the Cluster was the answer to the increasing competitive pressures and the need of innovative concepts. Before the cluster was founded, a number of investigations were carried out, from an initial opinion-gathering project entitled "Vehicle Cluster" to a technology/policy plan. The intended purpose of the cluster was to improve communication, information and cooperative agreements pro-actively among the Styrian vehicle supplier companies, the leading OEMs and existing research institutes to secure the so called Detroit of the Alps as an independent and strong car production location. For more than six years Mr. Uwe Galler has been the Managing Director of the ACstyria GmbH.

2) Organisation

In 1999 the cluster became a GmbH as a typical PPP-model (private public partnership) with four privately owned companies and the Styrian Business Promotion Agency (SFG); in the years before, the Cluster was defined as a "project". This project was carried on mostly by the Styrian Business Promotion Agency SFG (sustained by Agiplan).
Today the several stakeholders and important Leading Companies like AVL List, Magna Steyr, Lear Corporation, Johnson Controls, AT&S, Infineon Technologies or austriamicrosystems are engaged to carry on the targets of the cluster. In addition to this, the most important Research & Development Institutions are partners of the ACstyria too.
The membership in ACstyria is defined by the "annual automotive turnover of the company". There are five levels of annual membership fee between 550.- Euro and 7500.- Euro per year.

3) Objectives

ACstyria as the heart of an automotive and automotive supplying industries network has gained national and international importance with the Styrian region as pulsating centre. From its foundation in 1995 the Autocluster has methodically brought economic ideas together with the latest research and government initiatives with a view to identify and promote areas of synergies and strengths.

In short, ACstyria reinforces the strengths already existing in the automotive value-added chain. The Autocluster GmbH has dedicated itself to increase innovation and international competitiveness.
ACstyria brings together the right people at the right place at the right time for the right topic. The ACstyria offers a range of information and communication platforms: the homepage (www.acstyria.com), newsletter ("members only"), the numerous events from working parties, discussion groups, workshops, company visits, fair visits and delegation journeys – all working towards the overall goal: promoting the exchange of useful information and experience and to learn from others because competitors are stronger together.
One of ACstyria's key functions is to initiate and accompany cooperative ideas and projects. Company and cross-sector project management in areas with technology focus, international activities and skills expansion is an integral part of the cluster-business.
ACstyria is also engaged in the qualification of employees due to the automotive academy styria and the qualification project Automotive knowledge is cascaded through a variety of training courses, seminars and workshops. The ACstyria career and qualifications platform collaborates with experienced and widely acclaimed teachers and organisations.
Another important target of the ACstyria is the information- and contentmanagement/contactbrokering to enable the partners to access the right information at the right time.
Actually about 180 partnerships with 44.000 co-workers benefit from the services of the ACstyria.
All these targets are explicitly defined in the "Strategy 2011" which had been developed in 2004 by experts out of the cluster itself but also approved by honoured members of different OEMs.
The cluster management is doing annual business plans. The content for it comes up by the experience through the past and the expectations form the members.

4) Activities

The activities for the next year is always issued at the end of the calendar year and therefore Acstyria members can do the planning in participating in the different items of the programme. Members can participate very active (i.e. key note speakers or trainers etc.) or can also be just "consumers" or participants. Most kinds of services are mentioned in chapter 3 – objectives/activities.
It is very difficult to measure the "outcome": But we have collected some numbers as indicators for the automotive business in the region of the Acstyria: in 1996 there were 22.000 people working in automotive business; in 2006 there were more than 44.000 people working in the automotive sector. A doubling of jobs within 10 years.
At the same time there had been investments made in automotive business for more than 2,2 billion Euros!

5) Financing

App. 60% of the cluster-activities are financed by the fees paid by the partners of the ACstyria; the remaining 40% are generated by activity-fees entrance fees) and some other projects are supported by project-oriented fundings (projects that can be considered as marketing-activities helping the province of Styria).

6) How has the cluster and its activities reinvented itself to make itself relevant today and what has been the major success?

In spring 2005 - as a result of nearly a year hard work - the strategy 2011 was presented, focusing on “fit for south-eastern Europe”, “fit for knowledge”, “fit for technology” & “fit for future visions”. The growing importance of Research & Development has also been considered in the new strategy.

7) What are the barriers to the clusters continued growth and existence and how are these being addressed?

- sometimes international companies are not willing to integrate in a regional strategy
- lack of co-operation and communication

8) What types of programme of support is needed to ensure the cluster overcomes any current barriers to growth and existence?

- having a critical mass of companies;
- success depends on the co-operation capabilities of the companies;
- competition and permanent innovation is a must;
- acting regional but measuring with international benchmarks;
- permanent integration of the research and qualification institutions into the network;
- a bottom-up strategy is a must (companies must be convinced that a cluster is good for them, and they have to be willing to pay for the cluster organisation).

Styria’s success story soon inspired others in Austria. Clusters were formed in many industries and regions with varying degrees of success. Since clusters are living, complex systems, they require quite a bit of care, a lot of commitment, and favourable conditions in order to thrive.

6.b Salzburg Wood Cluster

Austria has a limited domestic market. It has always been important for the economy to direct its attention towards foreign markets. This situation has forced the fundamental reorientation especially among small and medium-sized enterprises (SME’s) which make up the vast majority of Austrian businesses. The crucial question was how to keep up on international markets as a relatively small player. This has called on one hand for specialisation and on the other hand for efficient cooperation with other enterprises by building networks and clusters.

Numerous clusters, networks and regional competence and technology centres have taken respective steps in all nine Austrian provinces. In most cases these clusters are run by the regional business promotion agencies or the regional economic chambers. Cluster initiatives have an intensive need for organizational and economic support during the start-up phase.

1. What were and are the drivers behind the Salzburg Wood Cluster?

The wood industry is one of the most important economic sectors in the Salzburg area. The initiative of the Federal Province of Salzburg for a wood cluster has started in 1999. The key actors were the Federal Government in cooperation with some representative actors of the wood industry. These institutions are still involved. In April 2000 a professional cluster management was installed. More than 1200 enterprises in the wood industry employ approx. 20.000 employees.
80 % of these enterprises are SME's. In order to remain competitive, it is indispensable to be pro-active in cooperation and to identify specific market niches. The Salzburg Wood Cluster is very active in building up this network, so that already 38 % of the wood enterprises cooperate with one another. Through the clustering the SME's - with their ability to act flexible, their innovation strength and their competences - are able to use business advantages even in the competition with larger companies.

2. Organization

The wood cluster management established in 2000 is permanently assessed by an advisory board. This board consists of experts from the wood industry. The combination of entrepreneurs and representatives from R+D-institutions offers an ideal technology transfer from business to business (B2B), science to business (S2B) and science to science (S2S). The members of the advisory board meet four or five times per year and discuss for instance strategic developments of the wood cluster with special consideration to regional and international developments.

The wood cluster management together with the members of the advisory board has been able to initiate and develop projects in various business activities in the past few years. This high-level expertise is permanently tested on its market relevance.

This concept will be permanently adapted. In the future the groups of experts will be networked and will cooperate flexibly in concrete topics and projects. The strategic orientation of the Salzburg Wood Cluster will be taken to perfection through this firsthand exchange of experience among experts and entrepreneurs.

3. Objectives

Mission of the Salzburg Wood Cluster: To empower enterprises to cooperate with each other, improve their competitiveness.

Strategic goals:

- market the activities of the cluster;
- putting the cooperation of the Salzburg Wood Cluster on a secure and sustainable basis;
- focusing the cluster services on the open-minded enterprises that are willing to learn and to cooperate;
- continuing and implementing the formulated innovation projects, implementing the results in the practical work of the respective enterprises.

The Salzburg Wood Cluster is an inter-disciplinary network supporting and promoting partnership for innovative wood suppliers and producers. Therefore, the cluster management supports the competitiveness and innovation of businesses that:

- manufacture furniture with wood and wood-based materials;
- use wood and wood-based products as building materials and,
- use wood for interior décor,

including their suppliers (manufacturers of semi-finished products, professional tradespersons and machine and plant builders).

These activities involve especially small and medium-sized businesses. The cooperation wants to improve the innovation capabilities and increase the national and international competitiveness of the partner companies.

4. Activities

The Salzburg Wood Cluster serves as an active and innovative platform for approx. 1200 innovative wood suppliers and producers. The cooperation of these partners enables them to develop synergies for a better market penetration, a stronger position against competitors, but also to develop new products, which can conquer new markets.

The cluster offers the following services in particular:

- initiate and moderate the enterprise cooperation process;
- assist in project management and marketing activities;
- develop and organize meetings, qualifying measures and activities;
- consulting in the field of innovation and financial support by the state or the EU programmes;
- build up and structure a common communication platform for the partner companies.

A special service of the Salzburg Wood Cluster is also the support in the range of research and development. Most of the involved SME's do not have the time and the know-how to formulate search request in such a way that they can be successful in the competition of getting funds. To prepare EU-funded joint projects the wood cluster management is able to collect research and development ideas of the partners and give a qualified support for the conception of the outline proposal and an application for additional funding.

5. Financing

The cluster activities are supported one third from the Salzburg Government and two third out of projects.

6. How has the cluster (and its activities) reinvented itself in order to stay relevant and what have been the major successes?

In the last five years the cluster management founded more than 60 sustainable networking groups.
More than 15 cooperations with 70 companies were supported by the structural funds of the County of Salzburg.
The export of wood and wood products plays an important role in the economy of Austria, because this industry is ranking no. 2 in the balance of foreign trade. Therefore, a special export manager for the domestic saw mills is looking for new sales markets abroad. In this initiative, under the logo of 'GO GLOBAL', more than 100 saw mills in the Salzburg area try to compete against the big players in the world market. With a broad product selection of highest quality and a just in time supply chain, they try to withstand the strong competition.

Research Intensive Cluster Case Study

A. The Agency for Innovation and Development of Andalusia (IDEA): A regional policy based on clusters

The emergence of the knowledge society is bringing about a fundamental reshaping of the global economy, to the extent that knowledge has become the predominant factor in the creation of wealth.

Having in mind this new circumstance, the AIDA Agency undertook in 1999 a strategic analysis to identify key issues for a new generation of economic policy for the 21st century. Cluster development and cluster performance has been considered as a very significant approach for the Andalusia Region. Factors such as promotion, collective learning, more selective use of capital grants, value-added public interventions, interface programming, institutional networking; and private/public partnership were identified as key factors.

The analysis, started in 1999, has shaped the current approach of the Agency's policy in the new century, taking into consideration that the success of enterprises and of regional economy becomes increasingly dependent on the economic and social organization that is necessary for gathering and using knowledge.

Today, like in 1999, the major objective of an economic policy based on clusters is to reinforce the systemic approach of industry support policies through the identification of clusters as functional systems for promotion and collective learning. It also means the ongoing approach in public performance better than traditional sectors.

For implementing such action the Agency faces a set of classical managerial problems: How to choose the specific productive activities that could have the greatest possible impact on the regional economic characteristics, and how to acquire and deploy the resources that enable the chosen productive activities to be carried out.

When facing these generic managerial problems, the Agency can not rely upon a strong social capital in the region in general or upon the systematic private-public partnership in particular.

In trying to fill these lacks, the Agency has devoted a large part of its resources to negotiate with political decision makers, public administrators in other departments of the regional and national government, companies, interest groups, regional social institutions, unions and other entities of relevance in Andalusia.

The aim of these negotiations is to reach a broad regional consensus on the role of a policy based on cluster promotion as a part of the regional industrial policy, which gathers the objectives to be reached, the resources to be made available, and the expectations of performance of the proposed system.

First of all, the Agency seeks to mobilize all the resources of the social and economic regional actors, rather than exclusively rely on the limited resources available in the public sector.

That scheme acknowledges that regional government's capacities to affect social change are limited both by scarce resources and by the fact that economic spaces (especially in cluster's environments) are heavily populated by private actors, the cooperation of which is totally necessary for implementing change strategies.

The Agency's role is to search for complementing and coordinating the activities of the other public sector organizations responsible for improving clusters' performance.

It is very important to keep in mind that Andalusia's relative under-development in the "knowledge economy", compared with the most developed regions, lays on the insufficient linkages between sectors within the regional economy. The Agency, through this cluster-based industrial policy, tries to direct the attention of the socioeconomic actors to the analytical identification of the most valuable linkages to foster and develop the capability to easily interact with public and private stakeholders throughout the region.

The planning process designed by the Agency seeks to initiate changes in three ways:

- Empowering each actor to think about how the available resources can be strategically used to modernize production and increase the livelihood of the sectors.
- Requiring all parties to commit themselves to act in accordance with the cluster-based policy.
- Presenting the cluster-based policy to outside institutions as a coherent "industrial policy" and as an opportunity to serve a unified economic "community".

The ultimate goal of this cluster-based policy is the total adaptation of the regional productive sectors to the knowledge society, using three specific characteristics of the policy: comprehensive, dynamic and negotiated

- Comprehensive: the focus of the policy is on improving the industry's performance as a whole rather than on improving one or another element.
- Dynamic: the policy has to be open-ended in time as well as in scope.
- Negotiated: both private and public sectors (including all the relevant actors) are coordinated and aware of resources devoted to the policy, responsibilities of all the parties, and performance required by the policy.

The Agency, which is a special relevant aspect of the designed policy, will serve as the general coordinator of the policy, taking into consideration that its role is a role of guidance rather than of control.

B. THE WOOD FURNITURE CLUSTER OF CORDOBA/JAEN/SEVILLA

1) Which were and are the drivers behind the start of the cluster?

The central area of Andalusia (namely the provinces of Cordoba, Jaen and Sevilla) has been producing furniture since 1960, taking advantage of the existence of a reduced number of carpenters in the area and, above all, the increasing demand derived from the large number of visitors proceeding from the rest of Europe to the neighbouring "Costa del Sol". This implies a large increase in buildings in the region and by consequence a high demand for kitchen, bedroom and living furniture.

The 1980s and 1990s saw a dramatic growth in the demand for this kind of furniture in the southern Spain coastal area. The industry expanded and the number of spin-offs from furniture producing firms in the central area of the region increased by 286% between 1993 and 1999.

More recently, the number of firms has been reduced due to mergers and liquidations. Although basic production is moving to Asia and other lower-cost regions in most of developed countries, Andalusia continues to produce the same items in the low level of the value chain. Sales and production levels have remained constant over the past few years despite the reduced number of firms.

Specialization of wooden furniture production in the basic/home market is significant, accounting for 90% of the firms' output.

2) *Organization*

The organization of the Wood Furniture Cluster is shown in the Figure below.

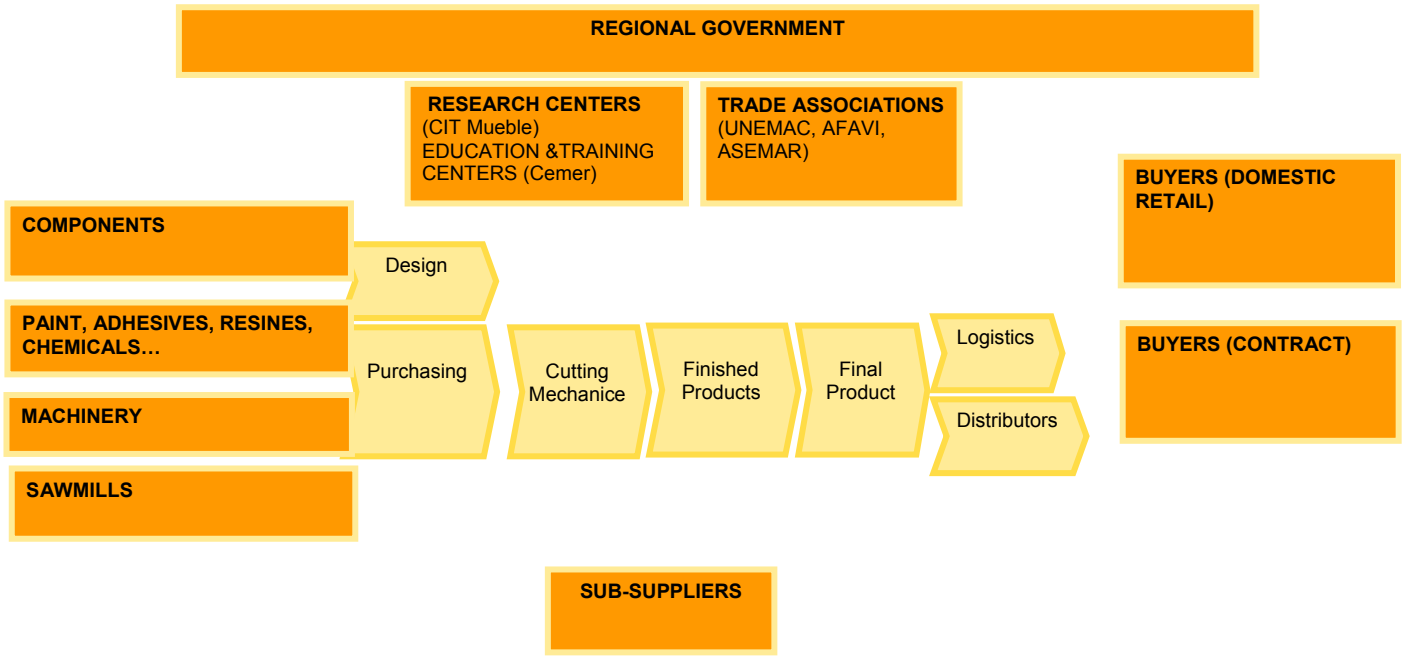


Figure: Organization of the Wood Furniture Cluster

3) *Objectives*

Small firms have traditionally dominated production and retailing activities in the furniture sector in Andalusia. Company size is generally far from efficient.

This pattern of size may affect upgrading capacity and performance of furniture firms. Firms tend to be unable to concentrate themselves on activities in which they could create distinctive competences, a first and important step in their upgrading trajectory.

Furthermore, they tend to concentrate on the batch production of standardized items, and therefore fail to develop the capacities to design and change their product range.

The aim of the process started by the Agency with regard to the wooden furniture cluster is to realign the value chain based on domestic producers and manufacturers.

In order to reach the goal of upgrading the cluster's competitiveness, the current initiative pursues the following objectives:

Objectives:

- Foster networks among companies and technical centres.
- Establish networks among firms.
- Promote innovation.
- Promote distribution expansion by existing firms.
- Assemble market intelligence.
- Reduce competition in the cluster.
- Improve firms' cluster awareness.
- Provide education and training.

4) *Activities*

Realigning the value chain requires a change of focus from the previous wood furniture value chain, which has traditionally concentrated itself on batch production of standardized products, into increasingly price competitive markets.

This change of direction requires capability to upgrade in four trajectories, i.e. process, product and functional upgrading, and moving up in the value chain

- Improving process efficiency:
    - Improvement in manufacture adapted to new patterns of demand.
    - Better coordination of deliveries.
    - Process of firms' concentration (mergers and acquisitions)
    - Different product specifications.
    - Human resources development.
- Introducing new products:
    - Design suitable for Andalusian cluster.
    - Design for manufacture.
- Functional upgrading:
    - Increasing links with the regional system of innovation.
    - Increasing collaboration inter-firms and with research and technical centres.
- Moving up to a new value chain:

- Moving from standardized production to personalized and mass-customized production.
- Moving from “production step” to “distribution step”.
- Moving from “furniture production” to “decoration”

5) Financing

Four different sources of finance will be used for addressing the cluster challenge.

a) Regional funding to promote action in the companies being part of the cluster in order to improve their competitiveness through the realignment of the value chain
b) Regional funding to promote links between Research and Technological Centres and companies, so that the latter can benefit from advanced services provided by existing and potential Research and Technological Centres.
c) National Funding to promote cooperation and collaboration between companies within the cluster
d) National Funding to design and develop strategic plans for the cluster as a whole.

6) How has the cluster and its activities reinvented itself today and what have been the major successes?

Prior to the Agency's cluster-based approach, the wooden furniture cluster was just a mere concentration of companies operating in the same industry, with a low complementary and co-operation level, as most of the Andalusian clusters. These circumstances have led to an internal competition above the level of desirable rivalry; the lack of differentiation and the competition on the same markets, essentially based on prices, lead companies to be less attractive.

After acting over the wooden furniture system, the cluster has evolved towards a more complex organization, through :

- Co-operation strategies both between companies and between companies and technological centres, both in production and in joint distribution.
- Realignment of the value chain from “production” to “distribution”, which has led from standardized markets to more customized demand.
- Development of flexible specialization by means of education and training of both the managerial and work force.

7) What are the barriers to the clusters continued growth and existence and how are these being addressed?

“Under-investments” in various fields are still a bottleneck for the wooden furniture cluster to gain new competitive advantages or to strengthen existing ones:

- Lack of access to innovation. – Promote co-operation both between SMEs and between companies and Technological Centers.
- Low educational level and low skilled work force. – Enhance managerial and creative capacities
- Mature industrial structure – Promote and develop networks of small and medium size companies.
- Unsophisticated local market – Improve the access to new market by means of promoting distribution instead of production.

- Increased production with weak distribution structure. – Promote the existence of joint-distribution networks
- Lack of social capital - Improve the social consideration of entrepreneurs.

9) What types of support programmes are needed to ensure that the cluster overcomes any current barriers to growth and existence?

- Reinforcement of managerial capacities (strategy and consolidation):
  - Training in strategic orientation;
  - Size and companies consolidation.
- Reinforcement of creativity capacities (design, marketing, and distribution):
  - Innovation reinforcement programmes;
  - Risk innovation reduction programmes.
- Optimization and costs reduction (purchase and production):
  - Co-operation with suppliers;
  - Purchasing management.
- Reinforcement of commercialization capacities (distribution channels)
  - Improving commercialization programmes;
  - Channel distribution programmes.

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Regional Research Intensive Clusters and Science Parks

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The main task of the expert group was to analyse and describe ways in which **research-intensive clusters and science parks** can most effectively contribute to the **research and technological development (RTD) capacity of regions** and the exploitation of their existing RTD potential.

For this purpose the expert group identified cases, and the underlying conditions thereof, where clusters of research actors, businesses and public administrations have been set-up around a research topic or an agenda and contributed in an important way to **reinvigorating regional economies by exploiting the R&D results**.

As a final outcome, the report provides a series of **recommendations** and proposes measures to sustain successful RICs and science parks, or to develop new ones. These measures are addressing the three inter-linked policy levels, i.e. EU, national and regional.

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