Report on Design of Regional Innovation Systems

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The Design of Regional Innovation Systems

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Abstract:

Regional Innovation Systems are an analytical approach to better understand the organizational microstructure of innovation processes taking place inside a region and its connectedness with the outside world. Since traditional economic approaches primarily focus on markets its agents and the process of price formation there is a significant disregard of the institutional framework including non-market public institutions and governments as policy makers. Because of the interconnectedness between the communications and activities between these heterogeneous agents and the lack of a common target function the approach is more descriptive than analytic. The present paper outlines basic design principles for regional innovation systems derived from case studies of successful innovation clusters and regions like the Silicon Valley in the US, the Audio Valley in Germany and the Zhongguancun Science Park near Beijing. These experiences derives from such endeavours is that in general that these innovation systems reach far beyond the traditional framework of R&D, new technology generation but stress the importance of creating an innovation eco-system which includes as well the innovation business infrastructure and the regional links between generation of knowledge in a couple of research areas and the knowledge transfer into production for global markets. The creating of new knowledge often focused on high-tech innovation areas which are Big science and the implementation of these regional comparative advantages in this knowledge creating into business success meaning marketing new products and services for the global market has become a central long-term aim for regional innovation system design. It also makes clear that the necessity to reach a critical mass makes this strategy an impossible option for very few regions around the world. However, the EU member countries facing the stiff competition from abroad have to accept that the European research Area has to follow these lines to obtain long-term locational competitiveness in innovation at a global scale. Otherwise the ERA will fall behind other centres of excellence.

Keywords: Regional innovation system, regional comparative advantage in innovation, globalization in innovation

JEL codes: O2, O31, R11, R58, L52

Introduction

The concept of a regional innovation system (RIS) has been developed to take into account a holistic attitude of innovations created by interaction between heterogeneous agents. It contrasts with the Schumpeterian view of a single entrepreneur (Schumpeter 1934) who as a single person is considered as the originator of an innovation. The innovation process have become much more organized over the last century to diminish the significance of single persons like the single entrepreneur in the innovation process e.g. Bill Gates or Steve Jobs. This does not mean that entrepreneurs and entrepreneurship are not important ingredients of an innovation system, but they have to be complemented by other agents.

Nowadays there is a much better understanding that it takes regularly more than a single actor to successfully create an innovation and implement it into a market with a significant sustainable impact. Companies and regional innovation systems which crucially depend on single persons are highly vulnerable if this person leaves at some time.

The innovation system approach contrasts as well with the more traditional one where a linear process of invention – innovation and introduction into the market often focused on a linear sequence which is highly biased towards the supply side. This supply-push innovation process often disregards the necessary demand-side. A good example are production functions which embody innovation indicators as explanatory variables (see e.g. Nadiri, Kohnen, Prucha 1986). Even by breaking down this function into first stage R&D-functions or knowledge production functions and second stage production functions (see Aghion, Howitt 1992, Grossman, Helpman 1991) do not change the criticism of the disregards of innovation as an interacting and learning process not properly represented by such formalization as it is common in econometric studies. Evolution and co-evolution of systems does not fit nicely into the recursive linear causality framework of functions. An innovation system is a dynamic system with a continuous interaction process between its heterogeneous agents (firms, government institutions, customers, external-partners like independent research organizations, etc.).

Beyond supply-push and demand-pull approaches

The dissection of innovation into supply-side and demand-pull innovations (see e.g. Stoneman 1995) therefore ignores the necessary interactions between both sides in an innovation process. The complex intertwined activities associated with such an endeavour also cannot be managed by a single person who lacks the sufficient understanding of all necessary aspects

involved. Innovations successfully created are regularly the outcome of teams of innovations who coordinate and co-operate across institutional boundaries to accomplish particular aims.

The interactions and connectedness of there different entities involved in innovations (companies, research organizations like universities, government, etc.) which are located in a particular region combine into a whole regional system which aims to facilitate and promote innovations. This regional system often shows emergent behaviour[1] in the sense that there is no central planner who designs and controls the system and is able to predict its behaviour with sufficient certainty. Still often a significant degree of uncertainty prevails as part of the system due to imperfect knowledge about all its parts, its particular capabilities and incentive structures to commit to a joint-innovation effort. Often now one compares the innovation processes generated from such systems similar to an innovation eco-system.

Aims and scope of RIS: Beyond simple mission orientation

Therefore it also differs from the concept of a mission oriented innovation organization, e.g. the legendary Manhattan Project[2]. Searching for realistic aims for regional innovations systems in a highly competitive environment of regions is a first important step for the design process of a RIS.

Often the aims and scope of innovations targeted are much less clearly defined in an innovation system as in a mission oriented project for e.g. the Manhattan project. Often the aims and scope of particular targets have to be at first defined by an interactive communication and coordination process between all stakeholders itself. These have to take into account the current regional capabilities embodied in a set of institutions available by using a SWOT-approach[3]. Furthermore a regional innovation system addresses a whole area of specific innovation activities. The Silicon Valley has a profile of innovativeness which reaches beyond a single mission like developing a high performance microprocessor or a single technology e.g. enhancing semiconductors at the global frontier of innovations in this field (Lee, Miller, Hancock and Rowen 2000, Saxenian 1994, 2006).

[1] Emergence means that the system behaviour is not embedded into a single component and cannot be predicted by an analytic approach breaking it down into its single components. Like baking a cake cannot be understood by looking at the single elements included by a recipe like flour, eggs, water, sugar, salt, etc. the components are fused by an innovation process in a way with each other to produce the cake as an output from bakery.
[2] For a brief description of the project see the respective key word at Wikipedia http://en.wikipedia.org/wiki/Manhattan_Project.
[3] SWOT analysis is a strategic planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or in a business venture. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favourable and unfavourable to achieving that objective.

Without taking stock of the resources available in a region and discuss by the community of the regional innovation system which are feasible aims to be accomplished by this environment the design of an innovation system will lack a sufficient foundation in the reality of the regional capabilities.

The ten dimensions for creating a successful regional innovation system

Lee, Miller, Hancock and Rowen (2000) have identified ten essential elements as success factors for the Silicon Valley Habitat. These are:

1. Favourable rules of the game. Silicon Valley operates within the distinctive American system of innovation and entrepreneurship. The national system is composed of laws, regulations, and conventions for securities, taxes, accounting, corporate governance, bankruptcy, immigration, research and development, and more. Because these governing rules are generally uniform throughout the country, they alone do not explain Silicon Valley's unique position within the United States, but they have been a necessary condition for Silicon Valley's pre-eminence.

2. Knowledge intensity. The Valley is a cauldron of ideas for new products, services, markets, and business models. They come from entrepreneurs, people in established firms, faculty and students at universities, venture capitalists, and people elsewhere in the world who move here. Collaborative practices create communities of networks working closely together on the edge in creating new products-and also cause knowledge to spread widely.

3. A high-quality and mobile work force. The Valley is a magnet for talent. Many engineers, scientists, and entrepreneurs have been educated in Silicon Valley, and skills are continuously advanced in doing demanding work. The region's major universities play a critical teaching and training role. In addition, because merit is rewarded-and the rewards can be large indeed-many talented people come here from around the world, as exemplified by the immigrant entrepreneurs. The Valley's labour force is also unusually mobile, resulting in a market that matches the needs of individuals and firms in a rapid, continual recycling of people.

4. Results-oriented meritocracy. In the Valley, talent and ability are king. In today's Silicon Valley, ethnicity, age, seniority, and experience are not what dictate opportunity or responsibility. Successful entrepreneurs in the Valley vary widely in age and style, but they share a common feature of raw ability. The region's merit-based system removes obstacles for immigrant entrepreneurs, as demonstrated by the founding members of Intel, Sun, Yahoo!, and many other pillar Valley firms. In addition to their impressive contributions here, large groups of immigrant entrepreneurs from around the world build connections to high-tech centres in their home countries, resulting in two-way flows of capital that lead to outsourcing, co-investments, technology exchanges, and network-based innovations across countries, an important source of Silicon Valley's vitality.

5. A climate that rewards risk-taking and tolerates failure. Certainly a distinctive-and to many observers, unique-feature of Silicon Valley in comparison with other regions, especially non-U.S. ones, is the degree to which its business climate encourages risk-taking and tolerates failure. Calculated risk-taking and an optimistic entrepreneurial spirit are part of the fabric of

the Valley. In Silicon Valley, there are many examples of entrepreneurs who have failed and successfully started over. These entrepreneurs (and their financiers) usually view failure as a learning experience, and they are rarely punished for it in subsequent ventures. On the reward side, laws that permit entrepreneurs to receive stock in a company for the ideas, organization, and hard work they put into it reinforce the taking of bold initiatives. The culture of independence, egalitarian management, and networking and the introduction of venture capital formed a model that established the pattern for a host of spin-offs over the years.

6. Open business environment. Although companies in Silicon Valley fiercely compete, there is also an attitude that all can gain from sharing knowledge that is not company-secret. Within this open environment, individuals are open to win-win exchanges of knowledge. Whether in formal or informal settings, interactions among people with overlapping networks of relations are continuous and intense.

7. Universities and research institutes that interact with industry. Research institutions and universities are such rich sources of advanced research, and of well-trained and often experienced scientists and engineers, that locating near them is now widely recognized as a powerful advantage for high-tech companies. In the information technologies, Stanford has been a major source of ideas and people that have led to the creation of many Silicon Valley firms. The universities foster these exchanges by allowing faculty to participate in industry as consultants and advisors to companies, to be on their boards of directors, and, if it is consistent with the universities' needs, to take short-term leaves of absence. The companies, in turn, further exchanges by sponsoring research at universities.

8. Collaborations among business, government, and non-profit organizations. In addition to collaborations between universities and industry, those among companies and trade associations, labour councils, and service organizations have built a coherence of purpose in Silicon Valley's community. These organizations, including such nonprofits as Joint Venture: Silicon Valley Network, are financed and largely led by those in the private sector, along with public-sector and community leaders. Initially aimed at mitigating the Valley's economic downturn in the late 1980s, these organizations worked at improving education, building the information infrastructure, reducing traffic congestion through telecommuting, and improving government operations.

9. High quality of life. The beauty of the Bay Area, its proximity to open spaces and the urban amenities of San Francisco, and the intellectual qualities of its leading universities historically have been major attractions. Recently, however, frustrating highway congestion, soaring housing prices, and a relentless, "24/7" pace of work have led some people to a less enthusiastic view of life in the Valley. Nevertheless, opportunities for innovation and entrepreneurship, as reflected in new job growth and higher wages, have (so far) continued to draw people to the Valley. These factors are in a delicate balance, with major initiatives underway to address growing concerns about the Valley's quality of life.

10. A specialized business infrastructure. Perhaps the most distinctive feature of Silicon Valley's habitat is its array of support services for new high-tech businesses. These include venture capitalists and bankers, lawyers, head-hunters, accountants, consultants, and a host of other specialists.

Finance. Individuals ("angels"), venture capital limited partnerships, commercial banks, and investment banks are some of the channels though which businesses receive financing. In

addition, these backers, many of whom have experience in running high-tech firms, often coach founders who lack important kinds of know-how and need advice.

Lawyers. In conjunction with the American system of laws, which is especially suited to fostering entrepreneurship (as noted above), Silicon Valley's lawyers themselves have become important assets for local start-ups. Lawyers are not only expert at handling the legal procedures involved in putting together and running new firms but, more importantly, in counselling inexperienced entrepreneurs; they, too, act as coaches.

Head-hunters. Head-hunters make the market matching people with jobs more efficient, especially by recruiting people for CEO and other senior positions. Valley executive search firms have played a key role through rapid, effective targeting and recruitment of top company leaders, especially through aggressive compensation and equity packages.

Accounting firms. Accountants in Silicon Valley serve firms whose needs and practices often do not fit with generally recognized accounting rules and standards. Valley accountants provide value far beyond their traditional roles as auditors and tax advisers, acting as innovative interpreters of accounting practices and valued guides for structuring new venture deals.

Consultants. As Silicon Valley, with its dynamic business environment and advancing technologies, has evolved, so have the roles of the growing array of consultants.

All these elements are essential capabilities necessary to understand the long-term success of the Silicon Valley region. As becomes obvious the RIS stretches significantly beyond the focus of technology and considers the whole business environment summarized as the specialized business infrastructure as an important ingredient for successful innovations. Without this interconnectedness between creative innovations in technology fields on the one hand, educational institutions and a local specialized business community who embody the knowledge for successful marketing of innovations other regional innovation system are incomplete and struggle with internal impediments.

However, there will be emerging the understanding from such a search process that particular regional deficits are important impediments for establishing a competitive regional innovation system opposite others who probably try to accomplish the same aims, but have a more favourable environment with regard to the already availability of necessary agents and resources. If therefore a debate in the regional innovation system community develops a sufficient consensus about what are potential reasonable aims to pursue over the up-coming next couple of years, they should start as well a screening process who and where potential regional competitors exists.

It seems very important for the European Research Area (ERA) and their respective national and regional innovation systems to understand that without sufficient abilities in all these ten

dimensions of regional competitiveness in innovation the chances for a long-term success of European RIS will be low. Furthermore it is obvious that not all regions of the EU have sufficient capabilities to succeed in this global competitiveness RIS-framework.

Only if this benchmarking process with other potential competitors shows a sufficient degree of likelihood that the own region has a fair chance to succeed opposite the other competing regions it makes sense to devote substantial resources in a regional innovation strategy. Therefore communities of regional innovation systems have first to search for a common goal for a reasonable time frame and as well to make an assessment if the regional capabilities are sufficient to give the region a fair chance to succeed against other competing regions in the end. In the past regional innovation policies lacked a realistic assessment about the regional capabilities for particular innovations and their respective competitiveness opposite other regions.[4]

This has to be organized as an open learning process which addresses all potential stakeholders. Regional innovation systems are therefore learning organizations which sui genesis. They have first to find feasible aims and scopes for their regional innovation activities. Without managing this first stage successfully the later implementation process will be at risk of failure because of the weak foundation the innovation concept itself. It might be that the aims and scope are reasonable by itself, but the region lacks the capabilities to succeed with their effort. One cause might be internal weaknesses to manage the system effectively one other might be external weaknesses opposite superior regional innovation system.

Winner-takes-it-all innovation races between RIS

Innovations often have the property of the winner-takes-it-all (Frank, Cook 1995). Only one team can be the first to reach e.g. the summit of Mount Everest. All the others loose in such a contest. Therefore this is a high-risk innovation strategy for a RIS to participate in such a contest (see e.g. Scherer 1994).

[4] One experience for example of the German unification process was that many East German regions tended to become high-tech regions without any clear knowledge about their relative competitive advantage opposite others regions competing for the same technological areas as locational centres. Even a lot of government money spend on industrial and technology parks in many regions very few in the end succeeded. The too ambitious aims and scope of such locations could not succeed in the end. To set-up a regional innovation system as a green field operation is a high-risk of failure endeavour. Instead it seems that those regions who have established a high reputation as an innovative region in the past have long lasting comparative advantages in maintaining this historical lock-in into the future. See Krugman (1992, 2009), Fujita, Krugman, Venables (1999).

Other types of regional contests in innovation are less risky. It might be sufficient to be part of the happy few who manage innovations in a particular technology field and gain by this a sufficient market share of a regional oligopolistic market structure. Therefore there is room for a coexistence of a couple of regions to successfully innovate even if some are more successful than others.

A monopoly of a particular innovation are much less common than oligopolistic regional location structures in innovation. Beside the Silicon Valley there are numerous co-existing around the globe. Some regions may be ranked on top in specific innovation activities but they not necessarily cover the whole global market and range of possibilities associated with a basic innovation. Therefore one should as is well known from the theory of industrial organization from product differentiation (see e.g. Piana 2003) tend to differentiate a region opposite a strong competing region or regions so that it does not face a head-on competition with these. If such differentiation opposite strong competitive regions is successfully accomplished it might even open up the possibility of co-opetition (see Brandenburger, Nalebuff 1996), i.e. cooperation in some areas where complementarily has emerged and competition where strong substitutionability prevails. To give an example from Germany, there has recently be established by two regions in Germany, Hannover and Oldenburg, an Auditory Valley initiative[5], which is part of the excellence cluster initiative receiving financial support of the German Federal Ministry of Education and Science (BMBF). This regional innovation system managed to build a network of companies (see figure 1) participating in the endeavour of the following goal:

"The mission of the cluster is to ease the acquisition of hearing aids for most people suffering from mild to moderate hearing loss. This target audience do not see hearing aids as a solution to their problem, due to many negative associations related to the products. Furthermore, there are derogatory ideas related to being "hard of hearing". Nonetheless, in their day-to-day lives they are strongly affected by their hearing loss. A direct result is the loss of productivity and the loss of quality of life." ibid.

[5] http://hoertech.hausdeshoerens-oldenburg.de/auditory-valley/web_en/auditory-valley/index.shtml

Figure 1 – Stakeholders in the regional innovation system of the Auditory Valley

They address a couple of audio technologically interconnected global markets:

global market for hearing systems and hearing aids	Size: 4.5 billion US$ Six manufacturers covering 92% of the global market Market penetration: 21% Growth rate: 5-8%.
Cochlear implants[6]	Size 1.2 billion US$ Four manufacturers covering 100% of the global market Market penetration: 10% Growth rate 20%

[6] See e.g. http://en.wikipedia.org/wiki/Cochlear_implant

Audio Technology	It is very difficult to quantify the global market of audio systems because these are often integrated into complex products and applications. Since 2007 the analysts Frost&Sullivan follow a new market segment denoted as "Personal Audio Communications Peripheral (PACP) Market Segment". It deals with individual mobile audio conference systems. Their prognosis is that between 2007 and 2012 the yearly growth rate of this segment will surpass 65%.

The regional innovation system includes a well-balanced mix of small and medium sized companies specialized in this area together with global players like Siemens, Audi (Volkswagen), Thomson and Sennheiser. They include university research and non-university research institutions (Fraunhofer Research Institute - IDMT[7]) together with Isono GmbH located in Ilmenau and headed by one of the worlds leading experts in this area Karlheinz Brandenburg (father of the MP3-Audio-Standard). By this innovation cluster in the area of audio systems development in Germany the RIS in Oldenburg and Hannover expects to have brought together sufficient critical mass to compete with other regional innovation systems in this field successfully. The before separated activities of basic research, applied research and development, technology transfer, patenting, manufacturing of products, marketing, financing, etc. gain a higher level of interconnectedness contributing to a significantly better information flow between the different heterogeneous agents. This hopefully leads in the end to better products addressing particular markets and by embedding global market leaders in this field speeding-up the innovation process from invention to innovation to market.

Once this first stage of taking stock of regional innovation capabilities, potential aims to use these capabilities for particular innovations and the assessment about the chances to successfully compete against and/or cooperate with other regions trying to succeed in the same area of innovation, one could begin to discuss the necessary resources and time frame needed to accomplish these aims. The previous example illustrates that all potential stakeholders have to be identified, integrated into a more or less interconnected innovation system network.

Following the ten dimensions considered by Lee, Miller, Hancock and Rowen (2000) outlined in the previous section, we will still observe that there are not all perfectly matched. Therefore one should not expect that RIS will always be able to fulfil these completely.

[7] http://www.idmt.fraunhofer.de/eng/hearing_speech_audio_technology/index.htm

However, they help to derive a benchmark in the sense the SWOT-analysis to develop strategies to systematically improve the quality of the RIS.

Monitoring RIS

Beside the micropespective of a single RIS for development planners and managers of RIS it will be very important to have established a regular monitoring system of their and other RIS. The European Commission has established a regional cluster observatory[8] which is often complemented by national and international similar cluster observatories. A survey on national regional cluster policies can be found on the EU-Website.[9]

There one can access as well the regularly published European Cluster Organisation Directory. It is a quarterly report presenting the Observatory database of cluster organisations.

1153 cluster organisations have been identified and are listed in the Directory. The directory lists organisations across 204 regions.

Cluster organisations are indexed using 142 clickable industry indicators. The Directory provides the city and the web address of each organisation, which is clickable for easy access. The largest number of cluster organisations are found in the following industries:

- Information Technology (76),
- Biotechnology (64),
- General Automotive (55),
- Environmental Technology (52) and
- Agricultural Technology (43).

The European Cluster Observatory provides a wide variety of data on clusters in Europe and is divided into four main sections:

- Cluster mapping: regional clusters based on 38 cluster categories (agglomeration of employment in co-located industries) in 259 NUTS 2 regions. This section now also incorporates cluster organisations

- Cluster organisations: maps and lists of regional/local private-public partnerships focused on cluster improvements (if you represent one of these organisations, you are welcome to join the Observatory and be highlighted in maps and tables)

[8] http://www.clusterobservatory.eu/index.php?id=45&nid
[9] http://www.clusterobservatory.eu/index.php?id=42&nid=

- Cluster policies: reports on national and regional cluster policies and programmes

- Cluster library: including cluster cases and other cluster-related documents

During the period 2010-2012 the Observatory will be updated with new data, new visualisations and a new online collaboration tool for SMEs and organisations to benchmark their performance and find new partners. The European Cluster Observatory is managed by the Center for Strategy and Competitiveness (CSC) at the Stockholm School of Economics, and is financed by the European Commission, DG Enterprise and Industry, under the Europe INNOVA initiative.

The Directory includes 237 cluster organisations that are Members of the Observatory.

The current version is Q4-2009 (released November 2009).

This is therefore a useful source to identify potential competing regions or potential partners inside the EU. This kind of repository should be helpful to monitor the RIS in the respective competitive environment.

Forming clusters of entrepreneurship as part of a RIS-strategy

It is well known that employment growth is highly correlated with the number of SMEs present in a region. By establishing clusters of entrepreneurship taking into account as well the specialised business infrastructure needed for innovators as entrepreneurs could significantly improve the employment opportunities in particular for the high-skilled labour force. They will induce some complementary demand even for the low- and medium-skilled labour market especially in the service industries. Such clusters become strong attractors beyond the regional boundaries for potential new entrepreneurial talent (see e.g. Glaeser, Kerr, Ponzetto 2010)..

Looking beyond the horizon of Europe

However, in the age of globalisation one needs even look beyond the European framework. Not only as is traditionally assumed in the old Triad-theory the US and Japan are highly competitive players, but other emerging and developing countries around the globe have developed their innovation capabilities to a level where they are serious competitors in global competition for RIS. Particularly Asian countries like the PR of China, South Korea, India, Taiwan have very strong capabilities as regional innovation clusters which often outperform

those of the former leaders of the Triad (see e.g. BMBF[10]- Clusterportal http://www.kooperation-international.de/countries/themes/international/clustermap/).

The PR China has invested heavily over the past decade in setting-up huge innovation clusters in the regions around Beijing, Yangtse-Delta with Shanghai as a central hub, and Peal-River-Delta around Shenzen. Because of their huge size and companies involved they have been considered as mega-clusters. The Mega-cluster Zhongguancun Science Park near Beijing consists of ten sub-parks (see figure 3).

Figure 3 - Zhongguancun Science Park near Beijing

[10] BMBF - German Federal Ministry of Education and Science

- **Haidian Park**:
  Ist he origin of Chinas Hightech Industry. In it are more than 10.000 hightech companies located. Areas for innovation activities are: electronics, information technology, biotechnology, pharmaceutics, energy, new materials. It coveras an area of 75 sqkm and has been named Chinas Silikon Valley. It is embodying the West Park, Shangdi Information Industrial Base, Yongfeng Experimental Base, Zhongguancun Software Park, Zhongguancun Life Science Park, Tsinghua University Science Park and Peking University Science Park.
- **Fengtai Park** (Fengtai District) with over 2.000 companies.
- **Cangping Park** (Cangping County) with over 2.000 companies active in the area of medicine, pharmacy, biotechnology and electronics.
- **Electronic Town** (Chaoy-ang District):electronics, telecommunications, optoelectronics, energy technology, it is also a location of MNEs R&D centers.
- **Yizhuang Park** (Daxing County) is a production location of foreign companies
- **Desheng Park** (Xicheng District). This is a location for display manufacturing
- **Shijingshan Park**. Here activities for Cultural Creation and Digital Entertainment are located.
- **Yonghe Park**: activities related to Cultural Creation & Creative Industry", it is a major centre in China for „Digital Content".
- **Daxing Bio-Medicine Park**: Biomedical industry, testing and manufacturing of pharmaceuticals, National Platform of Bio-medical Technology Trade and Technology Services, Center of Drug Testing and Evaluation.
- **Tongzhou Park:** Optical-Mechanical-Electronics Integration Base, Telecom, car parts, Environmental Protection.

Furthermore additional 20 other specialized industrial parks and industry bases are located in the vicinity of Beijing

•National Base of Electronics Information Industries
•National Base of Software (Exporting) Industry
•National Base of Bio-Medical Industry
•National Base of Engineering Innovation
•National Center of Technology Transfer
•National Base of Online Gaming and Animation Industry
•Digital TV Park
•Cultural Creation Industrial Base

These are complemented by another 17 University-Based Science Parks

The most important are:

•Tsinghua University Science Park
•Peking University Science Park
•Beijing University of Aeronautics & Astronautics Science Park
•Beijing Institute of Technologies Science Park

From this brief description one gets a first idea how a major RIS in China is organized and how the vicinity and high diversity of innovation fields represented in this Mega-cluster could

easily be reorganized if cross-fertilization between different research and innovation areas would be needed in the future. The whole Zhongguancun Science Park entity is under the governance of the Administrative Committee of Zhongguancun Science Park, which is part of the Beijing Municipal Government.

The whole Mega-Cluster has been developed since 1988 and is still expanding rapidly. It shows how major agglomerations of innovation activities have emerged over the past two decades in China. China is tempting for head-on competition in all these areas with the best innovation centres in world in particular in the US.

What this brief characterization of this Mega-cluster show nicely is that China has focused its resources for innovation in a few core regions of the huge country. This significantly contributes to the better communication and cross-fertilization between different disciplines, innovation areas and the science-industry-linkages. Even if the sub-clusters are specialized in specific fields the overall Mega-cluster accomplishes a high degree of universality of innovation activities currently defining the global innovation frontier.

For a SWOT-Analysis of the Zhongguancun Science Park see Wang Xiaomin (2000).

Conclusions

One lesson to be learned from Europe is that to face the stiff competition from abroad in particular of the US as the traditional world leader in innovation and the emerging new innovations clusters in many Asian countries, there is an increasing necessity to agglomerate and specialize the innovation activities to significantly enhance the cross-fertilization and knowledge exchange in particular of tacit-knowledge. The creation of a globally competitive European Research Area would therefore make it necessary to establish similar Mega-Clusters without taking too much notice of the traditional national boundaries. The locational fragmentation of innovation activities in the EU could become a major impediment to compete in the long-run with the key players in the global innovation market place. Therefore there seems to be an urgent need to get a more integrated community oriented innovation cluster policy approach which helps to establish RIS which are able to prevail in a more and more competitive global environment. What seems to be little understood in the general public in Europe is the magnitude of change emerging in particular in Asia. Up to now most regional innovation activities are still stuck in a national framework. This is particularly problematic for smaller countries which have not the ability and resources to compete against these global Mega-clusters in the world.

Beside these Mega-Clusters there will be of cause the need and opportunity to have secondary and tertiary tires of RIS. These could contribute to the European Innovation System (EIS) by being efficiently linked with the Trans-European RISs to supplement and complement with them so that the knowledge flows generated at the centre diffuses more efficiently into the space of the ERA. After all it seems unavoidable to develop such a hierarchical network of RISs which through a hub-spoke-architecture of regional clusters has the possibility to fulfil the tasks of creating and maintaining competitiveness in innovation of the EU opposite the increasing challenges from other global innovations centres on the world.

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