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for European Integration, Cohesion and Enlargement

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**ABSTRACT
and
EXECUTIVE SUMMARY**

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European Union FP6 - CIT2-CT-2004-506242

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ABSTRACT

The IKINET project has aimed to increase the understanding of the **process of knowledge creation and innovation in medium technology sectors** in the EU and to identify the characteristics of knowledge and innovation networks within **regional clusters** and the barriers for their **enlargement at the European level**. It investigates **strategies** that **SMEs** in medium-technology industries apply to adjust their knowledge creation processes to **global structural challenges**.

Medium technology sectors have achieved high success in industrial restructuring and play a key role in European competitiveness, as they represent the largest share of European export in manufacturing industry and indicate the highest growth rate in European exports toward global markets.

Differently from the “**linear approach**” focusing on **internal R&D activities and external technology transfers**, which applies to large firms and high-tech sectors, innovation processes in SMEs and medium technology sectors are characterized, according to a “**systemic approach**”, by informal and gradual **collective process of interactive learning**, the **iterative adaptation between the different partners** and an **implicit process of automatic selection** of the most competitive innovations. This “**systemic approach**” leads to promote **knowledge networks and cooperation** between the various local and external actors and to develop **the internal capabilities** of these actors.

The processes of knowledge creation have a localized nature, as knowledge can only develop in a localized or specific framework and it calls for the “**cognitive proximity**” of the various actors, which participate to an interactive learning process. Differently from large firms, **SMEs should not be considered individually**, but rather as part of a **complex regional production and innovation system**.

The traditional industrial clusters, specialized in a single sector, have evolved into **territorial networks**, which are characterized by a **greater sectoral diversification**, a **greater integration of the various sectors** of the local economy and also by an **increasing internationalisation**. The cluster concept has evolved from a predominantly **material linkage and agglomeration based concept** to that of an institution that supports **knowledge generation and the sharing of knowledge**.

A **change in the corporate culture** is needed in order to promote knowledge sharing and the willingness to collaborate. Human resources should not be considered only for their **absorptive capacity and resistance to the adoption of technologies**, but rather as the **actors, which promote innovation and are endowed with specific capabilities**. Formal education and life long learning are instruments, which promote the **building of the competencies** of the various partners in localized knowledge networks and their ability to **use external tacit and codified knowledge** in the process of innovation.

The focus on the process of knowledge creation rather than on the adoption of technologies, should lead to **promote creativity**, which is based on **diversity, tight interaction** between different and dispersed actors and the capability to **establish new connections** between different pieces of information and knowledge. **Networks organize diversity** and facilitate the combination of information and knowledge. Creativity may be hindered by the lack of needed competencies in the local economy and indicates the **need for cooperation with international universities and major international companies**.

Innovation in medium technology sectors can be stimulated more by **projects aiming to respond to new needs and demands of the user side** and to the creation of new “lead markets” rather than by the aim to commercially exploit new technological discoveries. The problem is not the creation of **new geographical clusters**, but rather to promote **new strategic projects in the existing clusters and regions**.

Competence centres are new instruments of innovation policy, which are suitable for the SMEs in medium tech sectors and may be adopted in countries where they do not exist. The IKINET project may help in illustrating the different dimensions of the process of knowledge creation at the local level and in providing **guidelines for defining the strategy of competence centres**. Competence centres should promote:

- the **response to the emerging needs of the user side** and the creation of new “lead markets”,
- the **use of the accumulated knowledge** within the cluster and **collective interactive learning processes** between the local actors,
- **new activities** or “**strategic spin-offs**”, which can lead to a diversification of the local economy,
- the **design and adoption of large strategic projects** of innovation requiring the coordination and cooperation of multiple partners,
- success in an increasingly **complex and connected world and international links**, enhancing an international integration and competitiveness.

The role of the European Union changes in this context. **Direct R&D and capital subsidies actually can only hardly reach SMEs** in medium-technology sectors, as the SMEs miss necessary formal R&D and strategic resources to cope with EU preconditions in order to participate to large R&D European projects. Instead, **EU policy should focus on:**

- support of **competence centres as intermediaries for SMEs**,
- subsidisation of **public-private funding of competence centres in lagging regions** aiming to extend the cooperation between these regions and leading agglomerations,
- initiate **contests on strategic lead projects** on a regional and interregional level enhancing the **participation of new companies**,
- promote projects **integrating medium-technology industries with universities and high technology services** aiming to extend industrial value chains and to **diversify in new qualified productions**,
- promote **European linkages between regional competence centres** by standardisation of information, qualification courses for the managers of competence centres, technological norms and support to bridging organisations,
- adopt **strategic regulations** to strengthen European technical safety and environmental standards in the global market and promoting the **development of new productions**.

EXECUTIVE SUMMARY

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1. Project objectives

- 1) The IKINET project has aimed to increase the understanding of the **process of knowledge creation and innovation in medium technology sectors** in the EU and to identify the characteristics of knowledge and innovation networks within **regional clusters** and the barriers for their **enlargement at the European level**. It investigates strategies that SMEs in medium-technology industries apply to adjust their knowledge creation processes to global structural challenges.
- 2) The results presented in this report are based on an empirical study executed in the European project “IKINET - International knowledge and innovation networks for European cohesion, growth and enlargement” between 2004 and 2008, funded within the 6th European Framework on Research, Technology and Development (CIT2-CT-2004-506242). **Eight units** contributed to the results of this study¹:
 - University of Rome, Tor Vergata, Italy, led by the coordinator of the overall project, **Riccardo Cappellin**,
 - Polish Academy of Science, Warsaw, Poland, led by **Stanislaw Walukiewicz**,
 - Ruhr Research Institute for Regional and Innovation Policy (RUFIS), Bochum, Germany, led by **Rüdiger Wink**,
 - Centre for Advances Studies at Cardiff University, United Kingdom, led by **Phil Cooke**,
 - Joanneum Research, Graz, Austria, led by **Michael Steiner**,
 - Autonomous University of Madrid, Spain, led by **Javier Alfonso-Gil and Antonio Vazquez-Baquero**,
 - Institute for Agro-Economic Research (INRA), Paris, France, led by **Andre Torre**,
 - Applica Sprl, Brussels, Belgium, led by **Terry Ward**.
- 3) The topic discussed in this report is absolutely crucial for the future of the European economy, as **medium-technology industries** are not only the **dominant sectors for European exports** into the global markets, but also **the fastest growing sectors in international trade**.
- 4) The **focus on high-technology sectors and knowledge-intensive business services** found in many studies of international organisations, expert groups and scientists misses the point that these new activities **are not independent from the traditionally strong manufacturing sectors** in Europe, such as medium-technology industries.
- 5) Most studies simply transfer the observations from high-technology sectors with their strong role of formal R&D, capital equipment and patents as typical output, to medium-technology sectors, thus **neglecting the specificities of these industries**. These specificities in the innovation processes particularly refer to the concepts of “**synthetic knowledge**” and **integrative technologies**, which mean that firms in the medium-technology sectors are able to

¹ The empirical and theoretical contributions of the research units are available at: <http://www.ikinet.uniroma2.it/>

connect general insights on modern technologies to concrete and very specific engineering problem solutions. Hence, medium-technology industries follow their own rationale in knowledge creation.

2. The role and characteristics of medium-tech sectors

- 6) While **innovation policies mainly focus on** the development of **high technologies and R&D investments**, European industry is still characterized by a **strong specialization in medium technology sectors**, such as machinery, transport equipment and chemical products. **Medium technology sectors** have achieved high success in **industrial restructuring** in recent years and play a key role in **European competitiveness**.
- 7) The analysis of key statistical indicators for the manufacturing sectors classified by technology intensity indicates that medium technology sectors have very **different characteristics than the manufacturing high technology sectors**, on which innovation policies mostly concentrate. In particular, the following empirical results seem to highlight the need for specific innovation policies for the medium technology sectors.
- 8) Medium technology manufacturing sectors represent the largest component in the **trade of OECD countries** (56,3%) and their share in the period 2000-05 has continuously increased, while both the share of low technology and also that of high technology products have decreased.
- 9) The share of medium technology sectors on **total manufacturing exports** is greater than or close to 50% **in almost all European countries** and it has increased during the 2000-2003 period. The **trade balance of the European Union** in medium technology sectors is positive and it is compensating the trade deficit in the high tech and in low tech sectors.
- 10) High technology sectors represent only 1,08% of **total European employment**, while manufacturing medium technology sectors have a much greater importance since they represent 11,61%.
- 11) The **share of medium technology sectors in manufacturing industry employment** is particularly important in the largest and most industrialized countries in European Union. Moreover, with the exception of only few countries, the share of medium tech manufacturing industry on total manufacturing has increased in all EU countries during the period 2000-2006.
- 12) Medium technology industry represent 57,9% of **manufacturing exports**, 53,3% of **manufacturing employment** and 47,8% of **manufacturing value added**, while the share of high tech industry is only 17,1% in the European manufacturing exports, 19,5% in manufacturing value added and 5,8% in manufacturing employment.
- 13) Medium technology sectors do not only have a much greater relevance than high tech sectors, but also **have a different “technology profile” from that of the high tech sectors**. In fact, medium tech sectors indicate a very high share of total exports, total employment of qualified workers and total employment. While the high tech sectors indicate relatively large value of the shares of total value added and especially of R&D.

- 14) **The intensity of human capital** is tightly related to the technology level of the industrial sectors. Medium technology manufacturing sectors have intermediate values of highly qualified workers on total employment and this share is constantly increasing.
- 15) The difference between the medium tech and high tech sectors is clearly indicated by the different relevance of qualified human resources (i.e. a proxy of “human capital”) and of R&D (i.e. a proxy of “codified knowledge”) in these sectors. In fact, medium tech manufacturing sectors and even more low technology sectors **combine a much higher level of human resources with an unit of R&D with respect to high technology sectors**. Thus, knowledge which is embedded in people or “tacit knowledge” is much more important for medium tech manufacturing sectors than for high technology sectors.
- 16) The share of medium technology sectors on total manufacturing exports is rather similar both in **European Union** (59,4%) and in the **US** (61,4%). Also the share of medium technology sectors on total manufacturing value added is rather similar both in European Union (47,8%) and in the **US** (44,6%). A point of similarity between European Union and the US is the fact that the evolution of the trade balance of medium tech sectors in the period 2000-2005 has been more positive than that of the high tech and of the low tech sectors.
- 17) A comparison of the share of “Human Resources in Science Technology” employees on total employment in manufacturing and in services indicates that **the gap in the use of qualified human resources between manufacturing and services** is much larger in the US than in most of the European countries. That indicates a greater capability of the EU manufacturing industry to use qualified human resources than the US manufacturing industry.
- 18) These statistics indicate **the importance of medium tech sectors** and underline the need to design an approach to European innovation policy, which considers **the specific factors and processes determining knowledge creation and innovation** in these medium technology sectors.

3. Innovation patterns and best practices in medium-technology networks

- 19) Seven regions were selected in the IKINET project to cover the variety of starting conditions and challenges of the European regions within the global competition:
- **Ile de France** as one of the most advanced metropolitan areas with a large R&D infrastructure and many big industrial companies: **Optics cluster**
 - **Hamburg** as one of the most advanced metropolitan areas with a high share of business related services and a smaller industrial basis: **Aeronautic cluster**
 - **Madrid** as a metropolitan area of the Southern European member states with a huge growth in recent years: **Aeronautic cluster**
 - **Styria** as an old-industrial area with huge success in the re-structuring process towards a knowledge-intensive industrial area: **Automotive cluster**
 - **Wales** as an old-industrial area with high growth rates due to foreign investments, but less R&D investments than Styria: **Aeronautic cluster**
 - **Campania** as a lagging region in the incumbent member states with growth rates in R&D and qualification levels: **Aeronautic cluster**
 - **Silesia** as a lagging region in the new member countries with a long industrial history but huge challenges of structural challenges: **Mining Machinery cluster**

- 20) The empirical studies were based on a **case study approach**. Instead of collecting a few quantitative data from a large number of firms and organizations, several **in-depth interviews** with different key persons in the firms were executed to receive more **detailed information** about the actual innovation processes within single firms.
- 21) The experiences in the quantitative part demonstrated that the adopted approach to structure the **quantitative indicators** according to key functions **indicated by the territorial knowledge management** approach actually improved the understanding of the structural differences between the regions.
- 22) The **traditional view on medium-technology SMEs** is based on the recognition of firms with severe scarcities of resources. These **scarcities hinder SMEs** in their capability to react to the structural challenges determined by the changes in the relationships with customers and in products markets, in the role of the various financial intermediaries, in the expectations by the more qualified human resources, as well as in international markets.
- 23) Most scientific papers on knowledge creation deal with the **creation of new, often radical, knowledge in high-technology sectors** based on capital-intensive investments in huge R&D laboratories and excellent staff. On the contrary, to develop **new products and services in medium-technology industries** requires a lot of **specified and embedded “synthetic knowledge”**, which consists in the capability to combine general theoretical concepts with the specific capabilities of individual production processes and the needs of specific application problems.
- 24) **Local networking** has already been a typical strategy for medium-technology SMEs to cope with **the requirements in the supply chain**. The conditions for local networking of SMEs changed due to **structural challenges** coming from the internationalisation of markets and changes in the knowledge paradigms. Consequently, **there is not one specific network model for all European regions**, but networks can be based on different objectives, entry requirements and modes of cooperation.
- 25) Traditionally, **medium-technology industry SMEs concentrate on national or even regional markets**, as they can use here their specific strengths in intensifying **long-term personal relationship** and continuity within their strategic outreach. **Internationalisation** has always seen as a potential threat, as most of the SMEs’ management **lack the necessary experiences and skills** to implement suitable strategies. With the change towards global and modular sourcing, however, medium-technology SMEs are **increasingly enforced to look for international partners** in developing **knowledge for the whole production cycle** or to take the risk of **relocations of standardised production** to cut costs.
- 26) Many studies state that the scarcity of SMEs resources makes it too difficult for them to cope with **new requirements on knowledge creation in integrative technologies, global and modular sourcing strategies** by multinational OEM and **increasing competition by firms located outside the EU**. On the contrary, our empirical analysis reveals that **medium-technology SMEs actually find different strategic solutions** according to different preconditions and needs in single cases. As general strategies, we observed the **growing role of science-driven spin-offs as SMEs are being integrated into new knowledge value chains**. Besides this relatively new phenomenon, **other firms diversified their markets** of applications or – as a contrast – **focused even stronger on very specific niches** or looked for **a more formalised way to cooperate with other firms**, even up to the formation of a joint holding by former individual firms.

- 27) As an extension to traditional strengths of knowledge creation in SMEs, **more investments in further education** could be observed. These activities help to **increase the loyalty by employees** and to **formalise the knowledge base of employees**. Other strategies focus on **new ways of cooperation between SMEs** or with other partners to cover the deficits so far identified for SMEs to be **integrated in global knowledge value chain**. Finally, **new financial instruments** are used by first entrepreneurial SMEs to overcome the capital gap while still keeping independence.
- 28) Within all clusters of investigation, **changes in local networking** could be observed. Strategies to **adjust local networks** range from the formation of “**identity networks**” to **connect personal and social linkages** with the more formal and organisational requirements of industrial value chains to the emergence of “**strategy networks**” in **material value chains**, where **OEM play a major part** to formulate a joint strategy and also the emergence of **knowledge-driven strategy networks**, where not only OEM are responsible for the development and assertion of strategies on knowledge generation and exploitation, but also **intermediaries like knowledge-intensive business service companies or R&D providers**.
- 29) SMEs are mostly positively reacting to the growing importance of interregional networking. The **identification of best practises** is driven by gatekeepers like OEM or R&D service intermediaries or by specific events like trade fairs and joint initiatives. It becomes obvious that interregional linkages will only be intensified after an **intensified diffusion of the new business strategies** by the most successful SMEs.

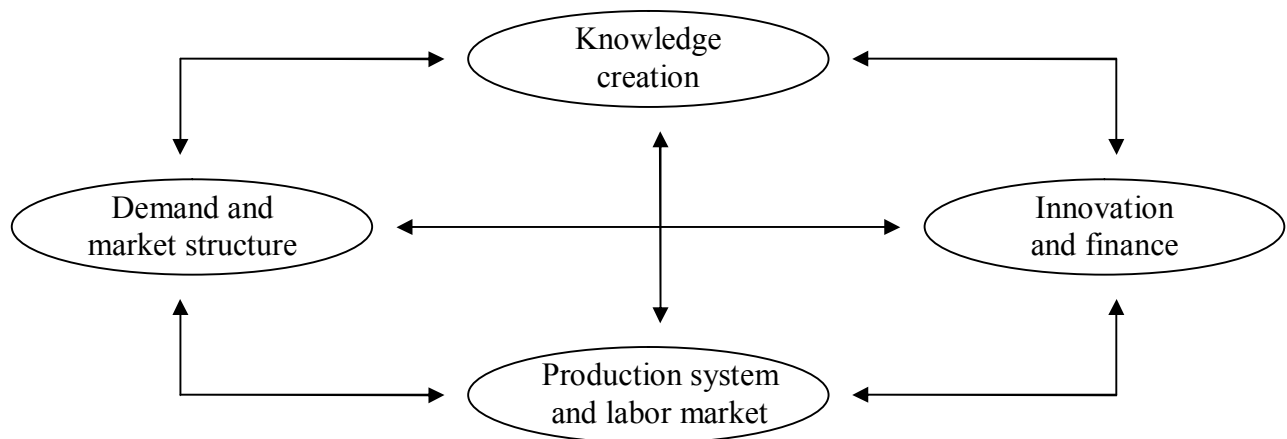


Figure 1: The relationship between knowledge creation and innovation

4. The analysis of regional knowledge networks

The process of innovation and knowledge creation

- 30) The IKINET project has aimed to increase the understanding of the **process of knowledge creation and innovation in medium technology sectors** and to identify characteristics of innovation networks within **regional clusters** and barriers for their **enlargement at the European level**.

- 31) **Medium technology sectors** have achieved high success in industrial restructuring and play a key role in European competitiveness, as they represent the largest share of European export in manufacturing industry and indicate the highest growth rate in European exports toward global markets.
- 32) Innovation is promoted by factors operating both on the **supply side** and on the **demand side**. Among the first are: the costs and the quality of labour, the use of new machinery embodying modern technology, the accessibility to qualified suppliers. Among the second are: the access to a specific market, the level of demand, the forms of competition, as also the existence of specific barriers to potential competitors, such as IPR, which insure a temporary rent. Internal knowledge and internal or external financial resources are two additional necessary conditions for the adoption of an innovation and they indicate the **subjective capabilities/weaknesses** existing in the firms in order to exploit **external opportunities** or to face **external threats**.
- 33) The focus on the **process of knowledge creation** rather than on the **adoption of technologies** explains the need to analyse the characteristics and factors of the process of knowledge creation in the case of **intermediate technology sectors**.

From a linear to a systemic approach in innovation

- 34) While most of the literature and policy debate on innovation focuses on high-tech sectors, the **innovation process in medium-tech sectors has rather different characteristics** and it is **explained by different factors than in high-tech sectors**.
- 35) Technology in medium technology sectors is characterized by an high complexity, as products are made by an **high number of heterogeneous physical components**, which require a variety of agents, competencies and pieces of knowledge for their production.
- 36) The **fragmentation of the production process** and the **high specialization** of the firms explain why economies of scale are less important and firms have a small size and develop a very strong interaction with their **external local environment**, made by an high diversity of private and public, local and non local actors.
- 37) Thus, differently from large firms and high tech sectors, innovation processes in the SMEs working in medium and low technology sectors do not depend on formal R&D, but on **tacit knowledge or on combinatorial capabilities and interactive learning processes** within networks of firms. Innovation has a **gradual character** and consists mainly in improvement of existing products, services and processes.
- 38) In particular, local production systems of SMEs are characterized by a **systemic process** within which different phases may be distinguished (Cappellin and Orsenigo 2000):
- **the phase of knowledge creation**, characterized by learning processes based on emulation and the close interaction of actors with different competencies,
 - **the innovation phase**, characterized by a “problem solving” approach that makes expert use of a combination of different and complementary knowledge,
 - **the production phase**, characterized by the joint work of various specialized suppliers.
- 39) SMEs develop **vertical flows of tacit knowledge within their respective “filiere” or value chain**. Moreover, they are increasingly **developing also horizontal linkages with different technologies and sectors**, which are crucial in order to promote structural changes and a **productive diversification of the cluster**, through the creation of new fields of production.

40) In a policy perspective, differently **from a linear approach**, which just promotes the **transfers of information and of modern technology** or provides customized expertise to individual firms, a **system approach focuses on promoting knowledge networks and cooperation** between the various local and external actors and on the **development of the internal capabilities** of these actors.

The complex nature of tacit knowledge and the creative capabilities

41) **Tacit knowledge** plays a key role in the process of innovation by SMEs in medium technology sectors, where innovation is based on the **capability to informally search for a solution to local problems together with other partners**. This process is different from the formal research activities in the high technology sectors.

42) **Codified knowledge can be interpreted as a stock or a resource**, which can be transferred between the persons through the language and between the firms within the market. On the contrary, tacit knowledge **can be interpreted as a complex set of competencies or capabilities to use the available resources**. That explains that tacit knowledge or “know-how” is **linked to the process of action**.

43) A key dimension of tacit knowledge refers to **creativity**, since creativity is a form of tacit knowledge. In fact, **“architectural competencies”** or the capability to recombine different fragments of knowledge in an original way are in itself tacit, as what has not been thought cannot be codified.

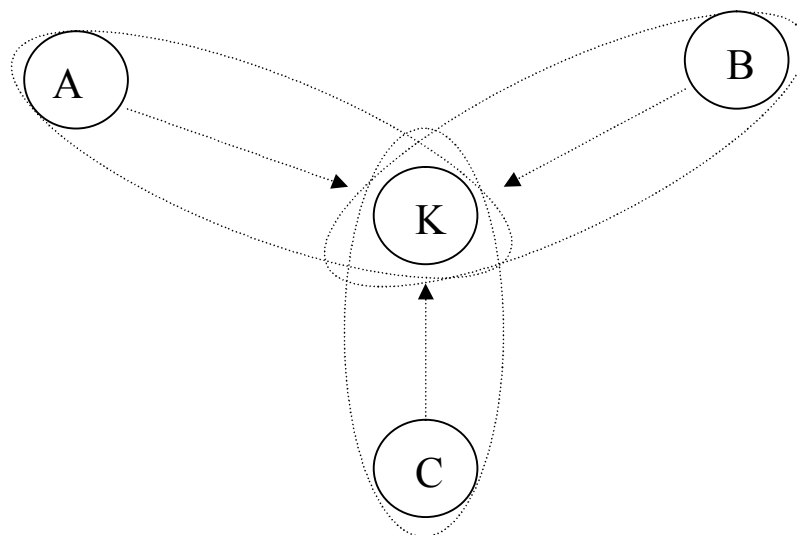


Figure 2: Creativity as combination of diverse accessible knowledge

44) **Creativity** is the result of a **process of selection and of association and simplification** (“pattern making”) that allow to **combine different and complementary information, technology and knowledge** borrowed from various sectors, disciplines and regions in the solution of a specific **problem**, which stimulates action and which usually requires the **joint contribution of various actors** interested to it. Creativity requires **exploration, social interaction and a wide set of connections**, allowing sharing, transforming, retaining and creating knowledge. It is based on **joint work** and it implies **reflexivity, contestation,**

negotiation and problem solving. It may be hindered by the **lack of needed competencies** in the local economy leading to a **situation of lock-in.**

- 45) Creativity requires the **combination of knowledge** in different fields and the **interaction between actors** having different competencies. The creative process is a fundamental component of a cognitive process, through which **various set of knowledge** are first searched, identified, understood, analysed for similarities and are finally brought together by **adapting and extending their significance** leading to the creation of a **new set of knowledge** (figure 2).
- 46) In particular, **tacit knowledge might be easier to be recombined** than codified knowledge, as it is more implicit, ambiguous and flexible. Thus, recombining knowledge from different agents, sectors, disciplines and countries may be easier, when the tacit component is very strong.
- 47) Therefore **tacit knowledge is not “transferred”** as in the case of codified knowledge, but it is rather a capability which can be learned, as the result of a **process of interactive learning** through which the actors develop internally with the collaboration of external actors **specific new creative competencies**, which will allow them to **adopt process and product innovation.**
- 48) Policies aiming to promote creativity are different in the various sectors. Creativity in **high tech sectors requires large investments in R&D**, while in **medium technology sectors** creativity requires **networks and informal interaction**, leading to interactive learning between SMEs. However, creativity also requires a **sustained effort in innovation** by SMEs.
- 49) Creativity does not only consist in the adoption of specific product and process innovation, but also in the **design of medium term projects** having a collective nature **between the various SMEs** and large firms. In fact, regional innovation policies, rather than to aim to the **creation of new clusters**, should **promote large innovative common projects in the various clusters and regions.**
- 50) **To enhance creativity** requires to **facilitate the vertical relationships along the supply chain** between client and suppliers in a vertical perspective, but also **horizontally between different sectors** both locally and with external partners, such as **international research institutions and large international firms.**
- 51) **Tacit knowledge is more difficult to transfer** among distant agents, as it requires personal contacts and a deep reciprocal knowledge and trust. However, in some cases, the lack of geographical proximity may be compensated by **an adequate organizational or institutional proximity**, which may allow to transfer tacit knowledge at large distance within organizations and institutions. In particular, **networks** may represent that organizational structure which is appropriate in order to organize diversity, facilitate the sharing and combination of tacit knowledge and **stimulate creativity.**

The localized character of the cognitive processes

- 52) **Clusters** may be defined as “**geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries and associated institutions...** in a particular field that compete but also co-operate” (Porter 1990 and 2000). It is also widely believed that industrial clusters can help to improve **the performance of regional economies** by fostering innovation and strengthening the competitiveness of firms, thereby generating growth and employment.

- 53) **Innovative activities are highly spatially concentrated** and that is usually explained by the existence of various forms of **agglomeration economies**, which enhance the development of innovative productions in specific central areas.
- 54) The IKINET project has aimed to come to a better understanding of actual processes of knowledge generation, transfer and absorption in and between firms and other organisations and it has focused attention on **innovation as an interactive process involving the sharing and exchanging of different forms of knowledge between regional actors**.
- 55) **Knowledge creation only apparently has an a-spatial character** and cognitive sciences clarify on the base of theoretical considerations that **the process of knowledge creation works in a localized framework**. Thus, the agglomeration of innovative productions can be explained on the base of the **localized nature of the processes of knowledge creation**.
- 56) The process of knowledge creation has a **combinative and an interactive character** and a closer geographical proximity and/or a greater cognitive proximity facilitate the combination of complementary pieces of knowledge and the interaction between various complementary actors.
- 57) **Time and space dimensions** are both relevant in the process of innovation. While the **evolutive approach** clarifies the path dependent character of the innovation process, a **network approach** clarifies the spatial embedded character of the innovation process. **A spatial perspective** to the analysis of the innovation process introduces **the interaction between various local and external actors**, as a new element with respect the **combination of different pieces of knowledge**, as indicated by a **functional perspective**.
- 58) In a spatial perspective, the success to solve previous problems is leading to strengthen the links with some specific actors and to create **soft infrastructures**, such as routines, norms, intermediate institutions, trust, common identity and sense of place belonging within the organization, **facilitating the future interactions with these actors**.
- 59) The “**territorial knowledge management approach**” indicates a spatial approach to the explanation of innovation. It illustrates the characteristics of a process of **learning through networking** and it highlights various phases of a process of knowledge creation, which is the result of interaction between various actors, such as: external stimulus, accessibility, receptivity, identity, creativity and governance.
- 60) The localized dimension of cognitive processes implies that **space is not only relevant in order to examine the process of territorial diffusion of knowledge** or the impact of this latter on the structure of the territory. On the contrary, in a more fundamental way, **the territory affects the process of knowledge creation**. Thus, knowledge occurs within specific local areas or clusters and the specific characteristics of the individual areas, both the central and most developed areas and also the peripheral and less developed area, lead to the different characteristics of the processes of knowledge creation in these areas and affect the **competitiveness of their firms**.

The changing nature of clusters and the role of proximity

- 61) **Geographical proximity per se is not sufficient to generate knowledge between firms**. The forms of organized learning differs remarkably between clusters, as the diffusion of knowledge within clusters is highly selective and strongly depends on the position of firms within networks and their **absorptive capacity**.

- 62) **Geographical distance** between two individuals may represent an obstacle to their interaction. However, it may be compensated by “**organizational proximity**”, when these individuals are linked by the belonging to the same organization, such as a the same firm, characterized by internal routines and procedures, which may facilitate their relationship. On the other hand, **geographical distance** between two firms or other economic and social collective actors may be compensated by “**institutional proximity**”, when these firms are linked by the existence of a common institutional framework, made by procedures, contracts, norms, intermediate institutions, which perform the role of “soft infrastructures” facilitating their relationship.
- 63) While the **three concepts of geographical, organizational and institutional proximity** refer to external obstacles hindering the relationship between individuals, firms or actors, the **internal characteristics** of these individuals, firms or actors determine the concept of **receptivity** or “**cognitive proximity**”.
- 64) **Regional innovation systems and territorial networks** insure the advantages of **higher geographical, organizational and institutional proximity**, between the firms belonging to the same regional innovation system. On the other hand, regional innovation systems and territorial networks also insure the advantage of **an higher receptivity**, as the **actors may become more similar** due to the long term effect of more frequent interactions.
- 65) **Regional production systems** should be analysed in an historical background and are the result of **an evolutionary development**. **Regional production systems** in many countries have evolved from the **stage of pure geographical agglomeration of similar firms**, working in the same industrial sector and competing each other, as indicated by the **cluster concept**. Regional production systems often also do not correspond to **the traditional industrial districts, characterized by tight production and social linkages** between the various firms.
- 66) First, territorial **networks** are different from the traditional clusters and industrial districts, specialized in a single sector, and are characterized by a **greater sectoral diversification**, a **greater integration of the various sectors** of the local economy and also by an **increasing internationalisation**.
- 67) A modern **regional production system** is not characterized by the **geographical concentration of many firms specialized in the same sector**, but rather by an **increasing diversity and complementarity of the various firms** and by the **development of external relationships with other regions and countries**.
- 68) Second, the model of territorial networks implies a **greater formalization of the relationships** between the firms, which were based on trust and personal links in the traditional geographical clusters and industrial districts.
- 69) Third, the cluster concept has evolved from a predominantly **material linkage and agglomeration based concept** to the concept of the **innovation network**, where the key process is **the creation of tacit or codified knowledge in traditional sectors and its diffusion into new fields of production**.
- 70) Fourth, according to evolutionary and institutional economics, **innovation networks** represent **an institution that supports knowledge generation** and the sharing of knowledge or **a form of governance enabling the generation and diffusion of knowledge** between various local and external actors.

The concept of knowledge and innovation networks

71) **An innovation network** is a set of **many actors**, such as: firms, organizations and institutions, linked by stable, frequent, intense, direct and indirect relationships, which allow **flows** of intermediate products, human and financial resources, information and knowledge and are hindered or facilitated by different forms of **geographical or cognitive proximity** and by different form of **soft infrastructures or bridging institutions**.

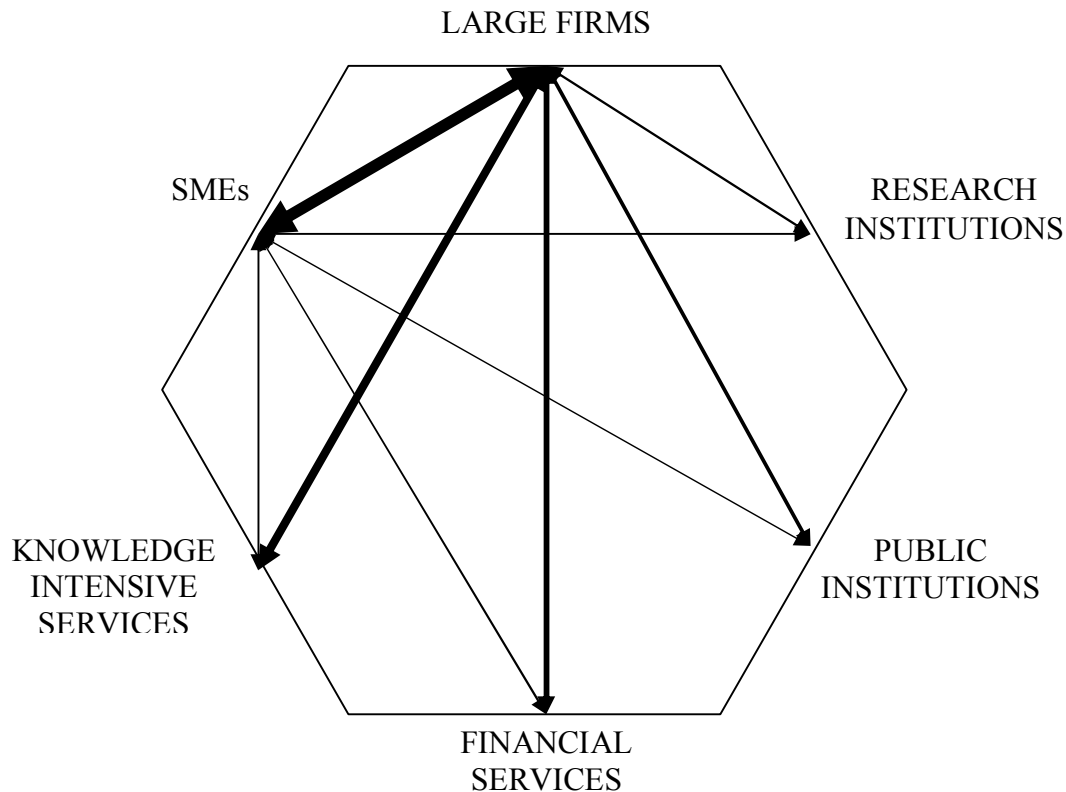


Figure 3: Information and knowledge links in a regional innovation system

72) Networks are an **appropriate form of organization**, which facilitates the interaction and the **flows of information and knowledge**. **Knowledge circulates within networks through formal and informal institutions**. Explicit or codified knowledge may be exchanged on technology markets. While, **tacit knowledge requires allocation mechanisms which are different from the markets**, since it has an asymmetric character, it implies high risks and it requires reciprocal trust, identity and shared values leading to collaborations. Only **specific organizations and institutions and not traditional markets** are capable to insure those connections, which allow the exchange and the tight interaction of tacit knowledge and competencies.

73) The structure of a network can be illustrated by the relationships between various actors, which can be classified in **six groups: large industrial firms, industrial SMEs, business services, financial services, research institutions and public institutions**, as indicated in figure 3. These actors correspond to those considered in the empirical analysis of the IKINET project which has analysed six specific clusters in different European regions.

74) **Networks have a different geographical reach**. **Knowledge flows are more important at the regional level, while the supply chains of material flows are becoming international**. Thus,

supplier relations are more or less separated from knowledge intensive ones. There is **no automatic parallelism of different types of interactions**.

The dynamic process of interactive learning within networks

- 75) **The adoption of a network perspective allows to focus some new aspects of the process of technological change.** In fact, in a network perspective, technological change may be interpreted as the result of the **continuous or gradual search by each node, of the most appropriate level and form of integration or co-operation with the other nodes or actors within the network.**
- 76) **Networks promote interactive learning and evolution. Network are a form of learning organization,** which insure a greater overall **dynamic efficiency.** While competition and monopoly are static models, **networks promote a dynamic process of adaptation, of specialization and of selection between the firms.**
- 77) **Networks represent the most effective form of organization to promote a fast speed of innovation.** In a dynamic environment the creation of value and of new knowledge depends on the integration of the knowledge acquired from many other firms. The speed of innovation depends on the interaction between a plurality of actors.
- 78) Networks allow a greater flexibility, **lower “switching costs”** in the choice of new possible partners and also to easily change the level of cooperation with previous partners, as implicit contracts can be more easily be adapted than formal contracts.
- 79) Networks lead the various actors to invest in the creation or strengthening of infrastructures or the creation of routines linking them. That makes the relationships between firms more intense or increase the speed of the flows. Thus, networks imply **lower “transaction cost”** in inter-firm relationships, than a competitive market made by isolated producers and users.

Three stages in the evolution of innovation networks

- 80) Regional production systems are evolving from the model of industrial clusters and industrial districts based on many rather homogenous firms linked by flows of knowledge spill-over to the model of **territorial innovation networks** made by complementary specialized firms, linked by formal forms of cooperation in production, commercial and technological field, not only locally but increasingly also at the interregional and international level. Territorial networks may be classified into **three types of networks: “ecological networks”, “identity networks” and “strategic networks”.**
- 81) In particular, ‘**ecology networks**’ are characterised by **strong unintended interactions** between various actors and facilitate various forms of **un-traded technological interdependencies** or spill-over effects, as it occurs in geographical agglomerations.
- 82) ‘**Community networks**’ are based on the **sense of identity and common belonging**, on the existence of trust relationships and of specialised intermediate institutions (“social capital”). They may be defined as **places of collective learning**, where as in an “industrial districts” the development of common production know-how occurs. Typical cases of community networks are the industrial districts or the regional innovation systems.

- 83) **'Strategy networks'** are based on **intended relationships and cooperative agreements** between firms and other organisations. They are the result of negotiations, agreements on specific strategies and the creation of formal and explicit 'joint ventures' by the participating actors. Strategy networks also imply the reciprocal commitment of specific resources, which are invested in order to achieve common goals and future but uncertain benefits. They imply **forms of central coordination**, the creation of procedures for the exchange of information, the codification of individual implicit knowledge and the **joint investment in the creation of collective codified knowledge**. Strategy networks may be represented both by widely geographically dispersed strategic alliances made by pool of large and small firms in different regions or by local clusters and regional innovation systems, which explicitly want to become a "learning region".
- 84) These networks are characterized by **different forms of knowledge interaction**. In fact, **knowledge spill-overs** characterize the "ecological networks", **interactive learning processes** is characterizing the "identity networks" and **explicit governance of knowledge relations** between the various local and non local actors is a characteristics of "strategy networks".

The role of institutions in knowledge interactions

- 85) **Economic development is stimulated in those territories with highly evolved, complex and flexible institutional systems**. Barriers, which hinder self-sustained growth processes, frequently appear due to **deficiencies in- and poor performance of the institutional network**.
- 86) **Cognitive theories** underlines that the creation of **new connections** or the reinforcement of **existing connections** implies the compatibility with other actors, the success in the adaptation and the development of appropriate routines and institutions. **The processes of new knowledge formation, that is, the learning processes, are social and interactive and dependent on the institutional set-up of the economy**.
- 87) The role of institutions is that to reinforce the **identity and the reciprocal trust**. These factors allow to limit the disadvantage related to the **asymmetric circulation of information**, by reducing **uncertainty** and the **risk** which are related to the **impossibility to foresee the effects of innovation** and increase the incentive to medium and long term investments. Clear examples are the creation of various forms of communication channels, such as the norms, technical standards, protocols, associations between the participants to a network and also the investments in continuous education, which increase the receptivity to new technologies by the various local actors.
- 88) **Besides formal institutions the concepts of trust and social capital** are increasingly being applied in attempts to understand the underlying institutional features of clusters and networks. **Social capital** represents an asset, which may become increasingly important in the emerging context of the learning economy. In fact, the **generation and transmission of new forms of tacit knowledge** is facilitated and may even be conditioned by a **certain level of social capital**. Moreover, in a globalized world of freely moving capital and increasingly freely moving people, **only "social capital" remains tied to specific locations**. In fact, the **"learning economy"** is characterized by the "hyper-mobility" of the information and knowledge and the local character of the "social capital".

The model of networks and the approach of multi-level governance

- 89) **Market competition, State norms or internal corporate organization and networks or multi-level governance** represent three different and complementary forms of regulations of economic relations in a market economy and innovation policies can adopt these different forms of regulations, in order to promote international competitiveness of a modern industrial economy.
- 90) **Governance is a model of regulation of the relationships** between the firms and the actors belonging to a **network**, based on **interdependent adjustments** decided on the base of **negotiation procedures**. It differs both from the **spontaneous interaction between atomistic behaviours** funded on the individual interest and competition, such as in the **free market model**, and also from the **changes enforced by a centralized authority**, such as in the **government model**.
- 91) **The governance approach is tightly related to the model of knowledge and innovation networks**. Governance is also about the adoption of organizational arrangements or different mechanisms of regulation, in order to **manage the knowledge relationships** between the various actors, which participate in the **process of knowledge creation and innovation**.
- 92) The adoption of a modern governance approach, based on **regional decentralization and public-private partnership**, seems **more appropriate for promoting knowledge creation**, innovation and competitiveness, than free competition or State planning.
- 93) While the free market mode advocates **more competition and more wage and labour flexibility**, the governance model focuses on the need of **a greater integration and a faster pace of the process of innovation**. Thus, the governance model implies the existence of intermediary functions, a greater stability, a long term perspective and the supply of adequate public investments.
- 94) The **governance of the knowledge networks** requires the **change in the links between the various nodes** and the **change in the intensity of the flows** between the nodes of these knowledge networks. This process of change is similar to Schumpeter's process of "**creative destruction**" and it implies the **integration of new nodes and the exclusion of others for integrating new specific complementary competencies**.

The speed of change and the different levels of integration

- 95) Free market, governance and government are **three different forms of regulation of economic relationships** characterized by a **different level of integration**. On the other hand, **the concept of innovation and of time advantage are tightly related**, as it is indicated by the concepts of: just in time, lead time, time to market, speed of change, speed in decision-making and coordination and time lags in the adoption of innovation. Thus, **the relationships** between the **level of integration** and the **speed of time advantage** may be represented as in the figure 4.
- 96) **A network organization** allows firms to have **easy access to rare complementary competencies** by other local firms, thus increasing the capability to respond to external stimulus, to exploit external opportunities and to face external threats and that leads to higher creativity and speed of change.

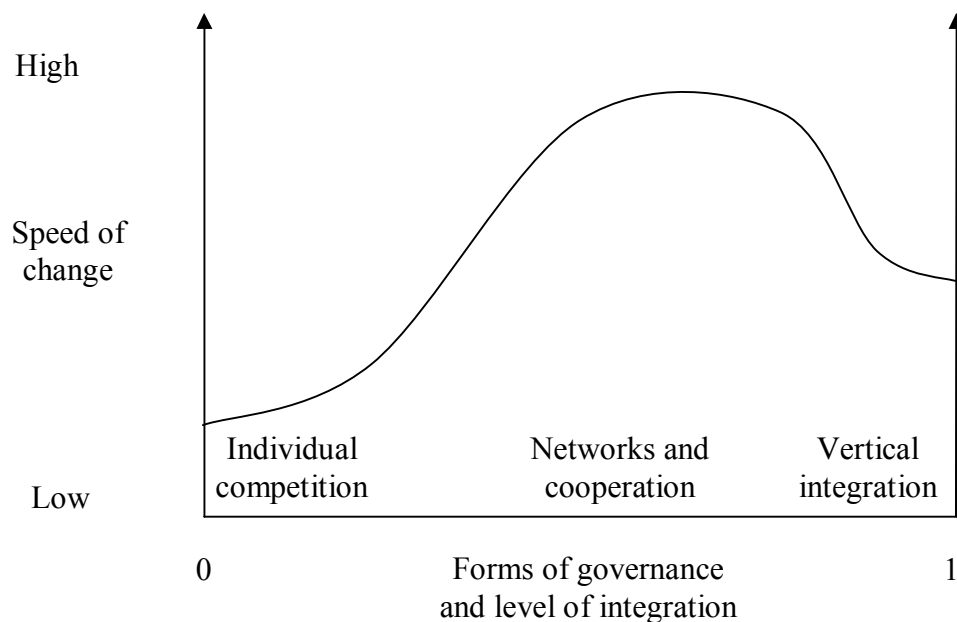


Figure 4: The relationship between increased connectivity and creativity

- 97) Creativity, continuous change and innovation require interactive learning processes between many different actors and the cooperation between various firms is more efficient, than the two extreme situations of the **isolation of the individual firms** competing one with the others or of the **consolidation of all production into a large firm**, where the relationships between actors are regulated by a central authority.

The “learning region” and the approach of Territorial Knowledge Management

- 98) The factors of competitiveness of a cluster have changed and are **not any more the economies of scale** external to the firm and internal to the cluster leading to lower production costs, **but rather a faster speed of change or rate of innovation**.
- 99) **Regional production systems may evolve toward the form of ‘strategy networks’**, which are based on intended relationships and formalized cooperative agreements between firms and other organisations. Strategy networks imply forms of central coordination, the creation of procedures for the exchange of information, the codification of individual tacit knowledge and the investment in the creation of collective codified knowledge.
- 100) **“Territorial Knowledge Management” (TKM)** is an operational framework which aims to **organize the cognitive relationships between the firms** in the process of innovation within a local network of cluster (figure 5). TKM aims to facilitate the flows of tacit and codified knowledge, by enhancing **six factors or dimensions: stimulus to innovate, accessibility, receptivity, local identity, creativity and governance capabilities**. This approach is highly flexible and can be adapted to the various European clusters.
- 101) Territorial Knowledge Management aims to **make more explicit and formal the organization of knowledge interactions**, through which the firms and the actors in a traditional production system circulate the required information and competencies among them in a **too implicit, complex and slow process**.

THE PROCESS OF INTERACTION

THE PROCESS OF COMBINATION

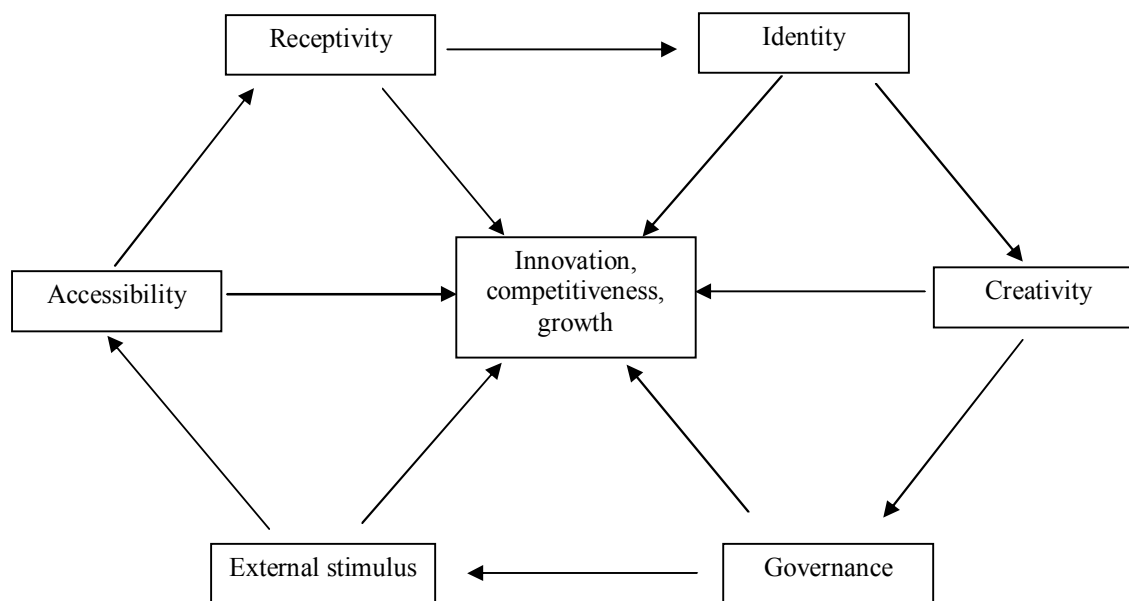


Figure 5: Territorial Knowledge Management as a framework for the governance of regional knowledge networks

- 102) These six factors allow to **focus the various policy instruments for the governance of the learning networks** in a regional innovation system **on a limited number of dimensions**, which are tightly related to the factors of the processes of knowledge creation according to the literature in cognitive economics.
- 103) **The approach of TKM may be applied** to the steering of knowledge networks and to clarify the policy challenges in the three types of territorial networks indicated above (table 1).
- 104) Major factors of weakness of clusters specialized in **medium tech sectors** are: 1) a low international accessibility, 2) the lack of creativity and the need of promoting product innovation rather than only process innovation, 3) the need for formal instruments of governance of the knowledge relations aiming to a more formal cooperation between the firms.
- 105) Clusters specialized in **high tech sectors** indicate different key problems, such as: 1) a low local embeddedness of large firms, 2) the problems in combining R&D activities or analytical knowledge and symbolic knowledge, which are science and technology driven, with creativity, which is driven by the users needs and the demand, 3) the need to avoid a too high concentration in large firms and to promote spin offs and participation also by SMEs and the other social partners in strategic decision making.
- 106) Clusters specialized in **low tech sectors** are characterized by various weakness, such as: 1) a too low international accessibility, 2) the lack of receptivity and of qualified skills, 3) the lack of identity and fragmentation in decision making.

Table 1: Policy areas according to the Territorial Knowledge Management approach within selected knowledge and innovation networks

| | Type of knowledge and innovation network | | |
|-------------------------------|---|--|--|
| Characteristics and factors | Ecological networks | Identity networks | Strategy networks |
| a) regions, sectors and firms | Peripheral regions Low tech sectors Traditional SMEs | Industrial clusters Medium-tech sectors Innovative SMEs | Urban areas High tech sectors Large enterprises |
| b) knowledge base | Symbolic/synthetic Knowledge | Synthetic/symbolic knowledge | Analytical/ synthetic knowledge |
| c) knowledge interaction | Knowledge spill-over | Interactive learning | K M and R&D joint projects |
| 1. Innovation stimulus | Cost competition in the global market | Customer needs and high supply chain integration | Product innovation in specialized markets and technology push |
| 2. Accessibility | Low international accessibility - low local accessibility | Low international accessibility - high local accessibility | High international accessibility - low local accessibility |
| 3. Receptivity | Low qualification of human resources | Specialized skilled workers | High internal sectoral diversity |
| 4. Identity | Fragmentation and external dependence | High local embeddedness and local identity | Low cognitive proximity and common identity |
| 5. Creativity | Technology adoption | Networking and interactive learning | High investments in R&D |
| 6. Governance | Public infrastructures and finance and deregulation | Multi-level governance at the regional level and bridging institutions | National industrial strategies and firms alliances in specific fields |

5. The approach of knowledge networks in innovation policy

Cluster policy in the European Union

- 107) The internationalization of markets and of production processes indicates that innovation and new knowledge are the key factors of **international competitiveness for the European firms and regions**.
- 108) In the long term, the real factors of international competitiveness are neither taxes and corporate profits nor labour flexibility and labour costs, but rather **productivity changes, innovation capabilities, knowledge and know-how**.
- 109) **Knowledge and innovation** lead to economic and employment growth, but also to **international division of labour**, agglomeration and **exclusion phenomena**. In fact, the major factor of growth disparities between countries is the gap in technology and knowledge.

- 110) **The factors of competitiveness of the European economy** with respect to the many and large emerging economies are related to:
- the **high diversification of industrial productions** within the various industrial clusters allowing the creation of new productions as combination of traditional specializations,
 - the **emergence of new needs**, which often have a collective nature, by consumers and citizens and the creation of **new markets**,
 - a high **qualified labour force**.
- 111) The **emerging “knowledge clusters”** are the result of the evolution from the **traditional industrial or “fordist” model**, based on the exploitation of economies of scale external to the firms but internal to an industrial cluster, to **the model of the “knowledge economy”** where **regional innovation systems and innovation networks** are characterized by intense knowledge interactions between the various local actors. That calls for **changes in cluster policies**, similar to changes which are widely adopted in the rest of the European economy and industry.
- 112) The changing economic and technological scenario is calling for a **new strategy in cluster policies**, aiming to reorient existing clusters. Cluster policies should be based on the identification of the **different evolution profiles of individual clusters** and of **their specific strengths and weaknesses** and on the design of explicit strategies for the individual clusters.
- 113) The **“Cluster Memorandum”** of the European Commission² has emphasized that:
- clusters have positive effects on the competitiveness of firms,
 - clusters most often emerge as the result of a bottom up process and they can not be completely planned exogenously from public institutions,
 - cluster initiatives are nationally differentiated and European coordination should be highly flexible and focus on strategic initiatives.

Cluster policies on the regional level

- 114) Our **empirical investigation of SMEs in different European regions** serves to explain the specificities of innovation in the medium-technology sector and the challenges SMEs face within the **changing environment** of these innovation processes.
- 115) One very important result of the empirical observation of networks refers to the **greater importance of knowledge flows** for the network linkages **than material flows** in almost all observed regions. This observation stresses the relevance of policies focusing on facilitation and competitiveness of **knowledge interactions** on the regional level instead of **more traditional instruments of regional development**, which concentrate on **capital subsidies** and infrastructures for **material linkages** within specialized clusters.
- 116) The **analysis of best practise cases** in our investigation provides a **summary of the political experiences** and helps to show, how cluster policies **support the emergence, growth and connection of knowledge networks** in the medium-technology industries and the possibilities for the **European institutions** to build up **interfaces between this regional initiatives**. This analysis allows to highlight the following challenges:
- Incentives for interaction between SMEs and actors with diversified knowledge as prerequisites for creativity,

² www.proinno-europe.eu/NWEV/uploaded_documents/European_Cluster_Memorandum.pdf

- Strategic exploitation and development of the knowledge base as prerequisites for accelerated innovation and adjustment,
- Infrastructures for regional knowledge networks,
- Funding within regional knowledge networks,
- Identification of regional knowledge networks,
- Openness towards knowledge from other regional knowledge networks,

Table 2: Why the process of innovation in SMEs and in medium technology sectors differs from that of large firms in high tech sectors

| | Linear approach | Systemic approach |
|-------------------------|--|--|
| Key word | Technology | Knowledge |
| Stimulus | Cost competition, supply changes and new equipment | Market orientation, demand changes and user needs |
| Process | In house R&D and technology transfers | Interactive learning |
| Role of human resources | Labour substitution and receptivity to new technologies | Competencies of the actors, creativity and entrepreneurship |
| Competitiveness factor | Productivity increase and economies of scale | Continuous innovation, flexibility and fast change |
| Governance process | Rational optimization by individual firms and market competition | Connectivity, iterative adaptation and selection within innovation networks |
| Policies | Public finance to R&D and public market regulation | Multi-level governance, bridging institutions and public-private partnership |

Guidelines for innovation policies in medium technology sectors

- 117) **The IKINET project** has clarified that the perspective of **the transition to the model of the knowledge economy implies a distinct change in the industrial development strategies** and in the **policy approach to the technological change**.
- 118) The IKINET project has emphasized that:
- **SMEs** also compete through **innovation**,
 - **R&D** is not the main factor of innovation in **medium technology sectors**,
 - **spontaneous clustering processes** are not always sufficient for competitiveness,
- 119) According to a systemic approach (table 2), the focus should shift from the aim to promote the adoption of modern technology to that of **enhancing internal capabilities and knowledge**. The stimulus to change and innovation within firms is not only determined by the pressure of competition, the need to increase productivity and reduce costs, or the opportunity created by the supply of modern technologies and to adopt modern equipments, but rather by the **identification of new markets**, the aim to adapt to **changes in the demand** and the opportunity to **satisfy new users needs**. While in the linear process of innovation the formal process of R&D investment plays a key role, according to the systemic approach to innovation, solutions are gradually discovered through a **process of interactive learning** involving many different actors also outside the R&D laboratories. The desired outcomes are not just the increase of productivity indicators, often interpreted as disjoint result, but rather the **speed of a continuous process of innovation**, where each change is the evolution of previous changes. **Entrepreneurship and governance**, through **public-private partnership**, are required in order to organize the joint effort of different actors and firms. The focus shift from that of stimulating competition between the local actors to that of **promoting connectivity** and iterative processes of reciprocal adaptation and of selection of the best productive combinations.
- 120) The **innovation process in medium tech sectors** is different from the “**linear**” **approach** focusing on R&D expenditure and the rational process of optimization of individual firms. On the contrary, innovation can be interpreted according to a “**systemic**” **approach**. This approach focuses on the process of **knowledge creation**, on collective processes of **interactive learning**, on the **iterative adaptation** between the different partners and on an implicit process of **automatic selection** of the most competitive innovations.

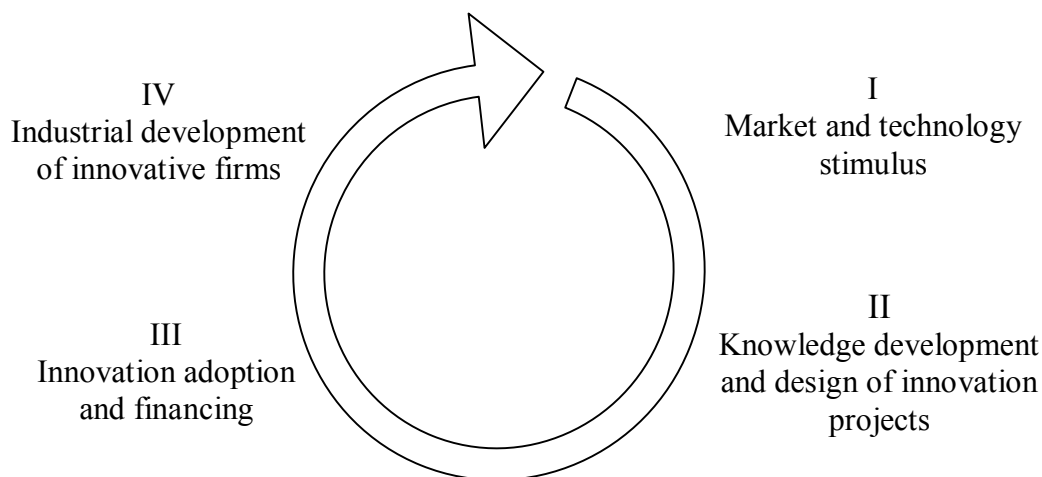


Figure 6: The fields of innovation policies

- 121) This new approach lead to identify a more complex set of domains for innovation policies, rather than the single financing of R&D, as indicated in figure 6. In fact, policies should first

promote openness and receptivity of the firms to the stimulus coming from international competition, the creation of **new market needs** and from the **availability of new technologies**. Second, policies should also promote the **creation of new knowledge** suitable for solving the problems and promote the **design of innovative projects by firms and groups of firms**. Then, policies should promote the **receptivity of the local actors** in the adoption of innovation and the **evaluation and financing of the innovation projects**. Finally, policies should promote the **coordination between the various firms**, their reciprocal adaptation and the **integration of innovative firms** in the international and local **technology and production networks**.

- 122) Cluster policies should invest in a better **organization of the cognitive relationships between the local actors**, as indicated by the approach of Territorial Knowledge Management. Technological. That would allow to integrate existing capabilities in production with greater **creativity**, improved quality of the products and services and the capability to respond to the new needs of the users.
- 123) A **change in the corporate culture** is needed in order to **promote greater receptivity** or knowledge sharing and the willingness to collaborate. Human resources should not be considered only for their **absorptive capacity and resistance to the adoption of technologies**, but rather as **the actors, which promote innovation and are endowed with specific capabilities**. Formal education and life long learning are instruments, which promote the **building of the competencies** of the various partners in localized knowledge networks and their ability to **use external tacit and codified knowledge** in the process of innovation.
- 124) The focus on the process of knowledge creation rather than on the adoption of technologies, should lead to **promote creativity**, which is based on **diversity, tight interaction** between different and dispersed actors and the capability to **establish new connections** between different pieces of information and knowledge. **Networks organize diversity** and facilitate the combination of information and knowledge. Creativity may be hindered by the lack of needed competencies in the local economy and indicates the **need for cooperation with international universities and major international companies**.

The network approach to innovation policy

- 125) A **policy for the knowledge economy** based on the approach of “governance” or “dynamic coordination” implies the use of **different policy instruments** with respect to those usually adopted in **traditional innovation policies**, such as:
- public R&D
 - public subsidied to private R&D
 - public demand of innovative products and services
 - IPR in order to insure a monopoly power to innovators
- 126) The knowledge networks indicates **new instruments of innovation policies** which aim to:
- create **new nodes** in the knowledge networks, such as the enhancement of innovative spin-offs from firms, the recognition of universities as a new actor in innovation networks, the promotion of diversity and attraction of new actors,
 - create **missing links** by defining new procedures in the relationships between the local actors.
 - promote **international links** in order to avoid regional closure and lock-in effects,
 - invest in **human resources**, education and life long learning, in order to increase receptivity to new knowledge,
 - promote alignment and **identity building** by defining joint long term projects and a joint strategy.

- accommodate the **switching costs or adjustment costs** implied by major changes in order to increase the flexibility of sectoral clusters and SMEs and accelerate the time of changes.
- determine the conditions in order to **aggregate scattered needs and demand** and to create **new markets** for innovative products and services,
- design and **adopt new regulations**, which may defend weak and dispersed interests, such as in security and environmental protection.

127) Innovation requires **flexible forms of cooperation** between many different private and public, regional and international actors, such as large firms, SMEs suppliers, knowledge intensive services, higher education and research institutions, financial intermediaries, public administration and many other partners such as professional association and media. Innovation requires the **combination of different competencies** within a process of collective learning, as firms are forced to cooperate to increase and diversify their knowledge base.

128) A rather diversified **typology of institutions** play a leading role in defining a long term strategy of innovation of SMEs within the different regions. Institutions and other forms of “**social capital**” play the role of **immaterial infrastructures** which organize the knowledge flows between SMEs within the clusters.

129) The speed of information flows and of decision making processes and a **faster adoption of innovation** is tightly related to the **stability of the organizational forms** and it depends on the existence of a well developed institutional system.

130) **Medium size firms** have developed **vertical flows of tacit knowledge** in their respective supply chain, but they need to be supported in order to **develop horizontal linkages between different technologies**.

131) The problem is not the **creation of new geographical clusters**, but rather to **promote new strategic projects in the existing clusters and regions**.

132) In **particular**, the challenge of increasing international competition calls for **large projects realized within national thematic networks** and building on the existing strengths and innovative capacities of the various regions.

Aims of the IKINET Policy Forum on Competence Centres

133) The **Policy Forum** on: “**Regional competence centres and European knowledge and innovation networks: an international comparison of innovation cluster policies**”³ organized by the IKINET project has aimed to discuss the role of competence centres in **innovation and industrial policies at the European, national and regional level**. The Policy Forum of the IKINET project has been held on **September 19-20, 2007 in Rome** at the Department for Public Administration of the Presidency of the Council of Ministers, Palazzo Vidoni. It has been promoted by the Italian **Minister for Innovation in Public Administration, Ministry of Economic Development, Ministry of Research** and the **Italian National Economic and Social Council**. Almost 50 experts from many competence centres, regional administrations, Italian and foreign national agencies and public institutions and of the **European Commission** have participated within three sessions devoted to the discussion of:

- Theme 1: How to promote **international accessibility and cooperation** between competence centres.

³ The contributions to this Forum can be downloaded at http://www.ikinet.uniroma2.it/Policy_Forum.htm.

- Theme 2: How to promote **creativity and new innovative projects** and companies.
- Theme 3. How to promote an effective **governance of networks of competence centres**.

134) The Policy Forum has advocated the need for international learning and benchmarking and **the launch of programmes for the creation of networks of competence centre** in countries and regions which do not have them. In particular, it has aimed to investigate how competence centres can promote the international competitiveness of SME and these latter can be linked in **international networks of knowledge and innovation**.

The characteristics of the “competence centres” policy

135) National and regional **competence centres** are designed to stimulate cooperation in research and technological development **in strategic important production fields** between companies, academia, the public sector and other organisations involved in promoting innovation, overcoming the gap between **pre-competitive technological research and practical industrial application**.

136) The idea of the cluster policies and competence centres in various European countries is based on the following **characteristics of competence centres**:

- are part of a **national or regional network** created by a national or regional public program, which has defined a competitive mechanism for the selection of the various proposals of competence centres and an national or regional agency for the steering of the overall network of competence centres,
- have a **regional focus** but act on an **international scale**,
- concentrate on a specific **thematic production field**,
- are capable of **generating innovations** with a particularly high value-added potential,
- cover many links in the value chain and **connect multiple sectors of industry** and scientific disciplines,
- establish an outstanding communication and **co-operation platform** by promoting **public-private partnership** and existing networks between large and small firms and other regional actors, in close cooperation with universities and research, educational and vocational centres,
- aim to implement a **common strategy** of innovation and economic development for a specific **territorial cluster or regional innovation system**,
- represent **an innovative and operational mode of “governance”** or a “soft infrastructure”, that aims to develop synergies around **specific collective innovation projects** oriented toward one or more **well focused markets**,
- allow to reach a critical mass, in order to develop **international visibility** in an industrial and/or technological perspective and to increase the attractiveness of a cluster with respect to international competitors.

137) **Competence centres** are new instruments of innovation policy, which are suitable for the SMEs in medium tech **sectors**. The IKINET project may help in illustrating the different dimensions of the process of knowledge creation at the local level and in providing **guidelines for defining the strategy of competence centres**.

138) Competence centres **are different from research “Centres of Excellence”**, which mostly belong to larger research institutions and focus on well defined fields of advanced pre-competitive research, often in tight cooperation of specific industries, with the **aim to raise the quality of research** and to improve its international visibility and reputation.

- 139) Competence centres should aim to **promote the accumulation of knowledge** between different firms and sectors through **processes of interactive learning**, rather than to focus only on the **investment in R&D**, as exchanges of tacit knowledge and building of specialized competencies should play a key role.
- 140) Competence centres are also **different from the traditional “Technological Centres”**, which have been created by local and regional institutions and aim to **provide new technological and business services** to individual SMEs within territorial clusters.
- 141) On the contrary, **competence centres aim to the design and management of large joint projects with several firms** and other partners for the development of new innovative productions for the **industrial diversification of a cluster**.
- 142) Competence centres should carry out an **exploration activity** leading to the **design of many large and small projects** and not represent just ad hoc organizations created in order to manage a specific large project. They should **identify emerging needs** in existing and new markets and **create coalitions of regional and also international partners** needed to solve the problems.
- 143) Regional “**competence centres**” focused on **new fields of production**, related to traditional specializations in the various regions, may promote the **collaboration between firms of different sectors** and having complementary competencies.

IKINET guidelines for competence centres

- 144) **The IKINET project** highlights that regional and national policies for competence centres should:
- respond to the **emerging needs of the user side**, identify and aggregate **new demand**, explore **new markets with high growth potential or new “lead markets”** for the regional productions,
 - promote the **use of the knowledge accumulated** within the cluster, the **circulation of tacit knowledge and the development of new competencies through the process of interactive learning** between the local actors,
 - create **new activities or “strategic spin-offs”**, which can lead to a **production diversification** of the regional economy into **new sectors of application**, by investing in projects close to commercialization to **avoid path-dependencies and lock-in effects**,
 - promote the **design and adoption of new large strategic projects** of innovation, requiring the coordination and cooperation of many partners, **in the existing clusters and regions**, rather than the **creation of new geographical clusters**,
 - raise new **funding** through **public-private partnership**, involve **modern financial intermediaries in strategic industrial projects** and provide key **competence in the selection of innovative projects** submitted for financial support, as the problem is the abundance of funding and the lack of profitable projects,
 - **build new formal and informal institutions**, infrastructures, norms, rules and routines, adopt new forms of “**governance**” of the **knowledge and innovation networks** and design an explicit **long term strategy of the competence centre**,
 - promote the **participation of new partners** in innovation networks, such as **KIBS and universities**, thus promoting a greater effort on innovation and a mid term development strategy,
 - represent a **bridging institution** and **promote local contacts** between **SMEs and large firms**, on the one hand, and between them and the **research institutions**, on the other hand,

- promote **international links between competence centres** of different countries, the **participation to European projects** and enhance a greater international integration and competitiveness in an increasingly **complex and connected world**.

The European dimension and the internationalization of competence centres

- 145) The **international extension of knowledge networks** of SMEs call for the identification of common objectives and projects with external partners, while maintaining a strong local identity. It is necessary to find ways in order to combine regional public assistance with firm **collaboration in projects that go beyond their own territory**. Competence centres may represent a **stimulus to the international openness** and competitiveness of the regional clusters.
- 146) **Clusters may contribute to the evolution of the European industry toward a knowledge economy**. In particular, the transition to the knowledge economy of the European economy is not only demanding large international investments in new strategic industrial sectors or “structural reforms”, but also the creation of new “knowledge clusters”, due to the localized nature of the processes of knowledge creation. Thus, **a cluster approach is also needed in the European policy for the knowledge economy**.
- 147) While the **internationalization of the markets** and the **internationalization of the industrial supply chains** are well developed, the **internationalization of knowledge links** is still lacking behind. Barriers of SMEs to international clusters can be rooted in different problems.
- 148) The process of internationalization is a **gradual learning process** and it requires a new mental model by the firms. Moreover the internationalization process has a **selective character** and a key role is played by “**gateways**” or “**bridging**” institutions. Thus, competence centres may create that **institutional framework made by trust, reciprocal commitment and well designed governance**, which allow the firms of distant regions to **exchange of tacit knowledge** and to participate joint projects.
- 149) The choice of the new specific production fields of specialization and the **creation of specific “competence centres”** in many European countries may be the result of previous local initiatives or may be **left to the regional governments**, which better know the production specializations of their region and the potentials of the various sectoral clusters.
- 150) However, a complex interaction is needed between **regional policies and national or European innovation policies**. Various new sectors (such as aerospace, environment, energy, finance, major international infrastructures, etc.) seem to require **an higher national or European coordination** and the initiatives to be taken at the regional level should be stimulated and orientated within the framework of national and also European networks.
- 151) The **national governments** may take various important initiatives, such as to:
- launch programmes for the **creation of networks of competence centres in regions, which do not have them**,
 - focus on the problems in the **implementation phase** of the competence centres, and not only on the creation of new competence centres, and identify **success factors** and **evaluation criteria**,
 - generate **new organizational and institutional solutions** and create a **consensus on a new common model of action**,

- develop some **systemic linkages between the various competence centres at the national and European level**, organize **working groups and periodic events**, allow an **easier exchange of knowledge**, promote **international learning and benchmarking**, create a **platform for exchanging experiences and best practices** and **compare the management models**,
- define **concrete set of proposals and possibly interregional strategic projects** based on the cooperation of various competence centres and promote the **creation of new competence centres** in fields of national and international relevance,
- promote **studies** dealing with innovation, human resources, internationalisation, etc. in clusters and organize **training sessions** dealing with cluster management,
- design **new public-private funding solutions**

152) As firms are increasingly integrated in international production networks, **also competence centres have to build international networks**. The creation of **European networks of “competence centres”** would **increase their specialization** with respect to those of other regions at the international level and **widen the knowledge base of existing clusters**.

153) There is a **tight relation between clusters and the European economy and policies**. The increasing international competition and globalization process require that **European institutions should give a distinct contribution to the cluster policies** of the various regions, as the transition of industrial clusters to the knowledge economy can be facilitated by **European policies**.

154) **The role of the European Union changes** in this context. **Direct R&D and capital subsidies** actually can only hardly reach SMEs in medium-technology sectors, as the SMEs miss necessary formal R&D and strategic resources to cope with EU preconditions in order to participate to large RD European projects. Instead, EU policy should focus on:

- support of **competence centres as intermediaries for SMEs**,
- subsidisation of **public-private funding of competence centres in lagging regions** aiming to extend the cooperation between these regions and leading agglomerations,
- initiate **contests on strategic lead projects** on a regional and interregional level enhancing the **participation of new companies**,
- promote projects **integrating medium-technology industries with universities and high technology services** aiming to extend industrial value chains and to **diversify in new qualified productions**,
- promote **European linkages between regional competence centres** by standardisation of information, qualification courses for the managers of competence centres, technological norms and support to bridging organisations,
- adopt **strategic regulations** to strengthen European technical safety and environmental standards in the global market and promoting the **development of new productions**.