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Instrument:	**STREP**
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Periodic Activity Report

Period covered:	**15th October 2005 – 14th October 2006**
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Contents

Executive summary

- **project objectives.** The IKINET project aims to study the problem of the transition of the less developed regions in Southern Europe and in the new member countries, to the model of the knowledge economy and how to avoid their exclusion with respect to the most developed regions, which operate at the frontiers of technologies. In fact, nowadays, it is widely accepted that knowledge and learning are at the core of competitiveness, international division of labour and agglomeration and exclusion phenomena. Innovation generates winners and losers at the same time and depends on learning processes and knowledge creation and accumulation. Thus, learning brings about enormous opportunities for growth but also severe threats of exclusion and marginalisation, especially for the economic lagging regions in Southern and Central and Eastern Europe.

- **contractors involved**. Eight contractors are involved: Università di Roma "Tor Vergata" (coordinator), University of Wales Cardiff, Ruhr-Forschungsinstitut für Innovations- und Strukturpolitik – Bochum, Instytut Badań Systemowych – Polska Akademia Nauk – Warszawa, Joanneum Research Forschungsgesellschaft – Graz, Institut National de la Recherche Agronomique – Paris, Universidad Autonoma de Madrid, Applica sprl – Bruxelles. Coordinators of the various national teams are: R. Cappellin, R. Wink, S. Walukiewicz, P. Cooke, M. Steiner, A. Torre, A. Vazquez Barquero and J. Alfonso, T. Ward.

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- **work performed in the second reporting period:**

- an analysis of the role of medium tech sectors in the European economy and of its major characteristics of these sectors (WP1).
- an analysis of various theoretical issues on the historical emergence of clusters and milieus, the contrasting approach to innovation by large firms and small firms, the role of tacit knowledge in the process of knowledge creation within SMEs, the spatial character of the cognitive processes, the role of geographical agglomerations and the development of local networks, the different types of geographical and relational proximities and the concept of temporary geographical proximity, the role of tacit knowledge in the process of innovation, the management of the knowledge value chain in clusters of medium-technology SMEs, the role of social capital in virtual production lines, the creation of international knowledge networks in medium-tech sectors, the evolutionary-institutional character of knowledge networks and the governance of interactive learning networks (WP2).
- preliminary policy indications, which emerge form the empirical analysis of the six sectoral clusters, from the analysis of the theoretical issues on which the project focuses and from the discussion with the regional stakeholders in the two diffusion workshops (WP4).

RESULTS ACHIEVED

a) Medium tech sectors have **different characteristics** than high tech sectors. Technology in these sectors is characterized by an high complexity, as products are made by an high number of heterogeneous physical components requiring specific knowledge.

b) Innovation processes in SMEs and in medium technology sectors, differently from large firms and high tech sectors, are characterized by a greater importance of informal and interactive

learning processes with respect to internal R&D activities. Innovation has a gradual character and consists mainly in improvement of existing products, services and processes. The process of innovation in medium tech sectors is driven by an intensive interaction between the suppliers and the customers, due to the high **specificity** of the need of the customers and the fact that products in the medium-tech sectors are made by **many specific components**. The fragmentation of the production process and the high specialization of the firms explains their small size and leads to a very strong interaction with the external local environment, made by an high diversity of private and public, local and non local actors.

c) The empirical and theoretical investigations clearly showed the need to follow a differentiated approach to support medium-technology SMEs, which may be distinguished into **three different groups**: conventional medium-technology SMEs, knowledge-intensifying SMEs and knowledge-intensive firms.

d) Knowledge creation only apparently has **an a-spatial character** and cognitive sciences clarify that the process of knowledge creation works in a localized framework and that is the main factor leading to the spatial agglomeration of innovative activities. In fact, according to this literature, 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. Therefore, innovation processes should not be analysed neither promoted only within firms as they would fail without taking into account various forms of innovation interdependencies with various actors.

e) The sharing of information and the development of various forms of interaction between SMEs lead to a process of interactive learning and the gradual development of **"tacit" knowledge**. While codified knowledge could be interpreted as a stock or a resource, which can be transferred in the markets, tacit knowledge is linked to action and it can be interpreted a complex set of capabilities, which are localized or idiosyncratic and cannot easily be transferred. In particular, tacit knowledge refers to competencies which explain both the production capabilities of the firm as also the relational capabilities, which facilitate the tight integration of a firm with other firms.

f) It may be argued that tacit knowledge for its **ambiguity** might be easier recombined, than codified knowledge, and it is a key element in allowing interdependencies in the process of knowledge creation. On the other hand tacit knowledge can not be transferred at long distance such as codified knowledge, as it requires personal contacts and a deep reciprocal knowledge. However, in some cases, the lack of geographical proximity may be compensated by adequate organizational or institutional proximity and organizations and institutions allow to transfer tacit knowledge at large distance.

g) SMEs differently from large firms should not be considered individually, but represent a **regional complex system**, where the turnover, due to births and closures, the changes in the selection of partners are strong and there is an high interaction, due to the grouping of the various SMEs within larger industrial groups and to the existence of rather stable subcontracting arrangements between the various firms. Clusters do not correspond to the traditional local production systems or industrial districts and may have a rather different and evolving nature in the various regions. Clusters of SMEs often can not be defined within a limited local area and have a regional or even interregional reach, as the spread over contiguous regions separated by a rather long distance.

h) Since interactive learning is the key process in knowledge creation and the access to tacit knowledge is crucial in SMEs and medium-tech sectors, **networks are an appropriate form** of organization, which facilitates the interaction and the flows of information and knowledge. Within networks nodes and links are constrained by the existence of spatial distance.

i) Networks may have different characteristics. In particular, clusters should evolve toward the form of **'Strategy networks'**, which are based on intended relationships and cooperative agreements between firms and other organisations. They 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.

j) The linkages between SMEs in the process of interactive learning within a cluster are often informal, rather chaotic and time-consuming. Interaction may become faster and strategically oriented by the adoption of the methodology of **"Territorial Knowledge Management",** which aims to consolidate the linkages between regional actors and to facilitate the flows of tacit and codified knowledge, by enhancing six factors: stimulus to innovation, accessibility, receptivity, local identity, creativity and governance capabilities.

k) 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 and sectors, by participating to regional "centres of competence" focused on new fields of production, with the participation of firms and research institutions having complementary competencies. **Productive diversification** is not only beneficial for small and medium firms but it can also be very positive for the large OEM firm since it can rely on collaborating partners in more than a single sector, but always within the industry.

l) Regional, national and European institutions are required in order to promote international forms of cooperation between SMEs both at the regional and at the international level. In fact, the development of international relations requires a more stable framework, than the market mechanisms or even multinational companies and private forms of bottom-up international cooperation may be capable to provide. Without any external support, SMEs in medium technology sectors are often unable to cope with medium-term internationalisation strategies, including new sales markets, knowledge acquisition, recruitment and relocation, and are restricted to short-term a reactive behaviour. Public and private associations can act as intermediaries by organising (or establishing joint participations at) international trade fairs, exchange programs, joint qualification schemes or participation in international funding programs. The creation of networks of "innovation platforms" or "centres of competence" may look as a promising solution to the above obstacles.

m) A new mental change is needed as medium size firms are reluctant to internationalize their knowledge linkages or to promote new forms of **international interactive learning** with foreign partners, due to the fear to loose their proprietary know-how, which they believe that it represents their most important tacit competitive asset.

n) While regional governments mostly think regional, firms think national or global. 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. The papers elaborated on the concept of proximity by the IKINET project indicate that rather than only focussing on the geographical dimension, when designing support policies for industry agglomerations or clusters, organisations and regional governments should also take other learning and innovation factors into account. If interregional knowledge-flows are more important than intra-regional ones, policy is well advised to nurture the relevant dynamics. It is

necessary to find ways in order to combine regional public assistance with firm collaboration in projects that go beyond their own territory. For instance, regional policy should place greater emphasis on inter-regional cooperation between regions in the same country, where similar industrial cluster are located, as in the case of aeronautic industry.

o) Medium size firms often rely only on forms of economic or commercial internationalization, which prove to be risky and short-sighted when are not accompanied by the development of **international linkages in the cultural and social field** with the cooperation of other local partners, research centres and regional institutions. The internationalization process of the individual firms is easier when it is accompanied by the support of the respective economic, social and institutional system.

p) The different and evolving **institutional framework** play a key role in the process of innovation within the clusters considered. 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. Institutional solutions to overcome lack of resources by SMEs are regionally specific and influenced by long-term historical and cultural heritage within the region.

q) The markets of the medium-tech sectors are under increasing pressure from safety and environment protection regulations. These **regulations** combined with standardisation and certification are main drivers of innovations and can be one of the most efficient instruments of the EU industrial policy in these sectors.

r) The multiplication of players and layers of negotiation – international, national, and local – demands a different model of government, called "multilevel governance", based on organisational structures of interaction and partnership. Research, Technology, Development and Innovation Policy (RTDI) is a field of concurrent legislation between various levels of government, and tighter vertical cooperation should complement an increasing specialization according to the subsidiarity principle. The regional government can play a crucial role in promoting cooperation and networks in regions where various clusters exists. Network-oriented also includes policy networks, which help to develop and implement regional strategies in the sense of multi-level governance.

s) A broader support is needed, aiming to the creation of an European network of regional **"innovation platforms**", integrating different technological skills according to fields of application and problem solutions and representing the nodes in the interregional and international flows of knowledge between SMEs.

t) A policy of the knowledge economy based on the "governance" or "dynamic coordination" approach 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

u) New policy instruments are those which aim to steer the knowledge networks and 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.
- design and adopt new regulations, which may defend weak and dispersed interests and determine the conditions in order to aggregate scattered needs and demand and to create new markets for innovative products and services.

- **expected end results**, **intentions for use and impact. The project aims to:**
  a) identify the key barriers to an efficient operation of knowledge creation and innovation networks not only within regional sectoral clusters but also at the interregional and international level within Europe, with particular reference to the relationships between the most developed regions and the less favoured regions in South Europe and in the EU candidate countries;
  b) improve the indicators considered in the "European Innovation Scoreboard" with a selected set of new key indicators focusing on the structure of knowledge creation and innovation networks;
  c) propose policy options and specific technology transfer measures aiming to enhance the integration within the "European Research/Knowledge Area", not only of higher education and research institutions but also of small and medium sized firms (SMEs) specialised in traditional sectors, through stable and flexible networks enhancing their Europe-wide competitiveness.

- **plan for using and disseminating the knowledge**
  a) May 2006: First Diffusion Workshop, Warsaw, organized by IBS- Polish Academy of Sciences, on: role of SMEs and regional institutions in knowledge creation and international co-operation, presentation of the results of the empirical analysis (WP1).
  b) November 2006: Second Diffusion Workshop, Graz, organized by Joanneum Research, on: role of large firms in international transfers of tacit knowledge, presentation of the results of the theoretical and empirical studies (WP2)
  c) June 2007: Final diffusion conference, Rome, organized by the University of Rome, on: national and European policies for knowledge creation and innovation, presentation of the results of research activities on a quantitative framework for innovation policy evaluation (WP3) and on policy recommendations (WP4).

- **project logo and project public website.**

IKINET

INTERNATIONAL KNOWLEDGE AND INNOVATION NETWORKS
for European Integration, Cohesion and Enlargement

http://www.economia.uniroma2.it/dei/ikinet/

Section 1 – Project objectives and major achievements during the reporting period

The following section of the Periodic Activity Report first illustrates the general objectives of the IKINET research project.

Second, it analyzes the role of medium tech sectors in the European economy and it indicates some major characteristics of these sectors, as they emerge from the empirical research undertaken in the first and in the second year (WP1)

Third, it presents the major results of the theoretical analysis on which the second year of research has concentrated (WP2).

Fourth, it presents some preliminary policy indication, which emerge form the empirical analysis of the six sectoral clusters, from the analysis of the theoretical issues on which the project focuses and from the discussion with the regional stakeholders in the two diffusion workshops (WP4).

Finally, it comments on the most important problems during the period including the corrective actions undertaken.

1. Aims of the research project

The project studies the problem of the transition of the less developed regions: Objective 1 regions and the regions of the candidate countries, to the model of the knowledge economy and how to avoid their exclusion with respect to the most developed regions, which operate at the frontiers of technologies.

It studies the obstacles, which usually hinder the diffusion of "technology spill-overs" outside a specific local economy, and the policies and "soft" infrastructures and institutions which can remove those obstacles.

The project aims to propose policy options to enhance the integration of EU research institutions in an "European Research/Knowledge Area", through stable and flexible networks, and to increase the ability of these latter to support the Europe-wide competitiveness.

The aims of the IKINET project can be summarized as:

- How to avoid **exclusion of economic lagging regions** from the European knowledge economy
- How to promote the **transfer of "tacit knowledge**" in the case of **medium technology sectors**
- How to promote "**interactive learning processes**" in an **international framework**.
- Which is **the role of institutions** in the **European knowledge and innovation networks**

1.1 Strategic objectives

The project aims at examining the problems and possible policy actions arising from the perceived need for tighter integration and cohesion within EU countries, as seen from the perspective of a "learning economy", taking into account the persistent disparities between the developed and the economic lagging regions (particularly Objective 1 regions) in the existing EU as well as the effects of the EU enlargement on interregional disparity patterns.

In fact, nowadays, it is widely accepted that knowledge and learning are at the core of competitiveness, international division of labour and agglomeration and exclusion phenomena. Innovation generates winners and losers at the same time and depends on learning processes and knowledge creation and accumulation. Thus, learning brings about enormous opportunities for growth but also severe threats of exclusion and marginalisation, especially for the economic lagging regions in the EU and Central and Eastern Europe (CEE) regions/countries.

The project analyses the following key policy questions:

- how innovation and learning processes can effectively contribute to economic development when it takes place within clusters and networks;
- how knowledge and innovation networks may extend from local clusters in the most developed regions to the EU economic lagging regions and to the new accessing countries, with a view to maximising the full potential of Europe's knowledge/learning capacity as a whole.

Thus, the project aims to the following objectives:

1. identify the key barriers to an efficient operation of knowledge creation and innovation networks not only within regional sectoral clusters but also at the interregional and international level within Europe, with particular reference to the relationships between the most developed regions and the less favoured regions in South Europe and in the EU candidate countries;
2. improve the indicators considered in the "European Innovation Scoreboard" with a selected set of new key indicators focusing on the structure of knowledge creation and innovation networks;
3. propose policy options and specific technology transfer measures aiming to enhance the integration within the "European Research/Knowledge Area", not only of higher education and research institutions but also of small and medium sized firms (SMEs) specialised in traditional sectors, through stable and flexible networks enhancing their Europe-wide competitiveness.

1.2 Scientific objectives

From a scientific point of view the project aims at a better understanding of the processes offering single regions access to codified knowledge and RTD networks as well as to tacit knowledge and know-how from other (developed) regions.

The EU Lisbon Agenda aims to build up Europe as the most competitive region in the world in 2010. A major part of this strategy to improve competitiveness against North America and Asia is the improvement of the knowledge base. Most instruments and programs, however, still follow a linear, sector-based concept of innovation with a special focus on high technology sectors.

Innovation research shows that successful innovation strategy are based on recursive interactive processes of knowledge generation, examination and commercialisation – focusing on input factors as R&D investments cause risks not to have the capability for successful market introduction.

Furthermore, innovation research stresses the increasing relevance of integrating technologies, which combine knowledge from different scientific disciplines and technological paradigms and

link high and medium technology sectors. A closer look to the competitive advantages of European firms and regions reveals the dominant role of medium technology sectors for employment and trade volume.

These sectors are characterised by specific forms of cooperation, knowledge acquisition and exploitation and a high share of SME. These SME now face specific challenges of adjustment to global market processes, as global, modular sourcing strategies by dominant OEM, shortening of innovation cycles, combination of traditional and high-technology sectors, changes of financial markets in the context of Basle II and increasing relevance of outsourcing and off-shoring strategies.

EU programs so far hardly reach these SME. As a consequence, an increasing knowledge gap between leading and lagging regions and between multinational companies having access to all R&D facilities worldwide and spatially bounded SME threatens to endanger Europe's dominant role in medium technology sectors.

The IKINET project intends to overcome these deficits in research and policy practise so far following three main research steps. Firstly, a better understanding of knowledge creation and exploitation strategies by interactive intra- and inter-organisational learning processes shall be achieved for medium technology sectors. In particular, the characteristics of the knowledge exchanged, the channels and codes of exchange as well as necessary formal and informal within and between organisations are investigated.

The question of proximity has to be addressed as a key aim since theory suggests it is important for knowledge transfer involving face to face interaction. Although many linkages are global not regional nevertheless proximities of many kinds like professional, organisational and relational are important even where geographical proximity is not. In fact much of the most sensitive knowledge interaction appears to have a geographical dimension according to most studies.

The project analyses the networks or the mechanisms of economic integration operating within regional innovation systems or local production clusters and at the international/interregional level. These processes may lead to new and higher forms of integration between industrial and service firms, not only in a commercial or financial perspective but also in sharing knowledge and innovation. The project may thus contribute to a much better understanding of the local and international dimensions of the *"knowledge based society"*.

In particular, the project investigates the key theoretical question of how important spatial proximity is for the sustainability of learning and innovation networks, and how the need for spatial proximity can be made compatible with the need for connectivity, in order to intensify European integration and cohesion and to bridge the gap between highly and low skilled in European economies.

This requires an original theoretical and empirical study of the international/interregional dimension of existing knowledge and innovation networks, where not only information or codified knowledge, as in the collaboration between RTD institutions, but also tacit knowledge, know-how and competencies circulate. In particular, the project aims to investigate how to decrease the "organisational and institutional distance" between the various regions at the international/interregional level, since tacit knowledge and innovation capabilities often are embodied in human capital and individual organisations and institutions.

Additional to the existing scientific literature on networks of firms and individuals within local innovation systems, recent methodologies originally developed to measure and improve performance and capabilities, which have usually not been measured due to their characterisation as

"invisible assets" (e.g. "intellectual capital"), have been integrated into the approach of IKINET project. This refers inter alia to methodologies like "knowledge management", "organisational learning", or "balanced scorecards". Besides these approaches from management and organisation studies, further interdisciplinary models on economic and social networks at the local level will be integrated into the theoretical framework. In particular, this theoretical framework has enabled to identify and overcome the obstacles usually hindering the diffusion of "technology spill-overs" outside a specific local economy.

The key aim is to enable territorial knowledge management policy to be better informed about knowledge flows and barriers at regional level so they may intervene to improve the potential for collaborative actions that aim to improve inter-firm knowledge the better to compete in global and other markets.

Secondly, the interplay between the spatially bounded organisation of regional knowledge clusters and international knowledge flows is analysed. Here, existing gaps between regional and national level for SME and ways to overcome these deficits by specific organisations, informal and formal institutional arrangements are investigated.

Finally, the role of European policies in this context is discussed. Causes for the low impact of the existing instruments in the EU R&D framework program on SME in medium technology sectors are analysed, options to improve the knowledge transfer between R&D intensive firms and research institutes and other firms in medium technology sectors are discussed, and the role of standardisation and regulation is investigated.

A special focus will be laid on economically lagging regions. These regions are particularly endangered of losing access to world market developments, as their traditional competitive advantage – cheaper factor costs – is easily replaced by competitors in Asia and other low-cost countries. If the improvement of the knowledge base is the only chance for Europe to stay competitive – which seems to be the common opinion of researchers and politicians –, then it is inevitable to look for new ways to integrate the lagging regions into European knowledge flows and look for institutional solutions to overcome barriers for SME in lagging regions to leading edge knowledge.

The empirical analysis elaborated in the project has allowed a ranking of factors affecting the innovation potential of regions based on quantitative indicators. Differently from the indicators actually considered in the "European Innovation Scoreboard" focussing on the endowment of specific stocks or immaterial resources, the empirical analysis aim to identify the flows, which characterise knowledge and innovation networks at the regional and the international/interregional level.

Through this, it will be possible in the final year of research to describe the structural characteristics of knowledge and innovation networks and to measure various factors (such as: international accessibility, receptivity, human capital and openness, social capital, entrepreneurship) affecting interactive learning processes within organisations and institutions and at the interregional and international level.

The theoretical study, elaborated within the project, has aimed to contribute to improved policy recommendations, as successful removal of barriers to interregional knowledge diffusion and learning – thus cohesion – crucially depends on institutional settings. Thus, an essential part of the project in the final year of research will be to consider policy measures in support of such institutions and inquire into the necessary institutional background for the creation and the support

of knowledge and innovation networks and the conditions for their extension to Objective 1 regions and the EU candidate countries.

Therefore the key scientific issues investigated in the research project are the following:

- Why the process of innovation is different in **SMEs and in medium tech sectors** ?
- Why the **territorial dimension** is important in the process of knowledge creation and innovation ?
- Which **institutions** are relevant in promoting interactive learning at the regional level
- Which institutional innovation may help the **enlargement of knowledge and innovation networks at the European level** ?

Specific research questions considered in the various contributions are:

a) how tacit knowledge circulate at the local level
b) how tacit knowledge circulate at the international level
c) which are the actual most important direct and indirect relations of the firms in the local clusters with firms in other regions and countries
d) how different are these relations with comparable relations at the local level
e) how international relations may be better integrated with local relations
f) how interactive learning processes develop within the selected cluster
g) how interactive learning processes develop or may develop at the international level
h) which obstacles hinder the economic lagging regions (Objective 1) in participating to European knowledge and innovation networks together with the most developed regions
i) which obstacles hinder the extension of cooperation relationships from a regional to an international framework
j) does the geographical distance play a greater role than the organizational (technological) distance between firms in economic lagging and developed regions
k) does the institutional distance or differences in the institutional framework play a great role in hindering relationships between firms in economic lagging and developed regions
l) which instruments may be used at the regional level
m) which instruments may be used by European research and regional policies

2. The analysis of SMEs in medium-tech sectors

2.1 The role and characteristics of medium-tech sectors

The highest component in the OECD trade is represented by medium high technology sectors (39,2) and this share has also increase in the period 1994-2003. The joint share of medium-high and medium low technology sectors represents more than half of the OECD trade (53,5) and this share is basically stable in the 1994-2003. Therefore, high technology sectors (24,8) and low technology sectors (20,7) have a similar importance and the increase in the former has compensated the decrease of the latter, while not affecting the relative importance of medium technology sectors.

This trends are to a large extent explained by the important changes occurred in the world trade during the last decade, as the most dynamic countries have been countries which still have a lower development level with respect to OECD countries and which mainly export and also import productions which are considered as low technology sectors.

Within the EU-25 in 2004, services accounted for approximately two thirds (66.9%) of total employment. The manufacturing sector was only responsible for 18.7% of total employment — see Figure 1. In other terms, almost 130 million persons were employed in services whereas only 36 million were employed in the manufacturing sector.

Employment in the total manufacturing sector between 1999 and 2004 decreased at an Annual Average Growth Rate (AAGR) of 1.2% at the level of the EU-15. However, Estonia, Greece, Spain, Italy and Slovakia increased or remained stable during this period.

Employment in manufacturing in the European Union is especially concentrated in Low and medium low tech sectors (23022 thousands). While been of less importance, medium high tech (11023 thousands) are much more important than high tech sectors (2218 thousands).

Medium high tech industry is especially important in Germany (3331 thousands), Italy (1443 thousands), UK (1276 thousands) and France (1275 thousands). Low and medium low industry is particularly important in Germany (4218 thousands), Italy (3226 thousands), France (2483 thousands), Spain (2168 thousands), UK (2188 thousands) and Poland (2103 thousands).

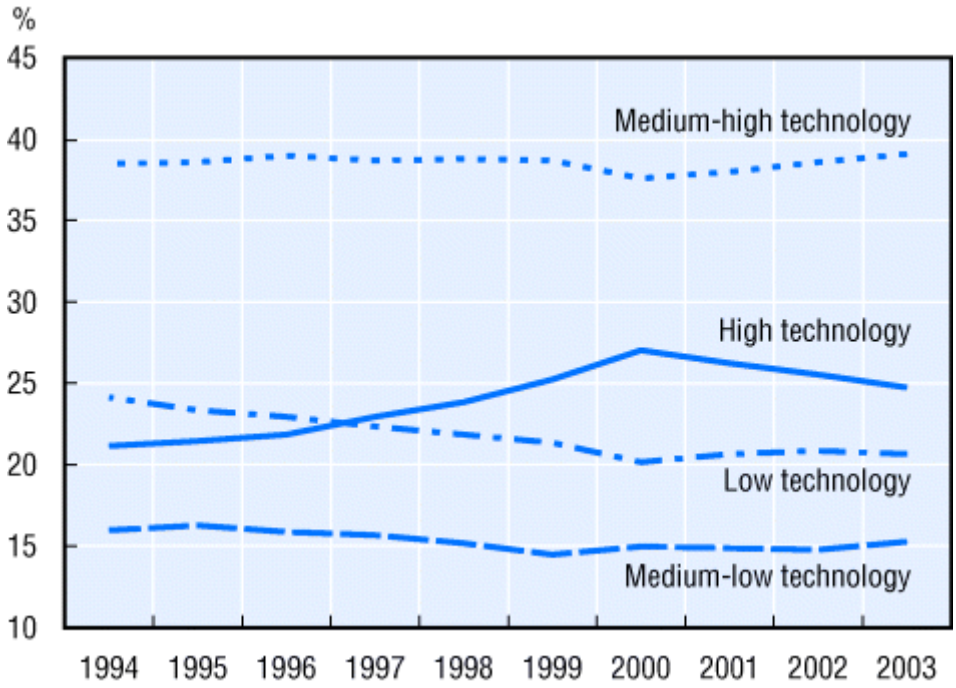
It can be noticed that the employment decrease in medium tech (-0,6) has been smaller than in high tech sectors (-2,0), where employment has decreased even more than in low medium tech sectors (-1,4).

Medium tech sectors indicate a positive employment change in Spain (2,0), Italy (1.2), Austria (0,4) and Germany (0,2), while they decreased in UK (-4,9) and to a little amount in France (-0,4).

Similar results are indicated by value added statistics as the value added of manufacturing industry (1 533 907) is to a large extend made by low and medium low tech manufacturing, as high tech industry represents only a small share (195 521), which is smaller than medium high industry (476 155).

These statistics indicate the importance of medium tech sectors in export, value added and employment 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 sectors

Figure 1 - Share in total manufacturing trade



1. Excluding Luxembourg and the Slovak Republic.
2. Average value of total OECD exports and imports of goods.

Source: **OECD Science, Technology and Industry Scoreboard 2005 - Towards a knowledge-based economy**

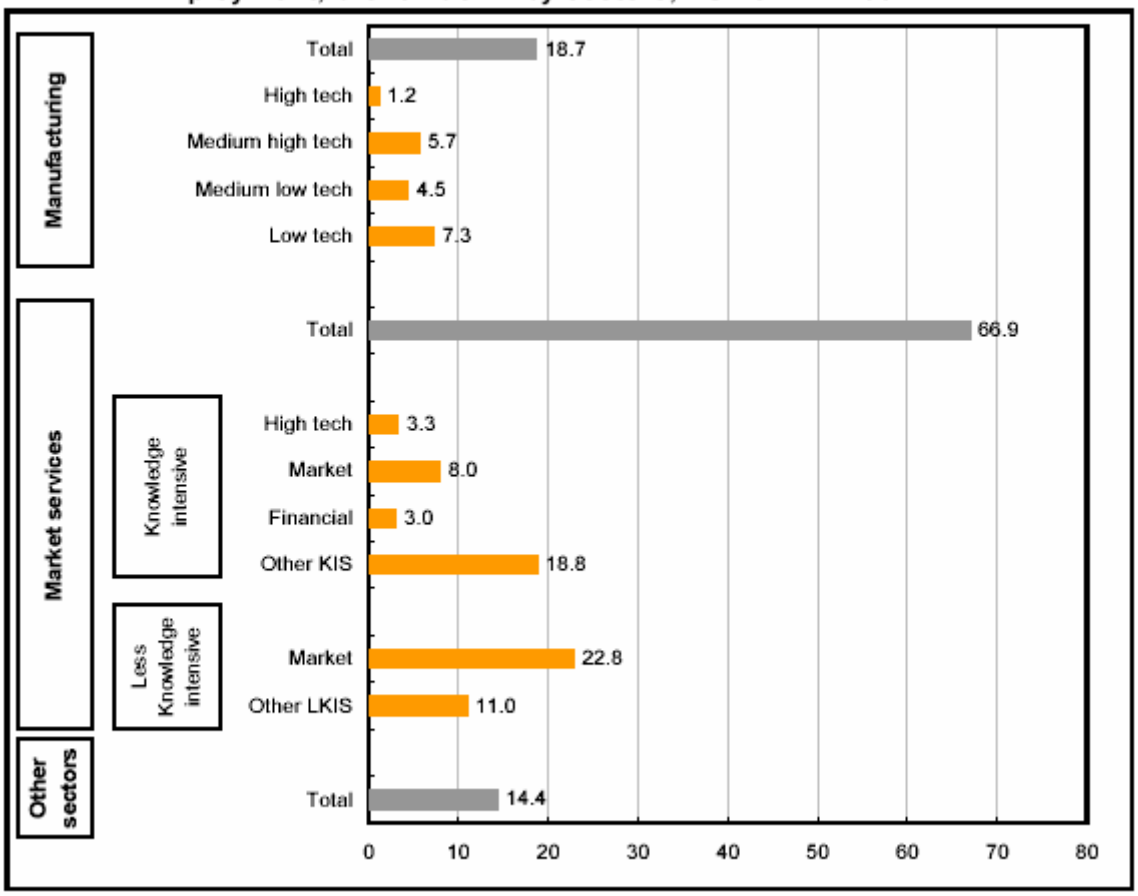
Table 1 - Structure of OECD[1] manufacturing trade[2] by technology intensity.
Share in total manufacturing trade.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
High technology	21,2	21,5	21,9	23,0	23,9	25,3	27,1	26,3	25,6	24,8
Medium-high technology	38,6	38,7	39,1	38,8	38,9	38,8	37,7	38,1	38,7	39,2
Medium-low technology	16,0	16,3	15,9	15,7	15,2	14,5	15,0	14,9	14,8	15,3
Low technology	24,2	23,4	23,0	22,4	21,9	21,4	20,2	20,7	20,9	20,7

1. Excludes Luxembourg and Slovak Republic.
2. Average value of total OECD exports and imports of goods.

Source: OECD, STAN Indicators Database, March 2005
www.oecd.org/sti/stan/indicators/

Figure 1: Employment in manufacturing and services as a percentage of total Employment, broken down by sectors, EU-25 (1) — 2004



(1) Eurostat estimate. Source: Eurostat.

Table 2: Total employment in manufacturing by sectors, in thousands and as a percentage of total employment, 2004 and AAGR 1999-2004 — EU-25 countries, candidate countries, Iceland, Norway and Switzerland.

	Employment in manufacturing - 2004								AAGR 1999-2004			
	Total		High tech		Medium high tech		Low and medium low tech		Total	High tech	Medium high tech	Low and medium low tech
country	1000s	as a % of total emp	1000s	as a % of total emp	1000s	as a % of total emp	1000s	as a % of total emp				
EU-25	36 265 s	18.7 s	2 218 s	1.2 s	11 023 s	5.7 s	23 022 s	11.9 s	:	:	:	:
EU-15	29 845 s	18.1 s	1 914 s	1.2 s	9 550 s	5.8 s	18 381 s	11.2 s	-1.2	-2.0	-0.6	-1.4
BE	718	17.4	32	0.8	233	5.6	454	11.0	-0.6	1.7	-2.0	0.1
CZ	1 275	27.2	61	1.3	361	7.7	853	18.2	-0.5	1.8	0.1	-0.9
DK	434	15.8	27	1.0	137	5.0	271	9.9	-3.3	-0.1	-1.3	-4.4
DE	8 201	23.1	651	1.8	3 331	9.4	4 218	11.9	-0.9	0.8	0.2	-1.9
EE	144	24.2	11	1.8	20	3.4	114	19.1	3.5	10.7	3.8	2.9
EL	570	13.2	7	0.2	89	2.1	473	10.9	0.0	-1.3	2.4	-0.4
ES	3 035	17.0	92	0.5	776	4.3	2 168	12.1	1.9	0.8	2.0	1.9
FR	4 053	16.8	295	1.2	1 275	5.3	2 483	10.3	-0.9	-2.1	-0.4	-1.0
IE	280	15.3	50	2.7	69	3.8	161	8.8	-0.8	-0.8	1.4	-1.7
IT	4 901	21.8	232	1.0	1 443	6.4	3 226	14.4	0.1	1.7	1.2	-0.4
CY	36	10.7	:	:	3	1.0	32	9.5	-0.4	:	5.6	-1.1
LV	166	16.2	:	:	14	1.3	151	14.8	-1.0	:	11.3	-1.7
LT	255	17.8	12 u	0.9 u	28	1.9	215	15.0	-1.9	3.6	-11.1	-0.5
LU	18	9.7	1 u	0.4 u	2	0.9	16	8.4	-3.3	-1.1	-7.3	-2.9
HU	895	23.0	101	2.6	222	5.7	572	14.7	-0.8	7.4	-2.1	-1.4
MT	29	20.2	6	4.0	5	3.6	18	12.5	:	:	:	:
NL	1 055	13.1	54	0.7	208	2.6	793	9.9	-0.8	-10.3	-4.5	1.3
AT	674	18.4	48	1.3	180	4.9	445	12.2	-2.2	-6.4	0.4	-2.7
PL	2 772	20.3	69	0.5	600	4.4	2 103	15.4	:	:	:	:
PT	1 004	19.6	23	0.4	158	3.1	823	16.1	-2.2	3.2	0.6	-2.8
SI	270	28.6	10 u	1.1 u	69	7.3	191	20.2	-0.4	4.4	0.9	-1.1
SK	577	26.9	34	1.6	150	7.0	393	18.3	1.1	11.0	4.5	-0.6
FI	445	18.7	46	2.0	116	4.9	284	11.9	-1.1	-0.6	-0.9	-1.2
SE	684	15.9	46	1.1	258	6.0	379	8.8	-1.9	-8.3	-0.4	-2.0
UK	3 774	13.5	310	1.1	1 276	4.6	2 188	7.8	-5.0	-7.0	-4.9	-4.8
IS	22	14.2	:	:	3	2.0	18	11.7	-1.0	:	6.7	-2.6
NO	263	11.6	12	0.5	77	3.4	174	7.7	-3.0	-3.0	-3.9	-2.6
EEA	36 549 s	18.7 s	2 231 s	1.1 s	11 103 s	5.7 s	23 215 s	11.9 s	:	:	:	:
CH	589	14.9	81	2.0	196	5.0	312	7.9	-1.1	-1.6	-1.0	-1.0
BG	709	23.9	13	0.4	124	4.2	572	19.3	:	:	:	:
HR	304	19.2	5 u	0.3 u	69	4.4	230	14.5	:	:	:	:
RO	2 089	22.5	38	0.4	490	5.3	1 561	16.8	-0.7	2.1	-4.2	0.5

Source: Bernard Felix, Eurostat, Statistics in Focus, Science and Technology, 1/2006

Table 3: Value-added (in million EUR) and labour productivity (in '000 EUR per person employed), for the manufacturing sectors and the services sectors, EU-25 Member States and Candidate Countries, 2002

Country	Manufacturing						Services			
	Total		High Technology		Medium High Technology		High Technology KIS		market KIS	
	Value added	Labour Product.	Value added	Labour Product.	Value added	Labour Product.	Value added	Labour Product.	Value added	Labour Product.
EU-25	**1 533 907 s**	**45 s**	**195 521 s**	**63 s**	**476 155 s**	**53 s**	**363 823 s**	**65 s**	**834 462 s**	**46 s**
EU-15	**1 450 220 s**	**52 s**	**188 463 s**	**70 s**	**456 113 s**	**59 s**	**355 107 s**	**68 s**	**823 151 s**	**48 s**
BE	44 271 (1)	65 (1)	5 761 (1)	104 (1)	13 652 (1)	76 (1)	9 261 (1)	67 (1)	18 526 (1)	44 (1)
CZ	18 120	13	1 316	15	5 885	14	2 701 (1)	23 (1)	3 099 (1)	9 (1)
DK	25 495	56	3 915 (1)	87 (1)	6 221	55	6 502	65	21 725	75
DE	401 497	55	43 734	63	177 389	62	71 669	68	194 638	56
EE	1 136	9	64 (2)	7 (2)	106 (2)	11 (2)	285	24	532	12
EL	8 371 (3)	34 (3)	519 (3)	37 (3)	1 203 (3)	34 (3)	:	:	:	:
ES	109 038	41	6 279	52	27 661	49	23 857	64	62 503	33
FR	207 984	52	35 419	68	57 687	58	53 966	59 (1)	127 401	48 (1)
IE	35 989	149	:	:	14 902	333	7 394	136	:	:
IT	203 014	42	19 340	56	53 925	47	42 982	65	69 250	34
CY	960	26	37	34	76	25	429	82	630	36
LV	1 635 (1)	11 (1)	:	:	140 (1)	9 (1)	491	21	479	8
LT	1 540	6	125	9	:	:	422	20	440	9
LU	2 309	67	75	37	301	64	1 211	115	2 063	48
HU	12 320	14	1 744	19	3 866	18	2 805	22	3 564	9
MT	808	25	354 (2)	72 (2)	58 (2)	26 (2)	230	49	557	37
NL	54 467	64	:	:	14 829	:	20 045	73	51 766	43
AT	37 516	59	3 706	69	10 637	67	6 973	65	17 794	61
PL	38 673	16	2 498	19	7 498	16	:	:	:	:
PT	18 208	20	1 065	39	3 280	27	4 053	74	7 070	22
SI	4 478	17	622	29	:	:	507	23	976	19
SK	4 018	10	207 (1)	9 (1)	1 236	10	846	18	1 035	15
FI	29 655	69	7 034	127	5 736	57	4 735	57	8 804	53
SE	43 364	55	6 518	62	:	:	11 506	54	26 926	54
UK	229 042 (1)	59 (1)	38 136 (1)	78 (1)	54 947 (1)	58 (1)	90 951	73	208 946	55
BG	1 795	3	146	6	398 (1)	3 (1)	783	12	321	3
RO	6 620	4	320	7	1 558	4	1 583	11	1 111	6

Exceptions to the reference year:
(1) 2001 (2) 2000 (3) 1999

Source: August Götzfried, Eurostat, Statistics in Focus, Science and Technology, 9/2005

2.2 Key findings of the sectoral cluster studies

The structure of the clusters

Most clusters indicate an increasing market orientation of firms, as the result of the privatization processes and the reconversion from state ownership or from military production.

Firms may be distinguished not only according to their functional dependence or independence with respect to their client firms, but also according to their high or low capability in knowledge creation. Some firms, while being technologically dependent, have increased in recent times their capacity of design and developed specific engineering capabilities.

SMEs are increasingly less isolated and more often linked between themselves by being part of an industrial group of SMEs. Thus, many firms have financial ties with other firms either directly, being controlled or controlling the other firms, or indirectly through the personal financial participations of the same entrepreneur.

Other financial linkages are due to the spin-offs of new companies from existing firms. In fact, most of the new and successful firms have been created as direct spin-off or transformation of previously existing firms. Many firms are planning to create new firms by making autonomous some productions units, which have reached a critical size to represent a separated company, also in the perspective to exploit a new potential market.

Other firms can be defined as indirect spin-offs from other firms, since their funding entrepreneur has had originally a work experience and built his know-how in other firms.

Firms may be distinguished between the final producers of integrated products (OEM – original equipment manufactures), the so called system suppliers, which often dominate their market niche at the international level, and finally the regional subcontractors, which may be distinguished between first level and second level subcontractors.

SMEs are favoured by trend towards greater outsourcing from major firms. That also implies a greater standardisation of productions.

The lack of growth or the limited size of many SMEs is often related to the lack of an explicit aim and strategy to growth by the entrepreneurial family.

The growth of the firm depends first of all on the capability by the entrepreneur to elaborate a medium and long term projects and only afterwards on the availability important financial investments. This is the result of the technological and managerial knowledge accumulated in the firm and of an investment in the elaboration of formal research or informal searching activity.

The investments in machinery and structures have to be anticipated by important investments in the training of the technical staff and/or in the acquisition of external qualified human resources.

SMEs decentralize only a minor part of their production to other smaller subcontractors. On the contrary, a greater vertical integration is required in order to participate to international tenders and to increase the export activities.

The definition of a cluster, which emerges from the regions analysed, indicates that these latter may be quite different from traditional industrial districts.

Some clusters can not be defined at the local level, since they have a regional or even interregional reach.

Moreover, clusters may be defined not by material linkages but rather by the flows of information and knowledge between firms operating in different

Knowledge clusters have the following distinctive characteristics:
- the gradual development of competencies and tacit knowledge,
- a strong identity and professional ethics between the technical workers,
- a very informal cooperation between the firms.

It is mostly defined by flows of information and knowledge, but not by material linkages. The development of the cluster is strongly supported by the sectorial research institutions. It is mainly based on very informal cooperation between firms and strong personal relationships among their technical workers what builds strong professional ethics. Almost all key specialists and technical workers have finished the same universities, have the same technical background, participate at the same professional conferences, fairs, etc.

In the case of the Hamburg aeronautic cluster, the firms interviewed differ in the assessment of own innovation capabilities and strategic positioning in the market. Conventional firms and act as technological followers adjusting existing technologies to their production. Their main strength is based on experiential knowledge and existing linkages to the dominant client.

Other companies are knowledge-intensive or knowledge-intensified firms developing their own original products and having at least selective R&D contacts to universities and research institutes. A high level of specialisation and experiential knowledge define their strategic advantage.

Other companies are knowledge-intensive firms with a systematic development of innovation projects and close linkages to R&D specialists. Their strengths are based on superior knowledge bases and originality of research and development. According to these strengths, threats to be substituted by rivals are limited for these firms.

Two main strategic forces have been identified in the market by all firms:
- growing pressure within the value chain, particularly by Airbus
- the integration of new technologies into aeronautics value chain and similar markets as opportunities for further diversification

Most of the firms interviewed are family-based SME with a relatively small number of employees.

Physical linkages between the three sub-networks identified in Styria (i.e. automobile suppliers industry, polymer and plastics processing and racing parts) are weak but intersections based on co-operative R&D and R&D-infrastructure, qualification and informal exchange are evident. Despite the evident sectoral concentrations, direct links to the science base as well as the local availability of human capital seem to loom larger as binding factors than long term supplier networks.

Small and medium sized supplier firms show familiar sometimes intergenerational tradition structures.

Compared to German or Italian regions with considerable weight of the auto-mobile and machinery sector a lower inter-organizational mobility and fluctuation of employees has been pointed out by several firm-partners. A considerable high share of the interviewed firms is part of a firm group.

Due to the immobility of the local labour-force and the restricted capacity of the regional labour-market most of these firms had the chance to hold the key-personnel resp. competences and the regionally integrative potential of the personnel.

Styrian firms in the machinery but also in the material based supply- industries benefit from the regional universities who provide the labour-market with highly qualified engineers.

The organisation of the industry in the North Wales can essentially be characterised as a supply chain to Airbus. The south is much more loosely structured, which suggest that the aerospace sector represents more of an agglomeration of firms and organisations than a cluster here. There is a strong vertical interaction between Airbus and all firms investigated in the north in that all are linked through the supply chain.

Three firms examined operate without special ties to the region. Here, interactions are essentially with companies located in England and overseas, rather than Wales.

Airbus represents the dominant aerospace company in North Wales. The Airbus suppliers in NW are branches of groups of companies or independent Small and Medium-Sized Enterprises, supplying aircraft elements and occasionally services to Airbus. For all suppliers, Airbus represents a key business partner. It is striking, however, that only few horizontal contacts between Airbus suppliers seem to exist. The almost exclusive link between the firms involved in the supply chain is Airbus, and business relationships and knowledge flows are largely vertically structured.

Most of aerospace companies examined in SW operate in isolation from all other firms investigated in the whole of Wales, and do also show only few interactions between themselves. Their business contacts are of a national or international nature.

Innovation processes

Innovation develop according to a gradual pace. Incremental improvements are often directly suggested by the client, in order to solve specific problems within the specific order considered (such as in the case of a new aircraft model).

Innovation in many firms analyzed can not be represented as an event but rather as a process. Innovation is related to the continuous change in the production processes and the continuous improvement of new products. Thus, innovation is not represented by the purchase of a new machinery, but rather the process of using this latter into new productions.

The purchase of modern machinery can not be considered as the really key factor, which is determining the development of new productions in SMEs. New products may have originally been produced through more traditional or less automated machineries.

Thus, innovation in SMEs can hardly be defined as “supplier dominated” according to Pavitt typology, being related to the use of investment goods produced in other sectors.

Technological or process innovation in the subcontracting firms are tightly related or dependent by the introduction of product innovation, linked to new order by key clients.

Moreover, key barriers to innovation are represented in SMEs by the lack of human capital, of access to complementary technologies and of the stimulus from international markets. Innovation is tightly integrated with the development of the capability by the technical personnel to design and produce these new products. Thus, rather than investment in machinery innovation requires investment by the firms in the development of these capabilities.

Innovation is increasingly less pushed by the autonomous internal search of technological excellence by the technical staff and increasingly lead by the need of the firms to comply to new requirements of the market.

However, formal R&D activity is only performed by those firms which are producing with their own brand, since they are capable to appropriate the benefits of their additional R&D effort. On the contrary, the subcontracting firms prefer to develop new technologies and products, through a continuous process of interaction with the client. In this latter case, the development of technological competencies is more important than formal R&D.

Most firms have adopted major products innovation following a short term perspective and through the adaptation to external pressures by clients and competitors, rather than being willing to ex ante introduce innovation in order to exploit new opportunities. This reactive behaviour may be called "ex post innovation" and "ex post learning process".

Innovation within SMEs is lead mainly by routine market relations and most SMEs are not capable to elaborate a long term innovation strategy into new productions

Innovation depends on a strategic vision by the entrepreneur, since the innovation is not always the result of marginal improvements, but it is sometime the result of key decisions to invest in new equipment and in the training of key personnel, well before the order of the client and the actual production will start. In fact, the clients do not assign new orders, whether they are not sure of the production capability of the subcontractor.

Technological innovation are not the only type of innovation and "organizational innovation" are most important. In this respect, institutional and organizational innovation, such as safety regulations, environment protection requirements and international quality standards have become a key requirements and represent a major factor leading to the adoption of technological innovation.

Moreover, the adoption of certification standards requires major investments in the firms, since in some cases these latter have been obliged to purchase various complex machinery for the testing of the products, for the production of these latter. For example firms have been obliged to create a new team of engineers and technicians for quality management.

In that respect, the shift from the situation where all intermediate materials are provided by the client, to the situation where the SMEs are responsible of the direct management of the purchase of intermediate materials leads both to an increase of production efficiency and to the development within the SMEs of the organizational structures.

Often the lack of financial resources does not represent the real obstacle to innovation at least for larger investments, since financial resources in international markets actually are plentiful in this latter case. On the contrary for smaller investments, innovation in SMEs is penalized by the lack of suitable public instruments, since these latter always require co-financing by the SMEs and the lack of seed capital or of funds for start-ups and turn-around.

In the case of the Hamburg region, the background of the innovations in aeronautic sector has been experiences in other technological segments – space technology, military aeronautics, or racing cars – and incremental adjustments to existing technologies in aircraft production. As the product cycle for each model refers to more than three decades, speed of innovative changes and adjustments is limited, although ongoing research for improvements enables incremental innovations, which are integrated in maintenance and overhaul cycles. In the context of cabin interior, the time scale differs, as the interior is changed several times within a life cycle of a model according to technological changes, preferences of the passengers or extension of sales markets to other cultures.

Any innovation means a change of the aircraft causing safety or environmental risks, which have to be investigated and approved by public authorities. Only big firms as Airbus or the international airlines can cover the necessary costs for certification, including documentation and testing. This constellation means that only innovations, which fit into the strategic plans of the OEM or airlines, e.g. reduction of costs, visible achievement of higher quality levels or compliance with public standards, have a chance.

The possibilities of the firms interviewed differ according to their knowledge base. For knowledge intensive firms having a high share of academically qualified staff and own R&D investments, close cooperation with Airbus and public research institutions in R&D projects builds the typical source for innovation. Some of these firms even have been created as spin-offs from universities and public research organisations. Public research organisations provide necessary interdisciplinary knowledge, e.g. in the case of new types of composites on adaptronics as a combination of physics, information sciences and material sciences, while the cooperation with Airbus makes it possible to integrate engineering experiences and examination of theoretical knowledge by challenges in production processes. These firms are used to be integrated into public R&D programs and have international contacts. As a result of this cooperation with customers from different markets, a diversified set of applications can be developed.

For knowledge intensified firms with a relatively high share of academically qualified personnel and restricted access to R&D, internal knowledge with specified experiences plays a crucial role for innovations. They need contacts to the dominant OEM in particular to receive necessary support for certification processes and a critical mass of demand for funding. For these firms, access to public R&D is often difficult, as the cognitive patterns differ between more theory-led research and experience-driven problem solutions. Furthermore, they are often confronted with a lack of contacts to a necessary variety of research institutions outside the region and the country. As cooperation within the value chain to other suppliers is relatively weak, these firms have to restrict their knowledge creation, examination and exploitation to their internal capabilities.

Conventional firms with a relatively low share of academically qualified staff and no own R&D investments concentrate their innovations on adjustments to requests by the OEM. For them, standards set by the OEM as an entry barrier to the value chain play the decisive role to extend the knowledge base. With increasing formalisation of private certification, these firms face problems to cope with technological requirements and necessary investments in their equipment and qualifications. Engineering and other service companies serve as providers of necessary training and information.

Therefore, most of the innovation in the cluster is customer-driven and demand-pull. However, the more knowledge-intensive the firms are and the closer the innovations are to scientific research and general, inter-sectoral insights, the more technology-push innovations can be observed. Accordingly, innovation in cabin systems and composites differ remarkably with the latter changing

the incumbent demand-pull pattern and the exclusive role of Airbus as dominant player for innovations.

A massive structural change of the Styrian regional innovation system was observable between the mid-eighties and the mid-nineties. High degrees of diversification and broad unspecified clienteles have been reduced to market niches and technological specialization, and higher lot sizes and a higher integration of functions (sourcing of basic materials, construction, tool making) maintaining flexibility by leaving scope for automation. Technological upgrading (including the introduction of quality and measuring standards) also opened doors to new clienteles. This has been accompanied by extended responsibilities for tool making or sourcing capabilities as well as by shifted quality and price responsibility from clients to suppliers.

Innovation in this loose and open cluster seems to be determined by specialized knowledge in the field of materials, tooling and processing techniques, or very specific problems in the machinery segment. For firms already active in R&D, a shift from demand pull driven to science push driven R&D seems to be evident.

The analysis of the aeronautic cluster in Madrid underlines that new forms of organization of production have conditioned the innovation process. The innovations created and introduced in the aeronautical and aerospace cluster firms of Madrid are mostly incremental in nature through the transmission of formal and tacit knowledge.

In the case where the aeronautical firm faces the challenge of creating a new airplane and the manufacturers require new specifications, is when a big push to innovation process and introduction of knowledge in products, processes and materials of the sector is produced. This often means adaptations and development of already existing knowledge. The adoption of innovations associated with new information and communication technologies is transformed into changes in management and in the organization of the firms.

The adoption and adaptation of technology from other activities comes about naturally in the aeronautical and aerospace industry because the productive system in aeronautics is an open cluster in which the firms are linked to other clusters and productive systems.

The adaptation of existing technologies in other sectors is made in an almost handcrafted manner since the aeronautical and aerospace sectors are highly mechanized and the activity is very specific and not very standardized, besides strict following of the rules and regulations that characterize the productive activity.

The capacity to innovate and add value to the supply can only come from a highly qualified team. Thus, upgrading the workers skills is one of the actions upheld by the more dynamic firms. Nevertheless, in the less innovative firms the “human resource” factor is also strategic because it allows them accumulate a stock of tacit knowledge, produced as a result of the work done for the more innovative firms of the cluster.

The more dynamic firms pay more attention to research and product development (R+D). The smaller less dynamic firms, who base their competitive strategy on acquired knowledge and experience over time and who try to keep it as secret, also devote part of their resources to research. The innovation processes in the aeronautical cluster of Madrid are essentially systemic. It is the result of the technological strategies of the firms that compete in each of the segments of the value chain of the aeronautical production *filière*. All the firms of the value chain participate in the innovation effort.

The central element in the innovation process is the sharing, within the network, of the accumulated knowledge in each of the firms of the cluster as a result of the learning process in the production of each of the component parts. Innovations are produced and disseminated because learning is interactive. Most of the development engineering of the main components of a plane (beyond initial ideas and blue prints) is carried out thanks to the collaboration between the engineers of the main firm headquarters and the engineers of the main suppliers.

Knowledge creation

The research process has an informal character within SMEs, since explicit R&D activities are lacking in the subcontracting SMEs, while they may be present in their major client.

For most subcontracting firms the final result of the production activity is the delivery of a product, which is very similar to a service, since it has to be tailor made for the needs of the clients and it is based on their long standing relationship or reciprocal cooperation.

Within the relationships of subcontracting, flows of tacit knowledge are tightly complementary to the material flows. However, the geographical span of the linkages of tacit knowledge also limit the span of material linkages, which are more rare in the case of firms belonging to other countries or regions or sectors.

In the case of the Hamburg region, most of the interviewed firms are traditional family or founder based SME. Hence, entrepreneurs from the founding family still have a major influence. In many companies, however, generational change also causes adjustments of management styles improving the openness of the firm for internal discourses and external contacts.

Employment is characterised by a high degree of mutual loyalty with long-term contracts. Again, differences can be observed according to the share of academically qualified employees. In conventional firms, fluctuation of employees is below 10 per cent. Only very few of the employed participated in further education courses, and the share of foreign employees is below 10 per cent. The top managers in these firms have only very few experiences in large firms or in other countries. Location decisions are affected by personal origins of the entrepreneurs. Knowledge and project management tools do not play a major role in these organisations. The recruitment of staff is concentrated on the region with regional universities of applied sciences and technical college as important sources. Labour flows with competitors in the region are more important than labour mobility from clients or suppliers. In knowledge intensified firms, loyalty of employees still is important.

These firms have regular contacts to regional universities for practises or diploma thesis. Recruitment, however, is not restricted to the region. Labour mobility is higher than in other firms. Further education is an important issue for these firms, which use team organisation and communities-of-practice for a better knowledge interaction between employees. These communities do not only refer to internal organisation but also to cooperation with clients like Airbus. As a consequence of only slow changes in the organisational structure of conventional and knowledge-intensified firms, tacit knowledge remains often on an individual basis.

Tacit knowledge refers in most cases to absorptive capacities, i.e. capabilities to understand and transfer own and foreign experiences. Common professional background – e.g. joint experiences at a university or at Airbus or its predecessor – plays also an important role for knowledge interaction on an inter-individual level.

In Wales, knowledge exchange at Airbus SAS is organised in 6 'Centres of Excellence' (CoE) which relate to R&D and unite technological expertise across the 16 key production sites the company operates in Europe. The Broughton plant, essentially a production site, belongs to the 'CoE Wing,' together with the other main Airbus UK site at Filton in England. Coordination and decision making between the different national entities of Airbus SAS tends to be insufficiently organised and difficult. However, within the two sites of the CoE Wing and within each of the sites, knowledge is exchanged efficiently. Regarding the transfer of knowledge between Airbus Broughton and its supply chain in North Wales, arising from the close business relationships established above, a substantial exchange of information takes place. However, most – codified - knowledge flows down from Airbus to the suppliers that build to print, which rely on their– mostly tacit – knowledge and feed back only limited amounts of knowledge to the prime. Features common amongst the suppliers are that management structures are flat, IT plays an increasing role, and that knowledge is easily shared internally. 'Cytec Engineered Materials' (CEM), e.g., has abandoned its previously hierarchical management style, and the management structure is now relatively flat. The development of staff skills and good internal communication is regarded important, and new schemes fostering knowledge exchange have been introduced. Major investments in IT have been made over the past five years. Many communication systems are now globally networked between all CEM operations. Thus, the suppliers are capable of efficiently absorbing and processing the Airbus knowledge.

Internal organisation and knowledge exchange in the aerospace firms of South Wales is fairly similar to the companies of the north. The only notable difference to NW is that, with the exception of Prematec, Airbus hardly plays any role in influencing internal organisation and knowledge flows. Remarkable is that some firms stress the significance of the experience and skills of the resident workforce, when explaining the reasons for settling in SW.

In the aeronautic cluster in Madrid, the group of large firms has a greater creative and dynamic capacity for the diffusion of innovation and knowledge through the productive fabric; the medium size firms have, in general terms, a certain capacity for incorporating innovations associated with the development of production engineering; and the small firms work according to the patterns already established by the firms under contract, though they also introduce know-how in "how to produce", thanks to the tacit knowledge they have acquired while working in the productive activity.

The existence of commercial, professional and technical relations within the aeronautical cluster facilitates the diffusion of knowledge between the more innovative firms and the less dynamic firms. A proactive action takes place at all levels of the network between the effects of the two types of learning: one is the result of the productive experience embedded within the firms and workers, and the other the result of the interaction between firms and workers.

The transfer of technology is done through the mobility of the specialized personnel of the firms, consultancy services supplied by the engineering firms, but also by the large innovative firms, as well as through the circulation of R+D results from one firm to another, based on the technology contracts signed by suppliers and clients. Subcontracting represents an exchange of knowledge and know-how between one firm and another.

However, given that the firms in the aeronautical cluster of Madrid are located in an environment where economic, social and institutional agents and actors exist, the learning process of the firms within the aeronautical sector acquires a collective dimension. Learning becomes collective precisely through the relations that the firms that are investing have with the actors of this environment.

The view held by the aeronautical firms of Madrid on this point varies widely. They indicates an easy going relationship with the universities of the region and with other public research organizations with which it participates in different R+D programs. In this way, they have access to the results of basic research and can undergo applied research independently. Yet, the firms that have a smaller projection have little relation with public research centres and universities (as well as with the public administrations).

The firms of the cluster act with very different innovation strategies, according to their specialization and function in the firm network. The leading innovative firms have assumed that the internationalization of their activities facilitates cost reduction in production and optimal use of the knowledge developed in other areas. On the other hand, these firms depend on the network of subcontracting firms, who permit them carry out the contracts.

Low intensity innovative firms attempt reduce production costs, satisfy the clients demands and keep the market quota within the subcontracting network. Because of this, they value the tacit knowledge acquired, and this allows them introduce incremental innovations, particularly in what concerns production processes.

Thus, knowledge emerges throughout the network and affects all phases of the productive system that is necessary for manufacturing an airplane or aerospace product, but the firms do not always take the necessary actions in order to protect their work through formal mechanisms like patents. Innovative firms in general, have a propensity to patent their innovations. Nevertheless, one can observe little pressure to register patents.

The model of innovation and diffusion in the aeronautical sector shows a hybrid structure made up, on the one hand, of those firms of an oligopolistic nature that produce innovation and those that use (adopt and adapt) it. Innovation in the sector flows horizontally among the final producers who jointly create innovation with the ultimate goal of building a new aircraft or improving an existing model.

Local networking

The networks of SMEs considered in the empirical research represent a more general form of organization of firm linkages than the traditional local clusters.

The success of the SMEs highly depends on the complex capability of the entrepreneur to master the complex personal relationships with other business partners, the key technical workers in the firm and the actual and potential clients in the local economy, the capability to identify potential partners or key workers and to avoid conflicts of interests and to promote flexible forms of cooperation in specific common fields.

The most important relationships of the SMEs at the local level are the relationships with the clients and the personal relationships with other actors of the local community.

In that respect the relationships with suppliers are considered as less important. Especially, the smaller firms decentralize only minor parts of their production and are not interested in the technological development of their suppliers.

The labour relationships are very stable and the turnover is very low. Labour indicates an high loyality to the firms. SMEs prefer apprentices, which have been qualified internally, for key positions.

Most of entrepreneurs have developed their competencies within previous professional experiences in other often larger firms of the same area.

The mobility of the key technical personnel is worth a more through analysis. That would allow to establish indirect links between the firms and to understand the process of the creation of intellectual capital in the case of SMEs.

Other important relations are those aiming to the technical training of skilled technical personnel through short term courses in the framework of technical cooperation between client and supplier.

There is a tight flow of information between the entrepreneurs of the various local firms. The receptivity to external information is high due to the sharing of a common production culture and of common values. However, this exchange is highly informal.

While interaction between the actors in the sector is high, it is rather low with actors belonging to other sectors in the same local area.

Subcontracting and physical linkages are often less intensive than other, mainly informal and immaterial, types of linkages, such as: technological exchanges and informal exchanges of information between the key technically qualified workers and the entrepreneurs.

These relationships of informal cooperation, while not being formalized in specific contractual agreements, are the precondition to the future development of material purchase-selling linkages. They are also the reason which explain material linkages, i.e. subcontracting relationships, face severe obstacles to expand to foreign countries, due to lack of reciprocal knowledge and trust between the entrepreneurs.

Relationship with local universities are mostly rather intense, while they still have an high potential in the future. In particular, these relationships are mainly related to the education function of universities.

The local clusters are often still characterized by a low thickness, low formalization of reciprocal relations and low diversification of the actors. Joint initiatives are often fragmented, discontinuous, not coordinated and overlapping.

From a traditional perspective on clusters based on material interrelationships, the aeronautics sector in Hamburg cannot be seen as a cluster. Relationships between firms are restricted to the hierarchical organisation within a value chain with Lufthansa Technik and Airbus as dominant organisations and common denominator. Most of the ties in the cluster remain weakly and hierarchically.

During the last five years, several initiatives have been launched to improve cooperation within the regional cluster. The main driving forces behind these activities are the big customers (Airbus, Lufthansa) initiating pressure on organisational changes and launching new topics on the agenda.

A formal umbrella for many activities is the initiative on the aeronautics location Hamburg "(Initiative Luftfahrtstandort Hamburg)". Members of this initiative are Airbus, Lufthansa Technik and Hamburg Airport, the municipality, the association of regional aeronautical SME (Hanse Aerospace) and regional engineering companies (HECAS), the chamber of commerce, the labour administration, the professional association of engineers, the employers' association and trade union. The initiative is registered as a network of competence by the Federal German government

(www.kompetenznetze.de) and is coordinated by the local agency for business development. The main functions of this initiative are marketing and public relations for the location, organisation of social events, internal regional information on firms and competences and the umbrella for several working groups on specific topics, e.g. qualification. The cooperation style within this cluster is based on informal structures. Geographical proximity helps develop joint social norms and mutual trust, and repeated informal events serve as framing processes. The overall cooperation is sub-divided into sub-networks according to specific topics (qualification, R&D, or finance). Joint communication codes are developed through common sectoral (disciplinary) and regional background. All members of this formalised cluster, however, accept the relevance of openness to international actors and clusters.

The city of Hamburg increasingly tries to promote cluster processes despite not being a region eligible to EU or national funding for regional development. Local political support refers to R&D funding, organisation of informal meetings (via the location initiative), formal cooperation with other aerospace regions (Midi-Pyrenees and Aquitaine on qualification and entrepreneurial exchange) and qualification initiatives. The role of the Business Promotion Agency as administration for the joint location initiative could make them a perfect knowledge broker on all organisational and social issues. In Lower Saxony, Bremen and Schleswig Holstein, aeronautics is also seen as an important future sector. Strategic objectives and organisational power, however, differs between Hamburg and its neighbouring regions. Only Schleswig Holstein plans to become a member of the location initiative Hamburg.

All in all, the regional cluster structures have to be seen more differentiated. One important distinction refers to the products. In the composites context, close cooperation structures have been developed due to the specific role of public research (University of Bremen and Technical University/DLR Brunswick) and the limited number of suppliers in geographical proximity to Stade. Here, cognitive proximity between specialised, knowledge-intensive SME and OEM from different sectors leads to a cluster structure, which can be described as a “knowledge club” with exclusive knowledge bases and communication codes within the club. In the context of cabin interiors, the high number of suppliers and the diversity of competencies reduce the benefits of cooperation. Formal initiatives along specific topics help interested firms to develop new forms of cooperation with a strong impact of the big regional clients. Again, conventional firms face the biggest problems, as they often miss necessary capabilities and resources to find suitable interface segments to other firms and develop necessary systems expertise. For knowledge-intensified firms, the initiatives offer new ways to overcome gaps to formal R&D staff in multinational firms and public research institutes, while knowledge-intensive firms are less dependent on regional linkages and develop their own transnational cooperation patterns. Due to the limits of many conventional SME to formalised knowledge bases, social proximity is more important than cognitive proximity in this cluster type.

The cluster the Machinery sector in Styria may be characterized as an individualistic open system which is based on particular informal linkages. The regional outreach of the cluster is restricted by personal contacts but not by buyer-supplier relations, respectively transportation or logistic costs.

In Wales, since the late nineties several co-operative research institutions at the edge of science and industry have been established in the machinery sector. One primary target of such so called Competence Centres is to co-operate with third party firms, which are not partners or share-holders. While the core-partners of the ACC - one of the 15 competence centres in Styria - are large R&D-players (MSFT, firm O) in the automobile sector, their third party project partners are medium sized firms in the non-automobile machinery-sector.

Several firms maintain contacts to Welsh universities or training institutions involved in aerospace. Training is offered by public as well as private sector organisations. So, there are several connections between the companies examined above, and the research & training and public organisations of Wales. A few additional aspects of these relationships, and especially the ways in which they can be further developed in the future, are discussed below. The focus is on skills and their potential for fostering the Welsh aerospace sector, as the most important issue brought up in the interviews with research & training, as well as policy organisations. The interviewees believe that SW has the potential to flourish from undertaking more aircraft Maintenance, Repair and Overhaul, R&D, and training, given the existence of a large pool of resident and trained aerospace personnel. The vision is to develop further MRO capacities by attracting and serving a domestic and international clientele for relevant services in the light of a worldwide rising demand. As there is a global shortage of relevant skills, the interviewees regard the Welsh aerospace sector to be in a good position for satisfying the demand. They also seek to encourage the expansion and upgrading of aerospace training and academic R&D, to be able to maintain the Welsh advantage in skills also in the future. The focus of such activities is SW, reflecting the need to make up for redundancies a major aerospace employer recently made, amongst other things.

The aeronautical cluster of Madrid is formed by a geographical concentration of very different firms, inter-related and specialized in the production of specific parts of the products that the large oligopolies of the aeronautical industry commercialise, particularly EADS/AIRBUS, as well as auxiliary firms, and firms and organizations that supply services to the cluster.

The aeronautical cluster of Madrid, still underway, displays an organization around the large firms of the EADS group with a cluster of firms who supply goods and services that allow construct airplane parts designed by EADS-CASA and Airbus. Furthermore, it is an example of a productive system of goods that incorporate modern knowledge and whose strength lies in the fact that the firms create and share this knowledge between them. Yet the cluster of Madrid also forms part of a network of centres and clusters located in different territories of Europe, influenced by the decisions of EADS.

The firms that manufacture the products and offer services in Madrid are widely varied. In some cases the firms have a long tradition in the production of highly technical goods and services, present in national and international markets of aeronautical products; in others, they are new firms that have surged as a result of existing opportunities within the aeronautical market, in some cases promoted by already existing firms (spin off) and in other cases as a result of the creation of new ventures.

The relations between the firms and the actors of the network are a central mechanism in the functioning of the aeronautical cluster of Madrid, since they establish the economic, technological and power flows that direct the cluster's dynamic.

The relations between the aeronautical firms in Madrid vary greatly. In some cases the relations are formal and explicit, and obey the decisions of the firms and actors and seek clear objectives, as occurs with commercial exchange of goods and services, the commercial relations between suppliers and clients and the technical relations between firms. Yet, informal relations based on personal contacts between firms and actors are also important. This often means relations among engineers, ex-employees and personnel that have worked in the sector many years. In this sense the significance of relations between engineers and executives that work in firms within the sector and others that work in public administrations and organisms should be pointed out, given that the characteristic of the aeronautical activity during decades was linked to the public sector and have created strong ties that affect the economic and even technological relations, and this facilitates exchange within the network.

Change in the organization model of aeronautical production has promoted important changes in the aeronautical firms by outsourcing a part of the production phases and developing subcontracting to different levels. These mechanisms have made the production system more efficient and flexible. Subcontracting is widespread among firms in the sector, but it is gradual according to size and significance of the firm and according to the value of the final product. This type of relation is usually established with firms located within the local (such as the municipality, metropolitan area and region of Madrid) and national area, though there are also examples of firms working on the EU (4%) and international (1%) level.

The relations among subcontractors and suppliers are characterized by strong competition between them for obtaining contracts to participate in the manufacture of specific products. Thus, competition between firms that manufacture final products has shifted to the subcontracted firms that supply parts of the product. Nevertheless, cooperation among competing firms is not uncommon, particularly when there is much work or one of the subcontracted firms needs the help of another member of the network to get the job done.

An issue that concerns the functioning of the Madrid cluster has to do with the power relations within the network. In the aeronautical cluster of Madrid the relations between firms and actors has a strong asymmetric character.

International networking

An important factor limiting the competition from less developed and low wage countries is the key importance of quality certification. For example, quality certification is highly complex in the aircraft sector and represents a key barrier to entry to firms in LDC where the labour costs are lower.

Thus, the diffusion of international outsourcing from the most developed EU regions to the EU peripheral regions or to Central Eastern Europe is still rather limited in the most technically qualified productions. These purchases are still only determined by the aim to reduce production costs. Thus the diffusion of technological know-how toward these regions is limited to the phase of the establishment of new production capacities, while explicit technological cooperation with the firms in these regions is still rather weak.

A further major obstacle to the development of international relations is represented by the too small size of the individual firms. Knowledge of firms, potential clients and suppliers in other countries and of the business environment in these latter is still very low within SMEs and an obstacle to the development of international relations is the lack of sharing of common values, history and traditions with foreign actors.

While export activity is still rare in the case of smaller SMEs, the international relations assume the form of exchange of technical information and most firms agree that foreign markets are the key areas for their future development. In some cases indirect international relations have been established by the experience of key personnel abroad, as that may bring an access to foreign technologies.

FDI are in the clusters considered are mainly quite rare, however their role is increasing. International mergers and acquisitions may become increasingly important in the cluster considered, as some companies have recently been characterized by rather frequent change of ownership.

The development of international relations seems to require a greater vertical integration of the various firms, since the international clients want to purchase complete products or systems rather than individual components.

All companies expect increasing international business, in particular in Western Europe. They identify sales markets as major driving force for internationalisation, which means that they expect to sell more to firms within the Airbus value chain at other European locations. Therefore, they try to follow the more conventional model of internationalisation, represented for example by the Uppsala model and based on slow international adjustment based on experiences. Two of the companies expect further business in Eastern Europe, which will be driven by the expectation of reducing production costs. Dominant barriers for the internationalisation of these firms are information deficits and lacks of experiences and contacts. Most of the managers do not have experiences in foreign companies, and there are lacks of resources in language skills and uncertainties on the organisation of foreign markets. As a result, these firms are aware of their needs to increase internationalisation but realise internal deficits.

Knowledge intensified firms have more experiences in exports and international business. Their shares of exports in sales are above 50%. They are not only focused on Western European markets but expect growing shares of business in Northern America and Asia. These business relations are not only driven by sales, but also by cooperation in production and R&D. For these firms, access to financial markets plays a major role as barrier to investment in foreign markets.

On the level of R&D, international contacts between public R&D institutions play a major role. German researchers have several contacts to Asian and North American institutions, organise joint research projects and stays and are members of the Advisory Council for Aeronautical Research in Europe (ACARE). Hence, many spin-offs and knowledge-intensive firms in close cooperation with the public research institutes use these international linkages.

The new Eastern European countries are interesting markets for future expansion and growth especially for small medium sized firms in Styria. Most of the supplying partners of the regionally leading firms can be found in Germany and Italy. Nearly all firms stressed the significance of their first contacts with firm-partners in the new member states and the strong need for intense interaction at the initial stage.

A frequent mode of interaction refers to either co-operation with or investments in a firm in the new member state which already has established ties to firms in Western Europe. Some of the firms have established mutually dependent economic ties or long time partnerships. Some of the firms (e.g. firm E or Magna Powertrain) reduced their engagement, however.

3. The analysis of regional knowledge networks

This section of the Activity Report summarizes the key results of the theoretical analysis which has been elaborated in the framework of the work-package 2. This activity has led to the elaboration of a series of papers, which are synthetically illustrated in the following theoretical boxes.

THEORETICAL BOXES

Emergence and transformation of clusters and milieus
Antonio Vázquez-Barquero
Universitad Autonoma de Madrid

Large firms and small and SMEs: a complementary role
Javier Alfonso-Gil

Geographical agglomerations and the development of local networks
Michael Steiner and Michael Plodder
Joanneum Research, Graz

Geographical and relational proximities in the European Airbus project
by Philip Cooke & Oliver Ehret
Centre for Advanced Studies, Cardiff University

Temporary geographical proximity
André Torre
INRA Paris

The role of tacit knowledge in the process of innovation
by Riccardo Cappellin and Luigi Orsenigo
University of Rome "Tor Vergata and University of Brescia

Knowledge Value Chain Management in medium-technology SMEs

Rüdiger Wink
Ruhr Research Institute for Innovation and Regional Policy, Bochum

Social capital and clustering
Stanislaw Walukiewicz
Systems Research Institute, Polish Academy of Sciences

Knowledge networks and their evolutionary-institutional character.
Michael Steiner and Michael Plodder
Joanneum Research, Graz

The governance of interactive learning networks
by Riccardo Cappellin, Immacolata Caruso and Giuseppe Pace,
University of Rome "Tor Vergata" and Institute of Studies on Mediterranean Societies, Naples

3.1 The relationship between innovation and knowledge creation

Innovation is promoted by factors operating on the supply and on the demand side, as indicated in figure 1. Among the former are: the costs and the quality of labor, 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 such as defined by IPR.

However, while these complementary factors define the viability of new process or product, innovation also requires the existence of subjective or immaterial factors, as innovation is the result of an original project and the internal capability of the firm and of the entrepreneur to elaborate an original long term project ("business Plan") and the subjective evaluation of the risk of the required investment, leading to secure internal or external financial resources to the project considered.

Thus, internal knowledge and internal or external financial resources are two additional necessary conditions for the adoption of an innovation and they indicate the subjective capability/weakness existing in the firms in order to exploit external opportunities or to face external threats.

In particular, knowledge creation is a crucial activity within the firms for the adoption of innovation, as it is required in order to search, evaluate and use technology bought from outside and especially for the design of the new product or process and the organization of the innovation project.

The IKINET project focus on the process of knowledge creation rather than on the adoption of innovation and it aims to explain the characteristics and factors of the process of knowledge creation in the case of intermediate technology sectors.

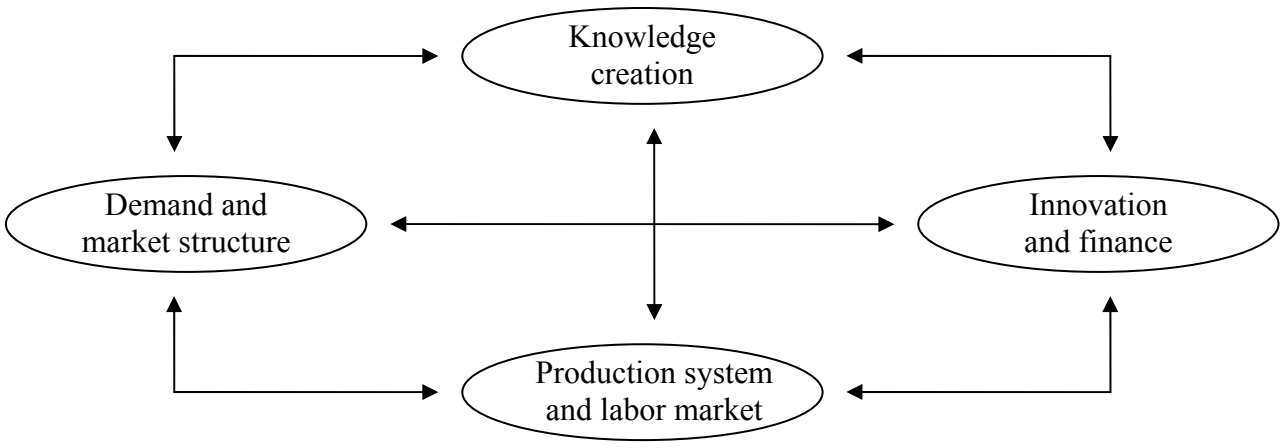


Figure 1: The relationship between knowledge creation and innovation

3.2 The role of tacit knowledge in the process of knowledge creation within SMEs

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 factors than in high tech sectors.

Medium-tech sectors have different characteristics than high-tech sectors. Technology in these sectors is characterized by an high complexity, as indicated by the high number of heterogeneous physical components to be assembled in the final product and the high number of possible forms of interdependence between these complementary components. Thus firms mainly produce intermediate products for other firms rather than final products for the consumer market. Also the pieces of knowledge in these sectors are highly fragmented and distributed between various firms. That lead the firms to specialize and they have a small size.

Many innovations in medium-technology sectors are based on technological paradigms, which started a century ago, but have been improved by engineering expertise and by integrating experiences from other technological disciplines, like material sciences or nature sciences (cfr. the theoretical box: "Knowledge Value Chain Management in medium-technology SMEs").

Machinery and transport equipment productions represent typical example of medium tech sectors. They are characterized by an high modularity, specialization of firms, forms of vertical quasi-integration between the firms which are organized in complex and continuously changing supply chains. Differently from high tech sectors such as: chemical, pharmaceutical or information technology products, the production process in mechanical industry may be distinguished in many different phases and also the final product is the result of the assembly of a very high number of intermediate components. That explains why economies of scale are less important and firms have a small size.

Medium tech sectors are highly dispersed and fragmented and characterized by a variety of agents, competencies and bits of knowledge. That leads to high competition between the SMEs and also to the need to promote cooperation. In fact, the high number of SMEs existing in medium tech sectors calls for a different approach in innovation policy, as policy should aim to exploit the potential of complementarity between widely dispersed components and actors.

Theoretical box

Large firms and small and SMEs: a complementary role

Javier Alfonso-Gil
Universitad Autonoma de Madrid

The canon of the Industrial Revolution is characterized by two basic events: the emerging political system offered greater individual freedom and, consequently, there were new opportunities for individuals to become entrepreneurs and create firms. Initially these firms were small and medium-size (SMEs) but in the 20th century large firms (LFs) began to appear. Although it seemed that LFs would dominate the entrepreneurial world and even lead to a drastic decrease of industrial SMEs, if not their entire disappearance, the data on number of firms, jobs and production tip the scales in favor of SMEs. Is there some reason to be found in the economic system which justifies this dichotomy between LFs and SMEs?

LFs have been driven by the simultaneous effect of a greater tendency to apply knowledge arrived at through R+D and scale economies obtained in production processes by means of necessary and successive capital increases. Although the physical representation of goods produced is by far the most obvious measuring instrument of the economic system, in fact the most decisive factor was also the most elusive aspect of the production process: technological change based on successive increases of knowledge in society. Thus, although capital accumulation is a necessary condition to obtaining long-term economic growth, it is not sufficient in itself. Capital accumulation processes that have not introduced increased

knowledge represented by technological change have consistently resulted in persistent decreases in productivity on the part of production units.

How is knowledge acquired? Basically, knowledge is acquired through the constant quest for both new products and new processes. This search obviously requires the use of resources with their corresponding economic cost. If research is carried out within the framework of in-house R+D departments, it is evident that the need for economic resources will multiply and have an immediate effect on the balance sheet. In other words, firms that wish or are able to maintain in-house R+D departments will have to meet increased cost due to the resources dedicated to research and this can only be done by way of higher prices on the market for their new products and processes. Therefore, the task of systematically searching for new, previously unknown, products and processes (the definition of "innovation") implies high costs for firms. These can only be recuperated outside of the competitive market with prices higher than marginal cost which, along with scale outputs, tends to generate large firms (LFs) in oligopolistic markets. Now it's obvious that there are industrial sectors (pharmaceutical, software, biotechnology, etc) where some SMEs are highly knowledge base and innovative but since the charge prices far above the marginal cost and they are a minority in the industrial landscape we can still use the model of LFs as innovators and SMEs as adaptors.

Industrial SMEs, we have observed above, constitute a majority in the system. How and why are they sustained? Firstly, SMEs, in general, do assign resources to R+D although they do not carry out a systematic search for new products and processes and they do not have in-house R+D departments. SMEs improve their productivity by imitating and diffusing technological advances developed in innovating firms by means of resources dedicated to increasing absorptive capacity (the other form of R+D). For SMEs this type of activity is "as if was innovation", they carry out R+D to adopt and imitate but not to innovate.

Secondly, SMEs have always tended to group into clusters which guarantees them rapid access to innovations coming from the LFs and minimizes access costs. This is because innovation acts as a public good and also because there are increasing agreements reached with LFs to transfer knowledge at a price. Easy access to knowledge for firms in clusters discourages them from generating costly formal in-house R+D departments whose lack is easily compensated by belonging to a cluster. Moreover, this attitude is reinforced by the knowledge each firm has of the other firms within the cluster. Besides, there is also the potential for increasing returns through specialization in subcomponents of the final product as well as less chance of entrepreneurial failure due to the distribution of total production among a large number of firms.

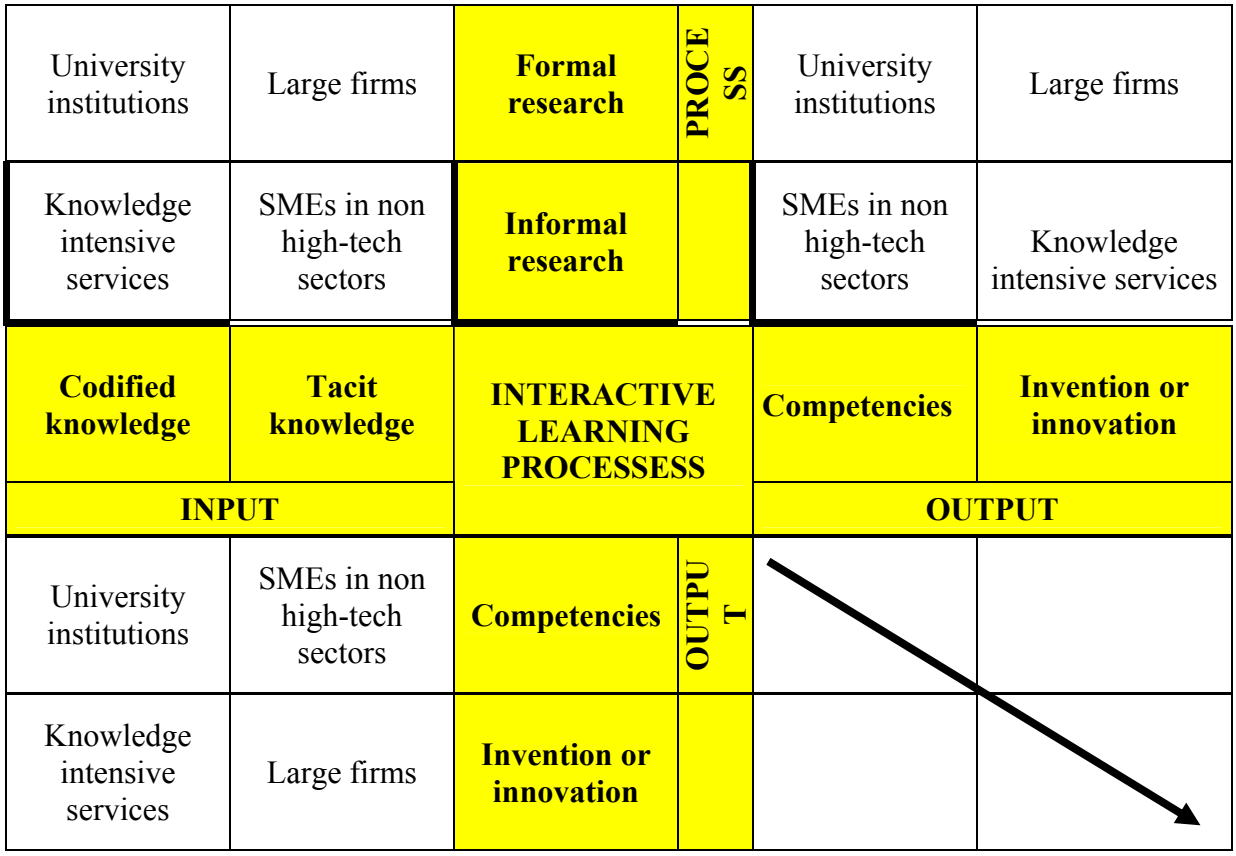
Finally, SMEs by producing in competitive conditions where there are many other firms turning out the same goods, their price is not a controllable variable but rather one that must be adapted to. If these firms wish to remain in the market, they must be able to offer the best price possible, a price much lower than that of the LFs. SMEs do not innovate because they cannot recuperate the high cost of routine R+D, so they imitate and diffuse at lower prices. On the other hand, diffusing at competitive market prices means the final goods can be purchased by a large number of consumers who would otherwise not have had access to them at higher prices. The cluster's work role is, therefore, essential in increasing demand for new goods and products. Clearly, both, LFs and SMEs tend to form a unity in the industrial construct base in their complementary role.

The dichotomy between large firms and SMEs is leading them to rather different approach in the development of innovation and SMEs do not innovate because they cannot recuperate the high cost of routine R+D (cfr. the theoretical box: "Large firms and small and SMEs: a complementary role").

Moreover, SMEs often lack necessary human capital resources to get into continuous interaction with basic research institutes and researchers from other disciplines (cfr. the theoretical box: "Knowledge Value Chain Management in medium-technology SMEs").

These specific characteristics of medium tech sectors are related to the different characteristics of the innovation and knowledge creation process in these sectors with respect to high tech sectors. innovation processes in the medium and low technology sectors and in the small and medium size firms depend on the availability of tacit knowledge, such as combinatorial capabilities, and on not formalized search activities, based on interactive learning processes within networks of firms (cfr. the theoretical box: "The role of tacit knowledge in the process of innovation").

Figure 2: Input, processes and output of knowledge creation in different organizations



Tacit knowledge can be better interpreted as a complex set of capabilities, which are localized or idiosyncratic and cannot easily be transferred, rather than as a stock or a resource. In particular, tacit knowledge may refer to competencies which explain how each actor behave and also how he interacts with other actors.

Tacit knowledge is both an input and an output in the process of interactive learning. Internal tacit knowledge has to be combined with other's tacit knowledge and with codified knowledge. Tacit knowledge generates other tacit knowledge and the socialization process may lead to generate new codified knowledge.

In particular, tacit knowledge plays a key role in the informal process of searching for a solution to local problems, which is particularly important in the innovation adoption by SMEs or in medium technology sectors and which is different from the formal search characterising the R&D activities.

It may be argued that tacit knowledge, while being more difficult to transfer among distant agents, might be easier to recombine than codified knowledge. If the "codes" inherent in different bodies of codified knowledge are excessively stringent, they can impose univocal interpretations and therefore rigidities in the use and modification of knowledge itself. Moreover, the codes underlying different bodies of knowledge can be incompatible with each other. In these cases, recombining knowledge from different agents, sectors, disciplines and countries can be easier when the tacit component is very strong.

On the other hand tacit knowledge can not be transferred at long distance such as codified knowledge, as it requires personal contacts and a deep reciprocal knowledge. However, in some cases, the lack of geographical proximity may be compensated by adequate organizational or institutional proximity and that allows to transfer tacit knowledge at large distance.

The distinction between codified and tacit knowledge, together with the distinction between the formal research activities and the informal search activities and the distinction between the development of innovation/inventions and the development of internal competencies within firms, allows to illustrate the different characteristics of the process of knowledge creation in SMEs with respect to the process of knowledge creation in other organizations. In particular, as indicated in table 2, innovation processes can be characterized by specific forms of combination between different inputs, processes and outputs (Cappellin, 2004).

1. the development of interactive learning processes in the traditional sectors where SMEs are dominant is characterized by: tacit knowledge, informal research processes and development of competencies.

2. the development of interactive learning process in the academic institutions is characterized by: codified knowledge, formal research activities and development of competencies, which are related to the education function of universities;

3. the development of interactive learning processes in large firms is characterized by: tacit knowledge, formal research activities and development of inventions/innovations;

4. the development of interactive learning processes in the modern knowledge intensive services is related to: codified knowledge, informal research activities and development of inventions/innovations.

3.3 The spatial character of the cognitive processes

Various concepts elaborated in regional economics literature, including *industrial districts* and *cluster* approaches suggest that geographical proximity is crucial to interactive learning and innovative success.

It is possible to supplement the geographical dimension with a broadly defined concept of *organized proximity,* which might deliver many benefits traditionally associated with geographical proximity. Moreover, the wide concept of *relational proximity* allow to identify other dimension of proximity, such as *cognitive, organizational, social* and *institutional proximity.* Thus policymakers need to know whether policies of regional economic development must be revised to cater for

learning and innovation factors associated with other dimensions of proximity different from geographical proximity (cfr. the theoretical box: “Geographical and relational proximities in the European Airbus project”).

However, knowledge creation only apparently has an a-spatial character, as the approach of cognitive economics underlines the spatial nature of the process of knowledge creation. In particular, as indicated in the theoretical box: ”The role of tacit knowledge in the process of innovation”, cognitive sciences clarify on the base of theoretical considerations that the process of knowledge creation works in a localized framework. In fact, according to this literature, 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.

First, the local environment and the aim to solve the problems of local users is important in providing a stimulus to innovate to firms. Spatial concentration of economic activities does not only allow to exploit economies of scale but also of economies of scope or synergies between various activities, as existing knowledge may be reconverted to satisfy new emerging needs. On the other hand, external stimulus should be compatibles with the internal integrity of the local production system and should lead to a gradual process of adaptation (Rizzello 2003). In fact, the aim to preserve the identity and to insure the survival of the local economy facing the external competition may represent a powerful challenge leading to innovation.

Second, the process of search of innovative solutions is constrained by cognitive proximity and it usually occurs first of all through the analysis of the complementary resources existing at the local level. A low cognitive distance explains the importance of client–supplier relationships in the process of innovation and co-makership.

Third, as knowledge creation requires the combination or use of various complementary resources the concentration of firms in large metropolitan areas (Cappellin 2000) or local industrial clusters (Steiner, 1998) facilitate innovation both because they decrease transaction costs between agents and because they enhance business opportunities and entrepreneurship due to the high diversity of origins, sectors, competencies existing in these areas and the easy access to a wide scope of new emerging needs and of complementary resources.

Fourth, knowledge creation is tightly related to the sectoral specialization, the industrial culture and know-how existing in the innovation systems to be considered. These factors may facilitate the early identification or the design of new patterns, combining previously existing ideas and pieces of information and knowledge. At the same time, however, they also constrain the discovery of new pattern in the attempt to insure the consistency and compatibility with existing solutions and that leads to path-dependency and in some case to “lock-in” effects.

Fifth, the local history and memory which are the result of centuries of interdependence between local actors, are a distinctive characteristic of the individual places. Common history leads to common cultures, patterns and visions of the future, reciprocal trust and also to the creation of local institutions and routines, i.e. the local “social capital” (Maskell 1999), which facilitates connections and decrease the cognitive distance between the local actors.

The spatial/local dimension of cognitive processes	
Components of the cognitive processes	**Territorial factors and processes**
The **type** of the external **stimulus**	Firms respond to **new needs in local markets** and aim to solve problems of **local users**
The **strength** of the external **stimulus**	**Low geographical and cognitive distance** facilitates the identification of weak signals and collaboration
The **process of adaptation** to external challenges and the search for **consistency and integrity**	Firms and actors respond by **aiming to survive** and to **preserve the integrity of the local environment**
Innovation requires the search and the integration of **complementary resources and capabilities**	Firms initially look for the **support of local suppliers**. The **diversity of metropolitan areas** or the **specialization of industrial clusters** allow to identify complementary capabilities.
Interactive learning is the key process in knowledge creation	**Local networks facilitate interaction and flows** of information and knowledge and the **links are constrained by spatial distance**
Knowledge develop according to **selected path**	The **specific characteristics of the local selection environment** allow to identify **new emerging needs,** but may create **obstacles** and lead to **lock-in effects**
Institutions play a key **role** in the process of knowledge creation	Local history, common culture, **values, norms, visions, trust** are **intermediate institutions** (i.e. **social capital**), which decrease the **cognitive distance** between different actors.

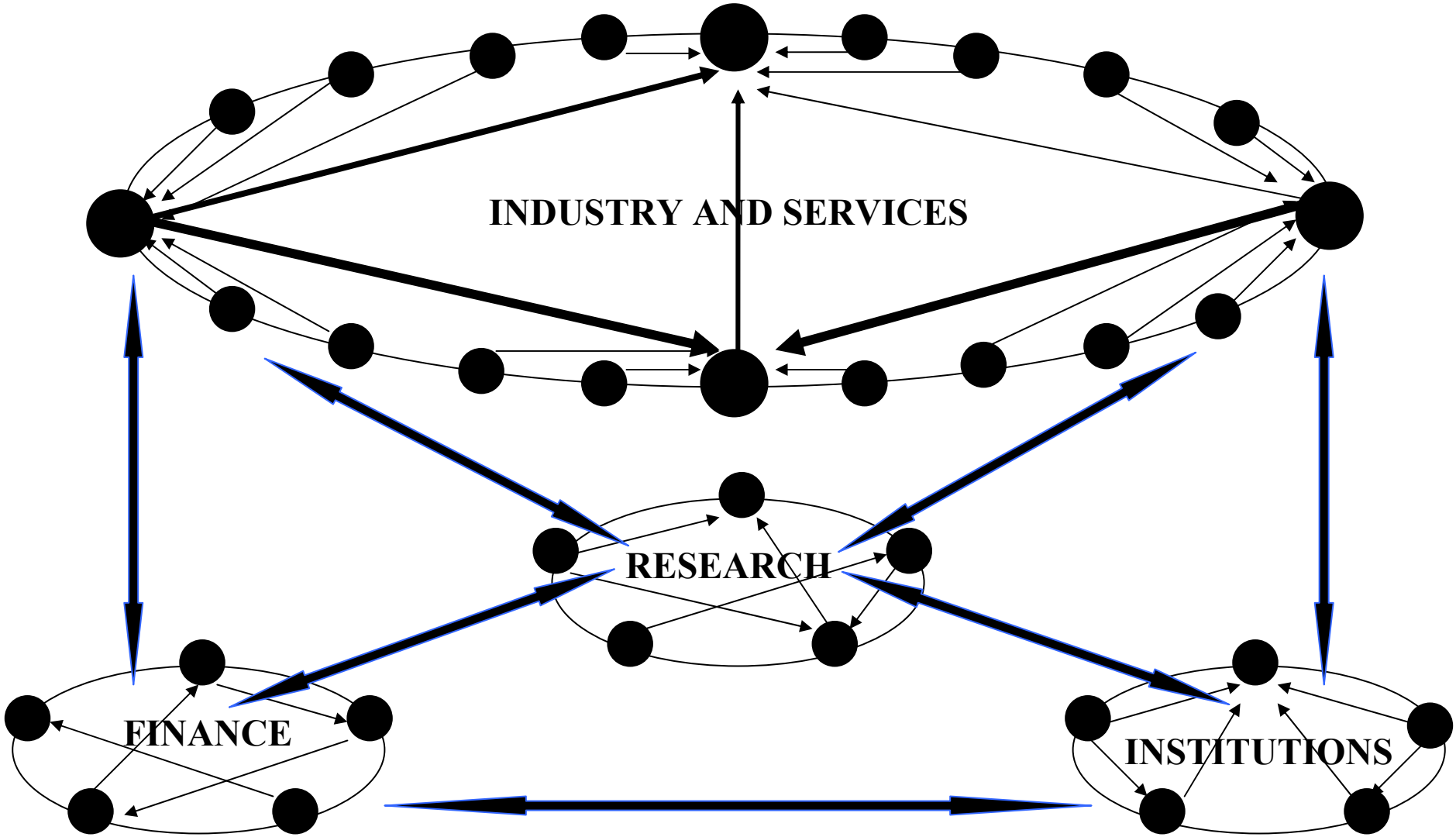


Figure 3 - The network of links in the regional innovation systems

Source: R. Cappellin, IKINET - International Knowledge and Innovation Networks, Research for FP6, Università di Roma Tor Vergata, November 2004

3.4 The different nature of clusters and of proximity

At the present time the organization of production is experiencing a profound transformation process in which the hierarchic models give way to more flexible and decentralized forms of organization. This has produced multiple interpretations such as the industrial districts (Becattini, 1979,, flexible specialization (Piore and Sabel, 1984, the new industrial spaces (Scott, 1988,, industrial clusters (Porter, 1990,, the knowledge economy (Cooke, 2002,, the new economic geography (Krugman, 1990; Fujita et al., 2000,, the theory of the innovative milieu (Aydalot, 1986; Maillat, 1995,, or economic sociology (Granovetter, 1985,. Thus, a single unique interpretation as to how production is organized within the territory does not exist (cfr. the theoretical box: "Emergence and transformation of clusters and milieus").

Competitive advantage is derived from the several discrete value adding activities both within and outside a firm's performance and for many industrial SMEs in medium-technology sectors, it is their embeddedness within value chain systems with OEM and other suppliers, which defines their competitiveness. Concepts like regional, national or sectoral innovation systems stress the importance of systemic linkages between single innovative activities and incentives to enhance innovations. Therefore, besides the traditional – material – value chain, a knowledge value chain covering the knowledge production process along knowledge generation, examination and exploitation has to be considered (cfr. the theoretical box: "Knowledge Value Chain Management in medium-technology SMEs",.

Given geographical agglomerations allow different types of networks and different patterns of behaviour in consequence also different forms of learning, of knowledge sharing and knowledge creation. Proximity per se is not sufficient to generate knowledge between firms, that the forms of organized learning differs remarkably between clusters, that the diffusion of knowledge within clusters is highly selective and strongly dependent of the position of firms within networks and their absorptive capacity. Special attention will be paid to the evolutionary development of these clusters and their historical background as a co-determining factor in cluster formation. Geographic agglomerations on the one hand and networking and clusters on the other hand have to be interpreted as interdependent dimensions which change in a co-evolutionary way.

Different dimensions of interaction can be observed. There are networking-dimensions of material, supply oriented transactions and networking-dimensions of knowledge sharing. They are different in respect of the involved actors, in the spatial extension and therefore also the significance of geographic agglomeration (cfr. the theoretical box: "Geographical agglomerations and the development of local networks").

The cluster concept has evolved from a predominantly material linkage and agglomeration based concept to an institution that supports knowledge generation and the sharing of knowledge. In the context of evolutionary and institutional economics, arguments are developed that emphasize the specific character of clusters as a form of governance enabling the generation and diffusion of knowledge within and between networks (cf. the theoretical box: "Knowledge networks and their evolutionary-institutional character").

Theoretical box

Emergence and transformation of clusters and milieus

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A renewed interest in the location of the productive activity has appeared during the last two decades. The literature analyzes a great number of cases of clusters and local productive systems in which all types of goods are produced and which are located in regions and countries with different levels of development (Altenburg and Meyer-Stamer, 1999; Rosenfeld, 1997; Staber, 1997; Porter, 1998). Electronics in Silicon Valley, in the U.S. and Silicon Glen in Scotland, but also in Guadalajara, Mexico and in Penang, Malaysia; optics in Rochester, New York, and in Orlando, Florida; the car industry in Detroit, Michigan and in Vigo, Spain, but also in Tianjin, China where Toyota has helped create a cluster; ceramic tiles in Sassuolo, Italy and in Castellón, Spain, as well as in Criciuma, Santa Catarina, Brazil; the shoe industry in Brenta, Italy and in Elche, Spain, as well as in León, (Guanajuato) Mexico; and in Marikina, Philippines; textiles and the garment industry in Reutlingen, Germany, but also in the Itají Valley, Brazil and in the Republic of Mauritius. Financial services in New York City, London and Frankfurt, Germany, but also in Hong Kong and Shanghai, in China.

This changing diversity has been dealt with from different points of view; no doubt due to the fact that sociologists, geographers and economists believe that at the present time the organization of production is experiencing a profound transformation process in which the hierarchic models, so characteristic of the large Fordist firm, reduce in hegemony and give way to more flexible and decentralized forms of organization. This has produced multiple interpretations such as the industrial districts (Becattini, 1979), flexible specialization (Piore and Sabel, 1984), the new industrial spaces (Scott, 1988), industrial clusters (Porter, 1990), the knowledge economy (Cooke, 2002), the new economic geography (Krugman, 1990; Fujita et al., 2000), the theory of the innovative milieu (Aydalot, 1986; Maillat, 1995), or economic sociology (Granovetter, 1985).

Thus, a single unique interpretation as to how production is organized within the territory does not exist. Several approaches try to explain the factors that make the industrial clusters appear the mechanisms through which they develop, as well as the reasons for its change and transformation. Furthermore, the arguments and analyses are often ambiguous and informal, possibly ideological or overly optimistic of a changing reality and so under criticism, but not always well argued (Amin, 1989; Harrison, 1994; Martin and Sunley, 2003). Gordon and McCann (2000) conclude that the diversity of the analytical approaches has led to some degree of confusion in the analyses and interpretations.

The paper proposes discuss the question of spatial organization of production, from the perspective of economic development. It maintains that the spatial organization of production emerges spontaneously as the markets and relations between cities and regions develop, the transportation and communication system consolidates itself, firms improve their form of organization, innovation and knowledge is introduced in the firms, as well as in the transportation and communications system, and the integration of the economic system is speeded up as a result of globalization. In fact, given that development takes on different forms in each historical period, spatial organization of production also changes and transforms itself. Both the territorial strategies of the firms and the economic strategies of cities and regions condition these changes, and thus they are also responsible for the surge and transformation of clusters and milieus.

The paper is organized as follows: Once economic development is presented as an evolutionary process that is territorial in nature, the outstanding features of the different forms of

organization of production are pointed out in light of the different stages of the industrial development process and of market integration. Given that innovations are a key element in the economic dynamic the discussion focuses on the outreach and significance that knowledge networks have today. Next, the question of diversity and the dynamic of industrial clusters is dealt with and the factors and forces that favour its change and transformation are put forth. It ends with some comments on the role of the local firm and actors strategies on the spatial organization of production.

Theoretical box

Geographical agglomerations and the development of local networks

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The role of the geographical scale for local networks represents a topic which is of special interest in respect of the transferability of established models of networks and cluster promotion to different regions. Geographic agglomerations on the one hand and networking and clusters on the other hand have to be interpreted as interdependent dimensions which change in a co-evolutionary way. The theoretical analysis explores forms and contents of economic interaction in networks which are based on various concepts of agglomeration. The existence of a pure geographical agglomeration (e.g. a city) favours the development of cluster; yet growing networks and clusters also could cause the emergence of a geographical agglomeration as it might have been the case in the Silicon Valley in California.

Geographic agglomeration respectively concentrated versus dispersed location patterns set a framework for economic interaction and (material and immaterial) linkages between economic actors. Existing interpretations of models and forms of geographical agglomeration allow different types of networks and different patterns of behaviour in consequence also different forms of learning, of knowledge sharing and knowledge creation. Firms establish a variety of types of interactions and relationships each of them having different impacts on the knowledge generation and diffusion process. Mariotti and Delbridge (2001) speak of the necessity for firms – in face of knowledge ambiguity, of knowledge related barriers, of tacitness and complexity of knowledge – to engage in the management of a portfolio of ties. Organizations therefore are likely to engage in inter-organizational relations that show a variety of types of ties.

Different dimensions of interaction can be observed. There are networking-dimensions of material, supply oriented transactions and networking-dimensions of knowledge sharing. The first belongs to the process of division of labour dealing with the exchange of goods and services, the second with knowledge. The main differences reside in the form of interaction and in the impact of interaction. The spheres of physical interaction (subcontracting relations) considerably differ from the spheres of knowledge intensive respectively R&D-driven interactions. They are different in respect of the involved actors, in the spatial extension and therefore also the significance of geographic agglomeration

The observed network in its regional dimension is dominated by knowledge intensive relations. The qualitative evidence gathered by numerous in-depth interviews in the machinery sector of the region of Styria reveals that the highest number of interactions was reached by pre-competitive R&D knowledge exchange respectively that immaterial dimensions dominate the material ones:. The (industrial) firms do have extensive supplier relations but not so much within the region and within the network. Yet their knowledge oriented relations are to a large degree regionally concentrated. Proximity per se is not sufficient to generate knowledge between firms. The diffusion of knowledge within clusters is highly selective and strongly dependents of the position of firms within networks and their absorptive capacity.

Clusters are highly differentiated across sectors, regions and countries. There is also no single model of knowledge transmission, also not within clusters. As already foreseen by Marshall variety exists also within clusters – there is much unobserved heterogeneity. Both a theoretical as well as empirical approach to network formation interpreted in a wider context of agglomeration show that approaches to cluster analysis have to avoid universalism – there is not only strong diversity between clusters but also within. This is of special interest in respect of the transferability of policy approaches and measures from one region to another (especially in astern Europe), where industrial structures, institutional thickness etc. is considerably different compared to regions in western Europe.

Knowledge transfer is by no means automatic and proximity per se is not sufficient to generate knowledge between firms. that the forms of organized learning differs remarkably between clusters, that the diffusion of knowledge within clusters is highly selective and strongly dependent of the position of firms within networks and their absorptive capacity.

Special attention will be paid to the evolutionary development of these clusters and their historical background as a co-determining factor in cluster formation. The roles of cluster, networks and geographical agglomeration considerably change more or less co-evolutionary. Different approaches concerning forms, channels and mechanisms of knowledge exchange offer different conclusions for the significance of geographical agglomeration in knowledge exchange. In the Styrian case the main dimensions of economies of agglomeration considerably changed during the last decades. The portfolio of interactions, at long last the meaning of agglomeration for the observed firms cannot be reduced to specific dimensions which merely exists or not.

Determined by firm capabilities and firm behaviour not all dimensions of agglomeration and therefore economies of agglomeration are accessible for all agents. While small and medium sized firms partially gain from economies of agglomeration in the field of basic technologies like material sciences or tool making, large firms concentrated pre-competitive research in the region to gain from economies of agglomeration in the field of Science and R&D. This agglomeration effects still seems to be concentrated around certain clubs of insiders. A considerable share of the investigated firms is not able to participate and gain from economies of agglomeration.

Yet there is a long tradition of pro-active promotion of clusters and networks in the most developed European regions in the meanwhile. Sectoral diversity (therefore low critical mass of actors) and the low absorption capacity hamper the development of and gain from discussed economies of agglomeration by a considerable part of SMEs.

Theoretical box

Geographical and relational proximities in the European Airbus project

by Philip Cooke & Oliver Ehret
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The notion of *geographical proximity* is prominent in the field of regional studies. Various theoretical concepts including *industrial districts* and *cluster* approaches suggest that geographical proximity is crucial to interactive learning and innovative success (see discussion by Oerlemans and Meeus 2005: Do Organizational and Spatial Proximity Impact on Firm Performance? *Regional Studies,* 39, pp. 89-104). The relevance of geographical proximity to economic success has also become accepted by policy-making organizations, such as the *Department of Trade and Industry* in the UK (2004: *A Practical Guide to Cluster Development*, DTI publication).

But several scholars, most notably Torre & Rallet and Boschma, have challenged the significance of geographical proximity, suggesting that other channels for learning might be similarly or more important. Torre & Rallet (2005: Proximity and Localization *Regional Studies,* 39, pp. 47-59) differentiate between permanent and temporary *geographical proximity,* and supplement the geographical dimension with a broadly defined concept of *organized proximity,* which might deliver many benefits traditionally associated with geographical proximity. Boschma (2005: Proximity and Innovation: A Critical Assessment *Regional Studies,* 39, pp. 61-74) argues that four types of *relational proximities* coexist with *geographical proximity.* These are: *cognitive, organizational, social* and *institutional proximity,* and might be as or more important than *geographical proximity*. Boschma's *relational proximities* show a greater differentiation than Torre & Rallet's *organized proximity,* but refer to similar facilitators of interaction between stakeholders in innovation. Examples are trust and set communication structures in organizations.

Both from an academic and policy-making point of view it is very important to examine the relevance of the different types of proximity. Academics need to refine their understanding regarding merits and problems of the different theoretical dimensions, to be able to evaluate and refine theory. Policymakers need to know whether their present faith in the benefits of geographical proximity is appropriate, or if policies of regional economic development must be revised to cater for learning and innovation factors associated with other dimensions of proximity.

The present paper by Cooke & Ehret responds to the call by other scholars researching *proximity* to empirically evaluate the relevance of the different types of proximity. At the same time, the paper seeks to inform policy-making as to what factors matter to learning and innovative success, to help them devising more effective policies of regional economic development. To do so, the paper examines the proximities that manifest within Airbus UK and the international Airbus SAS, during R&D, manufacture, transport and integration of wings for Airbus aircraft.

It emerges that permanent geographical proximity is of limited significance for learning and innovation within Airbus. The company is of an international nature and most knowledge flows between, rather than within, geographically closely delimited regions. Temporary geographical proximity, on the other hand, does play a more important role. This lends support to the theoretical propositions of Torre and Rallet in particular. It also becomes clear that cognitive, and to a lesser extent organizational, social, and institutional proximities matter significantly, and more so than geographical proximity. This is in line with the suggestions of Boschma. The affirmative evaluation of academic theory also yields lessons for policy-making. Organizations such as the DTI should widen their current focus on the support for geographically defined

clusters. Policies of regional economic development should also take account of the learning and innovation factors captured by other dimensions of proximity. If interregional knowledge-flows are more important than intraregional ones, public policy is well advised to nurture the relevant, for instance organizational, proximities.

Theoretical box

Temporary geographical proximity

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Far from denying the role of space in the implementation of innovation processes, recognizing the existence of moments of temporary geographical proximity helps put in its rightful place the need for face-to-face interactions. Thanks to increasing mobility possibilities, the need for geographical proximity, which is real for certain types of interactions - in particular for services or the sharing of knowledge - can be fulfilled temporarily through travelling, without the interaction leading to the permanent co-localization of the partners.

Firstly, the need for geographical proximity is generally not permanent in innovation and knowledge production activities. It concerns certain phases of the interaction and depends on the firm's or innovation's life cycle. Short or medium-term visits are then sufficient for the partners to exchange - during face-to-face meetings - the information needed for cooperation or for the construction of trust. Thus, permanent co-localization is not necessary even for activities where physical interaction plays an important role in the coordination. This is what we call the need for temporary geographical proximity.

There is no denying that face to face relations remain indispensable for certain types of interactions, in particular to solve problems related to the heterogeneity of reasoning modes or those related to the processes of deliberation and negotiation. However, the intensity of the need for face-to-face relations varies according to the phase of the process. Only two types of situations necessitate face-to-face interactions:
- the launch of innovative projects, in particular in cases where the actors have very different knowledge bases and where the project is not very structured;
- cases of conflict management between innovators, proximity facilitating consultation between the participants regarding the use of communication tools.

These moments of temporary geographical proximity can occur in the context of face-to-face meetings between people involved in the same project. But they are also made possible by organisations whose purpose is precisely to enable people to meet, to exchange information and knowledge. Fares and congresses, for example, enable firms to meet, exchange ideas, and give them an opportunity to develop trust with each other. There is indeed geographical proximity here, but it is organized by institutions that specialise in this type of activities. The same solution to a similar problem is provided by conferences of researchers or of high tech specialists, during which projects or collaborations are conceived, and during which individuals can build trust relationships that can later be developed from a distance. Here again, geographical proximity combines with the effects of organized proximity developed with the help of organisations that specialise in this task.

The recognition of the existence of a temporary geographical proximity based on individuals' mobility has direct implications on the question of clusters, as it calls into question the necessity for firms involved in an interactive research or innovation process to be located in the same area. Thus, big firms can more easily fulfil the need for geographical proximity by de-localizing part of their staff, including for relatively long periods of time; whereas smaller

firms (very small enterprises or small SMEs) are often forced to adopt a permanent co-localization even when they only need temporary geographical proximity. Big firms, group subsidiaries or universities can bypass the constraint of co-localization by sending teams of researchers or doctors for short or prolonged visits to distant research centres for example.

Thus, geographical proximity is not a factor of coordination if it is not activated by organized proximity. In some situations, the latter can even prove sufficient for the establishment of interaction relationships. Could organized proximity alone be sufficient, and function without geographical proximity? Despite the fact that some authors exclusively praise the virtues of clusters, the answer to this question seems to be yes. This is evidenced by situations in which supra-local organized relations occur: multi-unit firms, global networks of firms, national or international professional communities… As it is not geographic in essence, the organization has the ability to "travel through" territories and to cross their frontiers. It is located in space, does not ignore territories, but is neither defined nor limited by them: a multinational firm is a good example of this type of organization. The coordination of these long distance relations rests on the sharing of norms and standards (such as ISO 9000 standards), the existence of formal rules and common representations and on individuals' mobility.

Yet, not only do clusters exist, but their numbers are increasing and more and more policies are implemented to promote their development. What are the reasons for such a success? It is clear that the need for geographical proximity in the coordination of innovation and research activities, and in particular in the exchange of tacit knowledge, cannot alone explain the geographic concentration of actors. The existence of clusters rests on several other factors:

Firstly, *economic relations are embedded in social network,* and the latter often have strong territorial roots. In this perspective, the existence of localized networks of innovation is less due to the functional need for face to face relations in order to exchange knowledge, than to the fact that cooperation occurs between researchers and engineers belonging to different organizations but originating from the same university or belonging to the same social and family network. Geographical proximity is not so much an *economic cause* of agglomeration as a *social effect* of the embeddedness of economic relations in inter-individual relations. Face-to-face interaction between two actors cannot alone generate synergies; the latter can only develop between two individuals who belong to the same network or share common representations. Furthermore, the passage of time and the history of the localized innovation systems are key factors in the success of the local interactive processes;

Secondly, *the geographical context of economic interactions is largely conditioned by the role of institutions*. And nowadays, geographical proximity appears to be a factor legitimising these institutions (valorisation of the local in itself). Thus, local policies produce geographical proximity institutionally as a privileged mode of economic interactions. The search for synergies between local actors has become the basis for most policies of local development. This is evidenced by the development of technopoles, technological parks or poles of competitiveness created with the financial support of the public authorities, and which often lead to a co-location of actors without necessarily generating significant effects in terms of synergy. Indeed, recent surveys about interfirm cooperations show that in most cases the firms cooperate with organizations that are not located in the same region and that proximity based interactions are relatively rare.

Finally, with regard to the life of clusters, it is important to remember that the success of these local agglomerations - even in the absence of strong synergies - can often be explained by traditional economic factors - in which case there are no strong synergies between the different firms located in the agglomeration. The first factor is related to attractiveness based on land prices: the public authorities often maintain the prices of plots at attractive levels in order to attract enterprises or research laboratories, the latter seeing in these low prices an opportunity to set up and function at a reasonable cost. The second factor lies in a series of advantages, such as tax and financial advantages (tax abatements, temporary or permanent tax exemption...) offered by the local authorities in order to attract enterprises and convince them to set up within

their zone of activity. The third factor, which cannot be ignored, is related to the New Economic Geography argument concerning the local labour markets. Enterprises naturally seek to locate their activities in proximity of other firms that belong to the same or to related sectors of activity so as to be close to a pool of qualified labour available on the labour market.

Therefore, networks may have different characteristics and they may be distinguished in the following three types (cfr. the theoretical box: "The role of tacit knowledge in the process of innovation"):

'Ecology networks', sometimes assimilated to 'agglomeration economies'. They are characterised by strong interactions. Ecology networks are made by relationships of objectively observable stable interdependence. They are also based on behavioural adaptation, strong specialisation, complementarity and idiosyncratic relationships and lead to various forms of traded and untraded interdependencies or spill-over effects. Basically ecology networks are the result of geographical agglomeration and they characterize the areas of concentration of the firms belonging to the same sector or urban area. Clearly also information and communication technologies may favour the creation of these types of networks. They are the result of external economies and technology spill-over, which are also defined as "localization economies" or "urbanization economies" and which spread in a rather automatic and casual way between the various firms and actors living in a specific local environment.

'Community networks', are based on the sense of identity and common belonging. These subjective element distinguishes them from ecology networks. Thus, community networks require the sharing of an homogenous culture, common values and are characterised by the existence of trust relationships and of common institutions and specialised intermediate social organisations, which are defined as "social capital" (Coleman 1988). These networks are places of collective learning and the development of a common production know-how. However, they lack the capability of central coordination and strategy making. Typical case of community networks are the industrial districts or clusters and regional innovation systems.

'Strategy networks' are based on cooperative agreements between firms and other organisations. These 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. Strategy networks imply forms of central coordination, the creation of procedures for the exchange of information, the codification of individual implicit knowledge and the 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 or by local clusters and regional innovation systems, which explicitly want to become a "learning region".

Defining a region as a 'learning region' means that the actors of the system are committed to an interactive learning process, which allows the development of knowledge, know-how and other capabilities required for creating innovation and maintaining regional competitiveness (Maillat and Kebir., 1999).

The objective of a 'learning region' is the integration of tacit or implicit traditional knowledge, which is bounded within the local context, with the codified knowledge available at the world level, in order to stimulate the regional endogenous potential.

A 'learning region' may represent the final outcome of the evolution of an 'industrial district', which undergoes an ongoing evolution thanks to the active role of the processes of learning,

adaptation and innovation within the network.

Knowledge oriented relations are to a large degree regionally concentrated. The diffusion of knowledge within clusters is highly selective and strongly dependents of the position of firms within networks and their absorptive capacity. This agglomeration effects still seems to be concentrated around certain clubs of insiders. A considerable share of the investigated firms is not able to participate and gain from economies of agglomeration. Yet there is a long tradition of pro-active promotion of clusters and networks (cfr. the theoretical box: "Geographical agglomerations and the development of local networks")

The relationships between the firms become more complex, risky and require to be redesigned in a long-term perspective. This has compelled firms to devise new organizational forms and contractual arrangements, which may be capable to manage these new and more complex relationships. So the question who are – from a comparative analyses – the gatekeeper of knowledge exchange at an international level is of great importance especially for IKINET.

As indicated in the theoretical box: "Knowledge networks and their evolutionary-institutional character", clusters are not automatically there but that they are the result of an evolving process shaped by policy activities and entrepreneurial behaviour responding to new challenges. Institutions are themselves shaped by economic behaviour and hence subject to change. Since there is definitely room for agency there is ongoing interaction between the agents and the clusters which is a driving force for the adaptation of clusters. So there is in-built endogenity in the development of clusters: their institutional forms are exogenous in the short-run (so setting the framework for economic relationships and development, but become themselves endogenous over the longer run (cfr. the theoretical box: "Knowledge networks and their evolutionary-institutional character").

3.5 The governance of learning networks through "Territorial Knowledge Management"

Regional innovation policies should design appropriate methodologies in order to promote the creation of a "learning region" and to well organize the cognitive relations between the various local firms and actors, which represent a key advantage of agglomeration economies.

Knowledge generation is firstly based on processing *existing* – own or foreign – experiences. This conscious or sub-conscious processing can be defined as learning from existing expertise by combining new elements of existing experiential knowledge pieces or by improving the recognition of existing knowledge.

Knowledge examination is the process of assessing and filtering new ideas and it deals with the investigation of the quality of new knowledge, its novelty, applicability, non-intended consequences and prerequisites. For conventional industrial SMEs in medium technology sectors, this requires too high investments into technological infrastructures as well as formalised human capital.

Moreover, the more radical an innovation is the more important it is to change the cognitive perspective of customers on needs and solutions to fill the needs. Consequently, k*nowledge exploitation* requires a perspective on potential demanders, their (hidden, needs and channels to reach them (cfr. the theoretical box: "Knowledge Value Chain Management in medium-technology SMEs").

A virtual production line may be considered as a creative process, where similar to an hypothetical production chain a number of experts (teams of experts), scientists, specialists, etc. with computers, data bases, etc., connected via the Internet or any ICT networks, are engaged in solving a more or

less accurately defined problem of the firm. The experts combine their human capital, and their mostly tacit knowledge with codified knowledge to solve in a creative process a problem which may be at the beginning not well defined and described in a murky way, but due to their efforts (self organization), may become more and more clear-cut.

The history of improvement/development of the classical production line seems to delineate directions for research on the virtual production line. In fact the virtual production line appears as an instrument ("a transition chain") which experts may use to combine codified knowledge with their tacit knowledge, competence, experience etc., to produce improvements in products, services, technology and management, and contribute to the stocks of knowledge, both codified and tacit. Otherwise stated, it is a device on which social capital of the firm is making money ("financial capital"), using the "human capital" of its experts and its "physical capital" (computers with software, data bases, communication networks, patents, licenses, books, etc.), combined in a creative process In the case of SME`s, the process of cluster formation may be described as the design of a virtual production line, as it allows the formalization of tight relationships with research institutions, universities and other local knowledge providers (cfr. theoretical box: "Social capital and clustering").

Theoretical box

The role of tacit knowledge in the process of innovation

by Riccardo Cappellin and Luigi Orsenigo
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The process of knowledge creation, which occurs in clusters specialized in medium-tech sectors, is rather different from that in high-tech industries, which has been extensively studied. Specifically, in this kind of industries the innovation process presents three important characteristics:

- it has an interactive dimension;
- it has a re-combinative character, i.e. it is largely based on the use of (often) already known concepts and elements, the recombination of which leads to original improvements in products and processes;
- it is mainly based on the use, transfer and creation of tacit and local knowledge through informal searching processes.

Cognitive processes, i.e. processes leading to knowledge creation, have a territorial dimension and that is the main factor leading to the spatial agglomeration of innovative activities.

In fact, external stimulus stimulate knowledge creation and innovation, as firms aim to respond to the new emerging needs in their local markets and to solve problems of local users. A low geographical and cognitive distance facilitates the identification of weak signals and promote collaboration between local actors.

Knowledge and innovation are the result of a process of adaptation responding to the search for consistency and integrity when the local or regional environment has to respond to an external challenges.

Innovation requires the search and the integration of complementary resources and capabilities. In the search for a solution to these problems firms initially look for the support of local suppliers. The diversity of metropolitan areas or the specialization of industrial clusters may facilitate the identification of complementary capabilities.

Interactive learning is the key process in knowledge creation. Networks are a form of organization, which facilitates interaction and flows of information and knowledge, and their nodes and links are constrained by the existence of spatial distance.

Knowledge develop according to selected paths, as the specific characteristics of the local selection environment may facilitate the identification of new emerging needs and it may also create obstacles and lead to lock-in effects.

Institutions play an important role in knowledge creation. Local history, common culture, values, norms, visions, trust are the component of the local social capital. These intermediate institutions decrease the cognitive distance between different actors.

Networks are an appropriate organizational form, when the access to tacit knowledge is crucial as it is in the case of SMEs and of medium-tech sectors. While codified knowledge could be interpreted as a stock or a resource, which can be transferred in the markets, tacit knowledge is linked to action and it can be interpreted a complex set of capabilities, which are localized or idiosyncratic and cannot easily be transferred. In particular, tacit knowledge refers to competencies which explain both how each actor behave and how he interacts with other actors

Tacit knowledge is both the result and a factor in the process of interactive learning. In particular, tacit knowledge plays a key role in the informal process of searching for a solution to local problems, which is particularly important for the innovation adoption within SMEs or medium-tech sectors and which is different from the formal search characterising R&D activities in large firms.

It may be argued that tacit knowledge, while being more difficult to transfer among distant agents, might be easier to be recombined, than codified knowledge. In fact, whether the "codes" inherent in different bodies of codified knowledge are excessively stringent, they can impose univocal interpretations and therefore rigidities in the use and modification of knowledge itself. Moreover, the codes underlying different bodies of codified knowledge can be incompatible with each other. In these cases, recombining the knowledge from different agents, sectors, disciplines and countries can be easier when the tacit component is very strong.

On the other hand tacit knowledge can not be transferred at long distance such as codified knowledge, as it requires personal contacts and a deep reciprocal knowledge. However, in some cases, the lack of geographical proximity may be compensated by adequate organizational or institutional proximity and organizations and institutions allow to transfer tacit knowledge at large distance.

Networks may have different characteristics and they may be distinguished in the following three types, which all have a different cognitive characteristic. Some networks may be defined as 'ecology networks', as they 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. Other networks: '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") and may be defined as places of collective learning where as in "industrial districts" the development of a common production know-how occurs. A third type of network, defined as 'strategy networks' are based on intended relationships and cooperative agreements between firms and other organisations. They imply forms of central coordination, the creation of procedures for the exchange of information, the codification of individual implicit knowledge and the investment in the creation of collective codified knowledge. That is the case of those local clusters and regional innovation systems, which explicitly aim to become a "learning region".

"Territorial Knowledge Management" is a methodology for the governance of learning networks and it indicates six dimensions or levers to promote the innovation capabilities of a regional production system. According to this approach, knowledge policies for SMEs in

medium tech sectors may focus on:

- Innovation stimulus: aim to respond to customer needs and to strengthen the integration of the supply chain.
- Accessibility: enhance the low international accessibility, while maintaining an high local accessibility
- Receptivity: invest in education and to expand capability of learning as also relational competencies in the development of cooperation with other actors.
- Identity: enhance the high local embeddedness of economic actors and maintain a strong local identity
- Creativity: Invest not only in R&D but also in developing informal processes of interactive learning and favour an higher diversity of the local actors and insure to the potential innovators the possibility to invest in risky exploratory analysis and in the lengthy process of systematic search of innovation.
- Governance: strengthen intermediate institutions and base policy making on the model of Multi-level governance, rather than on traditional planning or free market approaches.

Institutions have a clear importance in the innovation process, as the creation of institutions and the governance of the knowledge creation process represent key factors for increasing the accessibility and the receptivity of the actors in a cluster as also for the development of their sense of belonging.

Theoretical box

Knowledge Value Chain Management in medium-technology SMEs

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Within strategic management, value chain approaches help identify specific needs as well as organisational strengths and weaknesses at different stages in the process, from procuring raw materials to distributing, selling and maintaining market products and services. Porter's concept of strategic management sees cost leadership and differentiation as the two major strategies to improve competitiveness. Identifying the sources for such successful positioning, however, requires further differentiation. Competitive advantages cannot be understood by looking at a firm as a whole. Indeed, competitive advantage is derived from the several discrete value adding activities both within and outside a firm's performance. For many industrial SMEs in medium-technology sectors, it is their embeddedness within value chain systems with OEM and other suppliers, which defines their competitiveness. Changes of sourcing strategies by OEM strengthening the formation of system suppliers, which integrate different capabilities and functions within the value chain challenges the traditional position of conventional industrial medium-tech SMEs in the value chain.

Strategic management decisions are based on performance assessments of all single activities and the identification of tools required to improve the performance. Cohen and Roussel define four perspectives to measure the strategic performance of single activities: impact on cost reduction, reliability of quality, specificity and individualisation of services, and speed to market with first mover advantages due to innovative capabilities.

These general value chain concepts, however, still refer to innovation as a "black box". This leads to confusion about performance indicators and innovation strategies. Elements of the Lisbon strategy, for example, refer to input indicators like R&D investments instead of looking at systemic linkages and output. Words like 'knowledge' or 'technology transfer' illustrate the cognition of knowledge as something, which can be formally codified and transferred without

loss of meaning or context. Concepts like regional, national or sectoral innovation systems stress the importance of systemic linkages between single innovative activities and incentives to enhance innovations. However, even these approaches need a strategic perspective on how these will help define some specific strategic requirements at different stages of the whole innovation process and to structure the complexity of the management task. Therefore, besides the traditional – material – value chain, a knowledge value chain covering the knowledge production process along knowledge generation, examination and exploitation has to be considered.

At the beginning, we have *knowledge generation*. Knowledge generation is firstly based on processing *existing* – own or foreign – experiences. This conscious or sub-conscious processing can be defined as learning from existing expertise by combining new elements of existing experiential knowledge pieces or by improving the recognition of existing knowledge. Many innovations in medium-technology sectors are based on technological paradigms, which started a century ago, but have been improved by engineering expertise and by integrating experiences from other technological disciplines, like material sciences or nature sciences.

The second source of knowledge generation is creativity, which means adding something *new* to the existing knowledge base. Creative amendments can refer to the use of new materials or procedures in the production process, such as the inclusion of composites into aircraft wing production instead of steel, or to the change of applications to existing products or services, for instance, the use of the Internet as a general means of communication.

The basic challenge in knowledge generation is always combining something new with something existing. While the processing of something existing appears rather easy to manage (depending on the information tools), managing creativity seems to be a more difficult challenge. Knowledge management studies, however, show that even the access to existing knowledge and the absorptive capacity may limit successful processing. For industrial SMEs in medium technology sectors, specific limitations have to be considered. They often lack necessary human capital resources to get into continuous interaction with basic research institutes and researchers from other disciplines. Furthermore, they lack financial capital to develop long-term R&D strategies. On the contrary, the increasing need for interaction with firms, institutes and individuals using different technological paradigms and knowledge bases limit the traditional way of organising interaction for conventional industrial SMEs, which was based on personal and social linkages.

Knowledge examination is the process of assessing and filtering new ideas. Here, the quality of new knowledge, its novelty, applicability, non-intended consequences and prerequisites are investigated. For example, a blueprint for a new aircraft fuselage system has first to be proved on its functionality, then on the compatibility with specific industry and company norms, then on the possibility to receive a patent on it, its ability to fulfil all relevant environmental and safety standards and, finally, to be accepted by the main demander. As a consequence, these processes of assessment create new demands for innovation, as a result of major accidents or failure of existing technologies, for example.

Due to the vanishing boundaries between basic science and product development, processes of knowledge examination are no longer as distinctly separated as in earlier times, when new knowledge had first to be accepted within the scientific community and then turned into commercial and social discussions. Furthermore, knowledge production is no longer spatially concentrated but has to integrate also knowledge from other regions and countries.

Besides language differences, different knowledge (engineering) cultures challenge existing ways of understanding and assessing new knowledge. Most OEM react on this new challenge by implementing a higher level of knowledge formalisation, which is expressed by industry or company norms and technical standards for direct online communication within the value chain. The concurrent engineering approach of Airbus having engineers from different locations and firms simultaneously working on engineering and design tasks online is a typical

example for that. For conventional industrial SMEs in medium technology sectors, this requires too high investments into technological infrastructures as well as formalised human capital. As a consequence, they become increasingly dependent on specialised engineering service firms, which provide necessary qualifications, or are threatened to loose contact to the value chain system.

Knowledge exploitation is the actual application of a new idea, which includes commercialisation and diffusion. The more radical an innovation is the more important it is to change the cognitive perspective of customers on needs and solutions to fill the needs. Consequently, innovators must have a perspective on potential demanders, their (hidden) needs and channels to reach them. This requires combinations of cognitive leadership, integrative knowledge, marketing and distribution expertise, and communication skills. In times of international markets, these capabilities have to cope with wide spread diversified cultures and institutional, as well as social, systems. Many conventional industrial SMEs are used to receive their orders and accordingly the requirements for new products and processes from their main customers (the OEM). The OEM, however, increasingly use outsourcing towards system suppliers in non-strategic segments to get new insights on specific new solutions. This means that conventional SMEs have to show a higher level of initiative to develop their own ideas on innovative adjustments to prevent downgrading within the value chain systems. Such new initiatives, however, require investments in human capital and R&D cooperation as well as funding for prototypes and regulatory approvals.

Based on these theoretical and empirical observations, three important messages to the European Commission and regional policy-makers seem to be worth further discussion:

- the relevance of formal public regulation to obtain international competitiveness of domestic firms: here, clear and transparent rules are as important as support for SMEs to overcome costs and administrative requirements for the regulatory process;
- the importance of access of SMEs to formal and informal knowledge bases to rise within international value chains: here, support for SMEs to adjust their ways of interaction, which was used to social and personal links, towards formalised ways of knowledge exchange needs to be supported;
- the need for strategic support for conventional and knowledge-intensified firms to overcome barriers to grow within knowledge value chains: here, a differentiated approach considering the specific needs of different types of SMEs have to considered.

Theoretical box

Social capital and clustering

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Until now there is no one commonly accepted definition of social capital, although the concept of social capital, which refers to features of social organizations, such as networking, norms and trust, that facilitate coordination and cooperation for mutual benefit, has found rising albeit grudging acceptance within the economic profession in recent years. Like other sociological concepts, its amorphous nature initially elicited deep scepticism from mainstream economists, who questioned the validity of classifying social interactions as a form of capital. An increasing number of economists now acknowledge that social capital shares at least some similarities with financial, physical and human capital in its intertemporal dimension and its ability to generate a stream of future benefits. These benefits include information sharing and the matching of people to economic opportunities, mutual aid and insurance, as well as effective collective actions.

We use systems research principles to weigh the amount of social capital in an industrial/service company, research institution, university, consulting firm, sports club, professional organization, etc. As a by-product we demonstrate how such principles can be used to contribute to better understanding of social capital, as a complex phenomenon in new economy. We present two new models for an analysis of social capital of a firm.

We define social capital as a resource that is composed of formal and/or informal relationships among workers, teams, organizational units, etc. within a firm, as well as its so-called organizational culture, viewed as a pool of formal/informal rules, principles, behaviour standards of people, procedures, etc. It is one of four forms of the entire capital of an analysed firm. The other three forms are: financial capital, physical capital and human capital.

The above partition of the entire capital of a typical firm into four forms is a base for the accounting model for an analysis of social capital, in which we claim that the market value of an analysed firm equals the sum of the value of its financial, physical, human and social capital calculated or estimated for any moment from the past, the present and the future of a firm. The market value of a firm is understood in one of two ways: either as the value defined via a stock exchange or as the value established as a result of the negations between a seller and a buyer.

Using the accounting model we claim that in one-man company the value of its social capital equals zero, i.e. there is no social capital, since it takes at least two staff members, two organizational units, etc. to build any relationship in a firm. We use the accounting model to analyze social capital of a university and a sports club. In the first example we demonstrate that it is useful to consider a multi-stuff organization as a set of a particular number of one man companies, each with corresponding human capital.

We introduce the concept of the virtual production line and demonstrate that it can be considered as a natural development (phase) of the well-known (classical) production (assembly) line concept, realized in practice for the first time by Henry Ford. We define the classical production line as a partition of a complex production/service process into a fixed number of simple operations (jobs) done by simple workers on a line (belt). In the case of many classical production/service lines manned by people or robots, we agreed for the purpose of our analysis, to join them into one production/service line, which is called the classical production line. We observed that the partition of a process into jobs is fixed for a time and does not allow any self-organization, i.e. the workers on the line cannot change the organization of the process.

We consider a virtual production line as a hypothetical belt, where we have a number of experts (teams of experts), scientists, specialists, etc. with their laptops, computers, data bases, etc., connected via the Internet or any ICT networks, solving a more or less accurately defined problem of our firm during a creative process. The experts combine their human capital, mostly their tacit knowledge with the codified knowledge to solve in a creative process a problem which may be at the beginning not well defined and described in a murky way, but due to their efforts (self organization), it became to be more and more clear-cut.

So, we define the virtual production line as a division into more or less precisely described tasks (jobs) of a complex, perhaps not so well-defined problem-solving process (creative process), combined with modern ICT. The division of labour into tasks as well as the number of tasks may be changed during the creative process by experts (team of experts) involved in the process. Such a modification is called self-organization of virtual production line**.** Obviously, self-organization may recur over the creative process. We observe that on the virtual production line we have, in general a division of labour, not a partition of it, as it is in the case of the classical production line. We also note that unlike the classical production line, the virtual one is not a division of labour alone but combination of labour division with modern ICT and self-organization.

The virtual production line forms the essence of the managerial model for an analysis of social capital. We conclude such an analysis with three observations: In the first, we note that without modern ICT, the value of social capital of the firm is negligible. This is true, inasmuch as we note that social capital became a subject of serious studies only in 90's when we began to be able to send information, data, etc. to virtually every corner of the world at almost zero cost. So, the information proximity is of a key importance for the virtual production line.

The second conclusion consists in observation that the history of improvement/development of the classical production line delineates directions for research on the virtual production line. In fact, the second is a natural development (phase) of the first one. We note that the virtual production line is an instrument (a transition belt) experts use to combine codified knowledge with their tacit knowledge, competence, experience etc., to produce improvements in products, services, technology and management, and contribute to the stocks of knowledge, both codified and tacit. Otherwise stated, it is a device on which social capital of the firm is making money (financial capital), using human capital of its experts and its physical capital (computers with software, data bases, communication networks, patents, licenses, books, etc.), acquired with a view to creative process.

Finally, in the third observation we argue that in new economy a big organisation combines the classical production line with the virtual production line. In fact, generally speaking, such a business runs a number of classical production/service lines, turning out goods and/or services, and a number of virtual production lines, as different problems may be solved there at the same time. A virtual production line makes innovations and improvements, viewed in a very broad sense as change for the better on a 'here and now' basis, accepted by the market. Since for a vast majority of SME`s, creating the virtual production line is practically impossible, they turn attention to clusters where alongside research institutions, universities, etc. they build a virtual production line to solve problems faced by respective clusters. So a given cluster can considered as the virtual production line and clustering, the process of cluster formation may be described as a design of the virtual production line. This is the essence of the innovative industry in new economy.

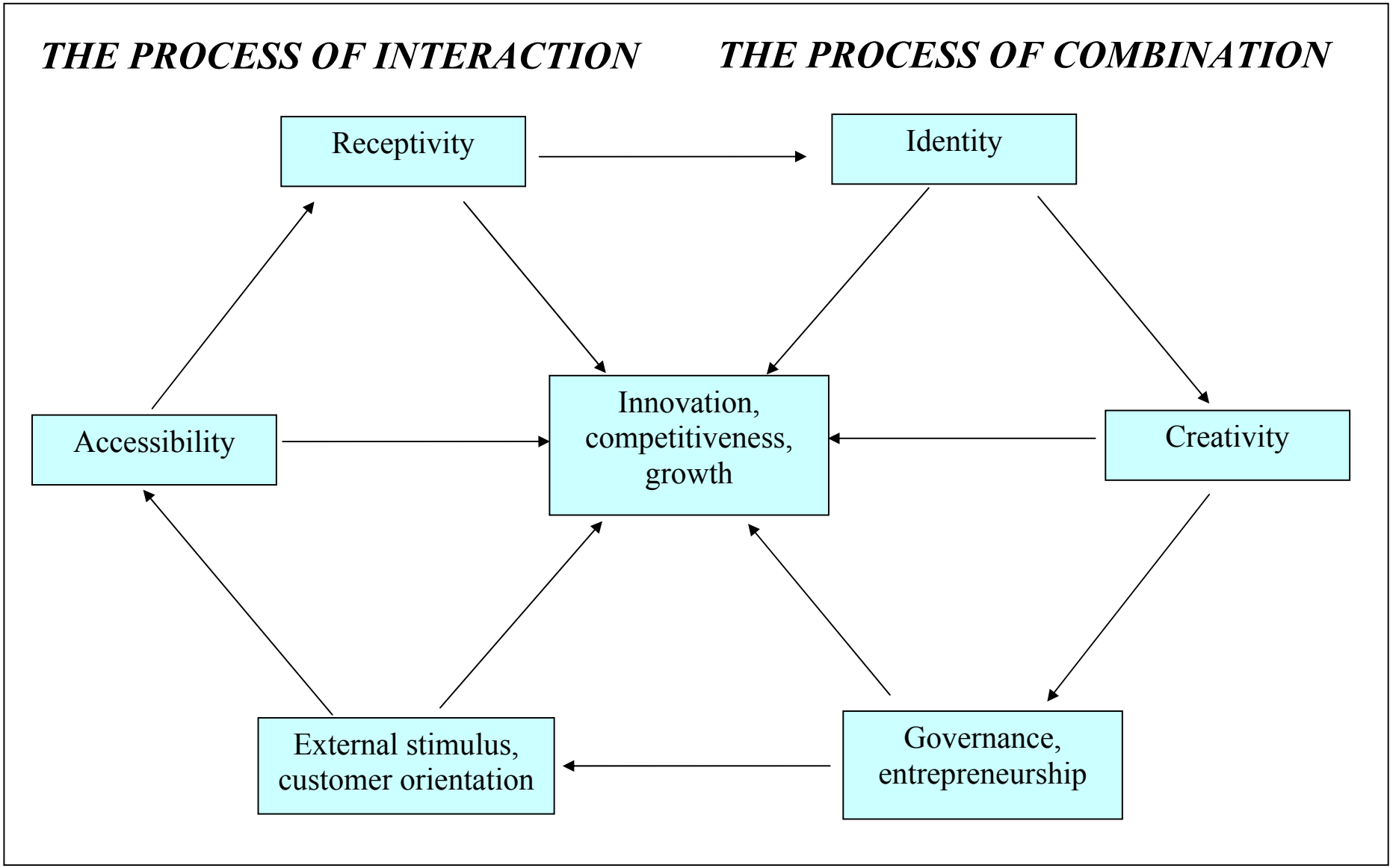

Figure 4 - Territorial Knowledge Management as a methodology for the governance of regional knowledge networks

The approach of Territorial Knowledge Management (TKM) is based on the concepts of cognitive economics, and it aims to promote the innovation capabilities of a regional production system through the growth of the "territorial knowledge capital" and the development of interactive learning processes (Cappellin, 2003).

In particular, TKM aims to:

a) promote the creation of the "territorial knowledge capital" (TKC), by accelerating the speed of circulation of information between local actors and between these latter and external actors, by avoiding lock-in effects and by managing the 6 levers to be described below;

Territorial knowledge capital is not the result of the summation of the "human capital" of the individual workers in a given region and by the "intellectual capital" of the various firms, but rather by the original combination of these two components and it represents a form of collective tacit knowledge.

b) to extract the value of territorial knowledge capital through the enhancement of innovation which represents the key factor for the competitiveness and growth of a regional economy;

c) to create new innovation networks within the regional innovation system and build new formal and informal institutions, infrastructures, norms, rules and routines which may manage ("governance") the innovation networks and the interactive learning process;

d) provide a quantitative accounting framework to measure the local strengths and weaknesses in the perspective of the knowledge economy.

Territorial Knowledge Management interprets and manages the relationships between the local actors and between these latter and external actors as cognitive relationships. TKM emphasises the process of networking and integration and relies on the concept of interactive learning and knowledge creation as developed in social sciences and knowledge sciences.

As Knowledge Management aims to transform individual tacit knowledge into corporate codified knowledge, similarly Territorial Knowledge Management aims to transform the internal knowledge of the various firms and regional actors into localized collective knowledge, to be shared between all actors of a sectoral/regional cluster. It also aims to facilitate the acquisition from outside of knowledge, which may be crucial for the competitiveness of the overall regional production system.

Territorial Knowledge Management aims to organize the cognitive relationships between the firms in the case of local clusters or networks. It 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.

According to the approach of Territorial Knowledge Management (Cappellin , 2003b) there are six dimensions or factors which represent key preliminary and instrumental conditions for the development of interactive learning processes within a cluster and for the codification of tacit knowledge and its transformation into codified knowledge

According to the approach of "TKM – Territorial Knowledge Management", different dimensions of the knowledge creation and innovation process are linked by cause and effects relations, as indicated in figure 4. In fact, the focus on specific customer needs determine a tension leading to a

search for a solution and to change. That is facilitated by an higher accessibility and an higher receptivity. The building of a common identity leads to cooperation and joint strategies. The design of innovative solutions requires creativity capabilities. These latter lead to the original combination of previous knowledge and are result of interactive learning between various actors, the commitment and empowerment of innovators. Finally, new ideas can be translated in economic innovations only through an appropriate organization and governance, allowing to integrate new ideas with complementary production capabilities.
The creation of knowledge and the adoption of innovation are the result of a cumulative process. The knowledge developed in previous periods and the internal capabilities of the individual actors affect the future path of evolution of the innovation system considered. Moreover, the process of creation of new knowledge by some actors affect their experience and receptivity to new ideas and capability to understand the emerging needs of potential users.

Institutions have a clear importance in the innovation process, as the creation of institutions and the governance of the knowledge creation process represent key factors for increasing the accessibility and the receptivity of the actors in a cluster as also for the development of their sense of belonging.

The process of knowledge creation in medium-tech sectors is different than in high-tech sectors and that is illustrated by specific characteristics of the above six indicated dimensions in the case of these sectors:

- **Innovation stimulus**. Medium-tech sectors are characterized by tight user-producer relationships. Innovation is the result of the adaptation to the local demand and aims to solve specific problems. In fact, the mismatch between plans and actual results pushes to generate new knowledge. Firms are lead to innovation by the fear of closure as the result of the selection mechanism prevailing in highly competitive markets.

- **Accessibility**. SMEs in medium-tech sectors are strongly embedded in their territory, which integrates cognitive, economic and social relationships among themselves. They participate to innovation networks, which have a local dimension and the international linkages are weak.

- **Receptivity**. The high specialization of firms in medium-tech sectors indicates high level of tacit knowledge. Thus the openness to external relationships is affected by the existence of rare internal specific capabilities suitable to be combined with external knowledge and by relational competencies in the development of cooperation with other actors.

- **Identity building**. SMEs in a sectoral cluster share common aims, mental models, as also trust and loyalty. Interactive learning processes lead to the development of individual knowledge and also collective knowledge. The sense of local identity and collaborative attitudes are enhanced by the creation of various intermediate institutions, such as industry associations or specialized services or just common agreed routines, which are part of the "social capital" of the regional economy.

- **Creativity**. Medium-tech sectors are characterized by informal process of interactive learning, rather than formal R&D. Innovation in SMEs requires an higher capability to select and originally combine internal competencies with external and scattered competencies, through networking and interactive learning for solving new specific problems. Firms are characterized by an high flexibility in their internal organization and in the relationships with external actors.

- **Governance**. The focus on knowledge creation rather than on investments and public subsidies leads innovation policy for medium-tech sectors to focus on new instruments. These may be designed in order to modify the dimensions indicated above, with specific reference to the

dimensions of receptivity, identity and creativity, which seems particularly crucial for clusters of SMEs in medium-tech sectors. SMEs requires supporting infrastructures, such as bridging institutions, as linkages should be systemic in order to reduce the institutional distance. Policy making should be based on multi-level governance and intermediate institutions, rather than on traditional planning or free market approaches.

Thus, knowledge policies for SMEs in medium tech sectors may focus on the six dimensions indicated by the Territorial Knowledge Management approach (cfr. the theoretical box: "The role of tacit knowledge in the process of innovation").

Key areas of innovation policy according to the Territorial Knowledge Management approach in selected regional innovation systems

Policy areas in the TKM approach	Specific types of Regional Innovation Systems		
	Metropolitan areas High tech sectors Large enterprises	**Industrial clusters Medium-tech sectors Innovative SMEs**	**Peripheral regions Low tech sectors Traditional SMEs**
1. Innovation stimulus	Product innovation in specialized markets	Customer needs and Supply chain integration	Cost competition in the global market
2. Accessibility	High international accessibility - low local accessibility	Low international accessibility - high local accessibility	Low international accessibility - low local accessibility
3. Receptivity	High internal diversity	High internal specialization	Low quality of human capital
4. Identity	High organizational and cognitive proximity	High local embeddedness and local identity	Fragmentation and external dependence
5. Creativity	High investments in R&D	Networking and interactive learning	Technology adoption
6. Governance	National industrial policies and companies strategic alliances	Multi-level governance	Public finance and public regulations

3.6 The creation of international knowledge networks in medium-tech sectors

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.

A too high distance may lead to no relations and to autarchy, which hinders the development of interactive learning and knowledge creation. On the other hand, an high proximity may lead not only to cooperation, but also to negative effects, such as a lock-in effect or local conflicts. Thus, an intermediate level of proximity is required.

The international competitiveness of the European regions depends on their capability:

- to respond to the new emerging needs in more sophisticated markets,
- to introduce new products characterized by high complexity and quality,
- to organize complex production systems with an higher content of know-how and made by different complementary partners.

The process of internationalization is 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 intermediaries.

Some traditional intermediaries in international knowledge networks are:
a) MNE - multinational enterprises
b) Investment banks and private equity funds
c) Knowledge intensive business services

However, new intermediaries are emerging in international knowledge networks, such as:
d) Medium size ("leader") firms
e) Universities and research centres
f) Regional administrations and interregional cooperation programs
g) European Union programs

In particular, intermediate firms in medium-tech sectors may become the nodes of international knowledge networks.

SMEs are efficient in a production perspective as they are allow to exploit the advantages of subcontracting and of focus on a precise product specialization. However, they may prove ineffective when the most important competitive factors become the innovation and the internationalization of the firms.

Medium size firms (100-500 employees) have been capable to combine an explicit effort in R&D, with the process of internationalization of their markets and the internationalization of their supply chain.

Medium size firms are strongly embedded in their regional territory and have an easy access to the tacit knowledge existing within the other local actors and are capable to combine this regional knowledge with external knowledge available in other regions.

The challenges for medium size firms in an international perspective indicates that:

1) A new mental change is needed as medium size firms are reluctant to internationalize their knowledge linkages or to promote new forms of international interactive learning with foreign partners, due to the fear to loose their proprietary know-how, which they believe that it represents their most important tacit competitive asset.

2) Medium size firms have developed vertical flows of tacit knowledge in their respective supply chain, but they should start to develop horizontal flows with other sectors, by participating to regional "centres of competence" focused on new fields of production, with the participation of firms and research institutions having complementary competencies.

3) Medium size firms often rely only on forms of economic or commercial internationalization, which prove to be risky and short-sighted when are not accompanied by the development of international linkages in the cultural and social field with the cooperation of other local partners, research centres and regional institutions. The internationalization process of the

individual firms is easier when it is accompanied by the support of the respective economic, social and institutional system.

The economic strengths of medium size firms should be combined with the greater experience in international relations of other local actors, which may be much weaker in terms of economic strength, such as universities, research centres and the regional governments, which can perform the role of "bridging" institutions or nodes in international networks.

Theoretical box

Knowledge networks and their evolutionary-institutional character

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Cluster policy should be legitimized from an institutional perspective. Despite legitimate recent criticisms concerning the theoretical foundation, the empirical validity and the policy implications of the cluster concept the concept has to be taken as a unifying approach for important elements for the changing character of the innovation process. The legitimization of clusters significantly changed from a predominantly material linkage and agglomeration based concept to an institution that supports knowledge generation and the sharing of knowledge.

Despite the basic institutional character there is a strong diversity of clusters both in form and content. In the context of evolutionary and institutional economics arguments are developed that emphasize the specific character of clusters as a form of governance enabling the generation and diffusion of knowledge within and between networks. As institutions they are co-evolving with new technologies and reveal both internal and external variety. In a globalized world of freely moving capital and increasingly freely moving people, it is only social capital that remains tied to specific locations. Thus, the "knowledge-based economy" is characterized by the hyper-mobility of information partly also of knowledge and the local character of social capital as a fore-condition for knowledge generation. What does this mean for the institutional setting of knowledge networks in an internationalized framework? What is the relative importance of local versus international knowledge exchange? The relationships between the firms become more complex, risky and require to be redesigned in a long-term perspective. This has compelled firms to devise new organizational forms and contractual arrangements, which may be capable to manage these new and more complex relationships. There is evident progress in the conceptualization of contents and forms of knowledge exchange and learning within networks.

Governance structures are never deterministic – cluster analysis has to avoid being "oversocialized". Within clusters there is ample room for human agency. One of the basic elements of an evolutionary approach is the creative function of the market as also expressed by innovative behaviour supported by clusters. Yet clusters do have a tendency for exclusivity – part of the goals of networks is to create some kind of knowledge monopolizing market of proximate firms and related support institutions.

As an evolutionary institution clusters are also exemplars of the relationship between economic organization and economic development. One important aspect of this perspective is that institutions like clusters are not automatically there but that they are the result of an evolving process shaped by policy activities and entrepreneurial behaviour responding to new challenges. This implies a changing character of institutions in support of knowledge creation and sharing – clusters as a form of "social technology" are co-evolving with new physical technologies and are therefore in a constant need to change themselves. Institutions are themselves shaped by economic behaviour and hence subject to change. Since there is

definitely room for agency there is ongoing interaction between the agents and the clusters which is a driving force for the adaptation of clusters. So there is in-built endogenity in the development of clusters: their institutional forms are exogenous in the short-run (so setting the framework for economic relationships and development), but become themselves endogenous over the longer run. The changing character of clusters – in forms of organisation, in the kind and mechanism of knowledge sharing, in their geographical reach – becomes a challenge for further research.

If clusters are a certain institutional response to a historically given logic of production then clusters themselves have to undergo change. As long as economic growth is to be understood as an evolutionary process the nature and dynamics of the organization of production, the role and change of institutions and technology and technological advance has to be specified.

Theoretical box

The governance of interactive learning networks

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The diffusion of knowledge and the process of innovation creation in a cluster depends on the "institutional thickness" of the innovation system to be considered.

Information flows through an interactive process and new knowledge is created through the combination of existing information and knowledge within learning processes, which involve groups of individuals, call for the development of links, networks and social and cultural institutions and conventions among different actors. Thus the co-ordination of this interaction process represents a key policy field.

Learning proceeds according to an evolutionary and adaptive processes, both dynamically (in time) and spatially (through regional diversification and integration). Innovation is the result of decisions of the various interacting agents not based on the principle of substantive rationality, but rather on that of procedural rationality. No complete sequence of decisions can be preordained. To achieve coordination, organizations need to learn rapidly Thus, a good design of the organization procedures involving the interaction of the various actors is crucial.

Since economic systems are complex and evolving, the main problem is that of organization or coordination, i.e., how to guarantee that the various involved actors will adopt a coherent behaviour, so that they can jointly attain the desired aggregate result without dissipating resources. Institutions allow to save the limited cognitive capacity of individuals and organizations and facilitate the process of reciprocal integration. Their role is that to create new routines or baseline, which insure the adaptability of connections between actors.

The multiplication of players and layers of negotiation – international, national, and local – demands a different model of government, called "multilevel governance", based on organisational structures of interaction and partnership. Governance is the challenge of steering and positioning complex organizations. These can be committees, research groups, firms, networks, clusters, communities, regions and international agencies.

Governance is made by complex policy networks. The expression governance is used with respect to decision making systems, where the decisions are not taken according to the traditional hierarchical processes by a public authority ("government"), but rather through open forms of collaboration between a plurality of public and non public actors, which may differ between the various specific areas of policy and between the various levels of government.

Multilevel governance is based on forms of horizontal and vertical negotiation between the various stakeholders, where the exercise of a hierarchical control is one of the components and it differs from the traditional free market approach, which thrusts automatic or non intentional mechanisms of interaction and, while advocating higher competition, leads to mergers and acquisition and greater concentration and various conflicts of interest. The governance model increasingly characterizes modern complex societies, where actors become increasingly different and interaction should be based on an higher division of tasks between the actors, in order to exploit complementarities.

Economic development is stimulated in those territories with highly evolved, complex and flexible institutional systems where a multilevel governance as a coordination mechanism is essential to assure cohesion, mutual comprehension and harmony between different agents

Territorial Knowledge Management (TKM) represents a new perspective to regional innovation policy. While traditional innovation policies mainly focus on financing the individual firms and providing financial incentives to R&D investments, the TKM framework indicates the need to promote the various factors which determine willingness and capabilities of firms in investing in an innovation strategy and facilitate the interactive learning processes among the different local stakeholders leading to innovation. In particular, according to the TKM, an interactive learning process involving various local actors is promoted by actions working on six different levers: the existence of an external stimulus, the level of accessibility between actors, their receptivity to external relationships, the building of a local identity, the enhancement of creativity, the capability to govern the innovation networks.

The study of the aeronautical cluster in the Campania region has allowed to identify some problems of the governance of innovation networks and weaknesses, which are shared also by other less developed regions.This cluster has a rather long history, which goes back to the beginning of the XX century and represents one of the few high-tech industrial clusters existing in the Objective 1 regions of the European Union. It is composed by approximately sixty specialized firms and research centres and by various large national enterprises, working for the major international firms in the sector.

Innovation seems to develop mainly due to an adaptive process of the firms, responding to the constraints determined by the external requirements of the clients and to the availability of external financing of R&D by public institutions, rather than being the result of a deliberate strategy aiming to exploit external opportunities and to face the emerging threats of the globalization process.

Most of the different stakeholders often do not share a common identity and interpretation of the needs of the cluster and that explain the difficulties to reach a consensus view on a common strategic perspective, as it would be required to form a critical mass of human and financial resources and infrastructures needed in important technological innovations.

The existence of relationships and the effectiveness of the joint initiatives seem to be related to informal and personal social ties rather than to the existence of a formal network having a certain degree of institutional thickness.

In the local context there are some invisible barriers, such as the scarce mutual knowledge, the problems of communication and the difference of language between the different actors, due to the difference of the system of values, fields of competence and adopted technologies, especially between the large companies and the SMEs and also between the industrial firms and the non industrial private and public organizations.

The circulation of information in the network of local actors is characterized by asymmetries between these actors, when some stakeholders do not allow full access to information to all actors, intentionally or due to deficiencies in their communication strategies. Such asymmetries

result in distorted decisions and undermine consensus, hence discouraging participation.

SMEs, as well as some intermediate institutions, above all financial ones, have a much weaker role, if any, in participating and influencing the multilevel governance process within the regional innovation system

Thus, the governance model adopted in the Campania aeronautic cluster has still a rather hierarchical nature and, although knowledge is no longer concentrated in the hands of a few privileged subjects, some local actors seem not to have equally benefited from advantages deriving from the participative and cooperative process or to have been cut off from these advantages.

The adoption of the TKM framework in Campania region and other less developed regions indicates:

- lack in consistency of the interactive learning process,
- weakness, and in some cases, absence of the intermediate institutions to influence and stimulate the decision-making,
- insufficient level of coordination among stakeholders,
- the absence of a strong catalyst of the governance process, able to promote, mediate, and represent the common interests,
- regional policy and EU regional support are mainly linked to short tem budgetary constraints and targets, on the contrary innovation policy requires a long-term perspective.

Thus, to increase the strength of the network and to produce new knowledge for the cooperative innovation among sectoral/local and regional systems, stimulating, at meantime, the transnational partnership between agencies of innovation and transfer, suggested policy guidelines are:

- the strengthening of partnerships between public and private structures, assuring more cooperation and continuous relations in the production, transmission, diffusion and use of knowledge and information,
- to understand the mechanisms of participation to the network by small stakeholders, strengthening their involvement both in the decision-making process and in the optimisation of the production cycle,
- to consolidate the long-term evolution of the strategic approaches of the different stakeholders and to reciprocally recognize it such as a source of competitive advantage,
- to enhance interactive learning processes and the organization of joint innovation projects between the local actors,
- to promote a greater international integration.

4. The approach of knowledge networks in innovation policy

The empirical and theoretical investigations clearly showed the need to follow a differentiated approach to support medium-technology SMEs. Important differences between SMEs include the formal qualification level of the human capital, existing experiences within R&D cooperation and international business. Conventional medium-technology SMEs often lack these basic requirements for the integration into modern knowledge value chains. Accordingly, they are not able and willing to look for support by European innovation policies. For this group, regional innovation policies had to look for reductions of existing barriers towards knowledge networks.

Recent work on innovation systems and clusters stresses that technological competitiveness depends not only on the excellence of research supply-side, but as well on the demand-side or on the absorption capabilities and the speed and extent of diffusion and application.

In agreement with the concept of absorptive capacity firms with low R&D and innovation potentials (mainly component suppliers, where innovation mostly has an investive character) revealed problems to build up and hold adequate relations to knowledge generating organizations.

Medium and low-tech SMEs without any R&D-capacities have no or at most mediate access to this sphere. The degree of accessibility and the exclusivity of clubs and communities depends on the technology, the possibility to save intellectual properties and the position of the firm in the innovation systems.

Firms and institutions ought to examine skill issues in greater detail and identify the specific skills required to successfully serve different markets, each calling for specific means of policy support.

Public policy should be based upon the technological capacity of the firm, avoiding as far as possible support to basic infrastructure investments (land, industrial space, etc.). Firms have other ways to face their infrastructure necessities.

As conventional SMEs are used to long-term personal and social linkages, instruments, which help strengthen the trust between potential partners seem to be crucial. Examples for this include social events creating opportunities to discuss specific topics, e.g. qualification needs or capital market instruments, in an informal environment. Within the European interregional context, such social events can be organised on the basis of exchange visit programs focusing on specific industries and themes.

A further important ingredient towards international linkages refers to international experiences. On the academic level, students and postgraduate exchange programs play an integrative role. Accordingly, exchanges on the level of vocational training and apprentices could help to reduce cultural and language barriers. This requires formal adjustments and agreements (the agreement between Hamburg and Midi Pyrenees and Aquitaine on exchanges of apprentices between vocational schools as a prominent example) between regions or even on a European level. The empirical investigation reveals the high importance of international fairs to build up international contacts, as they offer opportunities for at least temporary face-to-face contacts and concentrated interaction on specific topics. For European integration, support of such forums seem to be quite decisive, in particular for those segments, which so far are only weakly internationalised.

Differently from conventional SMEs, which are characterised by low shares of academic employment, formal R&D contacts and international business, knowledge-intensifying SMEs look for changes of their knowledge bases and markets. For them, suitable forums to overcome existing cognitive barriers towards universities and R&D institutes from other technological disciplines as well as suitable ways of funding expansion strategies seem to be the most important need. These firms are used to cooperate with regional universities in the context of practises, theses or small R&D projects, but they face problems in identifying suitable partners in other regions or disciplines, as the regional partners are too often not sufficiently integrated into interdisciplinary or international networks.

European R&D projects are not attractive for these firms, as they miss suitable technological priorities and are deterred by the requirements for European partners and administration. Sometimes, they are integrated into European projects as partners of the OEM, but this increases their dependence and does often not cover their specific technological needs. Therefore, intermediaries are needed to bundle the specific needs of these firms and provide suitable information on potential partners outside the region as well as act as information broker towards regional and European policy to influence program priorities.

In the aeronautic sector, multinational firms and big national R&D associations formed an advisory group together with politicians to develop long-term strategies for innovations. Similar approaches for SMEs, however, like ECARE, AeroSME or SCRATCH, too often remained in a position of a pure technological information platform on single firms and competencies instead of actively enhancing knowledge interaction and influencing research program priorities. European R&D policy might need in this context an additional bottom-up approach to integrate regional knowledge on research needs into the programs.

Among all supports to increase firm knowledge and good practice, those related to the establishment of Information Technologies (I.T.), as an irreplaceable tool in aviation, are the most relevant. Assistance in R&D related to quality and I.T. will have to be a high-priority in the budgetary effort of the different Administrations, and firms. Information Technologies and, precisely, the beginning and consolidation of a ¨Computer Science Common platform¨ for the small and medium firms of the sector, will shortly be essential for these firms to access awarding of work load with the titles firm (EADS or AIRBUS). The Common platform will facilitate relations between the different firms involved in complementary projects for the final producer (Airbus), which will significantly help to improve production costs and reduce the number of manufacture delays. It will also diminish transaction costs making contractual necessities of certification and manufacture easier.

A third group of SMEs refers to knowledge-intensive firms. These are often technological start-ups or spin-offs. For them, interregional and formalised R&D cooperation is not an insurmountable challenge. They are integrated in regional knowledge clubs with multinational firms and R&D institutes. In single regional cases, there might be the need for additional regional innovation policy activities to have a moderator or initiator for such clubs being sufficiently independent from single OEM to be accepted by all members. Other elements could include the provision of information on suitable partners in other regions to ensure the openness of the clubs. European R&D projects can help to build up networks between the regional clubs. Problems, however, often occur due to the sector-specific approaches and limited time frames. Accordingly, it could make sense to develop a broader – technology-based – interdisciplinary and intersectoral platform approach for such networks and to link the project funding with options to renew funding, if proofs of successful networking and product performance can be documented.

Firms with remarkable R&D-capacities even revealed to outsource their pre-competitive R&D partially to cooperative R&D institutions. These latter should not restrict themselves to a small and closed range of partners, but be more open to a broader range of also weaker partners which could benefit from technology spill-overs in the considered field. Also universities may play a prominent role as partners of R&D-intensive system suppliers, although cooperation is often based on continuous low-level exchange (e.g. diploma and doctoral thesis) and on long time widely informal personal relationship.

Firms with remarkable R&D-capacities revealed different strategies in dependence of their market and co-operation culture. The more these firms act in market niches which also demand for highly specialized cooperation partners the more they tend to long-time cooperations with rather specialized partners. The qualitative interviews strengthened the notion that firms seek to steer a portfolio of cooperation partners which consciously combine specialization and flexibility.

There is a necessity of more firms between 250 and 1000 employees to have a greater access to research and investment. In this study, we have found a clear statistic correlation between the firm's size and its predisposition to carry out more necessary labors of R&D. For this reason, new public policies should be developed to encourage and promote creation or association between firms to

face the increasing requirements and necessities of Airbus. We are not talking about choosing "winners" between the already existing firms but to establish some kind of attraction so that firms, through their own initiative, value growth within the sector.

Regulation is one of major drivers of innovation in medium technology sectors as it enforces a systematic and holistic view of safety, environmental and social conditions in which products/services of these sectors are used. Regulation is of major importance for all phases of any innovation process, from knowledge exploration to exploitation of new products/services. It intensifies innovation activities and can be one of the most efficient instruments of the EU industrial policy in these sectors.

Regional policies should focus on promoting a process of sectoral diversification, by promoting not only a tighter vertical integration between the firms within the same sector, but also the horizontal linkages between different technologies and sectors. For example, although most businesses carried out by small and medium firms remain mainly in the aeronautical sector, it would be advisable for them to assign part of their productive activity to other sectors. This precaution would guarantee alternatives when faced with changes in the productive cycle of the aeronautical sector. Productive diversification is not only beneficial for small and medium firms but it can also be very positive for the large OEM firm since it can rely on collaborating partners in more than a single sector, but always within the industry. The possibilities to access knowledge, either tacit or pure, are clearly multiplied.

While regional governments mostly think regional, firms think national or global. Therefore accumulated needs in respect of a strengthening of the interregional cooperation in respect of cluster policy are evident.

The theoretical on the paper elaborated on the concept of proximity by the IKINET project indicate that rather than only focussing on the geographical dimension when designing support policies for industry agglomerations or clusters, organisations and regional governments should also take other learning and innovation factors into account. If interregional knowledge-flows are more important than intra-regional ones, policy is well advised to nurture the relevant dynamics.

Trying to territorially parcel out the sector is unreasonable. It is necessary to find ways in order to combine regional public assistance with firm collaboration in projects that go beyond their own territory. To promote cooperation between firms, beyond where they are implanted should be a priority of Public Administrations facing a specific sector.

For instance, regional policy should place greater emphasis on inter-regional cooperation between regions in the same country, where similar industrial cluster are located, as in the case of aeronautic industry. reflecting the interrelatedness between different sites, and facilitating better knowledge-exchange between existing, but scattered, SMEs and R&D facilities in various regions.

Institutions play a key role in the co-ordination of this interaction process and institutions allow to save the limited cognitive capacity of individuals and organizations and facilitate the process of reciprocal integration. The multiplication of players and layers of negotiation – international, national, and local – demands a different model of government, called "multilevel governance", based on organisational structures of interaction and partnership (cfr. the theoretical box: "The governance of interactive learning networks",).

Research, Technology, Development and Innovation Policy (RTDI) is a field of concurrent legislation between various levels of government, and tighter vertical cooperation should complement an increasing specialization according to the subsidiarity principle. For example in a

federal country such as Austria, cluster policy is a matter of the regional level. However, the institutional structure of the Styrian RRSI policy is very fragmented, involving:

- three ministries on the national side and two policy resorts and to governmental departments on the regional level and
- a large number of publicly financed funds and semi-public agencies like the Austrian Research Promotion Agency (FFG), the Austrian Science Fund (FWF), the aws - Austria Wirtschaftsservice Gesellschaft mbH on the national side or the Styrian Business Promotion Agency (SFG) in Styria.
- Social Partners and Semi-public (integrating) associations

The regional government can play a crucial role in promoting cooperation and networks in regions where various clusters exists. Network-oriented also includes policy networks, which help to develop and implement regional strategies in the sense of multi-level governance.

Joint action between the various regional stakeholders requires a greater effort to devoted to the design of a joint long term strategy, on which to build the consensus a diversified set of specific projects. As an example, the formal starting point of Cluster Policy in Styria has been the "Technology Policy Concept" (1995), which has been up-dated and extended by "Science and Research Strategy for Styria" (2004) and the "Technology Policy Concept - new" (2005). This conceptual framework tries to give strategic implications for the network of organizations involved in technology promotion and development including a series of initiatives involving co-operation between different agencies on the regional and national level, local government, research institutes, capital providers as well as social partners and federal ministries. Then, an extensive analytical framework for the policy action can be accompanied by a process of policy learning.

The process of innovation in SMEs and in medium technology sectors differs from that of large firms in high tech sectors		
	Linear approach	**Interactive approach**
Key word	Technology	Knowledge
Stimulus	Cost competition Supply New equipment	Market orientation Demand User needs
Process	In house R&D	Interactive learning
Outcome	Productivity increase	Continuous innovation
Policies	Public finance Public regulation	Multi-level governance Public-private partnership

A policy of the knowledge economy based on the "governance" or "dynamic coordination" approach 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

New policy instruments are those which aim to steer the knowledge networks and 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. In fact, the creation of bridging institutions and soft infrastructures may improve the accessibility between existing nodes.
- 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. The creation of intermediate institutions and social capital may also promote the openness to cooperation.
- 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.
- design and adopt new regulations, which may defend weak and dispersed interests and determine the conditions in order to aggregate scattered needs and demand and to create new markets for innovative products and services.

Section 2 – Work-package progress of the period

The research project has been coordinated by:

- Università di Roma "Tor Vergata"

The other contractors are:

- University of Wales Cardiff
- Ruhr-Forschungsinstitut für Innovations- und Strukturpolitik - Bochum
- Instytut Badań Systemowych – Polska Akademia Nauk – Warszawa
- Joanneum Research Forschungsgesellschaft - Graz
- Institut National de la Recherche Agronomique - Paris
- Universidad Autonoma de Madrid
- Applica sprl – Bruxelles

The second year of research was mainly devoted to the elaboration of **"WP2 - Validation and improvement of theoretical models".** As indicated in the Annex 1 to the contract (Technical Annex), "the core objective of WP2 is to elaborate innovative contributions to the theoretical debate on regional innovation systems and interregional knowledge flows enriching state-of-the-art models by new interdisciplinary concepts developed and critically proved on the basis of the empirical study in WP1.

Work-package 2 follows three basic objectives:
- improving the scientific understanding of knowledge and innovation networks and overcoming misunderstanding between approaches of single disciplines,
- extending the regional focus within analysis of innovation systems to an interregional and international framework, which is a basic prerequisite for the actually successful of bench-marking models as bench-learning tools and transfers of policy expertise, and finally
- preparing the theoretical basis for the quantitative evaluation of innovation policies and the selection and design of policy recommendation.

The results of the interviews elaborated in WP1 have allowed to elaborate a series of theoretical contributions which have been presented at the European congress of the Regional Science Association, Volos – Greece, August 30 – September 3, 2006 (http://www.prd.uth.gr/ersa2006/) and are published in the project website: http://iunet.uniroma2.it/ikinet/.

1. Cappellin, R. and L. Orsenigo, Regional learning networks in medium tech technologies and European integration" (University of Rome "Tor Vergata" and University of Brescia)
paper number 334

2. Wink, R., Formal knowledge examination institutions: a cognitive and institutional perspective (RUFIS - Ruhr Research Institute for Innovation and Regional Policy, Bochum)
paper number 404

3. Vázquez-Barquero, A., Emergence and transformation of clusters and milieus (Universidad Autónoma de Madrid)
paper number 648

4. Lourimi, S. and A. Torre, Clusters and institutions. Towards a reassessment of the role played by local institutions in the transfer of knowledge and the setting of local networks (ADIS, Université Paris Sud 11 and UMR SAD-APT, INRA INA PG Paris)
paper number 87

5. Steiner M. and M. Ploder, Geographical agglomerations and the development of local networks (Joanneum Research, Graz)
paper number 680

6. Cooke P. and O. Ehret, Geographical and relational proximities in the European airbus project (Centre for Advanced Studies, Cardiff University)
paper number 306

7. Walukiewicz, S., Systems analysis of social capital at the firm level (System Research Institute, Polish Akademy of Sciences, Warsaw)
paper number 921

8. Cooke P. and O. Ehret, Industry outsourcing aerospace in Wales (Centre for Advanced Studies, Cardiff University)
paper number 308

9. Alfonso Gil, J., Innovation and its diffusion. The Aeronautical Case (Universidad Autónoma de Madrid)
paper number 256

10. Bianca, M. and R. Cappellin, Innovation and knowledge creation in the SMEs of an aeronautical industrial cluster (University of Sannio, Benevento, and University of Rome "Tor Vergata")
paper number 643

11. Cappellin, R, Caruso, I. and G. Pace, Intermediate institutions for interactive learning processes in a “governance” perspective: the case study of aeronautic industry in Campania region (University of Rome “Tor Vergata”, Institute of Studies on Mediterranean Societies, Naples)
paper number 458

12. Draganinska, S. and R. Wink, European interregional boundary-spanning institutions: the case of the aeronautics industry (RUFIS - Ruhr Research Institute for Innovation and Regional Policy, Bochum)
additional paper

13. Winch, S., Social capital and knowledge management (System Research Institute, Polish Akademy of Sciences, Warsaw)
paper number 919

The content of these contributions is illustrated in the theoretical part of this report and in particular in the theoretical boxes.

In particular, the list of the papers which will be delivered to the Commission will include the papers indicated above and the following three further papers:

Temporary geographical proximity
André Torre
INRA Paris

Knowledge networks and their evolutionary-institutional character.
Michael Steiner and Michael Plodder
Joanneum Research, Graz

From stock to flows: regional indicators of knowledge creation and diffusion
(provisional title)
Terry Ward
Applica, Bruxelles

These contributions aims to the explanations of the relationships between the various firms/organizations and their evolution in time, on the base of regional and firm specific factors and capabilities. Furthermore, linkages between the innovative performance of individual firms to the characteristics of the regional economy and network relationships with other local and external actors have been investigated. These theoretical contributions contribute to the debate in the literature of regional economics, economic of innovation, knowledge management, development economics, neo-institutional economics.

Due to a delay in the collection of quantitative indicators and the possibility to refer only to the qualitative part of the empirical analysis (which have later been summarised according to semi-quantitative indicators in questionnaire A industry and services) and the fact that most research units had not completed the questionnaire C containing quantitative indicators, a statistical and econometric has been postponed to the third year of research and it will be included in the final contribution to WP1.

The elaboration of these theoretical contributions has been the result of a continuous work and interaction during the second year of research and the research hypothesis and the results achieved have been discussed in a series of workshops: 1) Cardiff – February 2006; 2) Madrid – June 2006, 3) Bochum – July 2006 and 4) Volos – August 2006.

An improvement of the papers initially presented at the ERSA congress in Volos is required in the perspective of their publication. An editor (i.e. Edward Elgar) has been contacted and it has already indicated a preliminary interest in publishing a book based on these contributions.

Corrective action on WP2. The papers will be made available to the Commission as deliverable of WP2 (month 26).

The **"WP1 - Design of the empirical analysis",** as indicated in the Annex 1 to the contract (Technical Annex), aims to examine the operation of knowledge networks in seven regions from across Europe. The WP1 objective was to elaborate an extensive empirical internationally harmonized analysis structured according to different regional and firm characteristics".

Seven contractors (Rome, Cardiff, Bochum, Warsaw, Graz, Paris and Madrid), have been involved in this empirical analysis, while one contractor (Bruxelles) has been involved in designing the methodology of the three questionnaires.

The second year of research has been devoted to the collection of the information referring to questionnaire C: quantitative indicators, which complement the questionnaire A: qualitative

analysis of case studies, already completed in the first year of research. In particular, as in the case of questionnaire A, it has been proved opportune to elaborate two separate C questionnaire for industrial firms (i.e. 15 units) and for service organizations (i.e. 20 units: business services, research institutions, financial organisations, public institutions).

The actual situation of the collection of the questionnaires is the following:

Questionnaire A.I:
Received from: Rome, Bochum, Cardiff, Graz, Madrid and Warsaw
Not received from: Paris

Questionnaire A.II (ie service orgs):
Received from: Rome, Bochum, Graz and Madrid.
Not received from: Cardiff, Paris and Warsaw

Questionnaire C.I:
Received from: Rome, Bochum and Madrid
Not received from: Cardiff, Graz, Paris and Warsaw

Questionnaire C.II (ie service orgs):
Received from: Bochum
Not received from: Cardiff, Graz, Madrid, Paris, Rome and Warsaw

The delay in the collection of questionnaire C has been determined in several cases by the lack of further collaboration by some firms and institutions, after the same had participated to the various meetings required for the elaboration of the case study (i.e later summarized in questionnaire A). The situation is also different in the various research units and it is expected that almost all of them will be capable to deliver the questionnaires CI and C.II in month 27.

Corrective action on WP1. On the basis of the unexpected factors illustrated above, it proves necessary to prolong the period in which WP1 - Design of the empirical analysis" had to be elaborated. That will imply that the first six months of the third year (month 30) will be devoted to the elaboration of the following remaining components of the WP1 as described in the Technical Annex:

- completion of the collection of information on questionnaire C
- elaboration of a statistical and/or econometric analysis of the data collected in questionnaires A and C
- a database of the data collected through questionnaires A and C in each individual regional clusters.
- completion of the collection of: ***general economic structural indicators on the region***
- completion of the collection of: ***regional indicators considered in the European Innovation Scoreboard***
- completion of a report for each regional cluster which will update the previous draft of the same report. This latter had been delivered at the end of the first year of research and it is published in the project website http://iunet.uniroma2.it/ikinet/WP1.htm ,

"WP5 - Diffusion of research results" intends to disseminate the research results within three macro regions of Europe: North West, South and Central and Eastern Europe and to the relevant policy makers in various fields as research, innovation and structural change, economic and regional policy, foreign trade and labour market policy including members of the European Commission and interested persons on the European level: members of the European Parliament and selected researchers.

In the second year of research a diffusion workshop has been organized in Warsaw by CIMPAM (Warsaw), May 24th and 25th, 2006. The program and contributions presented at this diffusion workshop are published in the project web site: http://iunet.uniroma2.it/ikinet/FIRSTD_1.htm

Recently, although formally in the third year of research, a second diffusion workshop has been organized in Graz by Joanneum research, on 8-9 November 2006, and the program and contributions presented have also been published in the project website.

A final **"diffusion conference"** will be organized by the coordinating institution Università degli Studi Roma "Tor Vergata" in Rome in June 2007.

The diffusion workshop has allowed a presentation and discussion of the preliminary results to be illustrated in this intermediate report. Special attention has been devoted to the participation of persons and institutions from the Objective 1 regions and the candidate countries. The diffusion workshops has pointed out the needs of institutional support in the extension of networks beyond the local and regional level and to develop strategies and instruments promoting knowledge diffusion between the various Euro regions (North West, East-Central Europe and South Europe).

"WP4 - Policy recommendations" will aim to identify and analyse the most important policy instruments actually adopted in the seven regional innovation systems considered. This represents an ex-post evaluation aiming to assess the impact of the existing policy levers on the different dimensions of the knowledge creation and innovation process, identified in the research project. This evaluation shall lead to estimate specific scores of the effectiveness of the various policy levers and these scores will be adopted within the Matrix INT methodology to be elaborated in the third work-package. This research will also verify the appropriateness of the selected knowledge metrics, defined in WP1, to represent a "balanced scorecard" useful for providing strategic information to policy-makers and to clarify the causal link between levers and outcomes.

Within WP4, a set of seven research papers will be provided dealing with policy implications of the empirical and theoretical findings from WP1 and WP2 with respect to the specific policy experience in the various regions considered.

As indicated in the Technical Annex work , the work on WP4 represent the main content of the third year of research and will lead to the elaboration of a series of scientific papers - compiled as a single deliverable - to be elaborated by the various individual research units. The papers of WP4 will be presented in the two scientific seminars to be organized in the third year and made available on the project website.

In the second year of research, preliminary work has started on WP4 especially in the framework of the organization of the "**diffusion workshops**" (WP5), where analysis and proposals have been discussed with entrepreneurs, policymakers and experts. Policy indications have also been illustrated in the scientific papers elaborated in the framework of **WP2.**The results of this work is presented in a previous section of this report.

"WP3: Synthesis and quantitative framework for innovation policy evaluation" of the research aims to provide a quantitative framework for the evaluation of innovation policies to be used in the investigation of the gap between the demand/needs in the innovation process and the supply/instruments of innovation policies in various regions and countries. This framework will enable to use the various metrics collected in the work-package 1 in a synthetic way and to provide some initial guidelines on the policy strategies to promote regional and interregional knowledge and innovation networks. In particular, this framework will allow to identify international benchmarks

among a wide set of innovation policy instruments actually used in the various regions/countries considered in the research. The quantitative framework to be adopted is the "Matrix INT – Intermediaries and needs of technology", described in the Technical Annex to the contract.

The work on WP3 has been postponed to the third year of research, due to the lack of the quantitative indicators to be supplied by the questionnaire C industry and C services and also the need for collecting the indicators to be supplied by the various research partners in the framework of the elaboration of the various papers of WP4 - Policy recommendations.

The activities elaborated in the context of **WP5 – "Diffusion of research results" and WP7 - "Coordination activities"** have been the following:

Third Scientific Workshop
Organization of a Steering Committee Meeting
University of Rome "Tor Vergata"
Rome, 26-27-28 October 2005

Coordination Meeting on WP1
Organization of a Steering Committee Meeting
Applica
Bruxelles, December 15, 2005

Fourth Scientific Workshop on WP2
Centre for Advanced Studies, Cardiff University, UK
February 23-25, 2006

Fifth Scientific Workshop on WP2
Organization of a Steering Committee Meeting
Madrid, 6th May 2006

Organization of First Joint IKINET -EURODITE Conference
Organization of a Steering Committee Meeting
Centrum Badan Przedsiebiorczosci i Zazadzania Polskiej Akademiiauk
Warsaw, May 24th and 25th, 2006

Sixth Scientific workshop on WP2
Organization of a Steering Committee Meeting
RUFIS e.V. - Ruhr-Forschungsinstitut für Innovations- und Strukturpolitik
Ruhr-Universität Bochum, Germany
Bochum, July, 20-22, 2006

46th European Congress of the Regional Science Association
Organization of the Special Session on: "International Knowledge and Innovation Networks"
Organization of a Steering Committee Meeting
Volos, Greece August 30 – September 3, 2006

Organization of the Steering Committee Meeting
Leipzig, September 18-19, 2006

The representative of the Cardiff University did not participate to any of the meetings of the Steering Committee, while it participate to the scientific workshop.

The activities elaborated in the context of **WP 6 – "Intermediate and final report"** have been regularly secured by the following contractors: Università di Roma "Tor Vergata", Ruhr-Forschungsinstitut für Innovations- und Strukturpolitik – Bochum, Instytut Badań Systemowych – Polska Akademia Nauk – Warszawa. The University of Cardiff has not collaborated to the elaboration of the the Activity Report of the second year.

The **list of deliverables** for the entire project, including due date and actual/foreseen submission date, is presented in the following table. This new list of deliverables includes the organization of a number of scientific seminars greater than that initially planned, as it has proved necessary to organise at least two meetings/year of all partners in order to insure a tighter coordination of the research activity.

Corrective action suggested: postponement of the project deadline

The partners of IKINET have discussed at the Steering Committee Meeting, in Leipzig, on September 18-19, 2006 and at the Second Diffusion Workshop, in Graz, on 8-9 November 2006, the opportunity to ask the postponement at **month 36** of the deadline of the project initially defined at **month 30.** This proposal was also informally anticipated to the Scientific Officer in July 2006.

This proposal is justified by the following reasons:

- to develop a greater interaction between the various partners in the discussion of the results so far achieved, in particular, from WP1 (Design of the empirical analysis), WP2 (Validation and improvement of theoretical models) and WP4 (Policy recommendations) and to develop a joint final result.
- to allow a better management of the financial resources since the expenditure of the funds still lags behind the evolution of the research activities and the work performed by the individual researchers,
- to allow a more through elaboration of the data already collected in two rather large questionnaires (i.e. A and C) and to allow some research units to complete the collection of the data (i.e. questionnaire C) for all the firms and organizations already contacted,
- to insure that partners will work on a further improvement of the papers elaborated in WP2 and already presented in an international conference (i.e. ERSA congress 2006) in order to insure that they are suitable for publication in volume to be published before the end of the IKINET project,
- to allow a more intensive interaction with policy actors on the policy recommendations to be developed in the final year and to prepare in a better way the final diffusion conference in Rome, June 2007,
- to comply to the duration of 3 years which is common to most other STREP projects in FP6.

Table 1: Deliverables List
List all deliverables, giving date of submission and any proposed revision to plans

Del. no.	Deliverable name	Workpackage no.	Date due	Actual/Forecast delivery date	Estimated indicative person-months	Used indicative person month	Lead contractor
1	Project website	6	2	2	1	0,5	URTV
2	First Scientific Seminar	1	3	1	0	0	URTV
3	Second (and Second*) Scientific Seminar	1	13	8 and 13	0	0	URTV
4	Series of Scientific Papers on WP1	1	13	13 and 31	95	80	URTV
5	First Intermediate Report	6	13	13	4	4	URTV
6	Data Base on the empirical research	6	15	27	2	0,5	APPLICA
7	First Diffusion Workshop	5	15	20	1,5	1,5	CIMPAM
8	Second Diffusion Workshop (and scientific seminar)	5	19	25	1,5	1,5	JR-InTeReg
9	Third Scientific Seminar	2	21	15, 17 and 19	0	0	UWC
10	Series of Scientific Papers on WP2	2	23	26	29	29	RUFIS
11	Third Diffusion Workshop	5	23	22 and 23	2,5	0	URTV
12	Second Intermediate Report	6	25	25	4	4	URTV
13	Fourth (and Fourth*) Scientific Seminar	4	27	28 and 32	0	0	RUFIS
14	Series of Scientific Papers on WP3	3	27	33	5,5	0	URTV
15	Series of Scientific Papers on WP4	4	27	33	12	0	UWC
16	Final Report	6	30	37	6	0	URTV

Table 2: Milestones List
List all milestones, giving date of achievement and any proposed revision to plans

Milestone no.	Milestone name	Workpackage no.	Date due	Actual/Forecast delivery date	Lead contractor
1	Database	WP1	12	17	URTV
2	Reports	WP2	22	24	RUFIS
3	Matrix INT	WP3	27	33	URTV
4	Report	WP4	27	33	CIMPAM
5	Proceedings	WP5	23	32	URTV
6	Reports	WP6	30	36	URTV
7	Coordination	WP7	30	36	URTV

Table 5: Workpackages - Plan and Status Barchart
PROJECT BARCHART and STATUS
IKINET – CIT2-CT-2004-506242

		1ST YEAR																	2ND YEAR									3RD YEAR								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
WP1	***Empirical survey and construction of indicators of innovation potential***																																				
Task 1.1	Elaboration of a regional case study by the following partners: Rome, Cardiff, Bochum, Warsaw, Graz, Paris, Madrid. Bruxelles has helped Rome in the design of the questionnaire and will be in charge for the collection of regional and national data available at the EU institutions																																				
Task 1.2	Coordination of WP1 is assigned to Rome research unit																																				
Task 1.3	Seminars																																				
WP2	***Validation and improvement of theoretical models***																																				
Task 2.1	Elaboration of at least two research papers by each																																				

	partner, including an original quantitative analysis of the data collected in WP1, suitable for inclusion in the final publication according to opinion of selected referees																																			
Task 2.2	Coordination of WP2 is assigned to Bochum research unit.																																			
Task 2.3	Seminars																																			
WP3	***Synthesis and quantitative framework for innovation policy evaluation***																																			
Task 3.1	Elaboration by the Rome research unit of a research paper including an original quantitative analysis of the data collected in WP1																																			
WP4	***Policy recommendations***																																			
Task 4.1	Elaboration of one research paper suitable for inclusion in the final publication according to opinion of selected referees																																			
Task 4.2	Coordination of WP4 has been re-assigned from Cardiff to Warsaw research unit																																			

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Task 4.3	Seminars																																				
WP5	***Diffusion of research results***																																				
Task 5.1	Organisation of diffusion workshop 1 by Warsaw research unit																																				
Task 5.2	Organisation of diffusion workshop 2 by Graz research unit																																				
Task 5.3	Organisation of diffusion workshop 3 by Rome research unit																																				
WP6	***Intermediate and final report***																																				
Task 6.1	Coordination of intermediate rapport by Rome research unit																																				
Task 6.2	Collaboration to the elaboration of the intermediate report by Bochum and Warsaw research units																																				
Task 6.3	Coordination of final rapport by Rome research unit																																				
Task 6.4	Collaboration to the elaboration of the final report by Bochum and Warsaw research units																																				
Task 6.5	Management of a web site of the project by the Rome research unit																																				

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Task 6.6	Creation by the Bruxelles research unit of a data base of the all results obtained in the empirical analysis of WP1 and quantitative elaboration of the data included in the data base suitable for the elaboration of papers in WP2 by the various research units																																				
WP7	***Coordination activities (Management activities)***																																				
Task 7.1	Coordination of the overall project by the Rome research unit																																				
Task 7.2	Collaboration to the coordination of the overall project by the Cardiff, Bochum and Warsaw research units																																				
Task 7.3	Financial coordination of the overall project by the Rome research unit on the base of the individual financial statements of the various research units																																				

Section 3 – Consortium management

The Steering Committee has met on:

University of Rome "Tor Vergata"
Rome, 26-27-28 October 2005

Applica
Bruxelles, December 15, 2005

Universitad Autonoma
Madrid, 6th May 2006

First Joint IKINET -EURODITE Conference
Organization of a Steering Committee Meeting
Centrum Badan Przedsiebiorczosci i Zazadzania Polskiej Akademiiauk
Warsaw, May 24th and 25th, 2006

RUFIS e.V. - Ruhr-Forschungsinstitut für Innovations- und Strukturpolitik
Ruhr-Universität Bochum, Germany
Bochum, July, 20-22, 2006

46th European Congress of the Regional Science Association
Special Session on: "International Knowledge and Innovation Networks"
Volos, Greece August 30 – September 3, 2006

Technical University
Leipzig, September 18-19, 2006

Participants: R. Cappellin, R. Wink, S. Walukiewicz.

The discussion with the partner institutions in the research project has been organized in the framework of scientific workshops, as also in the diffusion workshops, the ERSA congress and a technical meeting, which have been organized on:

Third Scientific Workshop
Organization of a Steering Committee Meeting
University of Rome "Tor Vergata"
Rome, 26-27-28 October 2005

Coordination Meeting on WP1
Organization of a Steering Committee Meeting
Applica
Bruxelles, December 15, 2005

Fourth Scientific Workshop on WP2
Centre for Advanced Studies, Cardiff University, UK
February 23-25, 2006

Fifth Scientific Workshop on WP2

Organization of a Steering Committee Meeting
Madrid, 6th May 2006

Organization of First Joint IKINET -EURODITE Conference
Organization of a Steering Committee Meeting
Centrum Badan Przedsiebiorczosci i Zazadzania Polskiej Akademiiauk
Warsaw, May 24th and 25th, 2006

Sixth Scientific workshop on WP2
Organization of a Steering Committee Meeting
RUFIS e.V. - Ruhr-Forschungsinstitut für Innovations- und Strukturpolitik
Ruhr-Universität Bochum, Germany
Bochum, July, 20-22, 2006

46th European Congress of the Regional Science Association
Organization of the Special Session on: "International Knowledge and Innovation Networks"
Organization of a Steering Committee Meeting
Volos, Greece August 30 – September 3, 2006

No major problem has been encountered in the elaboration of the theoretical contributions for WP2, while some firms and organizations, who had collaborated to the series of interviews which have led to the completion of questionnaire A, have been particularly reluctant to fill the questionnaire C with quantitative indicators and that is requiring some additional effort from the researcher to chase the firms and organizations.

Problems have been solved through regular contacts between the members of the Steering Committee and the various partners, in the framework of the above indicated meetings and through email and telephone contacts. However, due to the repeated absence of Phil Cooke (Cardiff University) at the meetings of the Steering Committee, the responsibility in the coordination of WP4 (Policy recommendations) has been assumed by Staszek Walukiewicz (Instytut Badań Systemowych – Polska Akademia Nauk – Warszawa) and the elaboration of the intermediate report (WP6) has been carried out by the other three members of the Steering Committee: Riccardo Cappellin (Università di Roma "Tor Vergata") and Ruediger Wink (Ruhr-Forschungsinstitut für Innovations- und Strukturpolitik – Bochum).

The most relevant change in the project time table is the proposal to prolong for 6 months (till month 36) the completion date of the project. The dates indicated in the tables of the deliverables and of the milestone, as also the project barchart, indicate this new proposed plan for the completion of the project.

Appendix 1 – Plan for using and disseminating the knowledge

Section 1 - Exploitable knowledge and its Use has not been filled since it is not relevant in the case of economic research.

Section 3 – Publishable results

The following theoretical contributions elaborated in WP2 and presented at the European RSA congress 2006:

1. Cappellin, R. and L. Orsenigo, Regional learning networks in medium tech technologies and European integration" (University of Rome "Tor Vergata" and University of Brescia)

2. Wink, R., Formal knowledge examination institutions: a cognitive and institutional perspective (RUFIS - Ruhr Research Institute for Innovation and Regional Policy, Bochum)

3. Vázquez-Barquero, A., Emergence and transformation of clusters and milieus (Universidad Autónoma de Madrid)

4. Lourimi, S. and A. Torre, Clusters and institutions. Towards a reassessment of the role played by local institutions in the transfer of knowledge and the setting of local networks (ADIS, Université Paris Sud 11 and UMR SAD-APT, INRA INA PG Paris)

5. Steiner M. and M. Ploder, Geographical agglomerations and the development of local networks (Joanneum Research, Graz)

6. Cooke P. and O. Ehret, Geographical and relational proximities in the European airbus project (Centre for Advanced Studies, Cardiff University)

7. Walukiewicz, S., Systems analysis of social capital at the firm level (System Research Institute, Polish Akademy of Sciences, Warsaw)

8. Cooke P. and O. Ehret, Industry outsourcing aerospace in Wales (Centre for Advanced Studies, Cardiff University)

9. Alfonso Gil, J., Innovation and its diffusion. The Aeronautical Case (Universidad Autónoma de Madrid)

10. Bianca, M. and R. Cappellin, Innovation and knowledge creation in the SMEs of an aeronautical industrial cluster (University of Sannio, Benevento, and University of Rome "Tor Vergata")

11. Cappellin, R, Caruso, I. and G. Pace, Intermediate institutions for interactive learning processes in a “governance” perspective: the case study of aeronautic industry in Campania region (University of Rome “Tor Vergata”, Institute of Studies on Mediterranean Societies, Naples)

12. Draganinska, S. and R. Wink, European interregional boundary-spanning institutions: the case of the aeronautics industry (RUFIS - Ruhr Research Institute for Innovation and Regional Policy, Bochum)

13. Winch, S., Social capital and knowledge management (System Research Institute, Polish Akademy of Sciences, Warsaw)

and the following additional papers:

14. Temporary geographical proximity
André Torre
INRA Paris

15. Knowledge networks and their evolutionary-institutional character.
Michael Steiner and Michael Plodder
Joanneum Research, Graz

16. From stock to flows: regional indicators of knowledge creation and diffusion (provisional title)
Terry Ward
Applica, Bruxelles

will in principle be published by Edward Elgar in 2007/2008. A preliminary draft will also be made available in the project web site.

Section 2 – Dissemination of knowledge

The following diffusion workshop has been organized in the second year of research. The participation to the workshop has been extended to another FP6 project (EURODITE), which covers very similar topics.

First Joint IKINET -EURODITE Conference
Centrum Badan Przedsiebiorczosci i Zazadzania Polskiej Akademiiauk
Warsaw, May 24th and 25th, 2006

The program and contributions presented at this diffusion workshop are published in the project web site: http://iunet.uniroma2.it/ikinet/FIRSTD_1.htm

A second diffusion workshop:

Graz, Joanneum research,
8-9 November 2006

has also been organized, although formally in the third year, and the program and the contributions presented have also been published in the project website: http://iunet.uniroma2.it/ikinet and in the following web site:
http://www.ikinet.eu/index.php?option=com_content&task=view&id=26&Itemid=46

1. Publications

The major results of the research activities will be published in a book. The provisional title is:

"International Knowledge and Innovation Networks"

The publication will be organized in five major sections, which correspond to the scientific areas of research of the project.

Each of the first four sections will comprise contributions, which will consider:

- a survey of the literature
- a contribution to innovation theory
- an analysis of empirical results undertaken in the research project

The fifth section will contain an indication of policy strategies emerging from the project.

Overall approximately 20 papers will be published in the book. In particular: 16 papers in the first 4 Parts and 4 papers in the part V.

The preliminary draft of the contents of the book and the preliminary list of the contributors are the following table:

"International Knowledge and Innovation Networks"

final publication of the IKINET research project
FP6: CIT2-CT-2004-506242

Preface

Introduction

Part I - Geographical agglomeration within clusters and the development of the local networks model

Papers the following research units:
- Madrid
- Graz
- Cardiff
- Warsaw

Part II - Interactive learning and the process of knowledge creation

Papers the following research units:
- Rome
- Bochum
- Cardiff
- Bruxelles

Part III - The role of institutions and social capital in knowledge creation

Papers the following research units:
- Graz
- Warsaw
- Rome
- Paris

Part IV - Openness as a factor of innovation and development

Papers the following research units:
- Bochum
- Paris
- Bruxelles
- Madrid

Part V – Policy strategies

Papers the following research units:
- Rome
- Cardiff
- Bochum
- Warsaw
- Graz
- Paris
- Madrid
- Bruxelles

The book should be published by an international editor in Winter 2007, just after the end of the project. Material have been provided in different stages:
- research area to be considered: October 2005
- provisional titles: December 2005
- early draft of the paper: March 2006
- complete draft of the paper: June 2006
- presentation of the papers in the European Regional Science Association congress, August 2006

The final draft of the papers should be elaborated by December 2006 in order to be to the publisher for evaluation and eventual future revision.

2. Project web-site

The project website address is: www.economia.uniroma2.it/dei/ikinet. A second linked address is the following: www.iunet.uniroma2.it/ikinet

The project web site contain information of interest for the general public. These include the official information communicated to the EU commission. It contains information useful to contact the various research units. It contains indications of the research activities undertaken by these research units in the IKINET in the framework of the scientific seminars, the diffusion workshops and also the Activity Reports 2005 and 2006.

Research contributions to be included in the book will not be published in the project website as they are confidential and in order to protect intellectual property rights.

3. Conferences

A major role in the plan for using and disseminating the knowledge has been performed by the following two conferences:

First Diffusion Workshop, organized by IBS- Polish Academy of Sciences, on: role of SMEs and regional institutions in knowledge creation and international co-operation, presentation of the results of the empirical analysis (WP1).
Warsaw, May 24th and 25th, 2006

Second Diffusion Workshop, Graz, organized by Joanneum Research, on: role of large firms in international transfers of tacit knowledge, presentation of the results of the theoretical and empirical studies (WP2)
Graz, 8-9 November 2006

A third conference:
Final diffusion conference, Rome, organized by the University of Rome "Tor Vergata", on: national and European policies for knowledge creation and innovation, presentation of the results of research activities on a quantitative framework for innovation policy evaluation (WP3) and on policy recommendations (WP4).
Rome, June 2007

Is planned in the third year of research.

The speakers at the conferences have been the leaders of the various work-packages of the research project as well key note speakers from other EU research projects. Various round tables and working groups have been organized with the participation of entrepreneurs, public officials, policymakers and officials of the European Institutions and researchers in related fields. The public has been represented by students at local universities, entrepreneurs in small and large companies, public officials at the regional and national level

The first conference has been addressed to participants representing the industrial community and the public sector from new member states. The second conference to participants representing the industrial community and the public sector from central and north Europe.

The third conference (June 2007) will be addressed to participants representing national and European institutions. The size of the audience will be of about 60 participants

4. Flyers and posters

A flyer has been elaborated and be distributed at the first and second diffusion workshops and it will be updated in for the final diffusion conference. A flyer will be elaborated in order to publicize the book to be produced the final results of the research.

The key research results achieved by the eight research partners in the IKINET project have been summarized in posters which have been presented at the two diffusion workshops.

5. Direct e-mailing

A mailing list has been created in order to publicize the three diffusion conferences. This list includes regional development agencies, technology transfers institutes, specialists in the economics of innovation, coordinators of related research projects and key stakeholders in the various regional industrial clusters considered and finally of all the persons interviewed in the empirical analysis

6. Press release

Press release has been organised in correspondence to the two diffusion conferences.

Section 2 – Dissemination of knowledge - Overview table					
Planned /actual Dates	**Type**	**Type of audience**	**Countries addressed**	**Size of Audience**	**Partner responsible /involved**
Spring 2007	Publications	Research community	World	N/A	University of Rome "Tor Vergata"
November 2005	Project web-site	General public	World	N/A	University of Rome "Tor Vergata"
May 2006	Conference 1	Industrial community and public sector	Eastern Europe	30-60	IBS – Polish Academy of Sciences
October 2006	Conference 2	Industrial community and public sector	Central and north Europe	30-60	Joanneum Research
June 2007	Conference 3	National and European institutions	European Union	> 60	University of Rome "Tor Vergata"
April 2006 October 2006 May 2007	Flyers	General public	World	500	University of Rome "Tor Vergata"
March 2006 September 2006 may 2007	Direct e-mailing	General public	World	500	Various partners
April 2006	Posters	General public	European Union	150	Various partners
May 2006 October 2006 June 2007	Press release (press/radio/TV)	Media	European Union	40	Conference organisors