

**“Regional learning networks
in medium tech technologies and European integration”**

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Paper to be presented to the
46th European Congress of the Regional Science Association
Volos, Greece August 30 – September 3, 2006

Paper n. 334

1. Introduction

In recent years, it has become increasingly recognised that knowledge and innovation are primary factors of economic growth. At the same time, it has been also acknowledged that production and innovation have a fundamental spatial dimension. Concepts like clusters, industrial districts, etc., have become in the last two decades a major focus of attention for social scientists and policy makers.

The convergence of these two streams of literature has – not surprisingly – led to the idea that knowledge and learning are powerful factors of agglomeration, spanning an enormous body of research. Yet, linking precisely the properties of knowledge and learning to the characteristics and performance of specific geographical areas has proven much more difficult and complex than perhaps thought at the beginning.

In this paper, in a very modest and admittedly highly idiosyncratic attitude, we try to summarise and discuss some of the main linkages between the cognitive microfoundations of agglomeration economies on the one hand and the territorial dimension of these cognitive processes. In particular, we focus attention on processes of knowledge integration and of interactive learning between firms which occur in clusters specialized in medium technology sectors, rather than in high-tech industries which have been more extensively studied.

Specifically, we argue in Section 2 that in this kind of industries technological change presents three important characteristics (Cappellin, 2003):

- 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 however to original improvements in products and processes;
- it is mainly based on the use, transfer and creation of tacit and local knowledge through informal learning processes,

These properties of learning involve important spatial and relational dimensions, which go far beyond the notion of localised knowledge spillovers, which has been often used in economic models (section 3). Rather, these dimensions can be better conceptualised and understood relying on the concept of networks and related methodologies. We argue that it is possible to identify different types of prototypical networks, that may correspond to alternative forms of organisation and structuring of interactive learning and hence of models and levels of innovative activities within a region. In particular, we suggest that learning regions are networks where integrative capacities are developed which allow the efficient coordination of decentralised interactive learning processes among firms and other institutions.

Finally, in Section 4, we suggest that regional innovation policies should design appropriate methodologies in order to promote the creation of a “learning region” and that the approach of Territorial Knowledge Management (TKM) can be useful to this task. (Cappellin, 2003). Section 5 concludes the paper.

2. Some basic properties of learning: the contribution of cognitive economics

The confluence between cognitive sciences applied to economics and innovation studies has identified a few fundamental and general properties of learning. For the purposes of this paper, it is worthwhile emphasising:

- i) the interactive nature of learning
- ii) the crucial role of tacit knowledge

2.1 Innovation as the outcome of processes of knowledge accumulation and interactive learning: the role of integrative capabilities

The creation of a scientific breakthrough or an innovation may be analysed as the result of a process of *knowledge accumulation* and *interactive learning*.

Cognitive sciences (Rizzello, 1999) show that improvements in human knowledge are possible when outside stimuli reach the individual's cognitive system and these stimuli are integrated and processed within the cognitive system. The joint impulses or signals coming from other firms or actors should overcome a certain threshold of intensity: a condition that is facilitated by the existence of common standards of communication and routines. Any new external stimulus coming from outside the cognitive system is then analysed in order to determine whether it fits into the already existing cognitive system, categories, experiences and cultural values. In the positive case, an interactive process begins, leading to the search of consistency and compatibility. Then, a firm or actor can identify a new pattern or a solution to an existing problem and that stimulates the change and adaptation to the external stimulus (Gould, 1991).

This process of adaptation, reconversion and co-evolution of the relationships between the various actors and firms has an incremental character and it follows specific paths (Laughlin 1996). The compatibility with other actors and the success in the adaptation leads to the creation of new connections or to the reinforcement of existing connections, through the development of appropriate routines and institutions (Hayek 1937), which allow to save the limited cognitive capacity of individuals and organizations and facilitate the process of reciprocal integration (Rizzello, 2003 and Loasby, 2003).

On the other hand, if the stimulus is not compatible with the firm or actor's cognitive system, it is rejected. In particular, a cognitive blockade or lock-in effect may occur when accessibility and/or receptivity are too low. Accessibility is affected by the existence of infrastructures and institutions, which may decrease the distance between any two nodes. On the other hand, receptivity is mainly related to the scope of the diversified knowledge available to the actor or the firm considered, since that allows it to identify useful forms of complementarity in the relations with other actors or firms. Clearly also time is a crucial factor, as it facilitates to perceive a continuous stimulus or to adapt gradually to it.

In particular, the creation of new knowledge implies an intense process of interaction (Nonaka and Konno, 1998), which is characterized by transfers both of tacit knowledge and of explicit knowledge and which requires face to face contacts and physical proximity as well as contacts through the ICT on long distance.

The process of learning does not occur through accumulation of knowledge within firms in isolation, as innovation processes are tightly related to interactive learning processes and to various forms of co-operation within the networks made by firms and many other actors (Cappellin, 2003a).

Technological change is based on the integration of various abstract logical concepts and of various economic actors with different and complementary knowledge and competencies. Thus, learning is the process whereby previous existing knowledge is selected and it is viewed in a new perspective.

Whereas much attention has been devoted to the process of adoption, absorption and development of knowledge, we know much less about the critical process of knowledge integration. Yet, the strategic importance of integrative capabilities in explaining innovativeness is increasingly recognised.

In knowledge intensive environments, innovation requires a reconciliation between apparently conflicting objectives. On the one hand, specialisation by specific agents is necessary in order to be able to deepen and efficiently exploit competencies in existing bodies of knowledge and practice. On the other, innovation requires the ability of they need to combine, or integrate, such specialized skills to be able to deliver new products and services. This tension between specialization and integration applies at the level of individual agents (e.g. individuals, firms, other research organisations) but also at the level of clusters and networks as a whole. Of course, the dilemma can be dealt with through a large variety of organizational mechanisms and principles. Hence, increasing attention has been devoted to the analysis of knowledge integration (Grant, 1996); combinative capabilities (Kogut and Zander, 1992); architectural knowledge (Henderson, 1992); systems integration (Prencipe, 1997).

Such emphasis on ‘integration’ and ‘combination’ highlights the fact that what matters is not the mere accumulation of productive knowledge within organizations (and the incentives not to do so), but how organizations manage to acquire new knowledge, integrate it with the existing knowledge base and exploit it in a productive context. Processes of knowledge accumulation are often the result of a series of small (although sometimes really fast) steps in related bodies of scientific and technological knowledge, rather than “random” moves across unrelated technological areas (Teece, et al., 1994; Breschi et al., 2003). Integrating knowledge has become a widespread concern, as empirical evidence shows that, for example, large firms are more diversified in the technologies that they master than the products that they make, and that their technological diversity has been increasing while they have typically been narrowing their product range (Granstrand, Patel and Pavitt, 1997; Gambardella and Torrisi, 1998; Von Tunzelman, 1998). Similarly, evidence suggests that firms with higher integrative capabilities are supposedly more successful (Henderson (1992), Nesta (2004) and Nesta and Saviotti (2004)). But the same notion could be extended to clusters and networks, rather than to individual firms (Orsenigo, Pammolli and Riccaboni, 2001).

2.2 The complex nature of tacit knowledge

Tacit knowledge underlies various competencies, which are localized or idiosyncratic and cannot easily be transferred. Tacit knowledge may refer to competencies characterizing both the behaviour of individual agents and their interaction with other actors.

For example, tacit knowledge plays a crucial role not only as a fundamental building block of the knowledge accumulated through experience and learning-by-doing but also in defining the ways in which agents create “patterns”, “frames” and “mental models” for interpreting the world and therefore their receptivity to external information. The processes of construction of these models rely to a large extent on tacit routines and heuristics - and therefore the very ability to learn - involves largely tacit knowledge and capabilities. Moreover, these “frames” guide the selection and interpretation of external information and at the same time they define “insider information”, which may not be identified or understood by agents who do not have adequate experience and

knowledge of the state of the art in a specific field and/or do not share the same “model”.

Similarly, “creativity” is also essentially based on tacit knowledge: the capability to recombine and restructure different fragments of knowledge in an original way, in order to solve a specific or local problem is in itself tacit, since what has not been thought cannot be codified.

A fortiori, tacit knowledge is essential in the interaction between different agents. It is at the basis of “automatic” coordination, which develops when actors are capable to react to external stimuli following specific “routines”, which are often not explicitly codified and are only based on experience.

Tacit knowledge underpins also the ability to learn together, which itself has to be learned through repeated interactions and sharing of common schemes of interpretation of external information.

But also the organizational and managerial capability to govern or steer the action of other actors is more an art than codified knowledge: thus, leadership and governance capabilities involve tacit knowledge.

It may also 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.

2.3 The role of tacit knowledge, informal research processes and competencies

The distinction between codified and tacit knowledge can be to some extent matched with the distinctions 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.

Innovation processes depend, especially in the medium and low technology sectors and in the small and medium size firms, on the availability of tacit knowledge, such as combinatorial capabilities, and non formalized search activities based on interactive learning processes within networks of firms.

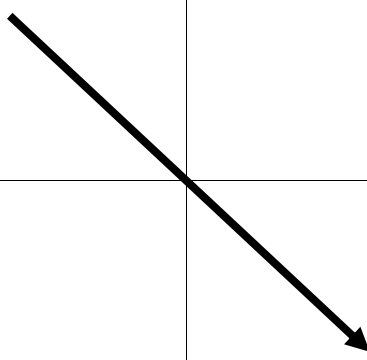
In particular, as indicated in table 2, innovation processes can be characterized by specific forms of combination between different inputs, processes and outputs (Cappellin, 2004). With a heroic simplification and for heuristic purposes, the following “taxonomy” can be proposed:

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.

Figure 1: The relationship between:

- a) types of knowledge,
- b) types of research processes,
- c) development of competencies,
- d) invention and innovation within the interactive learning processes

University institutions	Large firms	Formal research	PROCESS	University institutions	Large firms
Knowledge intensive services	SMEs in non high-tech sectors	Informal research		SMEs in non high-tech sectors	Knowledge intensive services
Codified knowledge	Tacit knowledge	INTERACTIVE LEARNING PROCESSES		Competencies	Invention or innovation
INPUT				OUTPUT	
University institutions	SMEs in non high-tech sectors	Competencies	OUTPUT		
Knowledge intensive services	Large firms	Invention or innovation			

Source: R. Cappellin, IKINET - International Knowledge and Innovation Networks, Research for the FP6, University of Rome "Tor Vergata", November 2004

3. The local nature of learning: geography

The emphasis on tacit knowledge and on interactive learning provides a suggestive analogy, – albeit still quite broad and generic – between the cognitive analysis of learning processes and the analysis of innovation in specific geographical areas. Indeed, much of the literature on innovative and productive clusters is based on the recognition that the local, tacit and interactive nature of learning constitutes an essential constituent of agglomeration economies.

3.1 Local knowledge spillovers

To a considerable extent, and especially in the econometric literature, this intuition has been operationalised through the concept of knowledge spillovers. Different types of methodologies (estimation of knowledge production functions as in Jaffee (1989), Acs et al (1992 and 1994), Audretsch and Feldman (1996), Feldman and Audretsch (1999), Feldman and Florida (1994); use of patent citations to track direct knowledge flows from academic research into corporate R&D (Jaffee et al (1993), Almeida and Kogut (1997)); and an immense set of empirical case studies and narratives confirm that indeed important localisation effects exist in innovative activities.

However, we still know very little about how these processes. It has become increasingly acknowledged that the evidence supporting the role of knowledge spillovers is largely indirect and that it is quite difficult to clearly separate knowledge spillovers from other types of pecuniary externalities and more generally between Marshallian externalities and more classic urbanisation externalities or even natural endowments (Glaeser et al., 1992, Ellison and Glaeser (1999), Henderson (1999)). In many cases, the definition of spillovers that is used includes only physical proximity (physical distance) to universities or research centres, although other studies extends the definition of spillovers to include also the proximity of a high number of firms belonging to the same sector (see among others, Autant-Bernard (1999)).

Perhaps more important, as forcefully argued by Breschi and Lissoni (2001), it has proven hard to precisely show how knowledge spillovers actually work and even whether they can legitimately interpreted as spillovers. To begin with, in econometric studies spillovers are often identified as a sort of a residual, rather than directly. But that residual might actually include many different processes that do not necessarily coincide with knowledge spillovers. Thus, for instance, in diverse instances, the pool of knowledge that should constitute the very origin of knowledge spillovers seems to be embodied in specific people and/or in a pool of specialised workforce, as argued for example by Zucker et al. (1998, 1998a) and Almeida and Kogut (1999).

Similarly, knowledge within a clusters in many cases does not appear to simply “spill over”. Rather, access to such knowledge seems to require deep involvement in the research process and bench-level scientific collaboration and the conscious investment of resources not simply to search for new knowledge, but to build the competencies to absorb the knowledge developed by others. Finally, in other cases, knowledge flows occur via (localised) mobility of researchers and of the workforce and are mediated by market transactions or other institutionalised or quasi-institutionalised mechanisms involving not simply mutual trust and face-to face contacts, but highly complex economic and social structures.

3.2 The spatial dimension of the cognitive processes

More generally, in the previous stream of literature, the nature of the process of knowledge creation is apparently a-spatial, or space is conceived as a pure physical variable. Other studies, mainly in the field of regional economics, have attempted to go beyond this simple representation. Regional economics for its special interest on territorial structure and spatial flows (i.e. migrations, investments, information, exports) has traditionally focused on the tight complementarity between the spatial flows and the process of diffusion of innovation, both within industrial districts/clusters at the local level as also between the centres of the urban system at the national and international level. Physical space is therefore coupled with “relational” space, made by all the different relationships built among local actors. For example, the well-known concept of “milieu innovateur” refers to this more complex concept of space (Capello and Faggian 2005).

In the regional approach the channels through which the relational capital becomes collective learning are defined as:

- a high mobility of local labour force
- stable and fruitful relationships with local customers and suppliers
- spin-offs.

A third field of literature which may be relevant is represented by the studies of cognitive economics, which only apparently have a a-spatial character, as they implicitly underline the spatial nature of the process of knowledge creation. In fact, this literature illustrates that the process of knowledge creation has a combinative and an interactive character. For the purposes of this paper, it might suffice to emphasise that both the combination of complementary pieces of knowledge and the interaction between various complementary actors are facilitated by a closer geographical proximity and greater cognitive proximity.

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-makship.

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.

3.3 From spillovers to networks

As it is recognised that learning and innovation are embedded in physical, cognitive and relational space, it becomes necessary to understand much better how knowledge flows within a specific geographical area are structured.

The notion of networks is useful in this regard and network analysis has become a fundamental conceptual and technical apparatus guiding research in this field. A network can be characterized by:

- nodes which, according to the network considered, may be firms or individual actors or even abstract building blocks, such logical concepts, and are characterized by different internal characteristics,
- flows or links, which may have different intensity and nature, such as material (i.e. intermediate products or equipment) or immaterial (i.e. finance, information or patents), and may be direct or indirect through intermediary nodes,
- distance among nodes, which may be measured according to the flows considered and can be represented by geographical distance, transaction costs, difference in technology levels, organizational structures and cultural frameworks. Its major determinants are the differences in the characteristics of the various nodes.
- infrastructures, which reduce the distance, facilitate or hinder the circulation of the flows between the nodes and may have a material, such as logistic infrastructures, or immaterial nature, such as norms or institutions or “social capital”.

In particular, a network perspective in the analysis of the learning process emphasizes the importance of the analysis of the structure of the direct and indirect links, the distance and the infrastructures between the actors.

Knowledge networks are characterized by direct and indirect flows of information, codified and tacit knowledge between various firms and qualified workers. They are hindered by transaction costs and differences in the technology levels or differences in the cognitive framework. Research organizations, higher education institutions and scientific associations represent the key infrastructures.

Knowledge networks however can be hardly conceived as static. The structure of knowledge and innovation networks may change due to:

- change in the links or in the paths between nodes, as indirect links between two disconnected nodes may be transformed into direct links;
- change in the intensity of the flows;
- change of the nodes, as new nodes may be created and previous nodes may disappear

- change in the nature of the flows, as the nodes may exchange various hard or soft inputs or outputs.

3.4 The different nature of networks

Networks may have different characteristics and they may be distinguished in the following three types (Cappellin 2003b):

‘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”.

3.5 Learning regions and integrative capabilities

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.

In order to understand how a region becomes a learning region, it is necessary not only to identify the specific structural characteristics of the network (e.g. centrality, density, connectedness, ties strength etc.), but also the specific functions played by different nodes within such networks (e.g. brokers, integrators, gatekeepers, etc.). The idea that focal nodes are key to understand network dynamics is not new. For instance, it has been shown that successful product and process innovations require *champions* (Allen, 1977; Roberts 1987; Rothwell, 1990) and Cohen and Levinthal (1989) have emphasised the importance of role played by gatekeepers to access externally generated knowledge. This line of enquiry has recently been newly approached in recent years, with the explosion of interest in network dynamics.

In particular, as mentioned earlier, increasing attention has been devoted to the concept of integrative capabilities and on the agents who embody these competences. We propose that these capabilities and agents play indeed a fundamental role in learning regions where collective learning and recombination are key processes leading to innovation and technological progress. However, we still know little about these competences and agents. For example, some authors discuss technology ‘brokers’, who recognize, store, blend, and transform technologies (Hargadon and Sutton, 1997), while Brusoni et al. (2001) talk about ‘integrators’ which coordinate loosely coupled networks of specialized suppliers. However, little is known empirically about the actual differences between, for example, brokering and integrating activities. They both have to do with coordinating specialized agents, but how they differ, if at all, and how such differences impact on networks’ evolution and performance is still unclear.

In fact, there are many different ways through which such integrative capabilities can be conceptualised and operationalised. In particular, one may distinguish between two fundamental and prototypical forms of such capabilities and functions within networks:

- knowledge brokerage
- knowledge integration proper.

Intuitively, it is relatively easy to distinguish brokers from integrators. Brokering can be conceived as the activity of alerting ‘distant’ agents that they have common interests and complementary capabilities (e.g. ‘yellow pages’ type of function). A broker may transfer some information between agents, but with little or no elaboration. Knowledge integration entails instead placing the contribution of others in a wider ‘interpretive’ framework which enables the evaluation of the function and value of the contribution of each. It requires therefore a higher level of understanding of the activity of others than brokerage. Knowledge integration involves also the ability to act upon and modify the contribution of others in order to identify and manage interdependencies and critical issues.

4. Developing interactive learning processes 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.

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;
- 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 Capital is given not only by the summation of the “human capital” of the individuals in a given region and by the “intellectual capital” of the various firms but also by the original combination of these two components and it represent a form of collective tacit knowledge.

TKM 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.

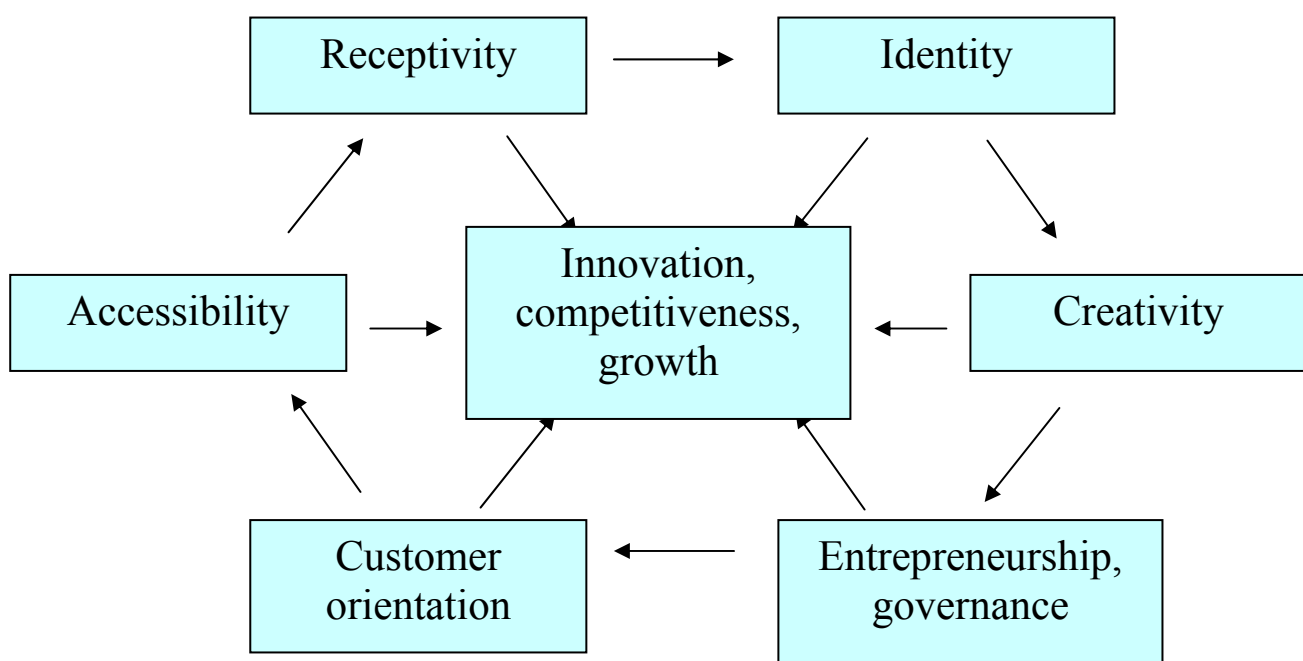


Figure 3 – The seven perspectives of TKM - Territorial Knowledge Management

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 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

1. Focus on customers satisfaction. The adoption of an innovation is the result of the focus on a localized framework and of the clear definition of a specific problem, which calls for a solution and motivates to a search of different complementary competencies. Cognitive processes and innovation within firms are the result of repeated attempts and a gradual search activity, stimulated by the motivation to reduce the tension created by specific problems and the challenge that these latter may represent to the survival of the firm, rather by the explicit desire to seek a profit maximization solution, which is the result of a deductive reasoning. Tacit knowledge is crucial in this phase since the capability to apply the codified knowledge to the solution of specific problems in different localized contexts has clearly a tacit dimension.

2. Manage accessibility and technological capital. Since cognitive processes and innovation in the firms often develop in the framework of a specific “local” problem and they require in-depth knowledge of clients needs and of suppliers complementary capabilities, geographical proximity and appropriate technologies, such as ICT, may favor the development of the relations with various other actors and firms. The access to external complementary competencies and the access to a variety of building blocks of codified and of tacit knowledge requires the creation of those hard and soft infrastructure both in a local context and at the interregional level, which allow to organize the knowledge and innovation networks. The development of understanding capabilities requires the availability of tacit knowledge. In particular, tacit knowledge is crucial in this phase since friendship relationships, leadership and reciprocal esteem and trust are tacit factors, which represent the conditions for the socialization of tacit knowledge within the groups, firms and organization.

3. Manage receptivity and human capital. The openness of the various actors and nodes within the knowledge and innovation networks should be enhanced, in order to avoid lock in effects and that they become capable to acknowledge the need of complementary external knowledge and to assimilate it. The capability to interact of the various actors to be involved in an innovation process may be considered as a form of tacit knowledge and it is hindered by the cognitive distance determined by differences in the education level, cultural background, but also the different sectoral or technological specialization, the lack of broad diversified experiences and a too low capability of learning. The availability of tacit knowledge by the individual actors represents the base for the development of interactive learning processes. Education enhance receptivity and it is about the use codified knowledge in the process of development of the tacit competencies of the various individuals.

4. Building a common identity and improve institutional/organizational proximity. Actors to be involved in innovation should share common aims, mental models, as also trust and loyalty. The promotion of knowledge sharing and of the willingness to collaborate requires a change in the corporate culture. The identification of common challenges to survival and development creates a sense of belonging to the same community or group and is a prerequisite for collaboration in innovation. Collaborative attitudes by the firms in a sectoral cluster can be considered as a form of tacit knowledge and are tightly related to 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. Interactive learning processes lead to the development not only of individual knowledge but also of collective organizational and technological knowledge, which is clearly tacit and characterizes specific groups of individuals, firms and organizations. The socialization of tacit knowledge within the groups, firms and organization is preliminary and instrumental to their codification and transformation into tacit knowledge.

5. Leverage creativity and manage internal organizational capital. According to cognitive theories, creativity is related to pattern making or the capability to establish new contacts between different potentially complementary information, technologies, know-how, thus leading to new discovery and inventions. Creativity is crucial in order to diversify the structure of the local economy into new productions. Creativity can not be planned in advance, being the capability to discover original solutions. However, it can be facilitated by favoring the diversity of the various actors to be involved in the innovation process and the exploitation of their idiosyncratic characteristics. In particular, to increase creativity firms should aim to leverage morale and the empowerment and commitment of people, in order to secure to potential inventors the freedom, security and willingness to invest in risky exploratory analysis and in a lengthy process of systematic search.

6. Insure the governance and enhance entrepreneurship. The implementation of innovative solutions requires the capability to cope with key problems of the organization and to manage the complex relationships between many different actors and to mobilize them. This requires entrepreneurship capabilities and the integration of knowledge with complementary material resources, in order to transform knowledge into action. The adoption of innovation requires tight collaboration of various actors and the facilitating role of intermediary organizations and institutions, which may coordinate the joint effort. The governance of the innovation process requires an explicit effort in institution building and institutional learning, as the creation and maintenance of “social capital” or of “public goods” require appropriate investments by all partners belonging to a given innovation system. The existence of routines, institutions and governance activity has a positive effect on all the above indicated phases of the knowledge management process.

According to the approach of “TKM – Territorial Knowledge Management”, these different dimensions of the knowledge creation and innovation process are linked by cause and effects relations. The basic logic of their reciprocal relations is the following. The focus on specific customer needs determine a tension leading to a search for a solution and to change and it is facilitated by an higher accessibility and/or receptivity. Accessibility interacts with receptivity. The building of a common identity leads to cooperation and joint investments. Creativity emerges by the commitment of complementary competencies and from decentralization of decision making. New ideas can be translated in economic innovations only through an appropriate organization and governance.

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. Clearly, the creation of institutions for 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.

Fig. 4 - Innovation within SMEs and medium technology sectors is based on a different approach

	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	Increase productivity	Continuous innovation
Policies	Public finance Public regulation	Multi-level governance Public-private partnership

5. The role of institutions in the process of interactive learning

Due to their interactive nature, learning processes involve groups of individuals and calls for the development of links, networks and social and cultural institutions and conventions among different actors. The passage from the individual learning to the interaction among individuals implies the co-ordination of the interaction process.

According to cognitive theories, the creation of new connections or the reinforcement of existing connections implies the compatibility with other actors, the success in the adaptation and the development of appropriate routines and institutions (Hayek 1937). According to Marshall order makes room for creativity, organization aids knowledge, as stable pattern may be used as euristics. Institutions allow to save the limited cognitive capacity of individuals and organizations and facilitate the process of reciprocal integration (Rizzello, 2003 and Loasby, 2003).

The exchange of knowledge cannot be effectively insured coordinated by conventional markets. The role of institutions is that to create new routines or baseline, which insure the adaptability of connections between actors. Therefore the creation of institutions enhancing the connectivity of knowledge should be a central concern of policy.

Institutions include any form of constraint: formal and informal. They can be created or they may simply evolve over time.

The role of institutions in regional development

New institutional theory argues that the strategic significance of institutions in development processes lies in the economies that its functioning provides. Barriers hindering self-sustained growth processes are often attributed to deficiencies and poor performance of the institutional network

The behavior of institutions can lead to:

- generate external and internal economies of scale,
- reduce transaction and production costs,
- increase trust among economic and social actors,
- favor economies of scope,
- improve entrepreneurial capacity,
- increase learning and relational mechanisms,
- reinforce networks and cooperation among the actors.

Knowledge networks depend on the development of so-called intermediate institutions, such as regional and local governments, local credit organizations, local education institutions, labour agencies, trade unions, chambers of commerce, and industry associations.

Thus, a wide range of institutions is required in the process of innovation. The diffusion of knowledge and innovation creation in a specific network or sectoral/regional/national innovation system depends on the “institutional thickness” of the innovation system to be considered.

The concept of “governance”

The multiplication of players and layers of negotiation – international, national, and local – demands for different models of government, called governance, based on organisational structures of interaction and partnership, that more and more characterise local societies. Governance is the challenge of steering and positioning complex organizations. These can be committees, research groups, firms, networks, communities, regions and international agencies.

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.

Governance is made by complex policy networks. The decision making processes may include forms of horizontal and vertical negotiation, where the exercise of a hierarchical control is only one of the components and most often not the major one.

Economic development, then, is stimulated in those territories with highly evolved, complex and flexible institutional systems. That is why training and research institutions, entrepreneurial associations, unions and local governments can more efficiently use available resources and improve competitiveness when firms are integrated into territories characterized by thick relational networks.

6. Conclusion

In this paper, we have discussed how one can begin to map the properties of learning in the forms of organisation and the performance of regions, emphasising how the former entail specific spatial, relational and organisational dimensions. In particular, we have stressed how the recombinative and interactive nature of learning, coupled with the tacitness of knowledge, is a key feature of technological progress in regions specialised in medium technology industries. We have also advanced the view that flows of knowledge and innovation in these contexts entail – both from a positive and a normative perspective – the development of complex networks: in other words, knowledge is not simply in the air, even at the local level, but its acquisition and growth requires the development of adequate organisational structures needed to sustain and embody competences of various kinds. Among them, the role of knowledge integration has been argued to be of particular importance. Territorial knowledge management can – against this background – become a useful tool for analysis and policy making.

Acknowledgement

This research has been elaborated in the framework of the EU FP6 project IKINET – International Knowledge and Innovation Networks, coordinated by the University of Rome “Tor Vergata”, Contract N°: CIT2-CT-2004-506242, <http://www.economia.uniroma2.it/dei/ikinet/>

NOTE

Draft version

The final version will be presented at the Conference and available on the project IKINET site <http://iunet.uniroma2.it/ikinet/>

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