



Fraunhofer Institute
Systems and
Innovation Research



Bureau
d'Economie
Théorique et
Appliquée

RETINE

(REgional Typology of Innovation NEEDs)

First interim report
April 2001

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Introduction

In the new framework of the European Research Area (ERA), fundamental questions must be re-examined:

- What regional dynamics are to be encouraged? (balanced spreading, specialisation, concentration, networking)
- What organisational/spatial grid should be favoured? (architecture around the European S&T backbone vs. array of co-ordinated local production systems)
- In their present forms, aren't the policy goals rather contradictory? (technological catching up and competitiveness in a globalised world; equitable development and intra-European convergence; forming European identity and solidarity)

Most of the countries and regions have developed policies and institutions for supporting innovation, technology transfer, economic valorisation of scientific research, etc. Such institutional sets constitute the regional context that must be kept in mind when designing any new policy device. But across such a variety of situations, some broad tendencies can be observed. Starting from policies devoted to strengthening innovation behaviour directly (supporting firms' R&D, innovation financing, etc.), the new priorities seem now to focus on indirect measures: improving absorptive capacities; systematising co-operation between firms and public research; supporting innovative business services in the proximity of the firms; regrouping firms in strategic networks; etc. Evolution at the administrative level is clearly required too: administrative simplification; assessment and flexibility in policy designing; capacity to learn from the best administrative practices and to adapt to local context; increasing the complementarity of regional, national and European policies; etc. On the other hand, the increasing number and complexity of the policies raise difficulties. The major problem concerns international and inter-regional coherence. More fundamentally, what is the optimal level of territorial competition? The European goal to be an influential actor on the research and innovation scene implies reformulating the regulation schemes, the latter being presently mostly national in certain countries and both at national and regional level in others.

The European regional policy is now at a crossroads. It is clear that important changes in the underlying philosophy have occurred, leading to new relationships with the innovation policy. In this respect, at least two main axes can be distinguished:

- one focuses on a European macroeconomic policy supporting the objective of social and economic cohesion (see Leroy, 1998)
- the other redefines the objectives and means of regional policy in putting stress on educational infrastructures, improvement of human capabilities (Martin, 2000; Crauser, 2000), harnessing innovation for the sake of regional develop-

ment, putting RIS at the core of the regional development policy (EC-FEDER, 2001).

Taking firms' innovation-related needs as a starting point, the issue is clearly to support firms in the improvement of their innovativeness or at least to favour their absorptive and adaptive capacities. For that sake, the institutional supply is generally abundant and diversified (it is even sometimes described by firms as an overdimensioned system with overlapping instruments). Answering firms' needs is obviously the declared aim of all policies, but one cannot be convinced that policies have been based on real analytical knowledge of the demand. The first reason is that firms "do not express an innovation demand" (Landabaso, Oughton, Morgan, 2001). It is sound reasoning to stress the interest of starting from the demand, instead of imposing top-down procedures regardless of the field, but who expresses or reveals the demand? Isn't the "need" for new knowledge, for strategic advice, etc. largely a constructed notion? If yes, what is the implicit rationale behind the notion? Another way to consider the problem is to address the ambiguity of the policies. There is often a real lag between the image regions want to build and the real needs of the local economic fabric. Looking at regional brochures could convince one that every region is destined to become the leader in most of the high tech areas! The point is not to minimise the role of such images (for instance in terms of attractiveness and as elements of a policy of exogenous development), but marketing arguments should not be confused with tools of endogenous development. Lastly, regional (as well as national or European) policies tend to over-estimate the "competitive" side of technological progress and innovation. Shouldn't policy action focus more on other aspects or externalities of knowledge-based economies, such as local benefits in terms of general education, quality of life, long-term sustainability of socio-economic development, etc.?

The aim of this preliminary part of the study, in presenting the state-of-the-art of the reflections dealing with regional development, innovation-related needs and policies, is to help the further phase that intends to provide measurement tools and other empirical matter to improve existing methodologies. The core of the project will be to design a regional typology of innovation needs. This will, hopefully, contribute to shed light on the notion of "Families of European Regions", a useful starting point for the conception of the future RTD policies. Nevertheless, the empirical investigation will rely on a diversified theoretical background. The areas concerned encompass general growth theory as well as regional economics, they require elements of the theory of knowledge, and they address questions of governance (from regional governance to the principles of European intervention). In order to explore these fields, the following five main topics are considered in the present paper: regional determinants of innovation; convergence issues; regional policies; RIS and regional governance; RTD and regions .

1. Regional determinants of innovation

Three main categories of argumentation allow the exploration of determinants explaining disparities in terms of regional innovation capacities: the new growth theory, network-based explanations and the concept of learning regions.

Referring to the **new growth theory** (see Krugman, 1995) it can be assumed that new knowledge is produced with each innovation (as by-product), leading to knowledge spillovers. Knowledge is perceived as a public good which is freely available and increases the knowledge base of the economy. Approaches that explain spillover effects point to the diffusion of knowledge over geographic distances (cf. for instance Jaffe, Trajtenberg and Henderson, 1993). In this respect, it is necessary to distinguish between tacit and codified knowledge since the former is mainly transferred by face-to-face contacts and thus requires a certain density of actors and opportunities to communicate personally, while the latter can be transferred through available communication infrastructure. Spillovers develop mostly in agglomerations that provide communication opportunities and access to knowledge generation organisation, such as institutions of the technological infrastructure. Some authors combine the spillover debate with the cluster concept and the product life cycle hypotheses, concluding that spillover effects through exchange of tacit knowledge occur to a high extent in an early phase of the development of a technology and lead therefore to clusters of innovative industries (as an example see Anselin, Varga and Acs, 1997). In this respect, the following factors determining regional innovation capacities can be stressed:

- presence, quality and density of actors playing the role of "knowledge generators"
- firms' absorptive capacities (which in turn is influenced by the structure of the regional economy)
- knowledge flows between the different actors within and outside the region.

Network approaches focus on co-operation between different economic actors. The overall goal of these relationships lies in the reduction of uncertainties and risks as well as the access to information and knowledge (cf. Håkansson, 1987). Localised innovative networks pursue the aim of realising innovations by co-operation (Camagni, 1991). Such networks are flexible systems without hierarchy whose gains are achieved through the activation of common resources of the network partners. Innovative networks are directed towards the exchange of resources, information and knowledge. Summarising, the constitution of innovation networks – including trust-building, medium- and long-term co-operations between network partners, flexibility, non-hierarchical relationships, etc. – can be mentioned as a crucial innovation determinant. Originally based on the ideas of Marshall (1900), the concept of **industrial districts** has been elaborated and used to explain the success of the post-

Fordist feature of flexible specialisation. Spatial proximity, a specific "atmosphere" and close collaborations between clients and suppliers characterise such districts. Especially in the case of the "Third Italy", close relations between small and medium-sized enterprises (SMEs), their specific character (often family-owned) and the industrial tradition are emphasised. Contrary to industrial districts that mainly concentrate on the production system, **milieu approaches** attach special attention to the environment conditions for innovations, i.e. the "atmosphere". Innovative milieux emphasise the realisation of innovations by multiple actors (Perrin, 1990, Maillat and Perrin, 1992). Members the GREMI school who developed the milieu conception focus on processes of interactive learning that reduce uncertainties and support innovation activities. The milieu is characterised by a specific regional culture and identity and a common vision. Interactive learning and the milieu culture are further developed by formal and especially informal contacts between the contributing actors. Consequently, they must have opportunities to communicate and exchange information. Innovation determinants according to networks-based and milieu approaches can be broadly summarised as follows:

- network relations between specialised firms that collaborate within one product field (niche strategy) supported by the existence of a local qualified and specialised workforce with high (intra-regional) mobility
- tight relationships between clients and suppliers (e.g. high specialisation of firms due to vertical disintegration); such social ties favour trust, which in turn fosters proximity-based exchanges of information and circulation of tacit knowledge
- regional consciousness for innovation as well as an industrial tradition of (regional) co-operation reinforced through the existence of intermediary organisations that support production processes and innovations within the region.

The concept of **learning region** stresses the importance of continuous learning processes within the regional production system. As Florida (1995, p. 532) puts it: "The new age of capitalism requires a new kind of region. In effect, regions are increasingly defined by the same criteria and elements which comprise a knowledge-intensive firm—continuous improvement, new ideas, knowledge creation and organisational learning. Regions must adopt the principles of knowledge creation and continuous learning; they must in effect become learning regions. Learning regions provide a series of related infrastructures which can facilitate the flow of knowledge, ideas and learning."¹ According to Braczyk/Heidenreich (1998, p. 415), regions do not only follow a technological, but also an individual trajectory in their development. This is consistent with the assumption that knowledge is context-

¹ For a detailed presentation, see for instance Morgan (1997) and Florida (1995). Landabaso et al. (2001) discuss the possibilities of implementing learning regions in the frame of European programmes.

dependent, i.e. rooted in the specific context in which it is generated² which leads to an individual knowledge base of every region. Therefore, a region disposes of specific competencies that are decisive for its success in overall competition: "In other words, although firms and regions are not the same things, both are ensembles of competencies which emerge from social interaction and so there appears to be no reason at all why the competence perspective should not be as equally relevant to the study of the region as to the study of the firm." (Lawson, 1997, p. 10). These competencies include knowledge of different types, an appropriate social system that favours the generation and diffusion of new ideas and learning capabilities, including "unlearning" or "forgetting"³, an important feature in order to avoid "lock-in"⁴ (Grabher, 1993).

Referring to the learning region approach, following determinants of a regional innovation capacity can be emphasised (cf. Florida, 1995):

- the production structure is interwoven, firms within the region are strongly inter-related to each other and continuously exchange information and maintain additional contacts outside the region
- education and training organisations support life-long learning and common learning by team organisation
- capital investors (banks, venture capitalists, etc.) are favourably oriented towards knowledge-intensive firms
- high density of "knowledge workers"
- local culture of communication and knowledge sharing.

2. The issue of regional convergence

Several definitions and approaches of convergence can be found in the literature of regional economics (Capron, 1997; Baumont, 1998; Jean-Pierre, 1999; Charlot and Combes 2000; Beine and Docquier, 2000). Two categories of empirical and analyti-

² Thus, knowledge and learning are localised, i.e. concentrated in specific areas (cf. Stiglitz, 1987, pp. 127 cont.; Saviotti, 1997, p. 845 and Asheim/Isaksen, 1999, p. 2).

³ The concept of "forgetting" is detailed in Johnson (1992, p. 29): "Old habits of thought, routines and patterns of cooperation, within as well as between firms, have to be changed before technical change can begin to move ahead along new trajectories. Forgetting is, thus, an essential and integrated part of learning, even if it is not always easy to separate *ex ante* between 'creative forgetting' and 'just forgetting'."

⁴ In describing the regional innovation system of Baden-Württemberg, Heidenreich/Krauss (1998) claim lock-in effects due to regional inability to adapt to new conditions. For a discussion of lock-in from an evolutionary economics perspective, i.e. in relation to the notion of path-dependency, cf. Boschma/Lambooy, 1999, pp. 414-416.

cal contributions are particularly relevant here - because they focus on structural conditions of growth. The conditional convergence postulates the existence of a long-term equilibrium for regions characterised by similar initial conditions (notably the access to technologies). In that case, structural factors explain persistent lags between groups of regions, and then the aim of the European policy could be to reduce such lags by offsetting the unbalanced endowments. The club convergence theory looks more closely at the empirical evidence. Europe indeed exhibits relatively homogeneous groups of regions. It allows interesting reflections in terms of policy, concerning the role of factors: e.g. capital mobility, human resources, knowledge flows, technology diffusion, etc. Are these flows natural within clubs and difficult between clubs? What sort of mobility should be encouraged? At what cost?

Contrary to neoclassical theory that postulates convergent developments between regions via the mobility of production factors in regions with highest marginal revenues, post-Keynesian theories consider investments as crucial for economic growth since they are supposed to have a multiplier effect on regional income. Regional disparities occur due to differences in the spatial distribution of investments and due to the spatial impacts of multiplier effects (Schätzl, 1998, pp. 137-142). Based on the ideas of Schumpeter and growth pole conceptions of Perroux, sectoral and regional polarisation approaches have been developed. Authors like Myrdal (1957) and Hirschman (1958), for instance, are sceptical about convergence between regions. They instead assume so-called cumulative socio-economic processes and trickling down as well as polarisation effects that lead to spatial differentiation via self-reinforcing processes. While Myrdal assumes divergence in the long run, Hirschman discusses counter balancing forces that may decrease income divergence.

Empirical evidence shows that measurement of convergence in the European contexts depends on (i) the indicator variable chosen and (ii) the spatial level investigated. Generally, convergence is measured in terms of income or income growth, productivity or employment levels (cf. for instance Dunford, 1997; Martin, 1999; Tondl, 1999). Concerning the spatial level of EU countries, tendencies of convergence were found during the last decades whereas analyses on the regional level (notably NUTS II) indicated divergent developments. Furthermore, regional incomes evolved unevenly: rather convergent income developments could be observed in the 50s and 60s until the mid-70s, followed by a period of divergence. In the late 80s, incomes in European regions converged again. This development was interrupted at the beginning of the 90s when regional disparities increased again (cf. Dunford, 1997; Martin, 1999; Tondl, 1999). Martin (1999, p. 172) analyses the impact of regional policy and its effects on human capital and infrastructure on regional convergence and gets different results for different regional types: for objec-

tive-15 regions, the availability of a well-educated workforce and sufficient infrastructure have positive impacts on growth performance, whereas in non-objective 1 regions R&D efforts mainly stimulate regional growth. In the case of the former regions, initial income lags have the strongest influence on regional growth which is reduced in non-objective 1 regions in favour of R&D. This indicates that the "natural convergence"⁶ has a high importance in poorer regions whereas research and development are emphasised in richer ones.

3. The aims of regional policies

From a neoclassical point of view, economic performance should be achieved by market mechanisms. Policy measures are only accepted in cases where market failures occur (externalities, monopolistic market power or information asymmetries). However, in reality socio-economic disparities between regions are apparent and led to the introduction of regional policy conceptions in various countries.⁷ These are based on the assumption that market mechanisms do not lead to the (neoclassical) equilibrium, i.e. to the optimal distribution of production factors in space (van Suntum, 1981). Regional policy conceptions in market economies have been strongly influenced by neoclassical approaches. The neoclassical regional growth theory concludes that the market mechanism will lead to an equilibrium in incomes between regions, achieved by migrations of (mobile) production factors to the location of highest marginal revenues. Regional policy conceptions have also been inspired by export base and growth pole theories.⁸ Export base approaches assume that regional development is supported by exports whose income effects induce intraregional income circles. These reflections led to the distinction between "basic" (export-related) and "non-basic" (directed towards the intraregional market) activities.⁹ In concentrating support on manufacturing firms, regional policy conceptions follow sectoral growth pole approaches that describe innovative sectors as "motors" whose income effects emanate in other parts of the economy.

⁵ Regions whose development and structural adjustment is below the European average.

⁶ Natural convergence describes the assumption that poorer regions should have higher growth rates than core regions (cf. Martin, 1999, p. 158).

⁷ Regional policy is understood as economic policy performed in regions, i.e. in socio-economic territories that are smaller than the nation state.

⁸ For an overview of these approaches, cf. for instance Schätzl (1998).

⁹ These ideas are adopted in German regional policy: one of the requirements for financial support are supraregional sales of at least 50 % of the turnover which is based on the export base conception, "supraregional" being defined as a 50 km distance from the firm location in the old West German states and as 30 km distance in the newly formed German states and Berlin.

Contrary to neoclassical theories, evolutionary approaches include phenomena like uncertainties, variety, routines, path dependency, bounded rationality and selection. The consideration of these mechanisms leads to a modified role of policy-makers: "In a world of uncertainty, policy-makers pursue a policy of trial-and-error. They learn and adopt in the light of experience, and there is no guarantee of success." (Lambooy/Boschma, 1998, p. 10) These authors point to the fact that adaptations to changes in the regional structure are rather limited and depend on the history of the region. In order to be successful, policy measures should consider the regional context in which they are implemented. In the case of structural change and the emergence of new technologies with increasing returns, Lambooy/Boschma refer to the stochastic and unpredictable nature of these new technologies and their locations. In this case, firms and institutions create their own selection environment. Even though it is not possible to predict *ex ante* where new technology firms will locate, policy-makers have different degrees of freedom to support a favourable regional environment. Apart from the availability of knowledge workers, firms in quickly developing technologies require that "... the barriers to entry should be low, especially the costs of producing or acquiring knowledge, and the availability of flexible regulations and access to credit seem to be decisive for success. It should be possible to foster the region's learning processes, not only by enhancing training and education, but also to assist SMEs to innovate and establish networks of cooperation; also it is possible to create an environment which retains or attracts innovators and the workers which are decisive for the development of competences." (Lambooy and Boschma, 1998, p. 19).

Regional policy pursues the following aims: (i) growth, (ii) equity and (iii) stability. The growth aim postulates that an efficient distribution of production factors in the territories of a nation state leads to overall growth within the national economy, whereas the equity aim focuses on a decrease in unequal living conditions within a state. The last aim – stability – is based on the assumption that there are not only sectoral, but also regional business cycles leading especially to unemployment in regions with declining industries (cf. van Suntum, 1981, p. 30 ff.). Considering the aims of regional policy in detail, it becomes obvious that they cannot all be achieved with one type of policy. Goal conflicts are the consequence, especially between growth and equity. Consequently, following the growth aim leads to the distribution of production factors in locations that promise the highest marginal revenues, whereas pursuing the equity aim would favour an equal distribution of production factors within the territory. Pursuing the first goal thus would result in a "picking the winner" strategy, the second in a "supporting the less favoured" policy. Regional policy generally focuses on the equity aim, i.e. the support of equivalent circumstances and living conditions in all parts of the territory. The European Union also takes equal conditions as main goal, assuming that convergence between European regions lead to more competitiveness for the Union as a whole: "Socio-economic disparities between regions can, however, be harmful to the whole Union. Under-performance in weaker regions leads to a fall in consumer demand for Euro-

pean products, hinders economic development, distorts competition in the single market and ultimately reduces the EU's competitiveness worldwide." (European Commission, DG Regional Policy). Besides regional policy, several sectoral policy types have spatial impacts, without being conceived as spatially oriented policies. Infrastructure policies, education policies (locations of universities, etc.) or technology policies have primarily different aims, but support of these aims has very often regional incidence. Technology policy, for instance, aims at encouraging technological developments. It is most efficient in cases where the bases for these technological development already exist (e.g. research laboratories, education institutions, specialised firms) so that technology policy rather supports already existing centres. Thus, this kind of policy might in some cases support those regions that are already well developed and not those that are lagging behind. Without having regionally oriented goals, certain policies like technology policy might even increase regional disparities.¹⁰

4. Regional innovation systems and regional governance

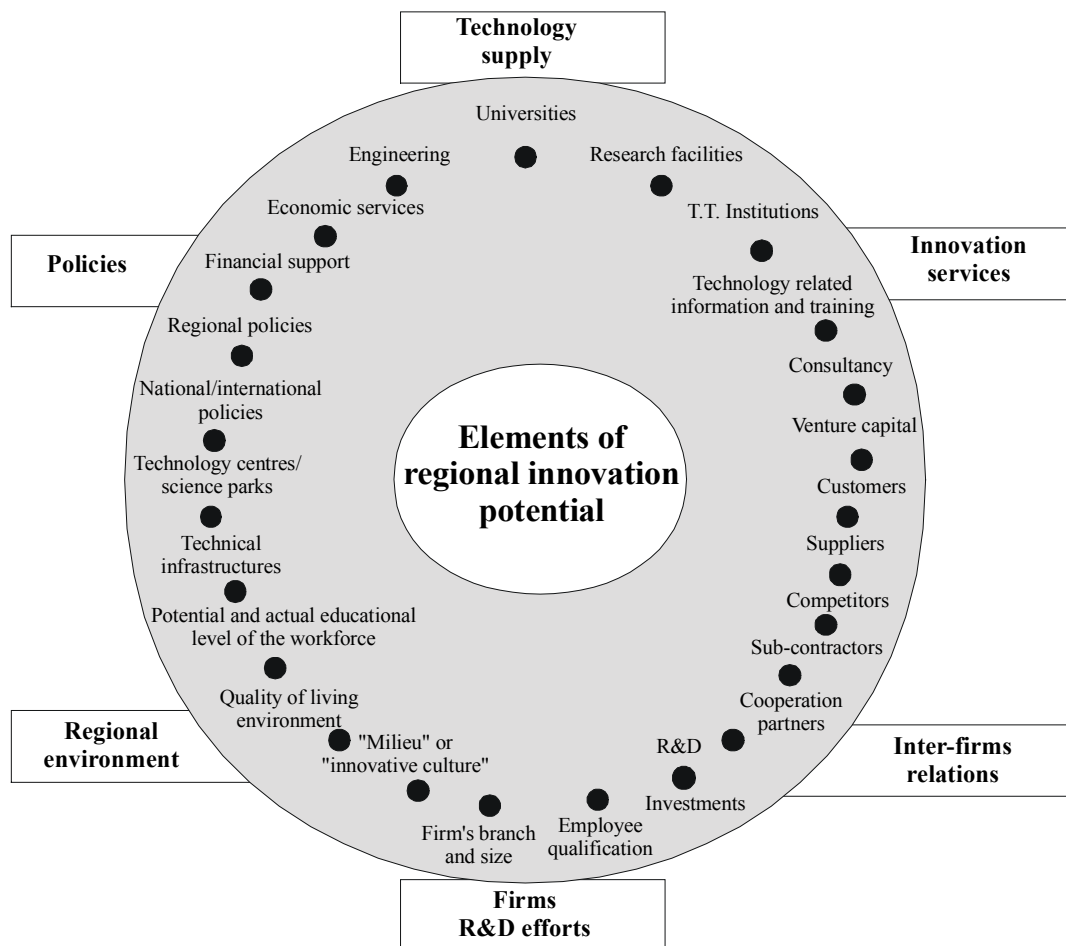
Originally developed on the national level (cf. Freeman, 1987, Lundvall, 1988, Edquist, 1997), the concept of systems of innovation has been transferred to the sub-national level and encompasses regional characteristics and specific innovation patterns (cf. Cooke, 1998). In this conception, the environment of an innovating firm (cf. fig 1) consists of a multitude of aspects that are involved in the innovation process: agents such as firms (manufacturing and business service firms), research institutions, education and training organisations, policy-makers (governance of the region), financial institutions, intermediary organisations (chambers of commerce, technology transfer organisations, etc). Additionally, factors such as history, culture, social developments and especially the existence of an innovation-supporting culture, i.e. an overall openness towards innovations, belong to firms' innovation environment.¹¹ Consequently, different regions display regional-specific governance structures that are rooted in the respective economic, political and social envi-

¹⁰ There are examples of "spatially oriented technology policies" though, e.g. the BioRegio competition performed by the German Federal Ministry for Education and Research. The aim of this competition was to identify and support so-called 'Bio Regions', i.e. regions that already possessed pre-requisites for a successful development of biotechnology. This was supposed to contribute to the overall goal of decreasing the 'biotechnology lag' of Germany in comparison with other nations (see for instance Dohse, 2000).

¹¹ Cooke (1998, p. 11) describes the systemic character of an innovation system like this: "Clearly, an innovation system is a social system, and innovations are the result of social interaction between economic actors. Furthermore, it is an open system in interaction with its environment. Here, the feedback mechanism is important in producing new knowledge and new technologies. The innovation system not only has an influence on its environment but also on its own external conditions."

ronments and also in their individual history.¹² Brazcyk and Heidenreich (1998, p. 434) state that appropriate governance structures are one precondition for innovation-related long-term co-operation arrangements: "Therefore, neither science nor industry nor politics can meet the challenges of global competitive innovation single-handedly. It is much more a question of coordinated cooperation between governmental, scientific and political actors. Such polycentric ways of organizing innovation activities may be referred to as innovation networks [...]. These are understood in the sense of cognitively and normatively anchored reciprocal relations between businesses, training and research institutes and politico-administrative authorities."

Figure 1 The "spectrum" of regional innovation determinants



Adapted from: Muller, Gundrum and Koschatzky (1994), p. 54

¹² Wiehler/Stumm (1995, p. 244/245) distinguish the following governance types in Europe: 1) regions with wide-ranging powers (e.g. German Länder), 2) regions with advanced powers (e.g. Spanish autonomous communities), 3) regions with limited powers (e.g. Dutch provinces) and 4) regions without power (e.g. Portuguese planning regions).

In a similar way, focusing on the systemic and interactive character of innovation, Cooke (1998, p. 10 ff.) points to the associative approach in innovation. Learning processes and innovation success are fostered by such interrelationships and are supported by appropriate governance structures: "*Associative governance* involves something of a shift from state regulation of economic affairs to a degree of self-regulation by responsible groups in economy and society. [...] this means ceding some aspects of economic governance to associations at large capable of managing certain aspects of communal provision (such as vocational training or technology transfer), supported by appropriate financial mechanisms. It also implies decentralized, transparent and consultative governance." (Cooke, 1998, p. 11). Attempting a typology of regional innovation system, Cooke (1998) considers regional governance besides the business structure as a decisive dimension. Three modalities of regional governance are derived: grassroots, networks and dirigiste. Grassroot regional innovation systems are primarily locally organised, whereas innovation systems of the network type can be described as multi-level. Innovation activities in dirigiste regional innovation systems are influenced by central bodies external to the region.

As stressed by Lambooy/Boschma (1998, p. 6): "(...) governments and other regional institutions are not only dependent on history or on markets. Their degrees of freedom to act are related to the argument that the specific local, regional and national patterns of institutions and national technology systems may offer opportunities for urban and regional authorities to influence the direction of the development paths of the technological and organisational processes." In a similar way, Nauwelaers (2000) emphasises the importance of "regional intelligence" and of "policy learning" which can be seen as "(...) the capacity of policy-makers to grasp the trajectories taken by firms in their knowledge governance modes (...) and the capacity to respond to such changes by developing flexible policy approaches in instruments." (Nauwelaers, 2000, p. 20). In other words, it appears as a necessity to combine regional intelligence (i.e. the ability to understand the regional socio-economic context and to identify firms' needs) with policy learning (i.e. the aptitude to allow and support evolution in policy-related aims and tools). In doing so, "adequate" governance can be achieved, integrating successfully at regional level "hardware" (physical capital), "software" (human capital) and "orgware" (social capital). Nevertheless, it seems realistic to consider that "adequate" regional governance constitutes rather an exception than a rule and one must be conscious that "(...) the understanding of innovation as an interactive, territorially-embedded process, is not yet translated in concrete policy evolution. (...) the innovation policy scene is still dominated by linear tools, addressing inputs in the innovation process rather than the functioning of the system, and providing support to firms in isolation rather than to networks of actors." (Nauwelaers, 2000, p. 10).

5. RTD and regions

Considering RTD policies as practised in Europe, it appears clearly that the main focus consists in strengthening the science and technology base of the different actors constituting the innovation system and in bolstering their international competitiveness. Nevertheless, additional aims are considered also, such as the stimulation of training and researchers' mobility; co-operation between firms and academic institutions in and between member states as well as with third countries.

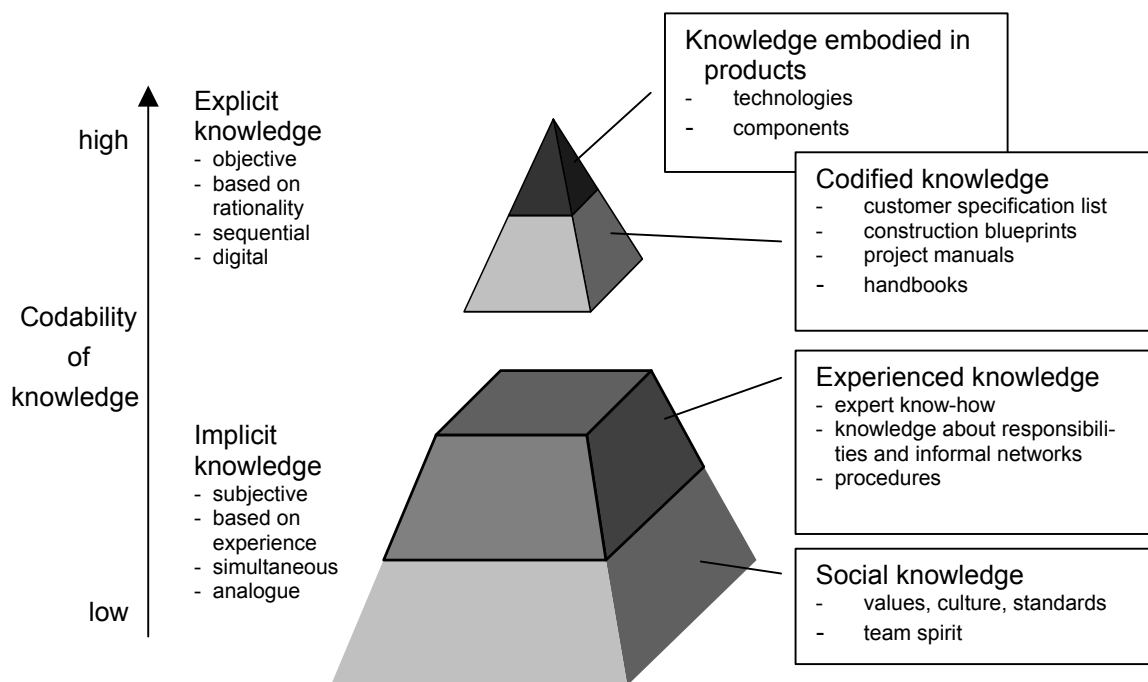
In this respect, the articulation between RTD policies and regional development policies raises at least three important issues:

- the issue of (intra- and inter-regional) networking, i.e. how do actors involved in innovation processes co-ordinate their efforts depending on the territories in which they are located;
- the issue of territorial equity (rather than "equality", since regions benefit from different initial allocations): investment decisions related to scientific and technological activities may for instance significantly affect regional development paths, especially in regions lagging behind;
- the issue of overall efficiency: since the results of innovation efforts appear as (at least partially) dependent from the spatial environment in which they are performed, it seems necessary to ensure that innovation investment and activities are adapted to their location.

The importance of the three issues evoked above is reinforced in the current context of "knowledge-based economy" or "knowledge-driven economy" (cf. European Commission, 2000). The main implications of this context for the issue of RTD policies and regional development can be detailed as follows. In fact, the economic understanding of knowledge relates primarily to the process of knowledge creation and diffusion within the economy. To grasp this process, it is necessary to consider the issues of codability and codification of knowledge. The distinction between tacit and codified knowledge has been established by Polanyi (1966). Whereas **codified knowledge** is easily transmittable in a formal and systematic language (comprising words, figures, etc.), **tacit knowledge** always has an implicit or individual related character (strongly based on personal experience) which makes its formalisation and exchange difficult. The "knowledge pyramid" provides a possible representation (among others) of the distinction between tacit and codified knowledge (cf. figure 2). Nevertheless, it is important to keep in mind that these two forms complement rather than substitute each other. In fact, they tend to co-evolve: the process of codification generates new tacit knowledge. For instance, the ability of an individual to understand or interpret the codes in which knowledge is articulated is itself based on tacit knowledge, which can only be acquired through practice and experience. "Any organization that dynamically deals with a changing environment

ought not only to process information efficiently, but also create information and knowledge", asserts Nonaka (1994, p. 14). This circulation of knowledge implies its transformation along two dimensions (explicit/tacit - individual/social). Focussing on firms and on innovation activities, the knowledge-base of a firm can be interpreted as a combination of *tacit* (or implicit) and of *codified* (or explicit) knowledge. The expansion of a firm's knowledge base can be realised by the exploitation of internal search capacities or by the acquisition of external knowledge (cf. Saviotti 1998). In this respect, a firm's expansion depends on the "absorptive capacities" it develops (cf. Cohen and Levinthal 1989). To sum up, knowledge constitutes a precondition for understanding (new) information; and to create (additional) information. Consequently, knowledge is intimately interrelated to innovation processes.

Figure 2: The pyramid of knowledge



Adapted from: Gassmann (1997, p. 152)

The phenomenon of innovation should be understood as a **cycle involving interaction between tacit and codified knowledge**. To make the link with the approach adopted by evolutionary economics, it is possible to assert that: (i) firms are organisations which apply different inputs, one of the most relevant for innovation being *information*; (ii) information is *accumulated in* and *processed by* the knowledge base of the firm; and (iii) *knowledge accumulation* and *knowledge processing* by firms result from learning. From a dynamic perspective, knowledge can be seen as

expanding by associating in different forms, tacit and codified knowledge.¹³ On the one hand, the codification of tacit knowledge allows an availability of knowledge which increases with time. On the other hand, the dynamic expansion of codified knowledge generates the appearance of new areas of tacit knowledge.

Turning to implications of the knowledge-driven economy for RTD policies and regional development, it can be stated that this context provides new opportunities as well as new threats. In a "knowledge-driven economy"¹⁴ context, it may be assumed that regional innovation and competitiveness is determined by the capacity of a territory to generate both economies of scale and economies of scope: in terms of scale, it must be stressed that scientific production generally needs proximity and concentration (the output of science is very codified and non-local, but certainly not the process of research); in terms of scope, the knowledge-based economy requires a concentration of diversified competences and assets and such a context is typical of large urban areas.

Focusing on the situation of regions in Europe, two facts must be noticed (cf. Clarysse and Muldur, 2001):

- discrepancies between European regions, notably in terms of economic indicators, are not decreasing as clearly as between member states,
- regional discrepancies related to innovation capacities and results are more important than economic discrepancies.

In the light of the above mentioned importance of expanding knowledge in a knowledge-driven economy, the relations between the tacit/codified nature of knowledge and the influence proximity/agglomeration effects must be particularly stressed. Basically, two contradictory forces may be observed in the economic development of regions. On the one hand, investments flow towards the "poorer locations" where factors are cheaper, which supports convergence. On the other hand, due to the effects of scale and scope economies, the "rich locations" get richer, strengthening divergence. For usual economic variables there is no systematic dominance of one of the forces in the long run (model regions of the industrialisation era have become "has been" - and then sometimes returned recently to successful development; rural areas of the early 20th century now belong to the core of the European technological backbone; etc.). Nevertheless, in a knowledge-driven economy, the tendency towards inter-regional divergence may be stronger than the convergence forces, since:

¹³ For a detailed analysis of knowledge creation, transformation and diffusion within firms, see Nonaka (1994).

¹⁴ Cf. European Commission, 2000, p. 11.

- knowledge production proceeds generally through combinations of existing knowledge
- although highly codified in their formal contents, big science and high technology need a lot of tacit knowledge to be processed, then proximity and agglomeration is favoured
- knowledge-intensive flows, between actors of the innovation process (notably private firms) suggest the existence of a dominant spatial hierarchy in terms of knowledge exchanges, diffusion and use (cf. Wood (1998) considering the case of knowledge-intensive business services).

At the same time, expansion of the knowledge-driven economy offers new opportunities for regional development and RTD policies. From "Silicon Glen" to several "sunbelt regions" in Continental Europe, we see examples of recent technological developments in areas that were no longer, or had never been, core industrial regions. Other regions exhibit high growth rates and innovative aptitude without following the model of industrial development: service-based development is also among the possible models of the new economy. Such a vision stresses the importance of adequate tools supporting the elaboration of relevant policies. The important point is to aim at balanced and sustainable policies, that often means to recognise the variety of the contexts and opportunities. On the latter point, it is worthwhile noting that local authorities do not systematically have a better intuition of the richness of opportunities and of the variety of development models to take into consideration. Furthermore, a confusion of image and reality is always possible in regional policy design, leading to a biased perception of the RTD "needs". Some of the new jobs around IC technologies are good examples of self-organised changes that were neither triggered nor foreseen by any local governance.

Conclusion: A regional typology of innovation needs as a tool favouring balanced and sustainable regional innovation policies is required

Are the policy aims of the ERA and the expectations of European regions necessarily in contradiction? In fact, from an overall perspective and for each scientific field which is a priority for the European Community, efficiency should lead to focusing RTD action on the (few) specialised regions with critical mass, instead of spreading support everywhere. At the same time and from a regional perspective, it is clear that in most European regions, actors tend to develop parallel initiatives (and individually ask for support), because their vision of the regional entity is that of a system living *per se*.¹⁵ As a consequence, there is real need for a reasonable vision,

¹⁵ Cf. Héraud (2000).

leading to a balanced position. As such, it may be of importance to accept the fact that there is no unique or "one best way" of innovation-related development at regional level. On the one hand, only a few regions will massively evolve following the science-based model of development and it is not necessary to have all the components of the chain-linked innovation process in every region. On the other hand, the existing variety of regional innovation systems must be stressed. This implies a diversity (in terms of local dominant type of competence to innovate) which, in turn, favours a multiplicity of mode of organisation of the innovation activities at regional level. Moreover, it must be kept in mind that regional innovation systems are not closed systems, and that every actor located in a region defines its own relevant cognitive networks, which are seldom limited to the region.

Adopting a vision of European regional evolution corresponding for instance to a polycentric spatial development model¹⁶, a significant contribution of the ERA could be to promote the development of networks of regional competencies through balanced and sustainable regional innovation policies. Policy tools developed in the frame of the ERA will not be spontaneously consistent with regional (and national) expectations and needs in terms of innovation capacities and economic development. As a consequence, a typology such as RETINE may provide a useful tool, establishing for instance a basis for negotiations between regions, member states and EU.

In this respect, and in order to support the methodological conception of such a typology, following questions must be raised:

- To what extent can an adequate regional integration of demand and supply of knowledge be expected, or in other words: **Can regional innovation needs be specifically identified?**
- What are the main factors and accompanying policy tools that successfully lead to socio-economic evolutions at regional level, or in other words: **What are regional vectors of change?**
- What are the relevant framework conditions for applying these policy tools, or in other words: **How can "families" of European regions be identified?**

In order to answer these questions, the second stage of the project will explore the elements supporting the constitution of a typology of European regions reflecting innovation needs, vectors of change and framework conditions. To achieve this goal, it will be notably necessary to examine existing regional typologies and classification¹⁷, to identify the main actors to be considered (SMEs, KIBS, ITI, large

¹⁶ Cf. European Commission (1999, pp. 19-34)

¹⁷ As an example of existing typology, see for instance Clarysse and Muldur (2001).

firms, venture capital firms, etc.) and to operate a selection of case regions in order to carry out field research.

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