In *GeoJournal*, n°49, 373-380.

Is Geographical Proximity Necessary in the Innovation Networks in the Era of Global Economy ?

Alain RALLET* and André TORRE**

* IRIS, University of Paris-Dauphine

E-mail : Alain.Rallet@dauphine.fr

** Institut National de la Recherche Agronomique

E-mail : torre@inapg.inra.fr

INTRODUCTION

The analysis of the spatial dimension of research and innovation activities was given renewed attention in the 1990s. Traditionally, the geography of these activities was analysed from the diffusion point of view (Hagerstrand, 1967). The question of the conditions of innovation production was mostly ignored, and as a result, so was the geographical framework of this production. In the 1980s and 1990s, the analysis focused on the institutional framework of the production of innovations; indeed, a number of differences had appeared between countries or regions which, at a comparable level of development, showed unequal rates of innovation. The concept of a national system of innovation was then developed in order to find explanations for this phenomenon (Lundvall, 1992).

But in this analysis, the spatial dimension of innovation remains mainly implicit. Space is, indeed, taken in account in the national framework, but the framework in question is institutional rather than geographical. The transposition of these analyses onto the local level poses a problem. This is why research turned, in the 1990s, towards an explicitly geographical analysis of the processes of research and innovation. (Jaffe, 1989, Jaffe and alii, 1993, Feldman, 1994, Audretsch and Feldman, 1996…). This literature on geographical spillovers examines the role of geographical proximity in the activities of research and the production of innovation.

The commonly accepted hypothesis is that "*knowledge transverses corridors and streets more easily than continents and oceans*" (Feldman, 1994). Indeed, knowledge is no longer considered as a public good freely diffused in the economy as suggested by Arrow (1962). A crucial distinction has to be made between two kinds of knowledge, namely tacit and codified knowledge (Polanyi, 1966). Usually, " tacit knowledge refers to knowledge which cannot be easily transferred because it has not been stated in an explicit form " (Foray and Lundvall, 1996) while codified knowledge – or " information "- is reduced to messages which can be easily transferred between economic agents through non human supports. It is assumed then that codified knowledge can be exchanged regardless of distance by using technologies of communication, be there old (postal mail) or new (electronic mail, computer conferencing...). At the opposite, to transfer tacit knowledge requires to share a common

work experience through face-to-face relations. As a consequence, geographical proximity appears as a necessary condition for an efficient share of knowledge, especially in the case of tacit knowledge intensive activities such as research and innovative activities.

These justifications serve as theoretical foundation to the literature dealing with "learning regions" (see B.Amein, O.Crevoisier, this volume). And yet, they correspond to rhetoric rather than to reality.

1) The reality of the geographical spillovers has not been proved. The econometric research undertaken to demonstrate their existence has seldom tested the hypothesis of the relations of proximity between the research and innovation agents. It tries to validate connections between geographical concentrations of agents (universities, research centres, firms) which are assessed through R&D expenditures or workforce and the performances of one region or area as regards innovation (patents or innovations counted in statistics studies), rather than to validate the effective relations of proximity between geographically concentrated agents (Autant-Bernard and Massard, 1998). This can be explained by the lack of data. Indeed, only two partial sources of data are available for us to be able to test the hypothesis of the relations of proximity: the quotations of patents by another patent, the bibliometric data (collective works and quotations).

2) The explanation given for the geographical concentration by the argument of tacit knowledge is very unsatisfactory. Our point of view is that the distinction between codified ant tacit knowledge cannot be used to explain the localisation of the agents who use this knowledge. Besides the problems of definition and measurement which this distinction poses, it is incorrect to believe that it can be made equivalent to the geographical distinction between a face to face relation and a distant relation. This is why we have not tried to use this distinction in our argumentation and in the case studies. The distinction between formal (or codified) interactions and informal interactions (co-ordination does not respond to rules which would be explicitly defined in advance) appeared to us more useful to explain the more or less important necessity for face to face relations.

In the first section, we discuss the necessity for the actors of innovation to be physically close to one another, starting with the analysis of their need for co-ordination and using some case studies. In the second section, we examine the importance given by the local development policies to geographical proximity to support the rapid development of local networks favouring innovation with the example of three French regions.

1. CHARACTERISTICS OF RESEARCH AND INNOVATION ACTIVITIES, CONSTRAINTS OF THE AGENTS' PHYSICAL PROXIMITY AND USE OF ICT.

This section analyses the need for economic agents to be closely located to develop research and innovative activities. According to the common thesis, the constraint of geographical proximity remains very strong, even with an intensive use of ICT. (1-1). But advantages supplied by physical proximity can also be provided to a certain extent by other means of coordination (organisational proximity) and ICT

increase to a significant extent the possibilities of remote coordination (1-2). A few lessons will be drawn from case studies (1-3).

1-1 Do ICT call into question the need to be closely located to cooperate in knowledge intensive activities ?

Let us remind ourselves of the arguments which justify the role played by geographical proximity in the joint development of innovative and research activities :

- these activities are tacit knowledge intensive

- the more tacit knowledge is, the more face-to-face relations are necessary

- the higher the frequency of face to face relations is, the more the need for permanent physical proximity is important.

Two of these criteria (the weight of tacit knowledge and the frequency degree of face to face relations) vary according to the nature of the activities and the stage of their development. The question is whether ICT change this situation. It is usually suggested that ICT do not basically modify the need for geographical proximity. According to this point of view, ICT are only increasing long distance exchanges of codified knowledge. From a remote location, it is easy now to be connected to databases, to read technical instructions or working papers, send texts, data or pictures... Consequently, it is expected that ICT increase the scope of remote coordination in so far as it is based mainly on exchange of codified knowledge. But as research activities also involve intensive exchanges of tacit knowledge, the geographical proximity constraint remains very strong.

However, it could be argued that ICT increase the possibilities of remote coordination insofar as it is a powerful means to turn tacit knowledge into codified knowledge (for instance conversion of tacit knowledge into expert systems and know-how databases, storage of organisational knowledge on CD ROM, automation of routines by the mean of workflow software....). If such were the case, the geographical proximity constraint would become less and less strong.

It should therefore be supposed that ICT can gradually reduce tacit knowledge considered as a given stock. However, that is impossible for four reasons:

- The process of coding knowledge implies a cost which is an increasing function of the tacit degree of knowledge. It is often more efficient and less expensive to rely on tacit knowledge exchanges than to codify knowledge in order to transfer it easily (compare the limits of expert systems, Hatchuel and Weil, 1995)

- Advances in science and technology constantly rebuild new tacit knowledge. The development of science and technology takes the form of emergent knowledge which cannot be immediately codified. That is the reason why invention and innovation are so concentrated in some places.

-Tacit and codified knowledge are complementary. As Nonaka (1994) underlines, the transmission of codified knowledge supposes the use and sharing of common tacit knowledge. Conversely, the transfer of tacit knowledge is based on the use of codified knowledge.

- The use of ICT tools requires the sharing of common codes and practices of communication which are tacit. This is why the tools of remote communication are especially used by individuals who meet frequently.

For all these reasons, tacit knowledge will always be used in research and innovative activities. Consequently, face-to-face relations and geographical proximity prove to be necessary to this kind of activities.

Conclusion : one has to expect an extension of the geographical scale of the coordination process in the research and innovative activities thanks to the possibility of remotely sharing codified knowledge. But the development of ICT does not basically modify the need for face-to-face relations owing to the important weight of tacit knowledge in these activities.

1-2 Geographical proximity as a relative and less and less strong constraint

Two arguments moderate the above thesis. The first underlines the possibility of satisfying the need for physical proximity by the temporary mobility of individuals (that is travel), and not by permanent colocation. The second stresses another kind of proximity (organisational proximity) which allows informal interactions between remote locations.

The need for a face-to-face relation does not involve that individuals are closely located. It implies only that individuals meet often. In certain circumstances, the problem can be solved by the mobility of individuals. This is the case when the frequency of informal interactions is not very high. This case is frequent : to design and to develop a product, firms constitute project-oriented task forces based on teams gathered temporarily together and belonging to different plants. Individuals of the task force meet at the beginning of the process and then only at defined moments. Alternation between moments of proximity coordination and moments of remote coordination is supported by the decrease of transport costs and the development of high- speed means of transport.

Geographical proximity is not the only kind of proximity which allows informal interactions. There is also a kind of proximity created by membership of the same organisation or professional community, which can be called *organisational proximity*. An organisation can be defined as a set of rules (or routines) showing individuals how to behave in such and such a professional situation. These rules can be written in the form of codified procedures or exist in an informal manner. For instance, organisations develop common ways to think and solve production problems. This collective and technical culture guarantees that employees will spontaneously give the same interpretation to exchange data or text, even if they are located in different places. This does not mean that there are no conflicts or differences of representations between individuals or groups of individuals but that there is a set of shared rules, including those used to interpret conflicts. Organisational proximity is the set of routines – explicit or implicit - which allows individuals of a same organisation to be co-ordinated without having to define beforehand how they must do it.

Organisational proximity is as efficient as geographical proximity to develop informal interactions. Indeed, it is well known that individuals can be closely located and nevertheless behave like foreigners. Geographical proximity is effective only if it coincides with the existence of organisational relationships. Whereas at the opposite extreme, one can imagine individuals developing informal interactions without being physically closed.

Geographical proximity is not the only supporter of coordination, especially for research and innovative activities. This argument is strengthened by the use of ICT to coordinate individuals and teams. The traditional thesis claims that ICT support only codified interactions. For this reason, ICT considerably widen the potential scope for remote cooperative work or activities (search for new partners, greater access to

knowledge databases, teleconferencing, codification of cooperative work procedures...). But ICT are supposed to have a weak impact upon informal interactions (unless they can be codified by ICT). The need for informal interactions continues to lock the door against extensive remote cooperation.

But this argument does not take into account one of the most important changes brought about by ICT during these last years, that is, their increasing ability to support informal interactions. Of course, ICT are not a simple substitute for in-person contact because social presence cannot be easily recreated by ICT tools. Many studies have shown this by comparing face-to-face relationships with mediated communications in laboratory simulations (the psychobehaviourist approach) or by analysing these two situations within the framework of an ethnological approach (on this subject, see the surveys of Garton, Wellman, 1996, Wellman and alii, 1996, Cardon, Licoppe, 1997). Face-to-face meetings and computer-mediated communication are never equivalent. As a result, the need for geographical proximity cannot be totally eliminated by the use of ICT.

Nevertheless, ICT can be used to support informal relationships. For instance, the practice of computer conferencing or e-mail does not replace face-to-face meetings but creates new kinds of social contact and even interpersonal relationships between persons who are physically distant. ICT increase access to new people, provide individuals with new opportunities of contact and facilitate social networking by weakening social, spatial and temporal barriers (see the use of e-mail, newsgroups, forums, discussion lists... on Internet). It is no longer possible to consider ICT as a means of formalised communication as was usual before the development of Internet. Other examples of ICT supporting informal interactions interactions can be quoted. For instance, ICT generate redundant information which is generally presented as one of the main advantages of geographical proximity because it provides the capacity to build up social ties as bridges between informal sources of information. Some ICT tools such as hypertext are based on cognitive processes similar to those which characterise tacit knowledge, for instance, the use of metaphors (see Nonaka, 1994) or the analogical way of reasoning.

Consequently ICT are used not only to support strong ties by codified relationships but also to support weak ties by informal interactions. We know the important role of weak ties in setting up, regulating and widening social networks and professional communities in the field of research and innovation. So ICT raise the capacity to develop new ways for informal relations between physically distant individuals or teams. The possibilities of coordination through space are improved thanks to this capacity. This could be one of the major impacts of ICT on location patterns.

However it must be repeated that ICT do not eliminate the need for face-to-face meetings. It generate a dynamic complementarity between face-to-face meetings and distant coordination. It is well known that the development of distant coordination by the means of ICT increases the incentives for people to travel in order to have face-to-face meetings. This rule is particularly true in the field of research and innovation : in many cases of telecooperation, airplane tickets are the main item of the team's budget. ICT thus reinforce the probability for coordination to be supported in an alternative way by mobility and distant coordination. In this perspective, the crucial location factor for individuals or firms engaged in cooperation is not to be physically closed to partners but to be located close to high-speed transport infrastructure which allows them to meet when ever needed.

1-3 A few lessons drawn from case studies

The first case study is focused on the case of a graphic data-processing company (Silicon Graphics) whose centres of R&D are distributed on five world sites. The purpose of their cooperation is to conceive and to develop graphic animation software. The second case study is the design and development of a videoconference system by CNET (National Center of Studies for Telecommunications, France). This project needs the cooperation of four research centres located at different sites. A third case study is on the development by a Corsican Studies Centre (CIRVAL) of an expert database on specific agricultural products. The database is fed and consulted by research and studies centres located around the Mediterranean Basin. Fourth, a questionnaire was addressed to academic researchers and teachers at two French Universities, the University of Bordeaux I (physics and chemistry) and the university of Bordeaux II (biology and medicine). The questionnaire focused on the communication practices of academic people in the framework of their research projects.

Some conclusions can be drawn from these four case studies:

1) *the geographical constraint of proximity is especially strong for research projects carried out within the university community.*

The need for frequent interactions is important throughout the whole process, not only for specific stages such as literature searches, the definition of a common framework or the conclusion of the process but also for the implementation stage for which the solution of a short, medium or long term stay at the same workplace is often used. This is because of the importance of informal interactions and frequent mutual adjustments between researchers at all the stages of research projects. This can be explained by the importance of basic research in these projects but also by the organisational characteristics of academic communities. The weak division of labour which characterises them leads to many overlapping tasks and as a result to the need for partners to carry out frequent mutual adjustments over all the project. This need is reinforced by the absence of a strong authority able to solve the problems of coordination. Whether they are important or not, these problems must be regulated by a direct and consensual dialogue between researchers.

ICT do not basically change this situation. The need for frequent mutual adjustments explains why communication is mainly supported by the use of "rich media" such as face-to-face meetings, telephone, fax, electronic mail and electronic forums. "Poor media" (that is, those which imply formalised and codified relationships, are hardly used. Such is the case of groupware tools whose diffusion is strongly limited by the need to formalise the organisational framework of cooperation.

2) *The more informal the organisation of the project is, the more difficult the remote coordination*

The CIRVAL example shows the difficulty in cooperating remotely through the sharing of knowledge databases within rather informal communities. The reciprocal and decentralised basis of Internet - I put on the network information in exchange for other information I can find there (network externalities) - is adapted to information and knowledge which is already compiled and available. Difficulties appear when the network is used as a decentralised means of knowledge production. Such an attempt immediately highlights organisational problems. Who are the actors who will produce knowledge for the network ? What are the incentives to do it ? Is there a sufficient strong common interest to prevent free-rider behaviours ? These problems are not technical but organisational. They are hard to be solved when the community concerned in the network is not well organised as in the CIRVAL project.

3) *In the case of R&D projects within firms, the need for geographical proximity is relative and can be mainly satisfied by periodic meetings.*

When research projects are developed within organisations characterised by well defined objectives and strong central authority, geographical proximity is necessary only for specific and limited stages (the case of both Silicon Graphic and CNET). It is especially needed for the launch of projects. In the upstream stage of a project, teams engage in brainstorming. During this stage, they are occupied in confronting arguments, convincing others, and finally converging towards the same position. At this stage, face-to-face meetings are required because consensus is obtained much more quickly than through remote coordination even supported by ICT. Remote coordination by phone can be used during this stage but in particular to discuss points of view related to a precise point within the framework of a bilateral relationship and not for long and multilateral discussions. Videoconferencing is more appropriate for technical meetings but cannot replace face-to-face meetings for complex discussions.

The face-to-face constraint is much less strong during the technical development stages. During these periods, tasks are defined and distributed prior to their being carried out, so that remote coordination becomes easier to manage. Adjustments between individuals or teams can be performed through remote coordination by using in a complementary way the whole range of ICT tools, from telephone to specific cooperative software (groupware) and by travel when an important difficulty must be solved.

In conclusion, case studies show that :

- the need for being closely located remains strong for specific stages of innovation and research activities. That is the result of some characteristics of these activities, namely the importance of informal interactions which imply frequent face-to-face contacts between partners but the weight of this constraint also depends on organisational characteristics. When work is divided into precise tasks, when the coordination of these tasks are under the control of a central authority and when partners share the same cognitive maps, the possibility of remote coordination increases

- the need for face to face contacts is not permanent and can be satisfied by periodic travels and short stays combined with the use of ICT to transmit codified knowledge and to develop new kinds of social networking.

Geographical proximity always plays a role but some of the needs for physical proximity can be satisfied more and more by the mobility of people and the use of ICT. One of the results is that functional needs for coordination are no longer a sufficient explanation of the high degree of geographical concentration of innovation and research activities.

2- THE PLACE OF LOCAL NETWORKS IN THE PROCESS OF TECHNOLOGICAL DEVELOPMENT

We have seen, from the analysis of the role of information and communication technologies, that localised actors do not always need to be closely located to take part in a process of innovation and that the organisational proximity is as important as the geographical one. One obtains an identical conclusion on the basis of the analysis of role of local networks in the diffusion of knowledge and technologies. In this section, we will try an assessment of local technological policies which plan to support the diffusion of knowledge and technologies by easing contacts between geographically closed actors, on the basis of the examples of three French regions.

2.1. From the importance of local networks of innovation to the institutional support for these networks

It is nowadays widely assumed that local networks play a major role in the economic and technological development of regions. This idea gives birth in the economic literature to an increasing use of concepts such as localised systems of production, local systems of innovation, etc. All these concepts rest on the importance of geographical proximity relations in the setting in network of the actors of the innovation.

Because they are convinced of the importance of these local networks, the public actors developed regional technological policies directed towards the support or the installation of collective processes of research and innovation. The policies having for objective to share knowledge or competencies within a local framework supplement from now on the traditional policies dealing with material infrastructures. The development of collective networks of actors is thus supported by the local or regional institutions. One must however wonder about the relevance and the limits of these local technological policies. Their implementation reveals indeed several obstacles. The major one relates to the connection between spontaneously created local networks and local networks developed by the institutions.

The spontaneous local networks are a regrouping of local actors around one or several joint economic projects, according to a non market form of organisation. The links are generally not based on contracts or completely explicit agreements, but rather on the support of processes of co-operation or collective learning. The main purpose is a common interest for the production of a good, for the sharing of a technique, or for the search of information necessary to all the members. The exchanges mainly relate to the transfer or the sharing of knowledge and are made through trust relations.

The institutional local networks correspond to structures settled by public bodies in order to bring support to the firms. They concern flexible organization forms, founded on common acceptance of rules which engage the participants, among which one can make a distinction between the producers and the users of information and technological knowledge. The link between the participants in the network is materialised by an adhesion as well as an utilisation of the services offered by an organising cell which also plays an animation part of the whole network. One can find general or specialised networks.

There is a difference between technological policies according to whether spontaneous local networks already exist or not. When they do not exist or are poorly developed, the policy aims to impulse them, to even create them, by the means of incentives or voluntarist policies. When they already exist, the objective is to support their development by in particular supporting transverse cooperations between partners belonging to different worlds (industry, research, higher formation, technical centers...). In both cases, the objective is to connect a spontaneous network of economic actors and an institutional network impelled by the local authorities.

2.2. Two examples of regional technological policies based on institutional networks

The first example is that of a Region, Corsica, *where the spontaneous local networks are poorly structured*.

In Corsica, the public authorities objective was to set up an institutional network in order to support the diffusion of knowledge and technologies. There exists for that in twenty French Regions the so-called Networks of Technological Diffusion (NTD)

whose mission is to diffuse innovations and to support technology transfers. Their main objective is to help the SMEs to solve their innovation problems, be there related to the internal organisation of the firms or to their relations with external partners (laboratories, Universities, other firms, public bodies...).

The Corsican network of innovation is characterised by cooperations between local and " continental " firms. The connections between the local firms miss coherence because of the very narrow local market and the weak development of the science-industry relations. The geographical proximity is not a sufficient condition to the existence of a system of innovating enterprises, and the search for competencies is done outside the Region when they do not exist or are very weak at the local level. In this context, the support brought by the public institutions for the local firms is a major one. It can be further trying to support the formation of a local network of innovators.

The Corsican NTD rests on the following statement : not enough local firms have access to available technological competencies and use the device of innovation support. It was created to make it possible to SMEs to reach external innovation and technology competencies, to mobilise and to regroup local actors, but also to match their actions and to promote the activity of consulting. It aims to improve the efficiency of the regional devices of development aid and support, by easing collaborations and exchanges in order to obtain synergetic effects. To fulfill its mission, it is thus based on " the network effect " as well as on the formation of human resource and the settings of incentives towards technological innovation.

The case of the Aquitaine and Rhone-Alps Regions is different because there exists already strongly structured spontaneous networks. Consequently, the role of the institutions answers the need for supporting specific projects or poles, in this case Biological and Medical Poles (BMP).

The Aquitaine Region is characterised by an old system of high and average technology industries like pharmaceutical industry and medical equipment goods (surgery, medical imagery). There are solids scientific and technological competencies in the field of health and life sciences but there are insufficiently developed and not articulated enough with the industry. In addition to the development of the infrastructures and human resources of scientific research, the industrial and academic actors thus sought to develop cooperations facilitating technology transfer. However, the setting of these networks appeared insufficient and poorly connected with local industrial competencies.

The innovation network of the Rhone-Alps Region occupies a foreground position in the activities related to the sectors of health. At the end of the Seventies, the Region was characterised by a strong presence of large pharmaceutical companies but also of firms specialised in medical goods or medical engineering activities. As regards hospital and R&D, the Region had an international reputation but the co-operation between the local actors was considered to be insufficient. The relations between firms, hospital and researchers were limited to traditional fields such as the drug industry. Construction of interrelations appeared essential in emergent sectors like the activities related to biomedical technologies.

BMP poles of the two Regions are specialised networks, organised around techniques and specific products. Constituted, directed and coordinated by a local institution, they are intended to support the creation of a local technological milieu. Their actions consist in encouraging the relations between research, industry and public authorities in order to support innovation and encouraging the creation of internationally

dynamic markets oriented firms. They were at the beginning to intervene upstream of the chain of innovation, i.e. to support the relations between the public scientific laboratories and the firms. But they quickly changed and rather became providers of services in response to the needs expressed by local industries. In 1993, the Rhone-Alps pole has been considered to be insufficiently efficient : the projects mainly associated public laboratories and not industries. The Region then creates an Agency for biomedical technologies, which gives the priority to industrial firms. The BMP Aquitaine followed the same evolution as revealed by the forming of an Health Strategic Action filiere whose objective is to shorten the delays between the R&D process and the industrial applications.

2-3 From the initial objectives of the policies to the actual local networks

These case studies reveal that the policies do not always achieve the announced goals. One can up to what point wonder if institutional networks, which promote geographical proximity while considering that it supports the process of technological development, are able to encourage synergetic effects at the local level. From this point of view, the gap between the initial objectives and the actual networks exhibits limits of the power of the geographical proximity.

The investigations carried out in the three Regions show indeed that exist only partial re-covering between spontaneous and institutional networks and that, very often, the objectives originally defined by the public authorities have not been reached or have changed on the way.

The Corsican NTD gathers primarily the regional public actors who intervene in the field of technology, but it especially succeeds with better coordinating the practices and the research operations between these partners. Their image, their competencies and their fields of intervention became more readable for local economic actors too. Several firms however remain outside of this institutional network, which is poorly articulated with the private actors networks because there are mainly non local ones.

Theses evidences reveal that in absence of strongly organised spontaneous local networks, the intervention of the public authorities to support local cooperations takes two main steps. The first one is to set up institutional networks in order to cope with the absence of dynamic economic environment and to organise assistance procedures for the local firms. These networks tend then to privilege an institutional functioning, i.e. to develop co-ordination between the public organisms specialised in the support for innovation without really articulating themselves with the local actors. As shown by the case of Corsica, the logic of partnership then remains largely centrifugal.

The analysis of the two other Regions exhibits different relations between spontaneous and institutional networks. The problem is rather to put in synergy various actors of the process of innovation and production of knowledge. In Aquitaine, the institutional networks suffer from an asymmetry between actual academic competencies and insufficient industrial activities. The BMP appears at the same time in shift compared to the spontaneous networks when they exist and in permanent search for a more solid anchoring. That condemns it to widen the field of its missions to the whole medical activities and to play on the connection with foreground institutional actors. In the Rhone-Alps, the existence of a strongly developed industrial system confers to the firms a prior role. The institutional networks have then two problems to define their place and their role. On the one hand, the firms relations largely exceed the regional area. On the other hand the industrial environment is heterogeneous with regard to the types of activities and the sizes of firms.

All that shows that it is difficult to connect, in a voluntarist way, the local actors belonging to different worlds. For example, the fact that doctors and entrepreneurs are located at a short distance is not sufficient to make them work together and constitute themselves in network, in spite of the efforts of the institutional actors. It is even observed that these efforts often lead to the opposite result. They end indeed up supporting homogeneous but distinct networks (the doctors, industrialists, chemists…) and thus give up their initial objective in spite of partial successes (a certain number of concluded contracts). The weakness of the relations between local actors is then likely to be reinforced and to lead to the maintenance of centrifugal logic's of cooperation. Once more, the geographical proximity is put in failure as a form of proximity organised for the activities of innovation.

2-4 Cognitive logic and importance of the organisational proximity

The case studies reveal the uneasy installation of local networks of innovation supported by public policies and show at which point it is difficult to impulse in a voluntarist way localised synergies in terms of innovation and of technology.

The fact that these policies had to deviate their initial objectives and to return to less ambitious goals shows that the often made analogy between geographical proximity and easy diffusion of the techniques or the knowledge must be seriously questioned, in particular if one connects it to the tacit or codified character of knowledge. It is clear that one of the aim of the regional policies is to impulse a technological development on the basis of voluntarist networks of local actors. It is not so simple, however, to break with organisational or cognitive logic's which function since several years.

Our results reveal two main obstacles for the installation of local networks of innovation supported by public policies (these obstacles make clear why these policies had to deviate from their initial objectives) :

- cognitive logic differences, or the importance of the organisational proximity :

One of the obstacles faced by local technological policies is to set up transverse co-operations between local actors of various nature (entrepreneurs, researchers, trainers...), as revealed by the experience of the BMP poles. The practices of work and cognitive logic's are very different from one world to another. Moreover tacit knowledge is more easily transmissible within a professional world (even at distance) than between different worlds (even in the proximity). Although it is supported by the voluntarist development of institutional networks, the sole geographical proximity is not sufficient to break these barriers. Consequently, the diffusion of knowledge and technologies assumes that exists an organisational proximity between the actors, i.e. former relations founded on professional links, these links having or not a local content.

Disjunction between researchers and firms whose cognitive logic's are strongly differentiated is striking in the Aquitaine and the Rhone-Alps Regions. It blockades the process of transmission of knowledge. The visions and expectations remain rather unmatched, the knowledge and the fields of application are heterogeneous. As a consequence, each group of actors only trusts partners with whom it is accustomed to work, even if they are located outside the Region and even if there are sometimes more skilled actors within the Region. The actors privilege the organisational proximity which is based on a long common experience of interactions and reciprocal learning and enables them to overcome the differences in cognitive logic's. Moreover, it is frequent that the required partner only exists in another Region, or even in another country, which limits the interest of the search for local relations. Between the " territory " of

spontaneous networks (which goes from the Region to the contacts on a world-wide scale) and the regional level of the institutional network, the interrelationships slowly build themselves.

- *the weight of the past :*

Thus, the organisational proximity does not necessarily have local foundations. For reasons linked with the way in which the local systems were constituted, the actors are often engaged in cooperations with partners external to the Region. They are accustomed to cooperate, a practice which results in the mutual knowledge of the men and the organisations, as well as by common procedures of work which proved reliable. Putting in contact actors who are geographically closed from each others is not sufficient enough if they did not keep organisational relations before.

The history of local relations counts (“ proximity matters ”) but also the history of the non local relations (“ distance matters ”). By forgetting that, the voluntarist technological policies often end up reproducing the situations to which they previously proposed to bring solutions. The example of the Corsican NDT reveals that it is unrealistic to seek to impose a fast technological development on an interventionist basis, and even more to support in a voluntarist way local interactions with the detriment of external contacts. This is why the current stage is that of an appropriation of new knowledge by the members of the institutional network. This stage is essential to build shared skills between them and because the development of projects and their realisation start a second phase, of recombining of the former relations on the basis of now well defined coordination. Once again, the permanence of the organisational and professional trajectories are very impressive. The previous relations appear strongest and it is only if they imply at the same time a geographical proximity and an organisational proximity that it is possible to promote or to support them within the framework of a regional technological policy.

Conclusion: What conclusions should be drawn from these studies for local development policies?

1) The argument about the “learning regions” leads one to privilege the search for local synergies. However encouraging the capacity of the local industrial and scientific agents to co-operate with non-local partners seems as important as developing, in a voluntarist manner, the local systems of innovation. The economic spaces of firms or universities are made of local and non-local relations. We agree, from this point of view, with the conclusions of Oinas (this volume). This should be taken into account when elaborating the local technological policies.

2) The local economic spaces are often represented as coherent systems of economic, social and cultural relations. The local policies then try to reinforce this coherence through the industrial linkages, the labour market, the training policies, the cultural factors…. This is the Marshallian approach of local economies. If the agents’economic spaces are more and more a combination of local and non-local relations, what should we make of the Marshallian coherence of local economies? The diversity and heterogeneity of the elements composing the local economies can become factors of development, whereas, in the Marshallian approach it is the specialisation and homogeneity of the economic, social and cultural fabric which are searched for. This problem should be examined, including for countries and regions known for the existence of Marshallian districts (Paci and Usai, this volume)

References

Arrow K. (1962), "Economic Welfare and the Allocation of Ressources to Invention" in Nelson R., ed, *The Rate and Direction of Inventive Activity*, NBER, Princeton UP

Audretsch D.B., Feldman M.P. (1996), "R&D Spillovers and the Geography of Innovation and Production", *American Economic Review*, 86 (3), 630-640.

Autant-Bernard C. et Massard N. (1998), "Econométrie des externalités technologiques locales et géographie de l'innovation" CREUSET, Université de Saint Etienne, 19 p

Cardon D., Licoppe C. (1997), Approches des usages en Computer Supported Cooperative Work (CSCW), CNET, Paris

Feldman M.P. (1994), *The Geography of Innovation* ; Kluwer Academic Publishers.

Foray D., Lunvall B.A. (1996), *The Knowledge-Based Economy. From the Economics of Knowledge to the Learning Economy*, Paris, OCDE, 11-34

Galegher J., Kraut R., Egido C. (1990), eds, *Intellectual Teamwork*, Lawrence Erlbaum Ass., Hillsdale, New Jersey

Garton L., Wellman B. (1995), "Social Impacts of Electronic Mail in Organisations : A Review of Literature, *Communication Yearbook*, 18, 434-453

Glaeser E., Kallal H.D., Scheinkman J.A., Schleifer A., "Growth in Cities", *Journal of Political Economy*, 100 (6), 1129-1152

Hägerstrand T., 1967, *Innovation Diffusion as a Spatial Process*, Chicago U.P., Chicago

Hatchuel A., Weil B. (1995), *Experts in organisations*, De Gruyter, New York.

Jaffé A., (1989), "Real Effects of Academic Research", *American Economic Review*, 75 (5), p.957-970.

Jaffé A.B., Trajtenberg M., Henderson R., (1993), "Geographic Localisation of Knowledge Spillovers as Evidenced by Patent Citations", *Quaterly Journal of Economics*, 108 (3), p.557-598.

Lundvall B.A., ed., (1992), *National Systems of Innovation*, Pinter Publishers, London, 45-68

Nonaka I. (1994), " A Dynamic Theory of Organizational Knowledge Creation", *Organization Science*, 5 (1), 14-37.

Polanyi M. (1966), *The Tacit Dimension*, Routledge & Kegan, London

Wellman B., Salaff J., Dimitrova, D., Garton L., Gulia M., Haythornthwaite C. (1996), "Computer Networks As Social Networks : Collaborative Work, Telework and Virtual Community", *Annual Review of Sociology*, 22, 213-238