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On the role played by temporary geographical proximity in knowledge transmission

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On the role played by temporary geographical proximity in knowledge transmission

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Abstract
In this article, we defend the thesis that geographical proximity remains essential for knowledge transfer, but not often implies the co-location of innovation and research activities. The need for geographical proximity now mostly affects certain stages of the process of production, research or development. Short or medium-term visits are often sufficient for the partners to exchange the information needed for cooperation. The mobility of individuals makes it possible to implement this mechanism. Temporary geographical proximity implies a strong relation to space but one that differs in nature from that described by the traditional approaches.

Keywords: geographical proximity, organised proximity, ubiquity, clusters

JEL Codes: O, O3, R, R3

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Rôle de la proximité géographique temporaire dans la transmission de la connaissance

André TORRE

Résumé
Dans cet article, nous défendons la thèse selon laquelle la proximité géographique demeure essentielle au transfert des connaissances mais qu'elle n'implique pas souvent la co-localisation d'activités d'innovation et de recherche. La nécessité de la proximité géographique affecte surtout, aujourd'hui, certaines étapes des processus de production, de recherche et de développement. Les visites à court ou moyen terme suffisent souvent aux partenaires pour échanger des informations nécessaires à leur coopération. La mobilité des individus permet de mettre en œuvre ce mécanisme. La proximité géographique temporaire induit une forte relation à l'espace mais une relation qui diffère en nature de celle qui est décrite par les approches classiques.

Mots-clés : proximité géographique, proximité organisée, ubiquité, agrégats

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Codes JEL : O, O3, R, R3

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Die Rolle der vorübergehenden geografischen Nähe zur Wissensübertragung

André TORRE

Abstract
In diesem Artikel verteidigen wir die These, dass eine geografische Nähe zur Wissensübertragung nach wie vor unverzichtbar ist, aber oft keinen gemeinsamen Standort der Innovations- und Forschungsarbeit voraussetzt. Die Notwendigkeit einer geografischen Nähe betrifft heute meistens bestimmte Phasen im Produktions-, Forschungs- oder Entwicklungsprozess. Oft sind kurze oder mittellange Besuche für die Partner ausreichend, um die für eine Zusammenarbeit benötigten Informationen auszutauschen. Die Mobilität der einzelnen Personen macht eine Umsetzung dieses Mechanismus möglich. Eine vorübergehende geografische Nähe setzt eine enge Verbindung zum Raum voraus, deren Beschaffenheit jedoch von den Beschreibungen der traditionellen Ansätze abweicht.

Keywords:
Geografische Nähe
Organisierte Nähe
Ubiquität
Cluster
JEL Codes: O, O3, R, R3

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CRES-2006-0154.R2
El papel desempeñado por la proximidad geográfica temporal en la transmisión de conocimiento

André TORRE

Abstract
En este artículo defendemos la tesis de que la proximidad geográfica sigue siendo un factor fundamental para la transferencia de conocimientos aunque esto no suele implicar la ubicación conjunta de las actividades de innovación y las de investigación. La necesidad de proximidad geográfica ahora afecta sobre todo a ciertas fases del proceso de producción, investigación y desarrollo. Las visitas a corto o medio plazo son con frecuencia suficientes para que los socios intercambien la información que necesitan para cooperar. La movilidad de los individuos facilita la aplicación de este mecanismo. La proximidad geográfica temporal entraña una estrecha relación en el espacio pero que difiere en naturaleza de la que se describe en enfoques tradicionales.

Keywords:
Proximidad geográfica

Proximidad organizada
Ubicuidad
Agrupaciones

JEL Codes: O, O3, R, R3

Introduction

One of the most widespread theses in regional analysis, *e.g.* the fact that firms have a strong tendency to settle near one another because of frequent and repetitive interactions requiring face to face relations (from Marshall's "secrets of industry" to Saxenian's local networks, or Perroux's growth poles, Isard's industrial complexes, Becattini industrial districts and many others) (Marshall, 1920; Perroux, 1988; Isard & Schooler, 1959; Saxenian, 1994), is now strongly challenged, in particular in the case of knowledge exchange. Indeed, for many years it was claimed that the spatial agglomeration of innovating firms and research laboratories – which is one of the striking phenomena of contemporary economies – resulted from the need for face to face relations between these different organisations, which had to exchange certain types of knowledge that could not be exchanged from a distance (Feldman 1994 & 1999, Jaffe et al, 1993). This strong argument was used in favour of a strategy of increasing polarisation and therefore in favour of policies promoting the concentration of innovation activities, particularly within local systems of innovation such as clusters or technopoles (see for example, Markusen, 1996; Porter, 2000).

Recently though, an increasing number of studies have shown that although the spatial concentration of innovation activities is still phenomenal, much of the interfirm exchanges occur outside clusters and local systems of innovation, between firms that are in most cases located at large distances from one another (see, for example, Gertler, 2003; or Dahl & Pedersen, 2004). Thus there is much interaction between firms located in different clusters

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and often far from one another, which reveals that two types of exchange coexist: local and long-distance exchanges (Batista & Swann, 1998). Furthermore, it has become clear that the geographical proximity between firms is not in itself the only way of facilitating knowledge exchange, and that the latter can also take place between distant partners, thanks, in particular, to the development of information and communication technologies (ICT) (Amin & Cohendet, 2004; Grabher, 2002). This is evidenced by the emergence of communities of practice, epistemic communities or forums of software users, which enable their participants, who can be located anywhere on the planet and who, in most cases, have never met in person, to exchange information and knowledge, via the Internet (Brown & Duguid, 1992: Creplet et al., 2001)

Thus, the hypothesis that the transfer of knowledge (of tacit knowledge in particular) is facilitated by geographical proximity is largely called into question. What is more, several recent studies have shown that the equation of the sharing of tacit knowledge and geographical proximity on the one hand, and codified knowledge and long-distance relations on the other, on which the demonstration of the localisation of knowledge was partly based, is simplistic (Breschi & Lissoni, 2007; Gertler & Levitte, 2005). Firstly, it is difficult to separate the uses of both types of knowledge, secondly face to face relations, and therefore geographical proximity is not the only possible support for the sharing of tacit knowledge, thirdly ICTs make the long-distance sharing or co-producing of tacit knowledge possible thanks to the technological evolution of computer sciences; fourthly, it is important for innovating firms, to exchange with distant partners so as to obtain new ideas or new types of information that are not available locally. In this regard, it should also be noted that the distinction between tacit knowledge and codified knowledge is not totally clear, which can call into question the very basis of that demonstration.

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For these reasons, one could argue that the exclusive relation between geographical proximity and knowledge exchange is no longer valid and that the idea of the absolute necessity of spatial relation in the context of innovation production and diffusion should be abandoned. After all, some authors consider that a district or a cluster is at once made of relations of geographical proximity and of interactions that have nothing to do with the spatial dimension. Indeed local actors share common codes, projects, languages and similar views of the world (Hakansson, 2005 ; Torre, 2006) and can just as well do so from a distance. Other authors go even further and predict, in a provocative manner, the death of distance (Cairncros, 2001).

In this article, we defend the thesis that, despite the validity of these new arguments, geographical proximity remains essential for knowledge transfer. However, this necessity of geographical proximity, which still forms part of knowledge exchanges today, has taken different forms: it no longer implies the co-location of innovation and research activities but rather takes the form of temporary proximity. The need for geographical proximity has in no way died, nor has it become negligible. But it now mostly affects certain stages of the process of production, research or development and does not necessarily lead to the co-location of the actors involved in this interactive process. Short or medium-term visits are often sufficient for the partners to exchange - during face-to-face meetings - the information needed for cooperation. The mobility of individuals, which makes it possible to implement this mechanism, and which we shall call *temporary geographical proximity*, implies a strong relation to space but one that differs in nature from that described by the traditional approaches.

In our first section, we discuss the weakness of the hypothesis according to which permanent geographical proximity and the co-location of research and innovation activities are necessary, by analysing the example of clusters. We argue that the hypothesis used to justify

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the localised nature of knowledge exchanges is not valid and that the success of many clusters is less due to the alleged facilitation of knowledge exchanges than to far more traditional factors of agglomeration (I). We then discuss the inverse hypothesis; e.g. the hypothesis of the abolition of distance according to which the development of ITC-based relationships makes physical contact entirely unnecessary. The example of epistemic communities - which prove quite specific and sometimes necessitate face-to-face exchanges - highlights the limitations of this thesis (II). In the third section, we defend our hypothesis of temporary geographical proximity by underlining the need for physical contact between individuals, both in their work environment and in their personal lives; we then give examples of places that are, today, dedicated to knowledge exchange in a framework of temporary geographical proximity (such as fairs and trade shows) (III). Lastly we show that moments of temporary geographical proximity are necessary at certain stages of the process of innovation and knowledge transfer. Indeed, the life cycle of a product or an innovation implies stages of face-to-face interactions and stages of spatial distance. Furthermore, moments of geographical proximity can be required by contract, or made necessary by the emergence of conflicts between the participants of a common project. This gives us a second opportunity to discuss the notion of clusters, by showing that small innovating firms tend to seek geographical proximity with one another more than larger firms do, because the former are less likely to have human and financial resources to fulfil their needs for temporary proximity through mobility (IV).

I. The weakness of the hypothesis that permanent geographical proximity is necessary: the example of clusters.

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The idea that co-location is necessary (or at least beneficial) for individuals or groups of individuals to be able to work together and exchange knowledge is, of course, not new. In fact, it is at the basis of the theory of location and of all the studies that, for many years, have concentrated on the phenomenon of polarisation, such as the emergence or the expansion of towns or the processes of agglomeration of industrial and commercial activities. Nevertheless, this idea has recently given rise to renewed interest, with the research conducted by Krugman (1991) and his followers in the field of Geographic Economy and with Porter's works on the concept of clusters, works which have been even more successful in terms of economic policies. The cluster-based approach argues in favour of the co-location of innovation and research activities in given geographical areas, and rests on the hypothesis that permanent geographical proximity facilitates knowledge transfer, without which there can be no innovation activities. However, one may question the validity of this assertion. Indeed, as we are going to show, although the success of clusters is undeniable, the analytical justification of the latter in terms of knowledge transfer suffers from serious flaws that raise questions as to the validity of the hypothesis according to which permanent geographical proximity is necessary.

i) Clusters or the commendation of co-location

Without going too far back in time or undertaking a detailed review of the works devoted to agglomeration economies (Hoover, 1948), central places (Christaller, 1933), circumlinear concentrations (Von Thunen), growth poles (Perroux, 1988) or development blocks (Dahmen, 1988), it is important to bear in mind that most of the analyses on innovation activities, and first among them Schumpeter's works (for example, 1934), have underlined the existence of processes of concentration of innovators. Indeed, Schumpeter considers not only that innovations come in bundles but also that innovators form groups that emerge at the same

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time and in the same place. This phenomenon has a two-fold cause, related to the systemic nature of innovation. Firstly, there is a necessary technical complementarity between the innovations; for example, steam locomotives only became operational when the right alloy was discovered to manufacture rails that would be strong enough to support the weight of the locomotives; this explains the emergence of bundles of minor innovations contributing to the success of a major innovation (Rosenberg, 1982). Secondly, innovators themselves tend to join forces when their ideas have reached a similar level of maturity, which explains the emergence of complementary or competing innovations, in the same places and at the same time. Innovation does not happen by chance, nor is it the result of a unique and isolated idea; on the contrary it arises within a given economic and social context.

Paradoxically, and though the link has never been truly established, these ideas are a continuity of the remarks made by Marshall (1890) at the end of the 19th century, on the process of concentration of innovation activities in certain districts of the Greater London area. When Marshall proposes the idea that the secrets of industry are "in the air", or talks about the "industrial atmosphere", he only makes the observation that the concentration of dynamic and innovative enterprises within certain geographical areas is associated with high employment and production growth rates in these areas. His intuition that there is "something" happening at this level, although it was not backed up by an analysis of the process of innovation or of technical progress, has been largely confirmed by the current data on the spatial dimension of innovation activities. It is clear today that innovation activities (the intensity of which can be evaluated on the basis of the level of high technology or research spending or of the volumes of R&D and numbers of patents) are concentrated in a small number of countries, in a few regions within these countries and in a few geographical areas within these regions. The spatial concentration of innovation processes is manifest and benefits a few privileged areas, whose dynamism in this field benefits – according to the now

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accepted evolutionist hypothesis that innovation drives growth – to their economic environment.

It is this idea that has served as the foundation for the cluster-based approach. In our opinion, clusters are the latest addition to a long list of local systems of production or innovation (growth poles, scientific parks, industrial and technological districts, technopoles, innovation milieus...) the existence of which is founded on the hypothesis that the co-location of innovating firms and research laboratories is necessary and benefits both from the innovation activities and the processes of economic development (see for example Porter 2000).

The positive externalities deriving from clustering have been exposed at lengh in various approaches. Research has been dedicated to various subjects such as innovative milieux, technological districts, technopoles or science parks and, in general, to localised systems of production and innovation, so as to highlight the complex connection between spatial concentration and technological advantage. Studies concerning innovative milieux have underscored the importance of connections between the different local actors as regards the technological development of a given region or geographical area, particularly when they have technology supplier-user type relations that can help to reduce technology leakages and promote the implementation and development of local learning opportunities. Research concerning technopoles attempts to highlight the advantages of grouping local high tech firms on the same territory, especially in regard to the production of innovations, not only because of the concentration of potential for research or innovation, but also because of the synergetic effects arising from the collaboration between local firms. Most of these characteristics can be found in the analyses of regional innovation systems, that include the setting-up of a local network based on technological complementarities, as well as an institutional dimension illustrated by implementation policies undertaken by the public authorities in terms of support

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to innovation or the training of engineers or scientists, and where the relation between science and industry occupies a central position.

All in all, and as the most recent syntheses on innovation clusters have shown, the idea that firms and productive systems benefit from the spatial concentration of their research and innovation activities, is widely accepted nowadays. One could argue, for the sake of providing an all-encompassing definition of local development processes, that the theoretical notion of cluster is generic in nature and that it encompasses the other types of systems (with the exception perhaps of technopoles which are exclusively centred on knowledge exchange between research institutions) (see Karlsson et al 2005, for example). Furthermore, this notion has the particularity of putting in the forefront the relations between local firms and firms located outside their local system, so that it simultaneously highlights the balance between the « local » and « global », unlike other approaches that are based on a more " localist " presupposition.

The success of clusters has been immense, both in terms of economic analysis and as regional planning tools, and it directly influences politicians' decision-making at local and national levels. Clusters are today considered as the basis of local, and even national, politics in many countries (UK, Germany, the Netherlands…). In France, for example, they serve as a basis for reflection on local systems of production, and can be compared to the new Poles of Competitiveness, which were launched by the government in 2004 with a view to replicating the success of local groups of producers in Italy, Northern European countries or Silicon Valley. Even more surprising, they are often considered by the great institutions of the global economy as major tools of development (see OECD, 2001 and 2005, or the World Bank, 2002). From the point of view of development policies, it is often considered that creating synergies between local companies is always beneficial. Thus all policies seeking to promote

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networking between firms have been considered valid, because they can only lead to an increase in competitiveness, the organization in "local networks" necessarily turning out to be superior to other types of operation, in particular decentralized ones.

ii) The hypothesis of permanent geographical proximity in the transfer of knowledge

The cluster-based approach is not always easy to understand for researchers seeking analytical clarity (see a critical approach in Martin & Sunley, 2003, or Taylor, 2005); so much so that Feser (1998) found that "despite the intense interest in industrial clusters expressed by policies of economic development in Europe and North America, there is little consensus about the precise meaning of an industry cluster, the dynamics underlying cluster growth and development, and the policy initiatives that would help build and strengthen clusters". Of Porter's own admittance (2000), the definition and delimitation of a cluster vary according to the expectations and visions of the public authorities and decision-makers (see however the attempt made by Dunning, 2000). In light of the recently developed approaches, clusters could be described as follows. They encompass at once internal and external relations and combine the advantages of the processes of localisation and globalisation. Clusters are not presented as closed or isolated systems, but on the contrary as structures that pay special attention to relations with the outside, either through other actors or through national or supranational policies.

A close look at the local dimension of the relations reveals something Marshall as well as the supporters of polarisation have already highlighted, that is the importance of the relationships that develop between firms at local level. In this case, the justification of clusters, as generally proposed in relation to innovation activities, often rests on a simple idea, but one

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which, on close examination, proves fallacious. It is the hypothesis of the necessity of permanent geographical proximity in the transfer of knowledge, a necessity that is supposed to explain the spatial agglomeration of innovation activities, and therefore the existence of clusters.

The theoretical basis of this approach can be summarised as follows: Innovation activities are believed to be essentially related to the possibility of producing or acquiring knowledge, particularly scientific knowledge emerging from public or private research. But, this type of knowledge presents a particular characteristic, which, incidentally, applies to innovation activities as a whole. It is its imperfect appropriability: it can be reproduced or imitated. This imperfect appropriability of knowledge (including in the case of patented knowledge) results in the existence of many spillovers effects generated by innovating firms and benefiting other firms in the same sector, or that link researchers belonging to different organisations. These effects are known as knowledge spillovers; they benefit organisations possessing knowledge bases that are compatible with those of innovators. The idea is that certain types of knowledge, the ways in which they are diffused, call for geographical proximity between the economic units that wish to benefit from it, and that those located too far from its source, are *a priori* excluded from its benefits.

The argument in favour of spatial concentration lies in the particular nature of knowledge, which according to Polanyi (1962), can be divided into two distinct but sometimes-complementary categories; tacit knowledge and codified knowledge. The latter, which includes all written sources, or those that are easily communicated through manuals or books, can be transferred over long distances, and can therefore be reproduced or copied by people who took no part in the initial process of creation or innovation. But the other type of

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knowledge, tacit knowledge, is incompatible with distance. It can only be imitated through observation, practice, and learning; it resides within human beings and within their daily behaviour and can only be communicated through face-to-face interaction. The advantages of the co-location of research activities and of innovating firms are clear here. Tacit knowledge can only be passed on and transferred among the members of spatially concentrated communities. This is why organizing innovation activities at local level, encouraging geographical proximity or promoting the development of clusters appear necessary. Thus, coming back to the phenomenon of spatial agglomeration, it is believed that in order to benefit from the effects of diffusion of this tacit knowledge, it is necessary for firms to co-locate, in other words to locate in permanent geographical proximity to one another.

But, from an analytical viewpoint, there is an important flaw in this approach. Indeed, the latter rests on the idea that spillovers effects are caused by the public nature of knowledge, which makes it difficult for the producers of knowledge to fully appropriate their creation, and which is favourable to the diffusion of knowledge within the economic system. But at the same time this approach claims that it is the tacit nature of knowledge – i.e. fully appropriable by its creators and not easily transferable – that makes face to face interaction, rather than long distance interaction necessary! Thus two contradictory theses explain, firstly, the diffusion of innovations and knowledge, and secondly, the fact that this diffusion is spatially restricted (Breschi & Lissoni, 2001).

To summarize, we are told that the existence of tacit knowledge explains the need for geographical proximity in innovation activities. Indeed, this type of knowledge is highly appropriable and difficult to transfer, hence the need for face-to-face interactions and therefore for geographical proximity. At the same time, we are told about geographical

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spillovers, which reflect the spatial diffusion of knowledge. But why can knowledge be diffused? Because it is a specific type of good, it is a public good that is not appropriable and which, therefore, can be transferred to other firms, including to competitors. Two hypotheses can be mobilized to eliminate the contradiction between the appropriability of the knowledge involved in spillovers and the non-appropriability of tacit knowledge. 1) Either tacit knowledge is a non-appropriable good, and there are no spatial spillovers effects since knowledge can be diffused everywhere, in which case, firms cannot draw any advantage from a close location. Tacit and codified knowledge are not in the least affected by distance and therefore this distinction cannot serve to justify the need for geographical proximity. 2) Or knowledge (tacit and codified) is appropriable. In this case, it can be transferred from one individual to another or from one organisation to another, for example via market or cooperation relations, whatever the distance or geographical proximity between them.

Thus, one can either retain the hypothesis of the existence of tacit knowledge and abandon the idea of spillovers. In this case knowledge becomes an ordinary good exchanged on the markets (see the so-called markets for technology, Arora et al., 2001) or through cooperative interactions (Von Hippel, 1998), and is no longer an externality good; or one can retain the hypothesis of the non appropriability of knowledge in which case one must accept the idea that knowledge, regardless of whether it is tacit or codified, can be diffused whatever the distance. Yet, it is the naturalist hypothesis that is the most frequently used in support of the policies implemented to promote the concentration of research and innovation activities.

Furthermore, innovation activities and high technology are here assimilated to R&D expenditure and patents. Yet, many studies have shown that a great number of innovations take form during the production process, that they are often incremental; they have also shown that R&D spending is often reserved to larger firms or high tech firms, and that the

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volume of patented innovations is hardly representative of the number of innovations that have actually been developed. The phenomenon of concentration of innovation activities concerns, above all, the firms that rank highest in the process of innovation, and it has actually not been possible to determine whether or not this phenomenon also concerns the large mass of secondary innovations and the knowledge transfers between actors that do no possess R&D departments, for example.

Yet, it is this argument that is the most frequently used in support of the policies implemented to promote the concentration of research and innovation activities, and clusters particularly.

iii) A first observation on clusters: The contingent nature of permanent geographical proximity

The invalidation of the hypothesis according to which permanent geographical proximity is necessary for the diffusion of knowledge, does not, of course make the existence of clusters any less real. Not only do clusters exist, but their numbers are also increasing and the policies promoting their development are gaining ground. What are the reasons for such a success? It is clear that the need for geographical proximity in the coordination of innovation and research activities, and in particular in the exchange of tacit knowledge, cannot alone explain the geographical concentration of actors.

A first explanation is provided in the literature on innovation by researchers who suppose that a cluster is based upon two types of relations, respectively intra cluster knowledge exchange and extra cluster knowledge exchange. According to Hakansson (2005) for example, the relations that firms develop with external actors play an important role in the development and success of the cluster. In particular, and as Giuliani & Bell (2005) have shown in the case

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of Chile's wine industry, there is a relation between clusters' ability to capture external knowledge and the firms' absorption capacities in terms of technology, and specifically the stock of knowledge accumulated within the firm, embodied in skilled human resources and further developed through in-house learning efforts.

Following the argument of Cohen & Levinthal (1989), the firms with higher absorptive capacities in a cluster are those which are the most likely to establish linkages with external sources of knowledge. This is explained on the basis of cognitive distances between firms and extra-cluster knowledge, so that firms with higher absorptive capacities are considered more cognitively proximate to extra-cluster knowledge than firms with lower absorptive capacities. Thus, one can hypothesize that R&D expenditures must be devoted to improving firms' external knowledge absorptive capacity.

Looking beyond the sole knowledge transfer aspect, one is forced to recognize that the existence of clusters rests on several other factors:

- Firstly, *economic relations are embedded in social network,* and the latter often have strong territorial roots. In this perspective, the existence of localized networks of innovation is less due to the functional need for face to face relations in order to exchange knowledge, than to the fact that cooperation occurs between researchers and engineers belonging to different organizations but originating from the same university or belonging to the same social and family network (see Grossetti & Bes, 2001). Geographical proximity is not so much an *economic cause* of agglomeration as a *social effect* of the embeddedness of economic relations in inter-individual relations. Face-to-face interaction between two actors cannot alone generate synergies; the latter can only develop between two individuals who belong to the same network or share common representations. Furthermore, as the cases of Detroit's production systems (Klepper, 2002) and of Sophia Antipolis (Longhi, 1999) clearly

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show, the passage of time and the history of the localized innovation systems are key factors in the success of the local interactive processes;

- Secondly, *the geographical context of economic interactions is largely conditioned by the role of institutions*. And nowadays, geographical proximity appears to be a factor legitimising these institutions (valorisation of the local in itself). Thus, local policies produce geographical proximity institutionally as a privileged mode of economic interactions. The search for synergies between local actors has become the basis for most policies of local development. This is evidenced by the development of technopoles, technological parks or poles of competitiveness created with the financial support of the public authorities, and which often lead to a co-location of actors without necessarily generating significant effects in terms of synergy. Indeed, recent surveys about interfirm cooperations show that in most cases the firms cooperate with organizations that are not located in the same region (Freel, 2002; Tether, 2002) and that proximity based interactions are relatively rare.

- Finally, with regard to the life of clusters, it is important to remember that *the success of these local agglomerations - even in the absence of strong synergies - can often be explained by traditional economic factors* - in which case there are no strong synergies between the different firms located in the agglomeration (see Gordon and McCann, 2005). We shall discuss four of these factors. The first is related to attractiveness based on land prices: the public authorities often maintain the prices of plots at attractive levels in order to attract enterprises or research laboratories, the latter seeing in these low prices an opportunity to set up and function at a reasonable cost. The second factor lies in a series of advantages, such as tax and financial advantages (tax abatements, temporary or permanent tax exemption...) offered by the local authorities in order to attract enterprises and convince them to set up within their zone of activity. The third factor, which concerns essentially the clusters located within urban agglomerations (i.e. a large percentage of all clusters), is related to the agglomerations effects associated with the existence of these urban areas, i.e. a series of

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advantages related to an easy access to information, the possibility of finding premises and offices to work from, or the proximity of public service departments or of commercial centres... A fourth factor could be the existence of transaction costs, because the institutional, commercial, cultural, and language characteristics are differentiated across the geographical space separating market agents (Storper, 1995; Wood & Parr, 2005).

Geographical proximity can reduce the transaction costs in the case of input-output relations (especially in vertical relations), but also when it comes to finding (and especially training) skilled workers, purchasing raw materials and ultimately acquiring or seeking knowledge through untraded relations. The latter factor, which cannot be ignored, is related to the *New Economic Geography* argument concerning the local labour markets (Krugman, 1991). Enterprises naturally seek to locate their activities in proximity of other firms that belong to the same or to related sectors of activity so as to be close to a pool of qualified labour available on the labour market. This point was highlighted earlier in the case of highly qualified engineers or "star scientists". Finally, one cannot ignore the importance of "window dressing" effects and of the effects of attractiveness exercised by the very image of a successful technopole or cluster...

II. The weakness of the hypothesis that geographical proximity is never necessary: the example of epistemic communities

We have seen that the argument supporting the hypothesis that the co-location of the actors of innovation in knowledge transmission is necessary is invalidated, not by the empirical evidence but by the lack of coherence of the analytical explanations concerning knowledge exchange. One can conclude from this that permanent geographical proximity, though it plays

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an important role, is not a sufficient condition for the success of innovative activities and cannot ensure alone the success of productive agglomerations.

Does this mean however that innovation and knowledge transfer can always be achieved through long distance interactions, i.e. in the total absence of geographical proximity? However convincing the hypothesis that knowledge transfer can always be undertaken at a distance through organized proximity might be, there is no certainty that all activities of knowledge diffusion can actually be successfully accomplished through long-distance interactions only. The example of epistemic communities calls for prudence in the matter. We shall see that one cannot seriously believe or claim that the activity of knowledge development and exchange can be conducted without any face-to-face interactions.

The hypothesis of the death of distance (Cairncross, 2001), or of the possibility that knowledge exchange can take place without geographical proximity, deserves to be examined with care, particularly in the case of knowledge transfer. Indeed, several arguments and concrete examples seem, at first glance, to back up this thesis.

i) Epistemic communities and the actors' ubiquity

The example that is the most often used in support of the hypothesis according to which there is no need for geographical proximity in knowledge transfer, is that of epistemic communities or communities of practice. Indeed, the finding that permanent geographical proximity is less and less necessary has given rise to an increasing interest in long distance communication technologies, which enable individuals to exchange information, express emotions and to be present with a distant partner. This interest has manifested itself, in the field of knowledge transfer, through research studies concentrating on epistemic communities and communities

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of practice (both modes of interaction have their similarities but consult Creplet et al (2001) for an attempted distinction between the two concepts).

The works that examine these questions are of great interest here because they invalidate the hypothesis of the necessity of permanent geographical proximity, by taking the opposite view of this approach. Indeed, epistemic communities (Hass, 1992) are groups of individuals whose communication and cooperation rests essentially on information and communication technologies (Brown & Duguid, 1991): they are used to meeting and exchanging information and knowledge in cyberspace, in the absence of any physical contact or face to face interaction. These exchanges often take place between individuals who have never met "in person" and do not envisage doing so (Amin & Cohendet, 2004; Steinmueller, 2002). Participants in these communities have the particularity of undertaking specific tasks, which they collectively endeavour to complete through frequent contact with one another.

A striking example is that of Linux Developers, or more generally of communities that form around free software developers. In this type of organisation, interaction is not localized in any particular place since the relation to space and place disappears. The participants interact in virtual space, which not only enables them to exchange information or practices, but also to mutually contribute to the development of a product that results from the interaction of a large number of actors engaged in a collective process of improvement and fault detection.

Similar characteristics are found in free software user groups in which the members cannot touch the core code of the software, but contribute, in exchange for free access to the software, to improving it and to correcting possible faults. Here again, the exchange user groups consist of a few specialists in very specific technologies, scattered around the world and who exchange their opinions and solutions from a distance. Shared projects and frequent

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interactions are, here again, central to this type of organisation. This is also true, though to a lesser extent, of exchange lists that enable the users of software to share their tips or to promptly find answers – from other members that might be located very far away – to problems they may encounter in their specific location. Here again, the constraint of geographical proximity is entirely removed by the immediate access to information and communication technologies.

Another argument that supports the theory of the death of distance is found in the development of what we shall call the actors' ubiquity. Indeed, *the deployment of information and communication technologies has resulted in an extension of the powers of economic and social actors, who are now in a position to act, at the same time, here and there*. This has resulted in a relaxation of the constraint of geographical proximity.

Historically, it has been possible to act at a distance since the creation of means of communication such as the post or the bill of exchange, but the invention of the telephone offered new possibilities and now enables individuals to conduct operations at the same time, that is to be present, at the same moment, in two or three different places. This virtual co-presence has recently greatly gained in scope with the development and generalisation of long distance communication technologies (portable phones, the Internet, long distance data exchange, e-mail, palms, blackberries...), which have been an important innovation and have contributed to radically changing the positioning of actors in space. One individual, or even better, a firm can act at once locally and globally by making its suppliers compete with each other at global level, or by passing orders on stock exchanges abroad, for example. Actors are not only localized but also capable of acting in real time in different places, which means that their registers of actions go far beyond their mere location and that they can develop

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interactions at local and « global » scales (which has been possible for a long time with the development of techniques of transport) at the same time, in real time (which is new).

As Callon & Law argued (2004), we have shifted from a romantic view of the world – in which distances and scales can be defined with no ambiguity – to a baroque, monadic world view (in the Leibniz sense) in which entities multiply and in which the distinctiveness between these entities becomes blurred, so that individuals become ubiquitous in space, thanks in particular to communication technologies. There are different ways of being present "there at the same time", particularly by using different technical objects that leave a trace of our actions or impose our presence even when we are in a situation that we would normally call absence (for more detail on the subject, see the articles published in the "Absence, Presence, Circulation and encountering in complex space" issue of Environment and Planning D: Society and Space, 2004). From this point of view, it is clear that the presence of an individual in one place does not necessarily imply his/her physical presence, and that presence for the other does not always imply the necessity of face-to-face relations (see Urry, 2004). More specifically, the development of ICTs has generated a multiplication of spatio-temporal links and contexts, so that the action of an individual can today develop at different spatial scales (here and there)

ii) The limitations of the hypothesis of the total absence of geographical proximity

Thus, a close examination of the modes of functioning of epistemic communities reveals that this example, however interesting it might be, is not easily transposable to all modes of knowledge transfer, and that it does in no way imply that geographical proximity is no longer necessary in the process of knowledge diffusion. Indeed, fruitful exchanges within these virtual spaces are made possible by a certain number of favourable factors related to the

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intrinsic characteristics of the product being discussed, to the idiosyncrasies of the relations that form around its design and development or to the particular nature of the modes of organisations in question.

With regard to the nature of the knowledge exchanged within communities of practice, it must be noted that the latter is mostly codified, since codification is by definition the mode of development of free software, and therefore the argument in favour of face-to-face interactions is invalidated. Secondly the knowledge base shared by the actors is relatively narrow and concerns people who share the same references, and in particular the same languages. In brief, they belong to the same networks, or in other words they are tied together by relations of organized proximity. Finally, the modular structure of the operating systems makes it possible to simplify the development of the software and therefore facilitates the possibility of complementarity between people who do not know each other (Coris & Lung, 2005). Here again, the design structures and the type of knowledge involved condition the relation that develops between the members of the group.

If we now concentrate on the relationships that form between the individuals involved in this type of operation, we note that they all share the same references: from a common software development culture – in free software or open source product development - to common hacker ethics, opposed to commercial software and to the aggressive commercial practices of their producers, via their adherence to the goals initially defined by a leader whose reputation has been built on his/her ability to successfully implement a certain number of projects, in communities of experience. Similarly, as Gallie & Guichard (2005) have shown in the study on long-distance collaborations between research laboratories, communication is greatly facilitated when the participants speak the same mother tongue, or have similar cultural

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origins, even in communities of researchers that might, at first glance, appear very cosmopolitan.

With regard to the modes of organization, it must be noted that the exchanges that take place within communities of practice are exchanges between people and not between organisations (Arena, 2003). One can raise the question of whether this way of functioning is transposable and in particular whether it is applicable in the context of interfirm exchanges or cooperation, which necessitate more complex relationships than the type of relationship required to improve a line of code in a software. We shall not discuss the collective dimension of these processes, but it is clear that the knowledge exchanges that take place between two people are far less complex from the conceptual and logistical points of view than those taking place between two organisations, with they subtleties, their internal rules and hierarchic systems. Works on the absorption capacity of firms are there to remind us that, even with the best will in the world, knowledge transfer can prove ineffective if it is not preceded by a stage of preparation requiring, in particular, a specific investment in R&D (Cohen & Levinthal, 1989).

Finally, and as Coris and Lung have noted, project leaders who interact in their epistemic communities, frequently have to meet in order to define common procedures and solve certain problems that may arise during critical stages of the software development. This in itself is a significant exception to the rule of long distance exchange, which tends to indicate that the necessity for moments of geographical proximity remains important, including within organisations that seem to have entirely substituted this mode of interaction with long distance relations. We shall discuss this question further in Section III.

In view of the characteristics and of the role played by organized proximity in interactions of knowledge exchange, one cannot but question the role of geographical proximity in this type

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of activity. But one cannot conclude from this that organized proximity alone is sufficient for all exchanges of knowledge and that the latter could then take place in the total absence of geographical proximity.

iii) From the death of distance to the primacy of organized proximity: proximities in clusters and epistemic communities

The contingent nature of geographical proximity, illustrated by the example of epistemic communities and of the development of individuals' ubiquity, must be put in relation with the importance, which has been many times highlighted, of organized proximity relations (see Torre & Rallet, 2005), that structure an important part of the relations between actors, and particularly of the knowledge exchanges between firms and individuals. We shall argue that the approach in terms of proximity helps to shed light on the types of relationships that exist in clusters as well as in epistemic communities, and that it helps to understand how and in what circumstances knowledge exchanges take place (or do not take place), locally or from a distance.

Let us remind the reader that, according to us, organized proximity is relational in essence. By this, we refer to the ability of an organization to make its members interact. The organisation facilitates interactions within itself, or at least, makes them easier than with entities situated outside the organisation. Two main reasons explain this:

- Belonging to an organisation translates into the existence of interactions between its members that are inscribed in the *genes* or routines of the organisation. This is what is called the *logic of belonging* of organised proximity: two members of an organisation are close to each other because they interact, and because their interactions are facilitated by the (explicit or implicit) behavioural rules or routines they follow. Thus,

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other things being equal, cooperation will, *a priori*, develop more easily between researchers and engineers belonging to the same firm, the same technological consortium or the same innovation network.

- The members of an organisation are said to share a same system of representations, or set of beliefs (1), and the same knowledge. This social relation is mainly tacit. This is what is called the *logic of similarity* of organised proximity. Two individuals are considered close to each other because they "are alike", i.e. they share a same system of representations, which facilitates their ability to interact. Thus two researchers belonging to the same scientific community will be able to cooperate more easily because they not only share the same language, but also the same system of interpretation of texts, results...

The research studies conducted on the subject (Kirat & Lung, 1999; Filippi & Torre, 2003) have shown that organized proximity plays an extremely important role in the organisation of economic activities, and more precisely of activities of innovation and knowledge diffusion (Rallet & Torre, 2000; Torre & Rallet, 2005). Geographical proximity alone is generally insufficient, and in some cases is even altogether replaced by organized proximity, and the constraint it exercises remains relative.

Two factors explain the relative nature of the constraint of geographical proximity :

- firstly, economic relations (for which the need for geographical proximity is reduced) are embedded in highly territorialized social networks (Gertler, 2003). In this perspective, the existence of localized networks of innovation is less due to the functional need for face-to-face relations in order to exchange knowledge, than to the fact that cooperation occurs between researchers and engineers belonging to different organizations but originating from the same university or belonging to the same social and family network. Geographical

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proximity is not so much an economic cause of agglomeration as a social effect of the embeddedness of economic relations in inter-individual relations. Face-to-face interaction between two actors cannot alone generate synergies; the latter can only develop between two individuals who belong to the same network or share common representations;

- secondly, the geographic framework of economic interactions is largely conditioned by the role of institutions. And nowadays geographical proximity appears to be a powerful factor of legitimacy of these institutions (valorisation of the local in itself). Indeed, and this is quite clear in the context of clusters, the policies of economic and technological development favour the development of local systems and the concentration of innovation and knowledge activities. Thus, local policies produce geographical proximity institutionally as a privileged mode of economic interactions. Furthermore, this dimension, which has for a long time been reserved to local and regional policies, has today become an integral part of national planning and development policies. The search for synergies between local actors has logically become the alpha and omega of most policies of local or national development.

Two conclusions can therefore be drawn from these elements: 1) if geographical proximity is given so much value in the discourse of development, it is less for reasons that are intrinsic to the need for economic coordination than because of a double embeddedness of economic interactions in social networks on the one hand, and in institutions on the other; 2) It is organized proximity that appears essential in the implementation and functioning of epistemic communities. It constitutes the link between the actors, by enabling them to interact thanks to the sharing of standards of communication, but also of shared rules, and even of a common culture. Both the logic of belonging and the logic of similarity of organized proximity are necessary. It is they which make long distance exchanges possible and which guarantee the efficiency of the diffusion of information and knowledge transferred in this manner.

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But part of the success of clusters is also due to the combination of both logics. Indeed, as Giuliani and Bell (2005) have shown, clusters are based on the superposition of two types of relations: the geographical relations on the one hand, and interactions between the actors on the other. The structure of the intra-cluster knowledge system is likely to be influenced by the formation of local communities of knowledge workers, who share common language and technical background, seek advice from other peers of the same community and in so doing develop networking practices, which boost processes of knowledge exchange and generation. We could say, as Hakansson does, that they are localised epistemic communities. "Clusters are not only comprised of firms producing similar or complementary outputs, but also of people who belong to the same professions, have similar jobs, formal training and types of on-the-job experience. To a considerable extent, they are familiar with and use the same theories, have the same or very similar views of the world, use the same language and codes to describe it and know how to employ the tools of their common trade or industry. In short, they belong to the same or closely related epistemic communities formed around the exercise of a specific professional practice" (Hakansson, 2005, p. 10).

That is what the theoreticians of proximity often find when they identify the successful clusters, operating at the intersection of both types of proximity (Torre, 2007). The only clusters which function successfully and have the ability to promote internal knowledge exchange are those that combine the conditions of organized proximity (with its logic of belonging or similarity) on the one hand and the conditions of co-location provided by permanent geographical proximity on the other. Let us note that these clusters are also those which resist relocation the most strongly, because they rest on internal networks that are difficult to replace immediately by new relationships.

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This approach is much easier to apply to epistemic communities since the latter are above all based on relations of organized proximity, and particularly on the logics of similarity and belonging mentioned above, and which would be interesting to examine further. Thus, proximity relations and the role they play in both modes of interactions – long distance interactions in the case of epistemic communities and local interactions in the case of clusters – can be summarised in the table below:

Table I: the role played by both types of proximity in knowledge transmission

III. The importance of geographical proximity: the hypothesis of temporary geographical proximity

The above discussion has underlined the limitations of the two extreme theses that claim to describe the relation between the modes of knowledge transmission between firms or research laboratories and the permanent presence or absence of geographical proximity. The thesis of the necessity of geographical proximity, or, in other words, of the co-location of innovators, rests on a hypothesis concerning the face to face transmission of so-called tacit knowledge. But this hypothesis proves to be flawed from a theoretical point of view and seems to be invalidated by the possibilities offered by contemporary communication technologies (2). As for the thesis of the death of distance (or of the possibility of total absence of geographical proximity), it cannot survive a close examination of the modes of functioning of the most extreme case - the furthest away from the most common definition of clusters - i.e. that of communities of practice, which are involved in very specific types of activities and exchange very specific types of knowledge, which do, occasionally, call for moments of geographical proximity.

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In fact, the changes in the conditions of production and the advances in information and communication technologies call into question the validity of these over-simplistic schemas and lead to a readjustment of the spatial scales in which people operate. We refer of course to the necessary complementarity between local and global relations, which has often been highlighted by authors in recent years (see Amin & Thrift, 1994) and which is now at the heart of the relations that characterise clusters' modes of organisation (Maskell et al, 2005). Similarly, contemporary firms, and particularly those involved in technological competition, must, it is clear, operate both at global and at local levels.

But more importantly, we refer to the fact that the economic and social actors' relation to space has changed. Though the role of space has evolved, it remains critical for many firms and institutions, including for their activities of knowledge transfer. More specifically, the necessity of permanent geographical proximity has lightened for many firms and institutions, so that the constraint of co-location of similar or complementary activities tends to become less stringent. This in no way implies that the need for geographical proximity has disappeared or that it is negligible. *Rather, it means that the need for geographical proximity has changed in nature in two fundamental respects: a) it has become more and more temporary, b) its temporary nature can, in certain circumstances, be fulfilled through mobility. In this case we talk of temporary geographical proximity.*

i) A return to geographical proximity: people's need for face to face contact

It is necessary to restore the role played by geographical proximity to its place of honour, by showing that space still matters in interactions between people, particularly in the field of knowledge transfer. However, this proximity can be used in different ways by the different

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actors and at different times. This can sometimes result in a change in the very nature of geographical proximity.

It is the question of mobility that proves central here. Mobility has been facilitated by the development of transport technologies and infrastructures and by the relative decline in transport costs. This question of mobility has to do with the daily commuting of individuals to and from work, as well as touristic or retirement movements, migrations or expatriations in the case of individuals seeking employment, or the migrations from the phenomenon of congestion that are characteristic of urban areas. Individuals now tend to travel more than in the past, can stay away for varying periods of time, in places that can be situated very far from their main residence (Donovan et al., 2002). There has also been an increase in multi-location, some people living in two or three different places between which they commute. For the people concerned, this commuting from one place of residence to another, implies that they can stay relatively long periods of time far from their loved ones, that is the members of their families, from their communities or groups of friends.

As sociologists such as Urry (2002) have shown, part of these individuals' needs for socializing are met thanks to telecommunication tools. One can phone or communicate from a distance through emails or online chats for example, which are practices similar to those of epistemic communities. But this type of activity often supplements face to face interactions and does not replace what Boden has called "the compulsion to proximity" (Boden & Molotch, 1994), which refers to a need for physical contact with others, however limited in time this contact might be. Thus, as many studies have shown, the mobility of individuals leads to a weakening of their daily interactions, and in particular of their interactions with their neighbourhood. A similar idea underlies certain economic approaches in terms of spatial externalities (Papageorgiou & Smith, 1983); approaches that are based on the hypothesis that

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individuals have a fundamental propensity to interact with others and to seek social contact, the latter being considered as a basic human need that is not necessarily expressed on the market. One cannot hug one's grandmother, share a cake or have tea with a friend, nor enjoy a meal with one's family if he or she is far from these people; a person has to travel in order to meet his/her loved ones and exchange with them messages and information that cannot be conveyed by phone for example. This is the reason why people travel more and more; and this travelling is aimed at fulfilling a need for geographical proximity, even, sometimes, when it takes the form of tourism.

Thus, even though our societies are characterized by the rise of long distance communication through ICTs, the fact remains that "corporeal travel and co-present meetings are of increasing importance because only they produce thick, embodied socialities of corporeal proximity where people are uniquely accessible, available, and subject to one another" (Larsen et al., 2005). Different surveys have clearly shown, for example, that having lunch with someone is considered extremely important, a shared meal having a strong social significance, characterizing a specific opportunity for social interaction that lies in temporality. In the same vein, it has been found that, while people seldom spend more than 15 minutes at a time on the phone with their loved ones, they seem to spend much of their time interacting with the latter when they go and stay with them for short to medium periods of time; indeed they spend long hours chatting or exchanging news at meal times. Thus, we can make the hypothesis that people compensate for the intermittence of meetings and the cost of transport (time, money and weariness) by spending a longer time together. The co-presence of individuals is maximised during times together and these times are normally filled with strong interactions. In other words frequent yet short visits maybe turn into intermittent yet longer periods of face-to-face co-presence, of hosting and visiting. Distance has changed

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the ways in which people communicate together when they have the opportunity to interact face to face.

Furthermore, travelling can be undertaken, on very specific occasions, by the members of a group. Larsen et al (2005) mention the example of trips undertaken by people when one of their relatives has died; on these occasions these people meet face to face with close relatives with whom they have daily contact via the phone or the Internet. This phenomenon is common among the members of a same community who feel connected by a very strong bond, including when they are far from each other. We shall related this type of connection to the logic of similarity of organized proximity. Finally, as some ethnographic studies have shown (Kyle & Garry, 2004) people who live far away from their loved ones normally enjoy meeting them on special occasions for events that take place at regular intervals, such as concerts or parties; as one economists put it, they make the most of these opportunities by combining the pleasure of being with their loved ones and that of experiencing an extra-ordinary event that provides a break from their daily routine. Mobility then implies a particular combination of places and significant people, which explains why people enjoy meeting loved ones during special events; the latter serve to attract people from sometimes very distant locations.

ii) Definition and examples of temporary geographical proximity

One can, to some extent, draw a parallel between the motives for individual mobility on the one hand and the strategies that govern the processes of long distance transfer of knowledge between organisations on the other, even though the motives for the mobility of the employees of enterprises or research laboratories are obviously not always of the same nature

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as those of individuals. However, in both cases, there is a need for geographical proximity that can be fulfilled through meetings that are occasional but dense in interactions.

Indeed, it seems that the professional mobility of individuals has strongly increased with the development of transports and the technological revolution in telecommunications. The complementarity of transports and communication increases this mobility, so that an increasing number of employees and entrepreneurs travel on a regular basis in the framework of professional trips that last for more or less long periods of time. Let us mention a few examples: the sales representative, the medical representative or the maintenance engineer's visits to their clients, the few day visits of a financial consultant to a enterprise to conduct an audit, the trips undertaken to solve technical or maintenance related problems, the participation of a researcher to a national or international conference, the temporary visits of an engineer to a distant firm's laboratory or to a university with whom his firm cooperates... (see Donovan et al., 2002) Furthermore, an increasing number of actors no longer have a permanent work place. They work by travelling (see Grague (2000) who shows that, in France, the number of workers travelling, as part of their work, to various locations within the region where they are employed increased by 40% between 1982 and 1994).

These forms of professional mobility have a strong impact on the modes of knowledge transfer, and consequently, on the role played by geographical mobility on these types of processes. Indeed, thanks to these developing forms of mobility, 1) the needs for geographical proximity can be fulfilled temporarily through travelling 2) they can be fulfilled without the interaction leading to the permanent co-location of the partners. *It is this mechanism that we call temporary geographical proximity (Torre & Rallet, 2005). It corresponds to the possibility of satisfying certain needs for face-to-face contact between actors, by travelling to different locations. This travelling generates opportunities for*

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moments of geographical proximity, which vary in duration, but which are always limited in time.

iii) The venues of temporary geographical proximity: fares, trade shows and conventions

It was Foucault who, during a conference devoted to the question of spaces and simultaneity (Foucault, 1984, 1967), first brought to the fore the principle of "heterotopias", interface sites that enable productive and social actors to interact in real or virtual spaces; these spaces are not necessarily permanent in nature and they express principles that have replaced the old principles of permanent location that characterized the modern and pre-modern eras. As Foucault showed "The heterotopia is capable of juxtaposing in a single real place several spaces, several sites that are in themselves incompatible". This definition of interface sites not only helps to eliminate the confusion between co-location and geographical proximity, but also indicates the different forms that temporary geographical proximity can take. Indeed, the latter is made possible by the existence of places of temporary co-location that must be equipped to facilitate the meetings, discussions and exchanges between different types of actors. As suggested by Perraton (2004), Disney's theme parks are heterotopic spaces to which people go, in which they meet but without necessarily modifying their habits or the ways they think. Access to these parks is organised so as to promote short visits and encourage maximum spending by visitors of the interface site.

Satisfying the needs for temporary geographical proximity of individuals or firms clearly rests on the mobility of individuals; indeed the latter need to travel in order to meet (Lee, 2001). But the places where individuals meet are not random and the parallel drawn with the interpersonal meetings that take place between socializing family members or friends still

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works here. Indeed, the venues of temporary geographical proximity can be divided into two main categories, according to the types of meeting and actor. First of all, there are temporary meetings between people involved in common projects of collaboration (see paragraph IV.ii, above); in this case the meeting venues are quite ordinary as they are generally the head office or offices of one of the protagonists in the project. The ordinariness of these places can be explained by the content of the exchanges - which are often related to the transfer of knowledge, to the establishment of collaboration schedules or to conflict management - between actors who have previously agreed on the details of the agreements that binds them. But a second category of exchange venues includes conferences, trade shows and conventions; the latter are all spaces in which relations of temporary geographical proximity can be formed and developed. It would also be interesting to examine the increasing role played by cities in this regard, and particularly by the commuting of private individuals and economic actors between airports, railway stations (Sassen, 2002) or cities which themselves play the role of gatekeepers, and particularly of gatekeepers of the clusters that develop within them (Acs, 2002).

Trade shows, conventions and conferences are all spaces and events that are specifically designed and organized to facilitate exchanges between actors, in the framework of temporary geographical proximity interactions. As Maskell et al (2005) and Epstein (1994) have shown these temporary spaces – or "temporary clusters" as they call them – have existed in Europe since the Middle Ages and were originally meant to facilitate commercial exchanges between different producers and between producers and consumers of final goods (Cattle fares, agricultural fares...), before progressively becoming places of exhibition, of production showcases, as well as places of information and knowledge exchanges. Thus, they facilitate exchanges between researchers (during conventions or inter-professional conferences) as well as inter firm relations, which are what we are interested in here.

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Nowadays, following the works of Boggs (2004, 2005), it seems that trade fairs can be analysed as places that allow a reduction of the costs of transaction between the people who attend them. The example of the Frankfurt fair shows that the participants attend the fair in order to collect information on the strategies of their competitors, initiate sub-contracting operations, and collect manuscripts. This is in keeping with Norcliffe & Rendace's (2003) conclusion of their analysis of comic book fairs in the US. This idea is also found in the works of Epstein (1994), who highlights the difference between spatial transaction costs, considered as transport related costs, and organizational transaction costs, which facilitate long-distance transactions; this leads us to the definition of both types of proximity. It must also be noted that North (1991) mentions trade fairs as a specific example of an institution that promotes extensive and intensive trade by lowering organizational transaction costs.

Part of the interest of trade shows, which lies in the possibility of presenting new products and their main technical characteristics, tends to disappear with the development the Internet; indeed the latter enables producers to present, on their web sites, their main or most recent products and to indicate and describe the purposes of these products as well as their performance. Nevertheless, as is frequently the case, this standardized information seldom suffices to convince potential users or to truly inform competitors. Furthermore, producers seek to meet one another for other reasons, and in particular in order to introduce themselves and to exchange knowledge (Lundin & Soderholm, 1995). Thus trade shows today have three main purposes (these conclusions are based on the results presented in the works mentioned above, especially those of Bathelt & Schuldt (2005), and on the many historical examples provided by Boggs (2004). They are also based on surveys we have conducted in the Ile de France Region on the topics of optics cluster (Torre, 2007):

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- their first purpose is to give firms access to detailed information about the technologies developed by their competitors or suppliers. This type of information cannot be obtained by consulting the web sites or technical brochures of the producers. It can only be obtained through an *in vivo* examination and a discussion with the technicians or representatives of the manufacturing firm. Incidentally, it should be noted that this operation is less risky for the manufacturers of technology than their competitors' daily scrutiny;

- their second purpose is to enable producers to be in direct contact (face to face) with their competitors, clients or suppliers. This is particularly important in the case of innovating firms, as it gives them an opportunity to meet their competitors or manufacturers of complementary products, or possessing techniques that could prove useful for the firm. Thus, trade shows offer first-contact opportunities to firms and thus help them form relationships based on trust and shared knowledge with firms that could become their partners. They give firms the opportunity to "test" potential partners, or even to lay the first stone of collaboration or of future common projects. Once again, face-to-face interactions prove essential to the development of future collaboration.

- finally trade also provide firms the opportunity to meet existing partners, without having to travel to any specific location.

IV. Moments of temporary geographical proximity in the process of innovation and knowledge transfer

Because the needs of firms and laboratories for geographical proximity are not necessarily permanent - in particular in activities of knowledge transfer - *moments of temporary geographical proximity* are sought for. These moments depend on opportunities, on evolutions in inter firm relations, and on the characteristics of the life cycle of the product

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innovations or of the processes in which the firms are involved. The need for geographical proximity is seldom permanent for innovators. More specifically, the process of knowledge transfer can often take place between distant partners; however, at certain stages of this process, face-to-face interactions are essential to the successful completion of the operations of production of goods and innovations.

There is no denying that face to face relations remain indispensable for certain types of interactions, in particular to solve problems related to the heterogeneity of reasoning modes or those related to the processes of deliberation and negotiation. We could mention the example of two actors who do not know each other and start cooperating on a new program or a new technology. However, the intensity of the need for face-to-face relations varies according to the phase of the process, as shown by the example of transfers of technology in the sector of bio-technologies (Gallaud & Torre, 2004). In this sector, the cooperations between firms consist of successive phases that condition their relation to space. The role played by geographical proximity diminishes with time. It is used in complementarity with organized proximity during the phase of co-production of fundamental, tacit and contextual knowledge. Its role diminishes subsequently during the phase of absorption of the knowledge produced during the scientific phase, which implies a re-contextualisation of the latter in order to test it in various situations. Finally, it is often replaced entirely by organized proximity in the phases dedicated to the design of prototypes and clinical trials or to the codification of research results.

i) The hypothesis of the life cycle of products and innovations

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One way of explaining and analysing this phenomenon consists in examining the life cycles of the product or industry; indeed the need for geographical proximity varies considerably according to the different stages in the life cycle of the product or industry.

It is generally considered that the life cycle is divided into three consecutive stages. The first stage is exploratory and consists in the implementation of the activity and in the exploration of possible technical options; the second stage concerns the intermediary production developments and is characterised by an increase in the volumes produced and in the sophistication of the techniques being used; the final stage is one of maturity; it is characterized by a stability of the techniques used and of the market. Characteristics specific to the field of innovation can be associated to each of these stages (Abernathy & Utterback, 1975).

Indeed, according to Klepper (1996), innovation, which is mostly generated by small firms, tends to be more intense during the first stage of the product's life cycle. It remains intense during the product development stage, but is then "taken over" by large firms. It looses momentum during the stage of maturity, for the benefit of firms that are more firmly positioned in the market, before becoming negligible and left to small firms during the stage of decline. Thus, the production process is characterised, not only by the specificity of the techniques and methods used, but also by the differences in size of the firms involved at the different stages of the product's life cycle, an aspect that can influence the configurations of clusters and the strategies implemented within the latter (Dalum et al, 2005).

To these successive stages of production and innovation can correspond different relations to space; in other words, the relations between innovating firms or laboratories, in terms of geographical proximity, vary according to the stage of production and innovation. According

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to Audretsch & Feldman (1996), who have conducted an empirical study based on data on innovation activities in the United States, the first stages and (to a lesser degree) the last stages of a product's life cycle prove to be the most demanding in terms of co-location of firms and research laboratories, particularly when it comes to activities of fundamental research or those that are not related to the skills of the workers. Thus, it seems important for innovating firms, to play the card of spatial agglomeration during these stages, whereas in the stages of maturity, during which the constraint of proximity is less demanding, the clusterisation process seems less central. Needless to say of course, that the implementation of this process does not call into question the fact that firms that belong to clusters develop relations and exchange knowledge with firms situated within and outside the cluster. Let us say that firms concentrate more on intra-cluster relations during the initial stages of the process, and more on inter-cluster relations during intermediary stages.

It is interesting to note that the process of co-location of innovating firms, which is considered in these studies as important or even essential during the initial and final stages, concerns essentially the smallest firms, which are supposed to be the most active in terms of innovation at the beginning and at the end of the cycle, whereas the largest firms seem less affected by the spatial constraint. A similar idea was expressed by Markusen (1985); indeed according to this author the spatial concentration of innovating firms is necessary during the initial stages of the innovation activity, because the latter need to be conducted in an environment that is favourable to their development, with is immediately accessible services and partners. This point is perfectly illustrated by the example of "nurseries". This result is in keeping with conclusions we drew from a study on French start ups in the biotechnology sector (Gallaud & Torre, 2004). Thus we concluded that small firms are more affected by the constraint of spatial concentration, whereas for larger firms this necessity seems less pressing.

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ii) Temporary geographical proximity and stages of the relations of collaboration

The relation identified between moments of temporary geographical proximity and the life cycles of products must not conceal the fact that other determinants of temporary interaction between the actors of the innovation process exist. It is the case, particularly, of collaborations between innovating firms, especially when the latter are involved in common projects of research or development (3). In this case, the organizations that cooperate or wish to cooperate, make use of the properties of geographical proximity in order to facilitate knowledge exchange; but at the same time they keep enough distance to prevent unwanted leaks of information to competitors. We shall now examine this question, which essentially revolves around both logics of organized proximity: belonging and similarity.

When organizations exchanging knowledge are located in the same area, interactions can be repeated. But when they are not, interactions are less frequent because of costs related to travelling, which can be divided into transport costs and the time necessary to meet the other innovators. This is why the participants to a project will then try and limit the moments of geographical proximity, by attempting to rationalize the need for temporary geographical proximity making face-to-face interactions only possible when they are necessary. It is particularly the case when different firms are involved in similar or identical activities (Richardson, 1972) and cooperate in order to reduce the costs of investigation arising from research and innovation, or to share fixed costs.

Thus, the need for geographical proximity affects certain phases of the interaction between firms : the phase of negotiation in a transaction, the definition of guidelines and the organizational framework of cooperation (as revealed by Aggeri & Segrestin, 2001, in the case of the project of elaboration of a new car in the French automobile industry), the

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realization of its initial phase in the case of a technological alliance, the necessity to share equipment in the experimental phase of a common research project or to exchange knowledge and above all to know personally the researchers (colloquium) belonging to a scientific community… Short or medium-term visits are then sufficient for the partners to exchange - during face-to-face meetings - the information needed for cooperation.

Thus, Gallaud has shown (2005) that it is particularly interesting to examine the strategies adopted in the French biotechnology sector concerning face-to-face meetings between the protagonists of innovation or development projects conducted in common by distant firms. In this case, the frequency of the moments of temporary geographical proximity between the protagonists is stipulated in contracts when the collaboration agreements are signed, so that the stages and periods of face to face interactions are known to the partners as soon as the collaboration begins. Thus, moments of temporary geographical proximity prove to be important at the beginning of the common process of innovation, as it is during these moments that rules can be determined, and procedures and project's design agreed upon. These moments consist in schedules meetings that take place about twice a year, and that take place at the head office of one of the partners. The rest of the time, the protagonists interact through telecommunications technologies (phone, fax, and internet) and, keeping in mind the commitments they made during the initial stage of the cooperation, manage to solve their problems by communicating in this manner. Every time they meet face to face, they reaffirm their agreement, discuss unsolved problems, and establish a detailed schedule for the main stages of their long distance collaboration.

It is clear here, that the projects are conducted from a distance and that they depend on the use of ICTs and on the establishment of formal schedules for moments of temporary geographical proximity. However, as Gallaud shows (2005), an exception to the rule applies in the case of

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serious conflicts arising during the process of collaboration. Indeed, conflicts can arise, in the course of the collaboration, between the participants of the project, and they might necessitate the setting up of meetings that were not planned in the agreement. These conflicts are mostly related to the question of intellectual property rights of innovations, and reveal how serious firms are about not diffusing their knowledge or revealing their inventions thoughtlessly. But they can also be related to the objectives of the projects or to technical questions about the modes of production of process innovations or the very characteristics of the innovation itself.

The type of proximity mobilized to solve conflicts then varies according to the method adopted to solve them (the categories of conflict resolution methods presented below have been tested on a sample of biotech start ups, based on the typology made by Dyer & Song (1999) and Gobeli et al (1998)). Four types of conflict resolution methods, to which correspond different forms of proximity, have been retained:

- avoidance, in which the project manager waits for the conflict to solve itself, at the risk of causing the project to fail leading to separation. If innovators do not recognize the conflicts, they will not travel to resolve it. In this situation geographical mobility is not mobilized (the actors do not have face to face interactions, but use communication technologies);

- the forced solution, associated to a relatively low geographical proximity. It is not necessary for all the participants to the project to meet when this solution is chosen. On average, only one trip/meeting takes place when this method is adopted.

Two cooperative solutions necessitate temporary geographical proximity more because they require the participants meeting in order to negotiate a compromise:

- the 'give and take' solution, whereby the hierarchy proposes a solution that is acceptable for all participants concerned. It differs from mediation – which refers to disagreements between an institution and a user more than to firms – in that one of the parties

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(the hierarchy) is both judge and party and proposes concessions elaborated with the workers. Temporary geographical proximity is used extensively and generally more than one trip/meeting takes place when this method is adopted;

- the concerted solution (concertation), in which all participants meet and find, together, a mode of resolution specific to their problems. The advantages of permanent geographical proximity are obvious here, as it enables the parties involved to hold repeated deliberations and negotiations and facilitates the quick mobilization of actors after latency periods. As in the previous case, geographical proximity is used extensively (more than one trip/meeting) to help solve conflicts. This mode of project organisation clearly calls for permanent geographical proximity:

iii) Back to the notion of clusters. Why do small innovating firms tend to concentrate spatially more than large firms do?

We have shown that clusters and epistemic communities represent two opposite cases of knowledge transfer relations, and that it is possible to reconcile them on the basis of geographical and organized proximities. The clusters "that work" rest on the combination of both types of proximity and include both strong internal relations and strong relations with external actors. However, the existence of many clusters can above all be explained by traditional economic factors related to agglomeration economies and to local labour markets. We have also seen that the smallest innovating firms tend to concentrate more than large firms. But for what reasons? It is not because small firms need face-to-face interactions with their partners more than large firms do; the explanation is far more trivial. In fact, all innovating firms need moments of geographical proximity for successful knowledge transfers. They simply satisfy this need through different means:

- very small enterprises or small SMEs often use co-location;

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- the larger firms often use mobility and the possibilities offered by temporary geographical proximity.

Indeed, the bigger the firm, the more easily it adjusts its localizations to the temporal nature (permanent, temporary…) of the need for geographical proximity. Thus, big firms can more easily fulfil the need for geographical proximity by de-localizing part of their staff, including for relatively long periods of time; whereas smaller firms are often forced to adopt a permanent co-localization even when they only need temporary geographical proximity. Big firms, group subsidiaries or universities can bypass the constraint of co-localization associated with the initial phase of exploration by sending teams of researchers or doctors for short or prolonged visits to distant research centres for example. These solutions are possible thanks to the important volume of human resources available to them. However, in the case of smaller organizations, the coincidence between the need for knowledge and the need for a geographical proximity during this process is often a determining factor of localization, one person being appointed to tasks that are part of different phases of the R&D process. They are then forced to settle near other firms or laboratories, even if they only need geographical proximity during one phase of their R&D or the knowledge transfer process.

Thus, large firms can at once take advantage of their co-location with other smaller firms - for example within poles of competitiveness - and develop partnerships with firms outside the cluster. They often privilege « horizontal » exchanges with firms outside the local system, and develop, internally, a network of small firms, laboratories or sub-contractors. It is the same logic that leads small firms to cooperate, both vertically and horizontally, within industrial districts characterised by intense information exchanges between firms that operate on the same production segment.

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It is also important to make the distinction between firms entering a sector and firms already localized; a distinction that also plays in favour of the co-location of small firms:

- firms entering a sector (start-ups), which must simultaneously decide where to locate themselves and possibly choose cooperation partners. They might find it in their interest to locate in the proximity of other firms or organizations because they might be in the process of acquiring production assets that will enable them to produce their innovations and might find it advantageous to use existing equipment that is used in common by other partners. This case is limited – with the annual entry rate into branches being low – and also refers to the setting up of new production or R&D units;

- firms already localized, wanting to cooperate with other organizations in order to innovate. These firms will not decide to re-locate in the proximity of organizations with which they wish to cooperate due to the cost of such an operation. This is the reason why surveys such as CIS (Freel 2003) find an important part of the relations of cooperation occurring between firms belonging to different regions or even different countries. The creation of a joint venture, consisting in building a new laboratory in a location approved by all participants, is not the most used solution because it is also deemed too expensive.

Thus, based on these results, we can make one last observation about the process of clusterisation. Many works on clusters or industrial districts are, in fact, centred on the study of very small firms or SMEs, because statistically SMEs represent the largest part of economic activities in clustered areas. As discussed above, these firms are to some extent forced to locate with other similar firms or in proximity of larger firms; but from this, it is often concluded, rather hastily, that the process of innovation as a whole necessitates co-location or permanent geographical proximity (see in particular, the works in geography of innovation). And yet large firms are relatively unaffected by these constraints, and what is more, they are very aware of the risk of disclosure of confidential industrial information

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associated with geographical proximity (see Simmie, 1998), which largely tempers their enthusiasm for the alleged virtues of co-location. Temporary geographical proximity actually largely supplants this need and in most cases provides all the necessary opportunities for firms or research laboratories to exchange their knowledge, while protecting them from the dangers of an uncontrolled disclosure of their knowledge and innovations.

Conclusion

The aim of this article was to show 1) that despite the validity of the approaches that now severely and justifiably criticize the hypothesis of the necessity of permanent geographical proximity in the process of knowledge transfer, the latter still necessitates a degree of geographical proximity; 2) that the geographical proximity mobilised for these exchanges, or what we have called temporary geographical proximity because of the non permanent nature of the face to face meetings it refers to, is made possible by the existence of specific moments and spaces that now call for closer examination.

With this purpose in mind, we first argued about the weaknesses of the hypothesis according to which the prevalence of clusters rests on the necessity of permanent face to face interactions in the knowledge exchanges. We then applied a similar mode of examination to the hypothesis according to which the transfer of knowledge is possible in the total absence of face-to-face contact. Here again, we found, in the case of epistemic communities, that this hypothesis could not be validated, notably because these modes of functioning cannot be transposed to those that prevail in the production sector, and because the main actors of these networks occasionally need to meet in person. We then developed the hypothesis of temporary geographical proximity, which corresponds to the possibility of satisfying certain

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needs for face-to-face contacts through mobility, and through trips and visits, especially in order to be able to exchange certain types of knowledge, or to enter into collaboration agreements. To finish, we identified the places that are specifically designed for this type of interaction, particularly fares, trade shows and conferences, and discussed specific moments of temporary geographical proximity in the process of knowledge transfer, such as scheduled face to face meetings in cooperation contracts, or the meetings required to solve conflicts.

Thus, through these different contributions we have shown that:

i) The combination of permanent geographical proximity and organized proximity is an essential factor of the success of clusters that « work »; indeed, in these successful clusters internal knowledge diffusion rests on both types of proximity;

ii) Face-to-face interactions are only required during certain stages of the innovative process ; for such face-to-face interactions to occur, permanent co-location is not required; only temporary co-location, through meetings between individuals, is necessary ; and these meetings are possible thanks to individuals' mobility and special events (such as fairs and trade shows). This is what we call temporary geographical proximity;

iii) Small firms are more tied to their territories than large firms are; their lack of financial or human resources forces them to locate close enough to the organizations with which they need to exchange knowledge. They benefit less easily from the advantages of temporary geographical proximity because of the high transport costs and because of their insufficient human resources.

This latter point explains in part the high concentration, in clusters, of small firms belonging to the same fields of production, and why large firms prefer to locate in proximity to sub-contractors or research laboratories operating at different stages of the production processes. It also reveals that large firms are more « footloose »; indeed the latter can more easily free

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themselves from the constraints associated with geographical proximity and relocate in areas that are more attractive in terms of financial or land-related advantages, and in terms of labour costs.

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End notes

1. This obviously does not mean that all the beliefs of the members are identical but that there is a common core of beliefs through which the organization identifies itself as one collective entity. Furthermore, the common corpus of beliefs can be based on the representation of the organization as a place of conflicts.
2. Let us note first of all that our work on clusters and technology exchange is based on the idea that it is necessary to identify the channels through which knowledge is exchanged and second of all that we focus here on the cooperative modes of knowledge transmission. Thus, we do not consider the hypothesis according to which clusters can, in some cases, be socio-economic contexts where firms' success heavily relies on their "unintentional" access to intangible knowledge available within the local area.
3. Let us note that this approach is coherent with the primary object of our research, which concerns above all the processes of cooperation in the modes of knowledge transmission.

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Table I: the role played by both types of proximity in knowledge transmission

	Geographical proximity	**Organised proximity**
Geographical proximity	Spatial concentration of activities (without knowledge exchange)	*Cluster* with local knowledge transfer
Organised proximity	*Cluster* with local knowledge transfer	Footloose *epistemic community*

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