Industrial Clusters and the Knowledge Based Economy: from open to distributed structures?

by

Frédéric Rychen, Université de la Méditerranée, IDEP and LEST Aix-en-Provence. Frederic.Rychen@univmed.fr .
and
Jean-Benoît Zimmermann[*], CNRS - IDEP and GREQAM, Marseille. Jean-Benoit.Zimmermann@univmed.fr.

Abstract : Clusters have been at the centre of local industrial development studies and strategies in recent years. Two complementary factors accentuate the importance for firms and territories of governing the interactions between industrial players: the globalization of the economy and technologies and the emergence of a knowledgebased economy. Efficient structures can generally be envisaged as deriving benefits from the complementarity between local and global relations. In this context, how far do the interactions between industrial players still require geographical proximity? The interfaces between local and global relationships become a strategic feature that can be achieved through different use of space and time. “Knowledge gatekeeper” and “temporary proximity” thus appear as two key-concepts for achieving partnering between players and a better flexibility in the local-global trade-off.

1. Introduction

Clusters have been at the centre of local industrial development studies and strategies in recent years. They appear as a strong factor in innovation and competitiveness due to the intensity of interactions they allow between the agents in industrial dynamics. Of course, this phenomenon related to geographically concentrated activities is not completely new, and has been addressed by a lot of older studies. The model of flexible specialization developed by Piore and Sabel (1984) at the beginning of the 1980's, in the line of the earlier work of Alfred Marshall, already shed light on the role of interacting small specialized firms as a response to the decline in the model of the big firm. A lot of empirical studies have also focused on the agglomeration of highly competitive firms in the late twentieth century (see for instance Best, 1990).

Two complementary factors nevertheless accentuate the importance for firms and territories of governing the interactions between industrial agents: the globalization of the economy and technologies and the emergence of a knowledge-based economy. It is clear that the immense advances in transport and communication technologies call into question the local nature of synergies and the geographical proximity of the agents. Knowledge now occupies a central position at the heart of more and more industrial and innovation processes, added to which, technologies of information and communication have powerfully developed, in terms of both

* Corresponding author:

Jean-Benoît Zimmermann – GREQAM-EHESS, 2 Rue de la Charité, 13236 Marseille cedex 02 FRANCE.

+33 (0)4 91 14 07 37; Fax: +33 (0)4 91 90 02 27; Email: Jean-Benoit.Zimmermann@univmed.fr

ge spillovers may have a significant local imp

act, but they can also affect distant firms th

rough non-geographical proximities.

Proximity as a driving force of agents' interaction and coordination (Pecqueur and Zimmermann, 2004) can be interpreted in different ways, depending on the nature of what agents share or have in common. Torre and Rallet (2005) make the distinction between a geographical proximity that can be measured in terms of distance (length or time) in the geographical space and an "organized proximity" that results from the existence of common routines, rules or even representations or beliefs that permit coordination. Thinking about the role of proximity in the innovation process, Boschma (2005) introduces the notion of "cognitive proximity" that facilitates communication and means "that people sharing the same knowledge base and expertise may learn from each

other", while "social proximity", defined "in terms of socially embedded relations between agents at the micro-level (...) involves trust based on friendship, kinship and experience" (ibid.).

In local systems, agents are mostly connected with other agents situated in their spatial proximity, while these local networks, as open systems, benefit from the long-distance connections that some of their members are able to activate. "Distant contexts can be a source of novel ideas and expert insights useful for innovation processes as shown, for instance, in recent patent analyses. Firms therefore develop global pipelines not only to exchange products or services, but also in order to benefit from outside knowledge inputs and growth impulse. Such findings imply that, in a globalizing knowledge-based economy, each cluster's economic prospects depend not only on its internal interactions but also on its ability to identify and access external knowledge sources located far away" (Maskell, Bathelt and Malmberg, 2006).

In itself, the co-location of agents in geographical proximity is not a sufficient condition for co-ordination, but it can contribute to its efficiency, provided the existence of other shared dimensions among agents, such as organic level, representations or projects. Thus, in strategic terms, industrial agents seek to make use of the different dimensions of proximity and their possible overlapping to manage their own problems of relationships at short (geographical proximity) or long distance. So efficient structures can generally be considered to benefit from the complementarity between local and global relations. In this context, how far do the interactions between industrial agents still require geographical proximity? In other words, to what extent do industrial and innovative performances depend on a durable co-location of agents? Consequently, how do internal links in a local industrial structure differ from but combine with external ones? Obviously, the way local-global interfaces are managed will play a very central role here. So when talking about clustering effects, geographical proximity should not be considered as the sole relevant level of meaning. It is more important to understand how and why firms build links and how the structure of links will give sense (or not) to the co-location of actors.

Going a bit further, these questions lead us to enrich the concept of *cluster*, usually considered as a spatial concentration of firms and industrial and technological activities. Insofar as the efficiency and performances of "classical" clusters are the result of the intensity and quality not only of internal but also of external interactions and coordination, to what extent is it still relevant to consider interaction structures restricted to bounded geographical areas? On the one hand, territories can no longer be considered as closed systems, and the questions of internal and external co-ordination cannot be regarded separately. On the other hand, coordination does not require durable co-location: many regular interactions between partners are satisfactorily achieved in spite of wide geographical separation. Relations sometimes stem from former co-location, as observed by Grossetti and Bes (2001) in the domain of scienceindustry relationships. Sometimes they emerge through temporary encounters, which may require further temporary meetings. This suggests that clusters should be considered as coordination structures less constrained by space and time. This calls for a reconsideration of the

spatial implications of both the interfaces and dynamics of interactions.

Local advantages of geographical proximity must be weighed against the global constraints and opportunities underpinning the performance of the firms involved. The interfaces between local and global relationships become a strategic feature that can be achieved through different use of space and time. “Knowledge gatekeeper” and “temporary proximity” thus appear as two key-concepts for achieving partnering between agents and a better flexibility in the local-global trade-off.

2. Clustering and interactions: the local-global trade-off

The study of the clustering process in the knowledge-based economy focuses on activities that are economically driven by immaterial factors. This framework emphasizes the reasons behind the co-location of firms. As space is not a direct factor in the production process, it is introduced through the location of the agents with whom the productive unit is connected. The pattern of interactions stems from the characteristics of the activity and contains the explanatory factors of the local/global configurations that we observe (Kogut, 2000).

Looking at the literature on the creation and transmission of knowledge between local firms, we can see that knowledge is considered as an exogenous flayer that facilitates clustering. Many papers refer to knowledge as an externality or a local public good (Antonelli, 2000; Bellandi, 2002). From this perspective, knowledge is an external factor that can influence the innovative process within firms, and the magnitude of the effect is more or less a function of the number of links with other agents (Dyer and Nobeoka, 2000; Kogut and Zander, 1992). Recent models of strategic link formation consider inter-firm links as a means of capturing knowledge spillovers and so reducing production costs, contributing to the formation of incentives for competing firms to enter R&D partnerships with each other (Goyal and Joshi 2003, Deroïan, 2006). The fact that knowledge links can be endogenous gives meaning to the fact that knowledge linkages between firms are not evenly distributed and why there probably exists a certain structure in the process of knowledge diffusion.

Describing knowledge as a local externality presupposes that the firms take this phenomenon as a given when they make decisions (about location, production, etc.). This hypothesis is somewhat restrictive, because it does not allow us to study the process under which interactions are constructed, and how these interactions can support knowledge creation, acquisition or transmission (Breschi and Malerba, 2001). Access to knowledge resources in geographical proximity depends on an active involvement in knowledge exchange networks and skilled labor markets. So, if space matters, this is both because and to the extent that social links are usually denser in a context of spatial proximity.

As far as learning and innovation are concerned, geographical proximity *per se* does not appear to be either a necessary or a sufficient condition and “should always be examined

in relation to other dimensions of proximity that may provide alternative solutions to the problem of coordination"(Boschma, 2005). Malmberg and Maskell (2005) point out that learning should theoretically derive the most benefit from geographical proximity, since there are important dissimilarities and complementarities between the cognitive repertoires of the partners (*learning by interacting*). But geographical proximity usually involves firms with similar or close cognitive registers, often rivals and competitors. The latter base their learning on observation and comparison (*learning by monitoring*) but also on the social proximity that generates a "local broadcasting" phenomenon (Owen-Smith and Powell, 2004) or a local "buzz", to borrow the term used by Storper and Venables (2004).

Generally speaking, most of the papers dealing with the knowledge-based economy consider relationship networks as a natural medium for spreading information and establishing linkages. But such networks should not be considered solely from the perspective of their role as medium; they should also be considered as an assembly of more restricted sets of relations that have been established by individual agents in order to improve the efficiency of their industrial processes (production, innovation or commercialization). In that case, it is impossible to understand the role these relations play in the use and creation of knowledge without taking into account how and why they have been constructed. It follows that spatial clustering analysis cannot be adequately addressed if it is not directly connected with the process of creation and use of networks, where individual ego-networks are the result of individual and bilateral decisions to form links that take into account the whole existing or expected network.

From this perspective, a clustering process should be considered as an adaptive process of interactions that relies partly on spatial proximity to spread and create knowledge (Feldman M., Aharonson B. and Baum J., 2005). Consequently, such local arrangements cannot be considered fixed and autonomous within the bounds of the local amenities that may influence the dynamics of knowledge. We should not imagine local networks to be efficient in themselves. Separating them from their outside connections could drain them of their meaning. Hence, the insertion of local clusters within wider networks is a key feature of the processes of knowledge creation and use that opens up the possibility of their renewal and possible recombination (Saxenian, 2005). Local arrangements within a global network take advantage of spatial proximity while keeping outside access to a large variety of resources and opportunities.

The methodological challenge that emerges is to discover the rationale underlying the endogeneity of local/global networks through empirical observation of the practices of the agents involved. This paper proposes to demonstrate that this rationale could be described by the building of new organizational configurations where the balance between distant and close relations depends on the design and location of interfaces between local and global networks. This kind of strategy in the building of the firm's ego-network gives rise to more complex network configurations that need to be described and illustrated.

3. The strategic role of local-global interfaces in the building of the firm's ego-network

The interfaces between local and global relations are a key feature of clusters, but they can be achieved through different network configurations. The diversity of such configurations is a valuable result, but it considerably complicates the task of identifying and rationalizing the behavior of the economic agents. If the agents face a dynamical process of interactions in an unstable local and global environment, they will be reluctant to commit their interaction strategies to a frozen network configuration. Constructing networks for multiple purpose relations will also be too costly. Alternatively, flexibility could be efficiently maintained in the configurations by establishing short-term localized interactions, for instance, or by building local interactions with a globally-connected agent. In a preliminary attempt to illustrate this idea, making use of temporary proximity or gatekeepers can be viewed as best response to a same goal, but with a local/global network configuration equilibrium that is better adapted to the geographical location of the firm's economic activity.

So the question addressed here concerns the nature of the local-global interfaces used by firms to organize their interactions and the strategies underpinning the choice of a particular network configuration. In order to clarify the presentation, only three types of possible network configurations will be considered. For a firm, the multi-spot configuration (a) is the option of building permanent interfaces near each distant relevant place and directly collecting the information and opportunities. The Gatekeeper configuration (b) puts a specific agent in charge of the interface, entrusted with the mission of collecting and distributing information and opportunities through her multiple relations. Last but not least, the temporary proximity configuration (c) is based on temporary interfaces operated either in a specific third place or on the site of one of the interacting agents.

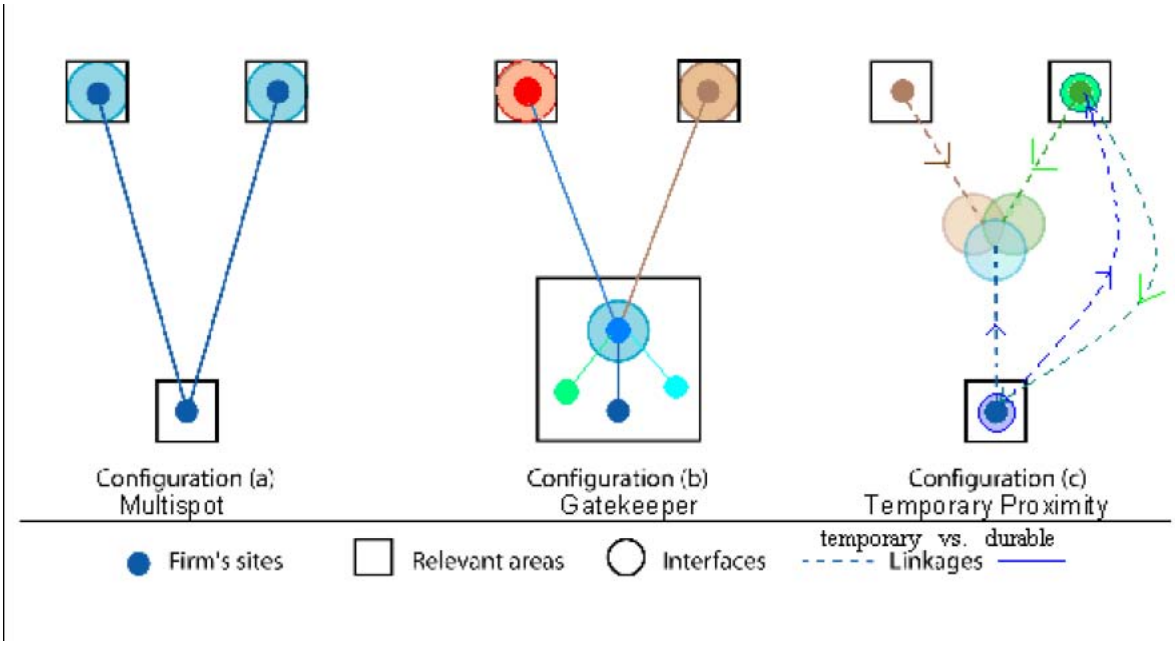


Figure 1: Basic ego-network configurations Each of these configurations has its specific costs and benefits for the firms, and it may be considered that there is some trade-off between them. As we are in a dynamic setting, the firm can switch from one configuration to one another (according to opportunities and costs) or combine them. But their use is dependent on certain conditions relating to the consent of the other agents. A multi-spot configuration does not rely on an agreement with other agents and so is a one-sided decision. A gatekeeper configuration assumes that the firm in the interface is willing to distribute information and/or opportunities. Temporary proximity relies on at least one of the partners being willing to move.

3.1. The multi-sites configuration

As illustrated in diagram (a) of Figure 1 above, the "multispot" configuration allows the firm to manage its local/global articulations by locating a plant on each targeted site to take care of the local interface, while global coordination is managed within the system of intra-firm relationships.
Firms relying on a multi-sites configuration follow an optimization process that has been extensively described in spatial economics. Depending on costs, competition and profits, firms may have incentives to build local units or subsidiaries so as to be as close as possible to the market, especially when transport costs are high or in order to take advantage of production or innovation opportunities when specific resources have to be exploited.

In such a configuration, the rationale is that of the integrated space of the firm. Interfaces required for market access and resource combinations are built into the localized units, interconnecting the geographical proximity to external agents with the "organized proximity" (Torre and Rallet, 2005) within the multi-sites space of the firm. By definition, such a configuration only concerns large and rather global firms that can base their organization on a multi-localization internal division of labor. In a dynamic sense, flexibility is relatively limited and costly insofar as it relies on avoiding any geographical lock-in and preserving the nomadism of the firm. It is achieved through a periodical reassessment of the merits of the firm's global architecture and spatial deployment. Thus, as far as the territories are concerned, this model also includes the possible departure of the firm, if opportunity costs lead it to prefer another location at the expense of the present one (Zimmermann, 2001).

Nevertheless, such a configuration can perfectly well apply to knowledge intensive activities, as in the case of the Californian "Cadence", worldwide leader in CAD (computer-aided design)[i]. In 1997, this company decided to locate a research center in Sophia Antipolis, in the south of France, to get closer to new customers in the emerging market of electronic CAD such as Texas Instruments, ST Microelectronics and Nokia, which concentrate an important demand for CAD software for the design of microelectronics circuits.

This configuration has the property that it can be self-generated by the firm's ability to set up in new sites. Such a configuration could also be interpreted as a specific client/supplier network in an industry characterized by a strong disintegration mechanism

and very specialized firms, where one of them has a leading position in the coordination of the activity.

So the multispot configuration can explain agglomeration through the convergence of firms' choices of location, when access to resource exploitation or capturing a local externality is involved. From that point of view, the internal composition of the cluster (number of firms in each sector…) is the main factor explaining the need for spatial proximity. The structure of the cluster and the strategies that construct the underlying network of relations does not change the result of the analysis. Although agglomeration economies are strong forces that drive regional growth, we consider that they are not sufficient to explain how clusters are structured and how they evolve. To better understand this question, it is therefore necessary to shed light on the individual strategies that contribute to the structure of the network supporting the clustering process. From this perspective, the gatekeeper configuration is a good example of an underlying network built from individual strategies that may support the clustering process. So the question of links formation and interfaces corresponds more to the two other configurations of networking.

1 See "Comment le californien Cadence coordonne sa R&D depuis Sophia", L'Usine Nouvelle, N°2991, 5 January 2005

3.2. The gatekeeper configuration

The diagram (b) of Figure 1 illustrates the way local firms coordinate to access remote resources through the instrumentality of an actor who is well embedded in global networks by way of intra as of inter-firms links.

The "Gatekeeper" configuration is largely based on the optimization of information management with respect to local and global flows. It derives from the concept of *technological gatekeepers*, first introduced by Allen (1977), whose function is to link "their organizations to the technological world at large", particularly in relation to "the problem of communication in technology" in a context of R&D organizations. This concept takes up the earlier idea of indirect flows of information forwarded through *opinion leaders*.

According to a more specific meaning, this concept of technological or knowledge gatekeeper concerns the role that a small number of agents can play in managing the local/global interface of co-localized groups of industrial units. Gatekeepers provide each of the agents with a connectivity function that enables them to avoid the cost of maintaining side-by-side relations. They have a double role of co-ordination to play.

Firstly, they contribute to the interconnection of internal and external resources, allowing local players to benefit from their own external relations but also giving external players access to local resources. In the Bologna automatic packaging machinery district in Emily-Romagna (Italy) – the so-called "Packaging Valley" – a small number of enterprises (*commitenti*), organize their network of subcontractors (theoretically more or less interchangeable) and co-ordinate the work of highly specialized SMEs to whom they transmit the requirements and specifications of external customers (Lorenzoni and Lipparini, 1999). In the textile district of Prato, from the 1950's on, this role was played by "particular economic actors (i.e. the impannatori or transformers). The impannatori designed the products, bought the raw materials, and distributed various phases of the production process among small, specialized producers --for example, rag-collectors (stracciaroli), spinners, warpers, weavers, dyers, finishers, etc. Moreover, they also coordinated all logistics and dealt with customers, both national and international (Lorenzoni, 1980)." (Locke R., 1995).

Secondly, they play a corollary role in terms of internal co-ordination, animating the local networks of firms through the mobilization and activation of local skills and complementarities, thus enabling benefits to be derived from geographical proximity effects, while improving access to locally-lacking resources or to external markets. They generate or facilitate the emergence of *productive encounters* (Colletis and Pecqueur, 1993), i.e. the capability of a group of local agents to bring solutions to productive problems or even to formulate and resolve some new and unprecedented ones.

Drawing on the same Italian packaging machinery case, Malipiero, Munari and Sobrero (2005) stress that technological gatekeepers play a triple role in coordinating and stimulating innovation, by capturing external relevant knowledge, absorbing it and diffusing it within the cluster. Obviously, private knowledge gatekeepers are likely to adopt selective diffusion strategies, because the network they create must also contribute to their own productive efficiency. In some cases, this may lead to the emergence of a non-profit institution in the role of gatekeeper.

3.3. Temporary proximity

Figure 2 illustrates the two main forms of "temporary proximity" presented in Figure 1, diagram (c). A firm can build an external interface by using its mobility towards a site gathering a set of agents for a limited duration or towards the location of another firm.

Temporary proximity is a means of avoiding the rigidity of fixed configurations by decentralizing the interface to a temporary meeting place, to which some or all of the partners have to make their way. Interactions do not require durable co-location, for three reasons. Firstly, all interactions require the prior identification of partners. If partners are not located in the same site, a face-to-face meeting will very often be required in order to initiate further interactions through "global pipelines", as Bathelt, Malmberg and Maskell (2004) refer to links between distant sites. Secondly, remote interactions can satisfactorily fulfill the partners' needs. Thirdly, inter-firm interactions are generally intermittent and do not require a continuous face-to-face.

These considerations give rise to the existence and justification of two large categories of temporary proximity. In the first, called "temporary clusters" by Maskell, Bathelt and Malmberg (2006), the meeting point is constituted by a temporary institution providing potential partners with a position of proximity that enables them to come into contact. In the second, a firm has to move from its own location to that of its partner, either reciprocally or not.

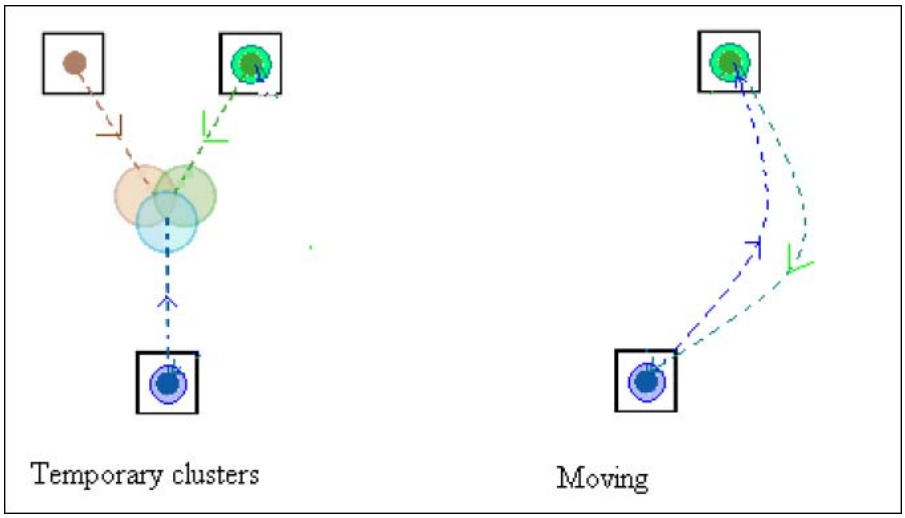


Figure 2: Temporary Proximity configurations

Following Maskell *et al.* (2006), "identifying, selecting, approaching and interacting with new partners is a tricky and costly process". This is the reason why international trade fairs and conventions and, more generally, all kinds of "international professional gatherings" can be a good means of identifying and approaching such partners. In that case, these temporary clusters are the site of vertical interactions, likely to be prolonged into long-distance relations. Furthermore, repeated presence in consecutive professional gatherings can help to build trust between potential partners without any preliminary commitment.

But temporary proximity can also correspond to a bilateral or multilateral relation between firms that are already partners. As analyzed by Torre (2006), innovation activities and knowledge production only require limited periods of face-to-face interaction, and do not necessarily give rise to localized clusters. Thanks to greater mobility, the geographical proximity constraint can be satisfied for a number of interactions, such as knowledge-sharing and services, through individuals or staff traveling to each other's location. Of course, as noted by Torre (2006), "the larger a firm is, the better it can adjust its localizations to the temporal nature of geographical proximity needs. Large enterprises can rid themselves of a strong geographical proximity constraint by moving some of their staff, maybe for relatively long periods, while smaller firms are often confined to a durable co-location, even though they only need a temporary geographical proximity".

4. Knowledge Gatekeepers and temporary proximity as networking devices

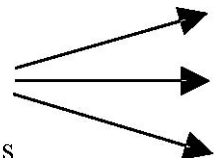
At this stage in the analysis, we arrive at the central question: "how do particular cluster structures emerge from the strategic building of ego-networks by individual agents?" As a first step in tackling this question, we argue that cluster configurations are the structural manifestations of local strategic responses to global constraints.

This shift from the firm to the cluster level requires us to explain how individual strategies can give rise to a collective construction, based on inter-individual interactions and improving individual performances and cluster attractiveness. So among the three basic configurations, the multispot is no longer to be considered, insofar as it is not in itself a driving force of clustering, except when the local plant of the firm plays a gatekeeper role within the cluster. Thus, two basic configurations appear as the basic bricks at the territorial level. By definition, the Gatekeeper is devoted to a more or less wide function of networking. Temporary proximity appears as a means for achieving a higher degree of flexibility, either for exploiting external links that do not require permanent co-location or for exploring possible future remote links, but avoiding high sunk costs.

So the dual local-global articulation of a located unit s_i is made up trough direct internal and, either direct or mediated, external relations. Distant relations are of either durable or temporary nature :

s_j Internal :

$i\ (\ s_i$

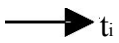


s_k local direct links

s_l

External : $i\ (\ s \rightarrow t\ )$

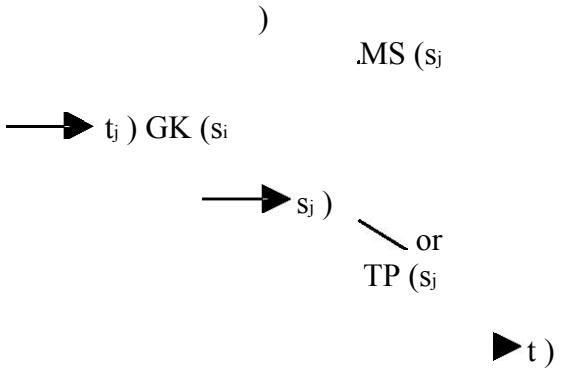
MS (s_i



t_i)

TP (s_i

t



Hence any inter-sites relationship needs at least a multi-sites or a temporary proximity interface, that can possibly be achieved by the way of one agent playing a role of gatekeeper.

Figure 3 : inter-sites relationships and interfaces

Now, how may particular cluster structures emerge from individual agents strategic building of ego-network? In order to progress towards such an aim, we claim that clusters configurations are the structural manifestations of local strategic responses to global constraints. But locality is of course not an actor even if some industrial and technological agents are likely to play a driving role in the coordination game of local behaviors, either for pure individual motives (leading firms) or for local development concerns (local institutions). Thus, the local emerging structure should not be considered as a "best response" to the local/global game, but as a result of the main or maybe

dominant strategic choices by industrial actors at a local level or, more precisely, the local projections of firms strategic choices of ego-network formation. So, from confronting local and global patterns would stem specific local networks and the way they do articulate into extended clusters within the global world.

It may be then possible to describe a typology of local area networks that represent the basic forms of local topologies, making use or not, for their external articulation, of the diverse alternative types of interfaces that have discussed. These basic forms can of course be combined in the making of real industrial organization. However they do not necessarily form clusters, at the level of a single site, in so far as their consistency can rely on external purpose or complementarities.

Three main basic local topologies can then be distinct , as shown in the Figure 4. The first one corresponds to a local network without significant external relationships what doesn't mean isolation or self-sufficiency in so far as this doesn't exclude external market activities. The second type corresponds to a more or less extended local network in which agents do assume their external relation on their own, through multi-site or temporary proximity interfaces. Then the third is a local network making use of a gatekeeper in order to achieve external relations. It has to be noted that the gatekeeper can be an autonomous decision unit or an establishment relying on an external decision unit.

Figure 4 : Three types of local networks

Note that the gatekeeper strategy induces per se a clustering rationale . In the case where gatekeeper is the dominant pattern at local as at global level, the industry organizes into strong collaborative local networks with efficient external links giving access to remote complementary resources. The typical structure should be a small-world network with local clusters strongly inserted within global industrial and commercial networks (Zimmermann, 2002). Alternatively the gatekeeper configuration may enter into

combinations with the other types of configurations often driven by firms incentives to access to specific or dedicated resources, or to benefit from local externalities or cost effects (agglomeration returns). The other combinations bring more indeterminacy whose issue in clustering terms, when it comes out, is most often the consequence of public policy care. Of course, one important point is the question of the stability of the related structures. The small-world structure is undoubtedly the most likely stable one in so far as it is carried by a set of local gatekeeper patterns articulated into a comprehensive and cohesive structure. The stability of the other combinations will more strongly depend on collective arrangements (see Srivastava and Gnyawali, 2006).

From there, it is now possible to draw the main features of the collective structures stemming from individual strategies of building firms' ego-network. These structures corresponds to a wider, more flexible and more dynamic approach of the concept of cluster, not restricted to the sole co-location constraint of the geographical proximity. On such purpose, geographical proximity is nowadays considered as a resource rather than a constraint. This embraces new forms of organization that combine space and time and the ability for several agents to play a go-between role within the structure and give rise to actual effects of transitivity. So the industrial fabric takes truly the shape and the nature of a network where inter-individual interactions and knowledge spreading are at the origins of an emerging collective dimension that impacts individual performances. Of course a critical question remains that of the frontiers of such consistent networks of firms that forms extended cluster structures. Here it appears necessary to refer to the regularity and intensity of the links activation, thus of agents interactions what corresponds to the distinction introduced by Granovetter (1973) between “strong” and “week” ties. This raises obviously a problem of subjectivity or at least of the particularity of each case in the absence of possible universal criterion. The critical question here is about the consequences of cutting a link or suppressing an actor on the viability or working of a cluster. Of course any actor may participate to different cluster structures and may possibly play or not a go-between role among them.

By evidence, there is a large number of such structures and it wouldn't be realistic to intend to describe them exhaustively. That's why our claim more simply concerns the description of the basic forms of which these new cluster structures are built, by the way of combination and switching from one to another in the course of time, aiming flexibility and cost-reduction. That's what we will briefly introduce as a typology.

Typically it is possible to exhibit four large types of basic structures that differentiate by the way they lean on space and time.

1. **Dispersed structures** : they gather geographically dispersed units whose location choices are weakly interdependent and that carry their activities in a at least partial complementarity. Interactions are achieved through transport and telecommunication channels and face-to-face is fulfilled by the way of temporary proximity. So distance can matter but not enough to require co-location. For some of the actors, like specialized suppliers, it is then possible to attain economies of scale by supplying different competitors on different locations.

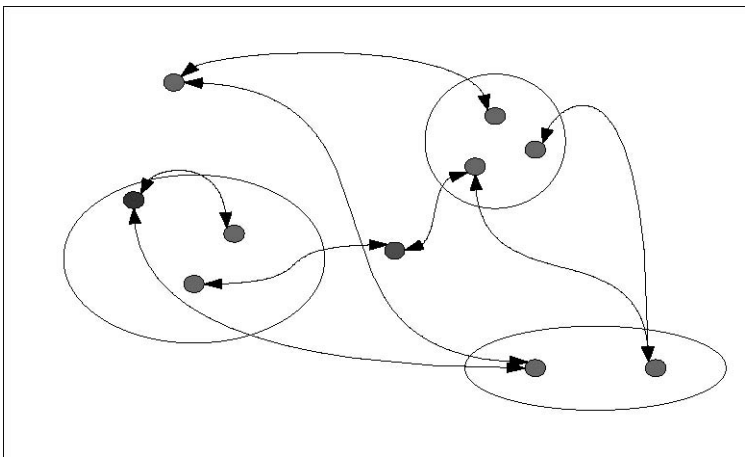


Figure 5 : Dispersed Structure

2.**Structural Holes** : a second type of structure combines short and long distance coherence by coupling distant locally connected components by the way of interface capacity and external relationships of gatekeepers. A variant of this type links a connected component to dispersed distant actors, for instance prime contractors.

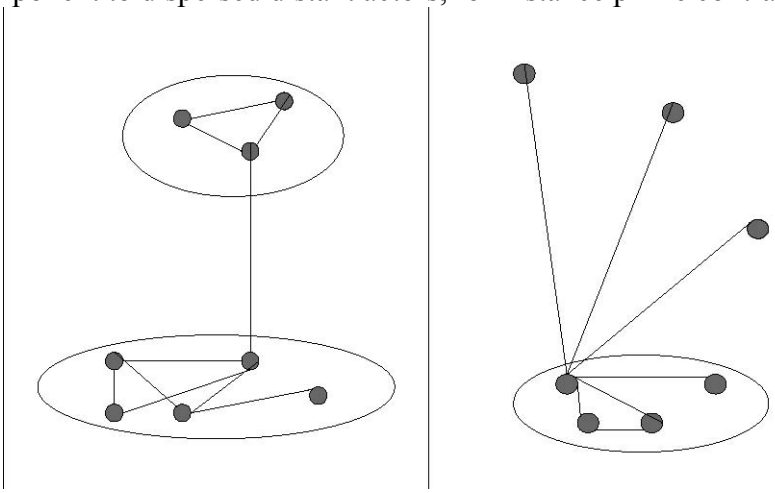


Figure 6 : Structural Holes

3.**Interconnected structures** : are formed by densely locally connected components (ie. distant classical clusters) that are interconnected by the way of inter-individual distant links and temporary proximity. These interconnected structures are the result of a strong complementarity between the localized components, possibly based on local differentiated comparative advantages or geographical proximity advantages. Interesting examples are given by the multimedia activity in France between Paris and Marseille or by the software industry between Silicon Valley and Bangalore in India.

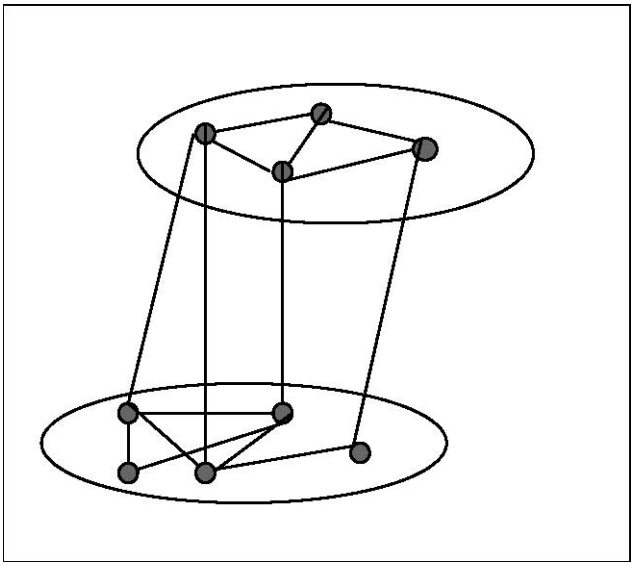


Figure 7 : Interconnected Structures

4.**Recombinable structures** : are actually the most flexible shape more likely to be observed when a high level of immaterial nature of the production enables a high efficiency of long distance links and short and medium term temporary proximity. In this case, a given configuration has to be considered as fitted to the specific needs and requirements of a given production and innovation project and its stability may be limited to the time scale of this latter. As projects follow each other as the time goes by, a new configuration can be built by the re-combination of local and distant links, of durable or temporary proximity for a high degree of flexibility required by the successive aims assigned to the cluster. It is for instance the case in the animated film production in Europe, as described in Cole (2008) , where the handicap of the too small sizes of the various studios has been solved by the networking of dispersed European partners while subcontracting routine works to Asia. Such flexible structures aim to possible reconfiguration following the requirements of the projects or the demand. Temporary proximity and gatekeepers are of course the central concepts of such configurations.

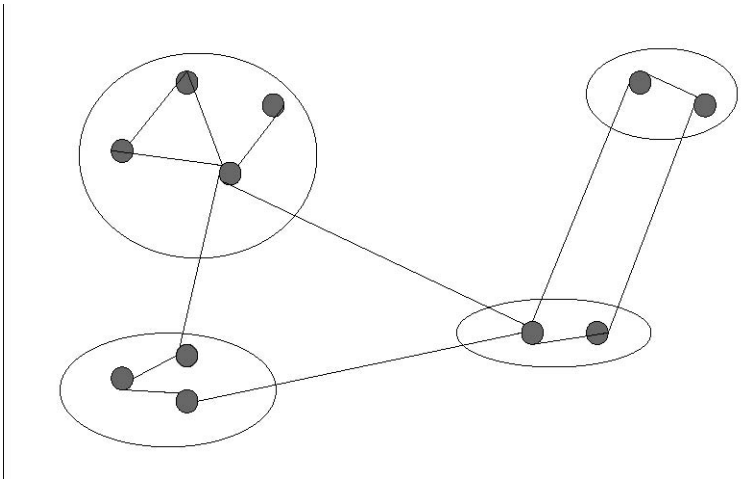


Figure 8 : Recombinable Structures

Conclusion

In this paper, we have settled up the bases of a renewed and more dynamic approach of clustering of industrial and technological actors, in the context of a knowledge based economy. This approach stems from the need for actors to take into account the constraints and opportunities of both geographical proximity and globalisation. It is based on the two basic concepts of knowledge gatekeepers and temporary proximity. The aim corresponds, in organization terms, to the necessity to attain a sufficient level of flexibility without having to support high costs resulting from relocating activities, switching from a spatial configuration to another one or the multiplicity of the geographical sites of the enterprise. To these considerations has to be added the idea that geographical proximity doesn't always play in a positive sense. As Torre (2006) shows, there are at least three main negative consequences that can lead to avoid geographical proximity. The first one is the unwanted aspects of local knowledge spillovers that can lead a firm to avoid a location next to her competitors, in so far as knowledge drains can be favored by geographical proximity, for instance through employees turnover. The second one refers to the dangers of a geographical lock-in, that can lead local production system in a regressive circle, locking it in an over-specialized character, in a growing isolation apart from the outside global dynamics. Last but not least the third negative aspect of geographical proximity stems from a the bad efficiency of the local system of innovation when it is too weekly connected with the outside world. This situation corresponds generally to a local system based on “weak ties, involving firms that share the same knowledge base, satisfying themselves being there and establishing communications for daily tasks. This weak local buzz (Bathelt and al. 2004), if it contributes to the system cohesion, only carries incremental innovations and doesn't favor knowledge spreading and synergies in terms of research and innovation” (Torre, Op.Cit.).

These considerations (negative aspects of co-location, need for flexibility and easier distant coordination) have led us to consider a cluster, understood as a cohesive set of strongly articulated industrial actors, beyond the postulated assumption of co-location, of geographical proximity. For understanding how such structures can emerge leaning on multi-sites locations, we have based our approach on the individual firms strategies of building egonetworks. There, the critical question is related to the way local activities in a given site can connect themselves with other activities in distinct and distant sites. So we have introduced a typology of three basic local-global interfaces that enable us to analyze local network configurations as the structural manifestation of local strategic responses to global constraints. Thus at a collective level, a large scope of structures can be considered that disentangle clustering from a strictly local conception. Of course the topologies of such multi-sites structures will highly depend on the specific characteristics of the related industry or technological field. “The emergence of structure in a network is sensitive to specific industry settings” (Kogut, 2000).

Following the approach we propose here, clusters nowadays have not any more to be considered as strictly local structures, by definition. Of course geography still matters. But the limits and the meaning of agglomeration of industrial and technological activities have no more to be considered in a geographically bounded area. Separated, distant locations can be in strong relationships, following diverse configurations, and these relationships can enter significantly in the way of working and the sources of each participants efficiency. Time and space enter in multiform combinations, engendering more complex structures and replacing the question of the geographical proximity source of benefits in a more open framework. Of course the question of the boundaries of the structure remains tricky and it is important to be able to identify such relevant structures in limited terms in spite of the idea that, with globalization, everything is in everything and reciprocally. That's one of the reason empirical methods of concrete clustering cases analysis have a prior importance to be developed and used.

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