

# **The multi-scale dimension of innovation: a proximitist analysis of partnerships build-up**

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## **ABSTRACT**

This paper tries to elicit elements, which explain the multi-scale dimension of science-industry collaborations by focusing on their construction process. Constraints linked to the search of specific resources, on the one hand, and constraints linked to the logics of coordination, on the other, weigh on actors when choosing their partner and may influence the geography of collaborations. An empirical study on collaborations established between Poitiers University's laboratories and firms reveals the geography of resources contribute to the spatial dissemination of collaborations. This study also highlights that the logics of contact enable the construction of both local and non local partnerships.

## **INTRODUCTION**

Collaborations became crucial in the innovation process of firms by allowing for the combination of heterogeneous skills required for a specific project. This element of collaboration is revealed in the increasing number of research partnerships established (Hagedoorn and al., 2000 ; Frenken and al., 2005). The University is a key partner, since it constitutes a source of new knowledge (Feldman, 1994 ; Saxenian, 1994, Anselin and al., 1997). The very first scholars of the geography of innovation draw attention to the significance of firms to locate close to universities to take advantage of their positive spillovers. Some recent studies in this field of research, focused more explicitly on science-industry interactions (Audretsch and Stephan, 1996 ; Autant-Bernard and Massard, 2000 ; Grossetti and Bès ; 2003 ; Levy, 2005), show how local and non local relations co-exist. They give new explanations to the spatial dimensions of these collaborations. They maintain that local partnerships result mainly from local inter-personal ties (Powell and Brantley, 1992 ; Zucker and al., 1998). However, generally speaking, these scholars explain only one spatial dimension : the local one.

Continuing the work of these researchers, this analysis attempts to go a step further by suggesting an explanation of the diversity of the spatial dimensions observed in recent studies. We think that the geography of the knowledge collaborations is influenced not only by the logics of contact, but more generally by a group of constraints that weigh on the

actors during the construction process of partnerships. A multi-scale dimension would result, at least in part, from the cognitive constraints and coordination constraints.

Indeed, in most cases, project leaders look for a specific resource when looking at their innovation project and they consequently choose a partner within a very limited group. The number of eligible areas is therefore relatively limited and the various partners have to communicate from a distance (the probability that the partners are co located is relatively low and one of the partners is very unlikely to move to collaborate on the project). In other cases, companies may decide to collaborate with a laboratory after having recruited a former PhD student. The logics of contact, in this case the social relations of the researcher, significantly influence the choice of partner and the spatial dimension of the collaboration.

Following studies from the French School of Proximity, we intend to use the term of proximity which « concentrate in one word the multiplicity of spatial scales in which economic activities and actors locate their actions » (Rallet and Torre, 2004, our translation). More precisely, our theoretical concept is based on an analytical breakdown of the term of proximity suggested by Bouba-Olga and Grossetti (2008). This latter underscores, in addition to spatial proximity, the existence of a socio-economic proximity which integrates cognitive constraints -thanks to the notion of resource proximity- and constraints linked to the logics of contact -thanks to the notion of coordination proximity. The coordination proximity is decomposed into an institutional proximity and relational proximity.

These different theoretical hypotheses are supported by an empirical study based on a database of 287 research contracts made between the research laboratories of the University of Poitiers and firms. First, a statistical study will allow us to draw conclusions regarding the spatial dimension of collaborations, to confirm their multi-scale dimension and to define the importance of the role played by intra-regional and extra-regional collaborations. Then, we will give an account of the geography of resources showing the existence of specialisation effects and size effects which contribute to the spatial dissemination of collaborations. We will go a step further by using a qualitative study based on reconstructing collaborations stories. This database, which includes more than 100 stories will allow us to identify the process involved in developing contacts and assess the importance of the role played by social networks (relational proximity) and institutions (institutional proximity). It will enable us to draw conclusions regarding the geography of these two modalities of connection and show how they contribute to the multi-scale dimension of knowledge collaborations.

In this paper initially we give an overview of the theoretical and empirical studies carried out in this field of study. We then present our concept of innovation from which we formulate our theoretical hypotheses. Thirdly, we develop our empirical model and indicate the methodology applied to create our database and our qualitative study. We finally present our results and our conclusions.

## EMPIRICAL AND THEORETICAL BACKGROUNDS

For some years, several scholars have analyzed science-industry collaborations (Joly and Mangematin, 1996 ; Carayol, 2003 ; Levy and Wolff, 2006) since these latter are crucial in the innovation process of firms and more generally in the territories development. Some authors focus more particularly on their spatial dimensions and reveal firstly their local pattern. Indeed, the very first scholars of the geography of innovation (Jaffe, 1989 ; Acs and al. 1992) observe that firms benefit from knowledge externalities when situated close to universities ; hence, they conclude that science-industry collaborations are very sensitive to spatial proximity. At the same time, a group of studies underlines more generally advantages linked to the spatial proximity in the innovation process. The low distance between actors enable to reduce costs linked to interactions ; in addition, the existence in a local area of a common culture and a mutual trust favor the information exchange (and notably the exchange of tacit knowledge) simply by « being there » (Gertler, 1995). The terms of « local buzz » (Storper and Venables, 2004 ; Bathelt and al., 2004), « local broadcasting » (Owen-Smith and Powell, 2002) or « noise » (Grabher, 2002) gather these different positive effects included in the local area.

For some years, some doubts are expressed on the previous empirical and theoretical analyses. Breschi and Lissoni (2001) highlight several limits about these very first econometric models and the spatial proximity hypothesis. Rallet and Torre (2007) show the risks linked to the co-location of innovation activities and the relevance of a temporary spatial proximity thanks to ICT for instance. Others note that extra-regional collaborations – allowed by belonging to an epistemic community (Amin and Cohendet, 2004)- are strategic (Owen-Smith and Powell, 2002) ; they complete local interactions which are naturally limited (Malmberg and Maskell, 2005). Last but not least, empirical studies show the co-existence of local and non local science-industry collaborations (Audretsch and Stephan, 1996 ; Autant-Bernard and Massard, 2000 ; Grossetti and Bès ; 2003 ; Levy, 2005); they also give new explanations to the spatial dimensions of these so-called relations : local partnerships and spatial proximity effects would result from local social relations between firms and researchers (Zucker and al., 1994 ; Grossetti and Bès, 2003 ; Breschi and Lissoni, 2006) and from the star scientists mobility (Almeida and Kogut, 1997; Lamoreux and Sokoloff, 1997 ; Zucker and al., 1998 ; Fleming and Frenken, 2006). By doing so, they point out the structuring role of the logic of knowledge access and the logic of connection with partners in the geography of collaborations ; nonetheless, their explanations only focus on the local dimension of science-industry collaborations whereas the multi-scale patterns of these relations are more and more admitted<sup>1</sup>.

Our study inscribes in the continuity of these scholars and tries to go a step further : we want to bring new explanations of the multi-scale dimension of science-industry collaborations thanks to a detailed analysis of the logics of connection with partners and more generally of the construction of collaborations which seems to structure, at least to a certain extent, the geography of innovation. In other words we search to understand more

precisely how and why collaborations are established by using the theoretical framework of the School of the Proximity. Following Boschma (2005), Bouba-Olga and Grossetti (2006), Ponds and al. (2007) and Lorentzen (2007), we show the relevance to integrate non spatial proximities to explain the diversity of spatial scales; we more precisely focus on non spatial proximities involved in the construction of knowledge collaborations.

### **THEORETICAL HYPOTHESIS**

We consider innovation as an interactive and collective process. Indeed, the process involving the creation or integration of innovations more and more requires a set of heterogeneous skills, especially considering the complexification of the products elaborated. The internal cognitive dynamic of a firm prevents the development of that set within the firm itself (Penrose, 1959) ; so it is led to specialize on its core competencies to be able to keep its competitive advantage (Nelson and Winter, 1982). Firms, constantly on the lookout for innovation, are compelled to look for complementary resources from outside. Innovation abilities and the construction of collaborations heavily rely on a cognitive problem and a coordination problem due to the uncertainties and risks linked to the innovation process. Hence, it's crucial to identify "how the different actors manage to work together collectively and efficiently, that is to say coordinating their actions successfully" (Storper, 1995, p.111, our translation). The logics behind the construction of collaborations determine the choice of the partner, his location and consequently the geography of collaborations.

To highlight these cognitive and coordination problems linked to the collaboration process, we adopt an interactionist approach (Kirman, 1998) in which the elementary unit of the analysis is not only the individual but also the relation between actors (Zimmermann, 2008) and we make the assumption that actors act out of limited rationality (Simon, 1959). Individuals only have access to a limited number of information (because of individuals' incapacity to take into account all the information or to have access to all the information and the costs associated to collecting these data); instead of making their decisions by having access to a whole set of possibilities they just rely on a sub category of possibilities. In order to cut their costs, the actors do not always proceed to all the calculations when making their decisions; as a result, choices made are not always optimal but simply "satisficing". To be more precise, we consider actors act according to a contextual rationality (March, 1978) also called situated rationality (Orléan, 1994; Pecqueur and Zimmermann, 2004). We think that the choices made by the different actors (concerning the definition of the innovation projects, identification of the complementary resources required and selection of the partners) depend on their situation in a socio-economic space.

Following approaches from the School of proximity<sup>2</sup>, we adopt a plural definition of the proximity: we highlight, next to the spatial proximity which « deals with *the separation in space and relations in terms of distance* », the existence of a non spatial proximity which deals with the "*economic separation and relations in terms of the organization of proximity*" (Gilly and Torre (2000), p. 12-13). This latter could be qualified as socioeconomic proximity to quote the terms used by Bouba-Olga and Grossetti (2008). More precisely, our theoretical

conception is based on an analytical breakdown of this socioeconomic proximity consisting to distinguish a proximity linked to the search of resources (proximity of resources) and a proximity linked to the logics of connection with partners (proximity of coordination). This proximate typology allows us to integrate both cognitive problems and coordination problems which weigh on actors during the collaboration process.

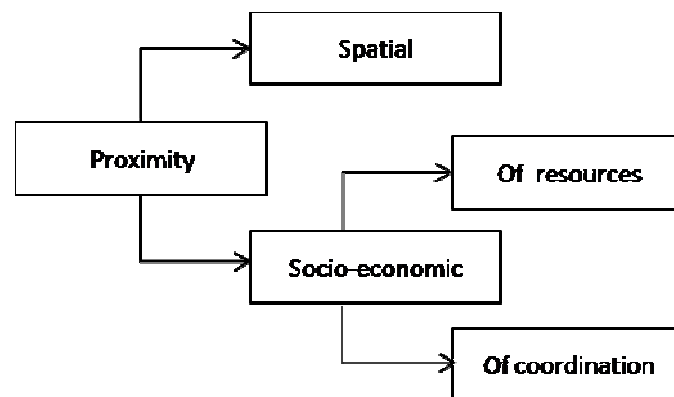


Fig. 1 : The proximate typology adopted (adapted from Bouba-Olga and Grossetti (2008))

### Proximity of resources<sup>3</sup>

During the construction of their collaboration, actors integrate in their choices cognitive constraints. The choice of a partner depends on resources needed which couldn't be always found locally. This underlines the relevance of the geography of resources which favors, in general, territories which concentrate heterogeneous resources, and for science-industry collaborations, regions specialized in high-tech sectors, like capital regions and major cities (Veltz, 1986). Other regions, on the contrary, have a disadvantage, like the Corse region (see Torre, 2000), and must necessarily develop extra-regional collaborations. The geography of resources, which could be considered as stable regarding the length to construct capabilities, promotes the development of trans-territorial networks (Bouba-Olga and Carrincazeaux, 2001). Indeed, the complexification of the products elaborated and the internal cognitive dynamic of the firm impose, in most of the cases, distant collaborations. Moreover, we consider the higher the degree of the resources specificity, the more limited the domain of possibilities. In science-industry collaborations, we can assume actors look for specific resources for which the number of potential partners and of potential territories is relatively limited ; hence, constraints linked to the resources must be high.

### Proximity of coordination

Another crucial aspect during the collaboration process on which we want to insist here is the modalities of contacts between the different partners. The logics of connections make the potential choices (more or less limited according to the degree of the specificity of the searched resources) effective. Acting according a situated rationality, the choices of actors depend on their embeddedness in social ties, institutional structures and previous economic relationships.

(1) Considering the costs involved in looking for new partners, we can suppose actors tend to resort first to partners they already worked with. The reactivation of past collaborations gives advantages in terms of cost (transaction costs notably (Williamson, 1985)), learning (Dosi and al., 1990) and trust (Granovetter, 1985). In most of cases, we guess actors choose their partners among a sub-category established from these already existing economic relations and rely on their experience ; hence, if the collaboration established has been successful, the experience will be systematically renewed<sup>4</sup>. A study led on the French technological diffusion networks underlines the firms preferences for partners with whom they already have collaborated with, even distant (Rallet and Torre, 2001). This underline the inertia of actor's behavior, the "path dependant learning trajectories" (Maskell and Malmberg, 1995) and the existence of lock-in effects (Arthur, 1989). On the contrary, if the organization is not satisfied, it will turn to its personal relations or to institutions to find and connect with its partner.

(2) The studies led in structural sociology are highly valuable to the geography of innovation because they show that the economic activity is embedded within personal ties and social interaction structures. Social networks or relational proximity facilitate exchanges and the development of contacts between the different actors. Granovetter (1973, 1985) gives an account of the construction of the actors' social capital and how to have access to certain resources thanks to the introduction of the concept of "social embeddedness"<sup>1</sup>. Through a study conducted on the US job market, he shows that interpersonal ties make it easier to find a job, 56% of the jobs were found through networking. In our study, the notion of social network, more and more frequently used in social sciences, will refer to a set of direct or indirect interpersonal relations (Grossetti and Bès, 2003).

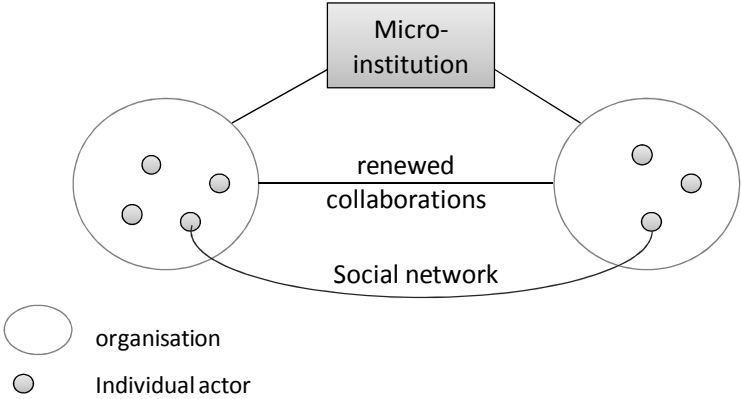
(3) Institutions, acting as functional substitute for trust (Granovetter, 1985), become an alternative solution to social networks. They also facilitate the development of contacts between actors by acting as an interface between organizations. To be more exact, macro-institutional structures create a system that conditions technological changes; they either act as a facilitator or a constraint since they represent the environment where socio-economic relations can take place (Amable and al., 1997). These macro-institutional structures materialize in micro-institutions such as CRITT, professional shows, etc., which operate as a mediator between the different partners. In other words, a proximity, which can be qualified as institutional, facilitates the development of collaborations. We have retained a restrictive definition of these micro-institutions or "mediation resources"<sup>2</sup>: they represent "everything that allows exchanges without resorting to networks of personal ties" (Bouba-Olga and Grossetti, 2008).

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<sup>1</sup> This term had already been used by Polanyi (1994) – it was meant to highlight the principles underlying the transfers of resources in the relations (reciprocity, redistribution and market).

<sup>2</sup> This concept, originally created by Hennion (1993) and used by Cochoy (2002) in his work on commercial mediations , was later used by Grossetti and Bès (2001) to qualify the modalities of the contacts established between the actors within innovation systems.

As social networks and institutions are two concepts relatively close and interdependent, they tend to be assimilated. Studies in sociology often tend to amalgamate these two notions within the notion of social capital. On the contrary, for some economists, the term institution includes elements in relation with social networks. By doing so, they forget about some fundamental aspects: indeed, the analytical breakdown of the modalities involved in the development of relations allows us to verify that the geography of social networks is not the same as the geography of institutions.



*Fig. 2: The three vectors of collaborations*

Moreover, that analytical breakdown allows to combine individual and organizational levels in the same explanatory chart. Organizations gather together individual actors: some collaborations are initiated and supervised more or less entirely by the members of the respective organizations but this group of actors operates at the same time in a mediation system, which facilitates the access to new partners (see fig. 2).

Considering the importance given to the collaboration build up process and the analytical breakdown suggested before, we think that the geography of innovation heavily rely on the geography of renewed collaborations, social networks and institutions—in addition to the geography of resources. A great number of scholars has highlighted the local aspect of social networks (Fisher, 1982; Grossetti, 2002); yet, they may also be transnational (migratory networks) and they distant ties could be more and more often maintained thanks to ICT. Therefore, « social relation may develop among social actors at different spatial levels » (Lorentzen, 2007). Others insist on the national aspect of institutions (Lundvall, 1992; Amable and al., 1997; Bathelt and al., 2004) although they tend to develop increasingly on a regional level. Social networks and institutions would lead to construction of local and non local collaborations.

Concerning the geography of renewed collaborations, to complete our analysis, we have not only to determine their spatial dimensions but also to analyze their genesis by getting back to the very first contacts developed between the actors in order to specify if these contacts have been initiated through social networks or micro-institutions. We will then be able to give a better account of the spatial scale of these two systems and explain different possible

situations. For that purpose, we will make the distinction between the situations mixing spatial and relational or institutional proximity and situations where there is a disconnection. In some cases, spatial and coordination proximities are linked to one another and they highlight cases of co-location of activities; in other cases, there is no connection and the innovation process is no longer located but it crosses territories to give birth to trans-territorial networks of innovation. We will then have the possibility to assess the importance of each situation and identify the most important ones.

### **EMPIRICAL ANALYSIS: DATA AND METHOD**

Our empirical study rests on a database built up with information provided and collected by the center promoting research in Poitiers. The University of Poitiers is the main University of the Poitou-Charentes region and counts 50 laboratories and 934 researchers. The database draws up a list of all the contracts signed with the various university laboratories of Poitiers from 2004 to 2007 and holds 943 different kinds of contracts; most of them being research contracts (853 out of 943). They have been signed with various partners: 37% with firms, 32% with research organizations, 15% with local authorities or the State, 9% with associations or trusts and 6% with mixed organizations. For the purpose of our study, we have chosen to concentrate on the 287 contracts signed with firms. Our database includes various variables such as dates, length of the contract, the type and value of the contracts, the sector of activity as well as the department of origins of the industrials and finally the name and type of laboratories. That base will enable us to quantify the relations between research and industry but also to confirm their multi-scale dimension. This map of partnerships will also allow us to assess the relative importance of specialization effects and size effects in the development of contacts with the actors of innovation in order to approach constraints linked to the geography of resources.

These quantitative data will then be complemented by a qualitative study meant to reconstruct the history of various collaborations; this is what seems the most relevant to give an account of non spatial proximities difficult to quantify and identify. This will allow to build up a database on which to carry out more systematic statistics: we will then be able to assess the impact of the economic relations developed previously, of the social networks and micro-institutions on the collaboration process and to underline the role of the coordination proximity (institutional and relational proximities). It will also be possible to confront the nature of the initial conditions taking place in the development of the relation to the location features of the partners involved in the innovation project to determine the relative importance of situations where spatial and coordination proximities overlap or disconnect.

For the purpose of the study, 38 researchers have been interviewed; as a result, 114 collaboration stories have been reconstructed. That sample seems to be representative since we interviewed a number of researchers in connection with the distribution of contracts by scientific fields. Regarding the information provided by the center promoting research we interviewed first a group of researchers directly involved in the research contracts. Then,

complementary interviews were made with firms involved in the projects studied to confirm the story.

We have applied the method used by Grossetti and Bès (2003). We have reconstructed various collaboration stories through half directed interviews of about two hours long and carried out among researchers directly involved in the innovation project; the aim was to obtain as many details as possible regarding the choice of the partner and the type of relation established. The people interviewed were supposed to give a personal account of the history of the project and describe the evolutionary phases of the innovation. Then, they were asked to provide further details about the initial meeting with the partners, the reasons behind the choice of the partner and the coordination means used through precise questions about the selection criteria, questions meant to obtain an enumeration of relations (who did you collaborate with to develop this project? How did you manage to find that partner?...).

The explanations given to account for the existence of renewed collaborations and their birth reveal two distinct steps. The first phase of the process concerns the relations developed between the different partners when working on the collaboration project, which permits to assess the impact of the three major vectors involved in the development of the relation (renewed collaborations, social networks and micro-institutions). The second phase focuses on renewed collaborations and goes back to the very beginning of the relation between the two partners; as a result, we can identify the channels through which the first collaboration took place (through social networks or institutions).

The two channels at the core of the development of the relation can be divided into sub categories (See appendix for a clearer typology of the social networks and micro-institutions). Within social networks, three sub categories of social relations emerge: professional and non professional ties as well as teaching relations. As for micro-institutions, we have to distinguish between external and internal ones. The former corresponding to the external structures of the organization (congress, publications, etc.) and acting as a mediator and the latter corresponding to the internal structures of the organization which facilitate the development of relations: that includes contracts or relations linked to the organization (relations with subsidiaries, agreements between laboratories)<sup>3</sup>.

## **RESULTS AND DISCUSSION**

First, the database on contracts established from the information provided by the center promoting research allows us to draw conclusions on spatial scales of collaborations established between Poitiers laboratories and firms. The spatial distribution of science-industry contracts confirms the multi-scale dimension of knowledge collaborations, given that the industrial partners of Poitiers' university laboratories are located on different

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<sup>3</sup> The economic relationships (when they are sufficiently « routinized » and « contractualized » to be integrated in the firm organization and when they can be considered as an inter-organizational relation) and the financial relationships couldn't be considered as personal ties since they are not inter-individual ; they also must be differentiated with external micro-institutions, the internal structure acting as a mediator.

territories. Non local collaborations are largely predominant and especially contracts signed on the national level (with 80% of the contracts). On the contrary, the number of intra regional and international contracts is quite low, each respectively representing 11% and 10% of the contracts signed.

On the national level, the industrials located in Ile-de-France can be considered as preferential partners; more than one contract out of two has been signed with an industrial from that region. Elsewhere, the contracts have been signed with regional partners (about one fourth) or with industrials located in Midi-Pyrénées, but to smaller extent.

The results obtained from reconstructing collaborations stories are quite similar to those presented above (See Table 1); it confirms that the sample is representative considering the spatial scale of collaborations.

*Table 1 : Spatial dimension of science-industry collaborations*

Location	Number of contracts (database CVR)	%	Number of contracts (collaboration stories)	%
<b>Local</b>	23	8%	13	11%
<b>Regional</b>	9	3%	6	5%
<b>Ile-de-France</b>	154	54%	40	35%
<b>National (hors IDF)</b>	73	25%	44	39%
<b>International</b>	28	10%	11	10%
<b>Total</b>	287	100%	114	100%

These results are similar to those revealed by two other previous studies. By analyzing the spatial distribution of the contracts signed with the University Louis Pasteur (Strasbourg), Levy (2005) shows that local interactions are few and that they co-exist with non local relations. An inquiry led by Grossetti and Bès (2003) (on the collaborations with CNRS researchers in five large cities – Grenoble, Toulouse, Clermont Ferrand, Bordeaux and Montpellier) reveals the same results. However, their study shows a higher representation of local collaborations (27%). That difference can be explained, at least to a certain extent, by the lower industrial density of our case study and its specialization. The weight of the industry of the region Poitou-Charentes is almost the same than the French average but the region mainly includes small-sized production units specialized in medium and low-tech sectors. They are rather inclined to look for short-term technical solutions than look for scientific innovation. Moreover, the industrial specialization of the region does not really seem compatible with the scientific specialization of the university laboratories, though it is the case with some larger cities such as Toulouse. It underlines the relevance of the territorial context and structural patterns of regions where are located the actors to understand the spatial distribution of knowledge collaborations.

We will precise the weight of these structural patterns in the spatial dimensions of collaborations by studying more precisely the role of the geography of resources. We will

then give more explanations of the multi-scale dimension of collaborations by focusing on the role of the geography of the logics of coordination.

### **(1) The role of the geography of resources**

Structural effects linked to the geography of resources, and notably specialization effects and size effects, explain, at least to a certain extent, the multi-scale dimension of the collaborations studied.

Concerning the agglomeration effects, the two database used reveal that the university laboratories of Poitou-Charentes mainly form partnerships with industrials located in Ile-de-France (See Table 1). Ile-de-France accounts for 43% of the industries'R&D costs and concentrates a great part of the industrial activities inclined to research activities; it also represents 28.7% of the GDP although it only represents 18% of the French population. It results that there is a strong agglomeration of R&D and industrial activities in Ile-de-France, which explains the overrepresentation of the contracts signed between the university laboratories of Poitiers and the industrials in Ile-de-France. The overrepresentation of capital regions in knowledge collaborations is observed in a large survey, established at the European level by Hoekman and al. (2008), as « resources are concentrated in large cities-predominantly capital cities ».

In addition to size effects, specialization effects (on the side of industries and/or laboratories) also contribute to the structuring process of the geography of collaborations and to its multi-scale dimension. In Poitiers, most of the laboratories are specialized in aerodynamics, six of them being part of the “Ecole Nationale Supérieure de Mécanique et Aérotechnique”. As for industries, the Midi Pyrénées region plays an important part in the aeronautic construction field. It is easy to understand why there is an overrepresentation of collaborations established between Poitiers'university laboratories and the industries operating in the Midi-Pyrénées region<sup>4</sup>. In this case, the geography of knowledge is all the more structuring as the resources required are specific and limited such as collaborations with a university laboratory. Indeed, some researcher states to be specialized in a very acute field and some industrial problems are connected to a specific scientific field, which limits the number of potential partners. In some case where there is a long history of collaboration, the laboratories or the industrials adapt their research field to the needs of their partners. In that case, the geography of collaborations gets stronger with time despite the evolution of the partners' field of study.

### **(2) The role of the geography of the logics of coordination**

Before focusing on the geography of the logics of coordination, we will determine the weight of each of these logics (past collaborations, social networks and micro-institutions) in the collaboration process.

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<sup>4</sup> The database shows that all the collaborations established with a partner located in Midi-Pyrénées take place in sector of transportation equipment and especially in the aeronautics manufacturing sector.

First important result, the 114 collaboration histories reconstructed reveal that in 61% actors (firms or researchers) turn to past collaborations, in 24% to a micro-institution and in 15% to a personal to choose their partner. We have to precise, in some cases (16 cases), they turn to both solutions, hence a total number of elementary collaborations reaching 130 (See fig. 3). Indeed, new collaborations can emerge from two similar or different coordination vectors and of equal importance in the development of the relation.

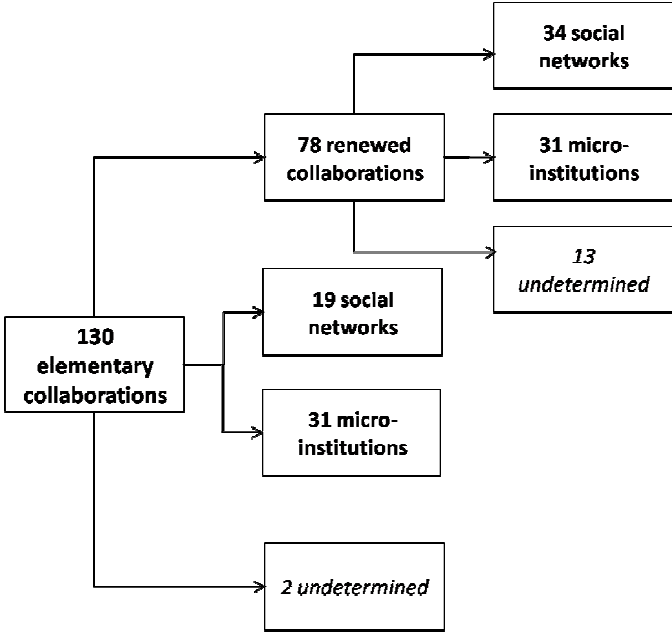


Fig. 3: the vectors involved in the development of the collaborations

Second result, the analysis of the genesis of renewed and new collaborations reveals that both social networks and micro-institutions operate as two alternative vectors whose importance is almost similar; the social networks were at the origin of contacts with 53 partners against 62 for the micro-institutions. These results are very close to those obtained by Grossetti and Bès (2003) in spite of contextual differences of our areas of study.

When examining more precisely the nature of the social networks and micro-institutions having permitted the initial contact between partners, we note that the external micro-institutions and the professional and teaching relations play a major part in science-industry collaborations (See Table 2). The very first contacts often take place at a congress: in that case, industrials can get information on research carried out in a specific field of study. Former PhDs are also often at the origin of partnerships or they help the renewal of collaborations; they favor contacts between two really separate and distinct areas that are science and industry thanks to their knowledge of these two areas. Fleming and Frenken (2007), Todling and al (2008) and Giuliani and al. (2008) also observe the relevance of former PhD recruitment in firms to favor science-industry collaborations.

Table 2: logics of initial connections of partners and location

Logics of connection	Number of contracts	Local contracts	Non local Contracts
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<b>Micro-institution</b>	<b>62</b>	<b>8</b>	<b>54</b>
<i>External micro-institutions</i>	40	8	32
<i>Internal micro-institutions</i>	22	0	22
<b>Social network</b>	<b>53</b>	<b>10</b>	<b>43</b>
<i>Teaching relations</i>	21	4	17
<i>Non professional ties</i>	5	5	0
<i>Professional ties</i>	27	1	26
<b>Undetermined</b>	<b>15</b>	<b>2</b>	<b>13</b>
<b>Total</b>	<b>130</b>	<b>20</b>	<b>110</b>

When we focus on the geography of these logics of coordination, we can notice first that renewed collaborations operate on various spatial scales. These latter have no different spatial patterns than the new collaborations : extra-regional collaborations represent 85% and intra-regional collaborations correspond to 15% of the contracts signed for renewed collaborations like new collaborations. These results reveal, on the one hand, the inertia of actor's behavior and the path dependant innovation trajectory and lead, on the other hand, to the strengthening of the multi-scale patterns of collaborations. Concerning the social networks, we note that the partnerships originating from a personal relation are not necessarily local ones even if they are more local than those originating from a micro-institution. Local relations are generally established through personal relations (in 9 cases out of 13) but the low number of local relations appearing in our sample cannot lead us to draw any conclusion on the result obtained. Contrary to what Fisher (1982) and Grossetti (2002) showed in their studies, we are unable to draw any conclusion regarding the local aspect of social networks. Professional ties and teaching relations seem to be non local and might allow to establish trans-territorial collaborations. The industrial and scientific density in our area of study being low accounts for the fact that the recruitment of former PhDs by local companies is limited. This could explain the weakness of local collaborations initiating by teaching relations. Our database reveals that only non professional ties seem to develop locally (all collaborations originating from a non professional tie lead to a local relation) but the size of our sample does not allow us to draw significant conclusions on this result. Concerning the micro-institutions, they don't seem to be linked to any particular spatial pattern, they lead both, to local and non local collaborations. Finally, more generally, our data reveal extra-regional and intra-regional collaborations originate from both social networks and micro-institutions, almost in the same proportion for the non local relations, the local ones originate more often from social networks.

A logistic regression model -in which the dependant variable is the spatial dimension and the independant variables correspond to the different logics of coordination- confirms the previous results. This econometric model help to explain a binary variable (Y) thanks to a group of independent variables ( $X=(X_1, X_2, X_3\dots)$  where  $X_1$  is the internal micro-institutions,  $X_2$  the external micro-institutions,  $X_3$  the non professional ties, etc.). In our model, Y refers to the local collaborations (Loc\_D) in the model 1 and to French extra-regional collaborations

(loc\_N) in the model 2. For instance, loc\_D is the binary (0, 1) dependant variable where 0 = non local collaborations occurred and 1 = local collaborations occurred. We can note  $P(Y=1|X)$  the probability of the dependant variable to have in the success category (coded 1) given the information of independant variables. The logit model where  $(P=1)$  is given as :

$$n \frac{P(Y = 1|X)}{1 - P(Y = 1|X)} = b_0 + b_1X_1 + b_2X_2 + \dots + b_nX_n$$

The model reveals that the type of logic of coordination (micro-institutions vs. social networks) has no significant impact on the spatial dimension of the knowledge collaborations Nevertheless, some sub-category of personal ties are significantly correlated to a particular spatial scale : turning to non professional relations to access to a partner give a probability ten times higher to collaborate locally (inside the Vienne department) whereas turning to professional relations favor collaborations with a French partner located outside the Poitou-Charentes region (see the following table).

Table 3 : Results of the binary logit model

Variables	Model 1 (Loc_D)		Model 2 (Loc_N)	
	Parameters estimate	Odds ratio	Parameters estimate	Odds ratio
Internal micro-institution	-	-	0,5552 -0,3908	1,742
Non professional ties	2,323*** (-0,701)	10,206	-	-
Professional ties	-0,576 (-0,546)	0,562	1,150*** -0,423	3,159
Teaching relations	0,616 (-0,403)	1,852	-0,038 (-0,338)	0,962
Engineering sciences	-1,046* (-0,585)	0,351	1,010* -0,521	2,745
Chemical sciences	-1,229 (-0,650)	0,292	0,767 -0,554	2,154
Others scientific domains	-0,584 -0,818	0,557	0,639 -0,710	1,895
	Observations	130	Observations	130
	Pseudo R <sup>2</sup>	0,242	Pseudo R <sup>2</sup>	0,092
	Prob (LR statistic)	0,0015***	Prob (LR statistic)	0,0404**
	LR statistics			

Notes : \*P<0,1, \*\*P<0,05, \*\*\*P<0,01. Robust standard errors in parenthesis.

The geography of social networks and micro-institutions is a determinant factor that contributes to the multi-scale dimension of knowledge collaborations. As the relations established between science and industry can happen on different territories and originate from different coordination systems, innovation may take different configurations: there

might be an overlapping or a disjunction between the spatial and the coordination proximity. It reveals the existence of a multi-scale network with a variety of proximities and interactions, some territorial and others non territorial (Veltz, 1999, p.608).

## **CONCLUSION**

The aim of this paper was to go a step further to scholars which study the geography of knowledge collaborations essentially focused on the local dimension; on the contrary, we want to give explanations of the diversity of the spatial dimensions. More precisely, we have tested different constraints linked to the construction process of science-industry collaborations which could explain, at least to a certain extent, the multi-scale dimension of these relations. For that purpose, we have analyzed the relations between science and industry and carried out a quantitative and qualitative study of the collaborations formed between the University laboratories of Poitiers and firms. After confirming the science-industry relations operate on different territories, it results that the constraints linked to resources (proximity of resources) and constraints linked to the logics of contact (proximity of coordination) contribute to the multi-scale dimension of collaborations. On the one hand, the geography of resources involves specialization effects and size effects and leads to spatial dissemination of knowledge collaborations; on the other hand, the logics of coordination enable the construction of local and non local partnerships. In addition, the weight of renewed collaborations leads to the strengthening of the multi-scale dimension of these so-called collaborations. Finally, some sub-category of personal ties seems to favor the formation of particular partnerships: non professional ties would give a higher probability to collaborate locally whereas professional ties would promote extra-regional collaborations.

We have to precise that our empirical study only focuses on the relations developed with a single university with its own characteristics; hence, it's not possible to generalize our results to all science-industry collaborations and all the more that we consider actors act according to a situated rationality. Due to the relevance of the socio-economic and territorial context, it seems to be necessary to multiply case studies to highlight similarities and differences. Moreover, these results only concern science-industry collaborations and we think, following Ostergaard (2007), their construction patterns are different to inter-enterprises collaborations.

## APPENDIX

### Categories of social networks and micro-institutions

Categories of relation ties	Sub-categories
Non professional ties	family, childhood, non professional organizations, friends
Teaching relations	Teachers, former students
Professional ties	Former co-workers in research, former co-workers in firms

Micro-institution	Sub-categories
Internal	Relationships linked with the firm or lab structure
	Economic relationships (with suppliers, subcontractors, consumers)
External	Public or parapublic institutions (CRT, CVR, D2RT, Oséo, etc.)
	Private structure, experts
	Professional organization (club, technological associations, commissions of specialists)
	Projects (pôles de compétitivité)
	Regroupements (congress, scientific or professional meetings, etc.)
	Medias (press, internet, publications, etc.)
	Reputation
	Training period market
	Market (invitations to tender)

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### NOTES

1. « It seems evident that the creation of new knowledge might be best viewed as a result of a combination of close and distant interactions » (Oinas, 1999, p.365).
2. One of the main results of the School of the proximity is to point out the plural dimension of the proximity notion and to explain each of its dimensions (see RERU, 1993, n°3). In this scholars, proximity is considered as to be a crucial condition of any collective activity ; hence, interactions and coordination issues are central in this research field and the authors have searched what is really necessary to share to act together.
3. In this paper, the term of resource mainly refers to capabilities even if it includes both material and cognitive resources.
4. « These procedures and routines are based on the firm's interpretation of its successful behaviour in the past and will continually be reproduced and reinforced as long as they seem reasonably efficacious (Maskell and Malmberg, 1995).

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