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The 'de-territorialisation of closeness' - a typology of international successful R&D projects involving cultural and geographic proximity

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Abstract

Although there is a considerable amount of empirical evidence on inter-firm collaborations within technology-based industries, there are only a few works concerned with R&D cooperation by low-tech firms, especially SMEs. Providing further and new evidence based on a recently built database of CRAFT projects, this study analyzes the relationship between technology and proximity in international R&D networks using Homogeneity Analysis by Means of Alternating Least Squares (HOMALS) and statistical cluster techniques. The resulting typology of international cooperative R&D projects highlights that successful international cooperative R&D projects are both culturally/geographically closer and distant. Moreover, and quite interestingly, geographically distant projects are technologically more advanced whereas those located near each other are essentially low tech. Such evidence is likely to reflect the tacit-codified knowledge debate boosted recently by the ICT "revolution" emphasized by the prophets of the "Death of Distance" and the "End of Geography".

Keywords: Research and Development (R&D); proximity; SMEs

JEL-Codes: O32; R12; R58

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"… we actually *know much less than we think* we know about how firms actually learn, particularly as regards the interplay between learning and proximity, be it *physical* or *organizational proximity* …" (Morgan, 2004: 17, emphasis added)

1. Introduction

The trend toward formalized cooperation – in the shape of inter-firm alliances, joint ventures, R&D and other agreements – has been on the rise (Coombs et al., 1996; Dodgson, 1993; Hagedoorn and Schakenraad, 1992; Powell and Brantley, 1992; Hagedoorna et al., 2003; Li and Zhong, 2003). Such phenomena reflect the accelerating pace of innovation, and the related requirements to stay abreast of technological and market trends, integrating relevant knowledge, and developing new products and processes (Lundvall, 1992). The literature on the relationship between cooperation behaviour and innovation activities suggests that cooperation should be conducive to innovation processes (Fritsch and Lukas, 1999; Fritsch, 2003).

Although there is a considerable amount of empirical evidence on inter-firm collaborations within technology-based industries, there are only a few works concerned with R&D cooperation by low tech firms, especially SMEs (e.g., Delgado et al., 2005). Indeed, Arora and Gambardella (1994) revealed the high importance of R&D collaborations for *large* US chemical and pharmaceutical companies in the biotechnology sector. Colombo (1995) provides empirical evidence of a complementary relationship between inter-firm cooperative arrangements and R&D intensity for a representative sample of international firms in the *information technology* industries (semi-conductor, data processing and telecommunications). SMEs, however, are increasingly regarded as a source of dynamism in the knowledge economy, and a growing number of them are either directly or indirectly involved in research, innovation and the generation of knowledge (EC; 2005). Technology-based SMEs are seen a key component in the innovation system, facilitating the emergence of new products and markets. Also low- and medium-tech SMEs, with little or no research capability, need to reinforce their knowledge and research intensity, expand their business activities into larger markets, and internationalize their knowledge networks. Networking and cooperation has long been identified as one of the most effective ways to do this (Doloreux, 2004).

Small firms are increasingly benefiting from joint interaction with other small firms (Bartels, 2000; Perrow, 1992; Welsh et al., 2000). The importance of R&D cooperation has risen steadily as a result of growing complexity, risks and costs of innovation (Coombs et al., 1996; Dogson, 1993; Hagedoorn and Schakenraad, 1992). Therefore, for small firms, partnering with other firms through the various forms of collaborative arrangements is becoming imperative due to the insufficiency of resources and the need to achieve world-scale efficiencies (Wright and Dana, 2003).

Public support programs to promote R&D cooperation have been implemented in the last two decades in most developed countries, namely in the US, Japan and the EU countries. The European Union's successive European Framework Programs (FPs) are a noteworthy example (Busom and Fernández-Ribas, 2004). Such programs are aimed at enhancing the performance of member countries, their organizations and citizens with regards to R&D and innovation. Committed to bridging the gap between SMEs and R&D, the most recent FP (FP6) defines instruments to enhance SMEs' technological capacity. On the one hand, exploratory instruments provide financial aid to project submission (partners research, innovation and market research, viability studies); on the other hand, there is a "cooperative research" instrument – CRAFT – allowing consortia involving SMEs from different countries, with low or medium technological capacity and limited research abilities, to entrust research and development activities to scientific institutions (Universities or Research Institutes), while owning the results.

In this paper we analyze CRAFT projects from the 3rd to 5th FP which have been classified as 'successful', covering a time span of 12 years (from 1990 up to 2002).[1] Based on information available at http://sme.cordis.lu/craft/home.cfm, we have constructed a database comprising 118 projects that contains general information on each project, mostly gathered from .pdf files associated to those projects. These CRAFTs involve 791 SME from 21 countries, allocating around 118 million euros, 52% of which was financed by the EU.

Providing further and new evidence on R&D cooperation in relatively low tech SMEs, this study seeks to answer the following questions: 1) What is the relationship between technology and proximity in international R&D networks?; 2) To what extent does cultural and/or geographical proximity in international R&D cooperation reflect tacit-codified knowledge considerations?; 3) Is it possible to put forth a meaningful typology of international cooperative R&D projects relating technology intensity, cultural and geographical proximity?

The paper is structure as follows. The next sections of the paper (Section 2 and 3) provide a survey of the theoretical and empirical literature on cooperation and proximity. Then, Section

[1] Although success criterion is not explicit, some contacts with national CRAFT managers provided the information that 'successful' projects were those that a given performer reckons as successful (information given by Margarida Garrido, Portuguese contact person at Cordis).

4 details the empirical analysis of successful R&D alliances by outlining some essential features of CRAFT projects. Section 5 aims at contributing to a typology of successful international cooperative R&D projects using HOMALS and the statistical cluster analysis approach. Finally, we present the main conclusions.

2. Innovation and the relevance of R&D cooperation for SMEs

In recent years, there has been growing interest in cooperative arrangements for innovation. Some commentators, such as Teece (1992), have argued that the rise in these relationships has displaced our existing understanding of the organization of innovation. Innovation is seen as increasingly more distributed, as fewer firms are able to 'go it alone' in technological development (Tether, 2002). Indeed, most innovation activities involve multiple actors (Becker and Dietz, 2004). The development of new and improved products requires an active search-process involving several firms and institutions to tap into new sources of knowledge and technology (De Bresson, 1996; Nooteboom, 1999; von Hippel, 1988). Exchange of information and resources with different partners are important factors in the innovation process.

Firms that engage in innovation activities are aware of the need to establish R&D cooperation to obtain expertise which cannot be generated in-house (Becker and Diez, 2004). Such cooperation is defined as collaboration to achieve a common goal, which is to develop new and improved products (technologies). Within a more or less durable collection of agreements between two or more partners, assets and activities are pooled and combined. Thus, technological capabilities to develop product and process innovations can be improved. For instance, Teece (1986: 293) notes that "[i]t is well recognised that the variety of assets and competencies which need to be accessed (for innovation) is likely to be quite large, even for modestly complex technologies. To produce a personal computer, for instance, a company needs access to expertise in semiconductor technologies, display technology, disk drive technology, networking technology, keyboard technology and several others. No company can keep pace in all of these areas by itself".

According to this 'complexity thesis', collaborations are particularly common when the technologies being developed are new or rapidly evolving, complex and/or expensive to develop, and when the market is poorly defined. By engaging in R&D alliances, firms are able to obtain the necessary complementary technology, achieve economics of scale in R&D, and monitor the competitors (Burgers et al., 1993; Powell, 1987).

Accompanying these trends toward more intense cooperation, public policies aimed at framing R&D consortia are becoming more favourable (Martin, 1996). These developments, whether they be called R&D alliances, R&D consortia or strategic technology partnerships, or simply collaborative innovation networks, are the central issue in a growing number of academic works (Levy and Samuels, 1991; Hagedoorn, 1996; Vonortas, 1997; Hagedoorn et al., 2000).

The reasons why firms in more advanced countries seek to pool their development efforts within R&D consortia, and the nature of the benefits they derive, is presently the central issue in a growing number of international studies (Mathews, 2002). The theoretical economic arguments (Spence, 1984; Katz and Ordover, 1990; Kamien et al., 1992) tend to focus on the "spillover" effects of R&D, creating a socially useful externality. According to this reasoning, firms enhance social welfare through their research activities, but this may depress their incentives to continue, unless a form of R&D collaboration can internalize such an externality. These arguments are of necessity couched in cost terms, with consortia seen as pooling costs, and with the inevitable assumptions that vitiate much economic reasoning, e.g. that cooperation either involves all firms in an industry or none (compared to the reality that cooperation usually involves a small subset of firms).

More comprehensive explanations for consortia formation and governance have come from the institutional economic literature and strategic management literature (Mathews, 2002). Here, the focus has been on matters such as how firms formulate and achieve strategic goals through the constitution of research consortia (Vonortas, 1997; Martin, 1996; Link and Bauer, 1989); how firms and agencies combine to enhance their resource base (Mowery et al., 1998); and how they can actually manage the complex processes of building inter-firm collaborative routines (Powell et al., 1996; Sakakibara, 1997a,b; Doz et al., 2000; Sawhney and Prandelli, 2000). These strategic goals include gaining access to technical capabilities that would not otherwise be easily accessed, particularly complementary technological resources, which generate new business opportunities (Link and Bauer, 1989; Vonortas, 1997).

The creation of value through inter-organizational relationships, and the capturing of "relational advantage" has become a topic for sustained inquiry (Saxenian, 1991; Dyer and Singh, 1998; Child and Faulkner, 1998; Barringer and Harrison, 2000). SMEs in particular have been able to take advantage of R&D consortia in order to overcome diseconomies of scale (Kleinknecht and Reijnen, 1992; Sigurdson, 1998, 1986). The aim is primarily to enhance the firms' absorptive capacity, and thus, provide them with potential access to a wider range of technological options (Cohen and Levinthal, 1989).

Summarizing, and following the course of an innovation process, from invention or scientific development through to the introduction of new products in the market place (Hagedoorn, 1993; Bayona et al., 2001), it is possible to assemble the motivations for cooperative R&D into three main groups (cf. Table 1).

Table 1: Motivations for involvement in R&D cooperation

Motivations		Details	Studies
Basic and applied research → general characteristics of technological development	*Complexity of technological development*	Access to new technological knowledge and to complementary technologies, which allow for different research lines to be followed.	Hladik (1985); Link and Bauer (1989); Hagedoorn (1993); Wang (1994)
		To achieve scale and scope economies and to respond rapidly in the market place despite technological uncertainty	Teece, 1992; Häusler et al., 1994; Hagedoorn and Narula, 1996; Katz and Martin, 1997; Tidd, 1997; Robertson and Gatignon, 1998
		Alliances as a mechanism of intermediate governance between the market and the hierarchy. The more complex the available technology, the more inefficient the market, as the place in which firms can acquire the necessary knowledge and technology.	Robertson and Gatignon (1998); Shing, 1997
		The possibility of acquiring and internalizing the abilities and competencies of partners, so as to create new valid competence for the firm.	Hamel, 1991; Steensma, 1996
	The reduction and sharing of uncertainty and costs	By combining their efforts, firms can reduce the uncertainty derived from the expected result not being obtained, not appearing with sufficient speed, or requiring more financial or technological funds than were originally expected and increase the possibilities of obtaining a positive result.	Hladik, 1988; Tsang, 1998). Porter and Fuller (1986), Dodgson (1992a) and Hagedoorn (1993)
		The probability of an innovation achieving success also depends on aspects such as the complementarity of the resources and the increase in R&D investments, which is favoured by cooperation.	Sinha and Cusumano, 1991
		As demands, preferences and needs of consumers change at great speed, the excessive period of time that may pass between the invention of the product and its final appearance on the market also implies a high risk for the firm and thus one objective is to shorten it.	Hladik, 1988; Häusler et al., 1994; Dodgson, 1992a; Hagedoorn, 1993
		Help to avoid the duplication of unnecessary R&D efforts and to achieve scale economies.	Porter and Fuller, 1986; Dodgson, 1992a
Market access and the search for opportunities		To absorb the knowledge and abilities which they lack and which is represented by the tacit knowledge of their partner, that is to say, its know-how, both in the area of technology and in other spheres.	Teece, 1992
		The aim of extending the range of products, or substituting those that already exist because they are found in mature sectors.	Hagedoorn, 1993
		Access to larger domestic and foreign markets, thereby improving their expectations of recovering the investment.	Hladik, 1988; Dodgson, 1992a, 1992b; Hagedoorn, 1993; Sakakibara, 1997a, 1997b
		The standardization of products or processes, aimed at excluding possible competitors by implementing a strategy based on differentiation or cost advantages that will act as a barrier to the entry of new firms in the sector.	Porter and Fuller, 1986; Hladik, 1988; Dodgson, 1992a; Hagedoorn, 1993; Miyata, 1996)

In the emergence of some R&D networks, especially in cases in which interdependencies are difficult to recognize (Corey, 1997; Sandoz, 1992), the existence of, and legitimacy of, a triggering entity is likely to be critical (Doz et al., 2000). In cases in which technologies are not as well specified, or where tacit know-how is to be employed, triggering entities may be required (Ring and Rands, 1989). A legitimate triggering entity may be required to lessen the concerns of potential participants that the costs and benefits of collaboration will be shared 'fairly' (Browning et al., 1995). The triggering entity's role has been played by governmental agencies (e.g., Kurozumi, 1992; Sandoz, 1992). Individuals acting as champions (e.g., Hausler, Hahn and Lutz, 1994) or specific firms (e.g., Hakansson and Shehota, 1995; Lorenzoni and Baden-Fuller, 1995) constitute other clearly identifiable triggering entities.

In the case of CRAFT projects, analyzed later (Section 4) in this study, Research and Technology Development (RTDs) performers actually represent a similar role to those 'triggering entities'.

3. Cooperation, proximity and the tacit-codified knowledge debate

An academic debate has been growing over the last decade on how tacit and codified knowledge can mediate the effect of distance on knowledge sourcing. Usually, "tacit knowledge refers to knowledge which cannot be easily transferred because it has not been stated in an explicit form" (Foray and Lundvall, 1996: 21), while codified knowledge – or 'information' – is reduced to messages which can be easily transferred between economic agents through nonhuman supports. It is assumed then that codified knowledge can be exchanged regardless of distance by using communication technologies, be they old (postal mail) or new (electronic mail, computer conferencing) (Koschatzky et al., 2001). At the opposite end, the transfer of tacit knowledge requires a sharing of common work experience through face-to-face relations (Maskell and Malmberg, 1999; Doloreux, 2004). As a result, geographical proximity appears as a necessary condition for an efficient sharing of knowledge, especially in the case of tacit knowledge-intensive activities such as research and innovative activities.

The renewed interest in tacit knowledge is largely due to its perceived social and spatial significance when learning and innovation are at premium (Storper, 1997): socially, because tacit capabilities like team skills and organizational routines constitute the core competence of firms; spatially, because tacit knowledge, being person-embodied and context dependent, is locationally 'sticky', a characteristic which helps to explain the clustering of knowledge-intensive activities (Maskell at al., 1998; Gertler, 2001b). Tacit knowledge comprises knowledge that cannot be articulated, as captured by Polanyi's (1966) famous statement, "we can know more than we can tell". In contrast with tacit knowledge, explicit or codified knowledge covers formalized knowledge that can be transferred in a depersonalized manner through technical blueprints and operating manuals, etc. As tacit knowledge is personal and context-dependent, it represents disembodied know-how that is acquired directly through interactive learning (Howells, 1996).

Antonelli (1999) and Roberts (2000) argue that modern information and communication technologies (ICTs), which lower the costs of codifying knowledge, and stronger intellectual property rights, are reducing the importance of short distances to access tacit knowledge while simultaneously increasing the ability of firms to obtain knowledge from outside the firm. Conversely, Senker (1995) proposes that most rapidly developing and complex technologies will always depend on tacit knowledge and, consequently, on close, inter-personal interactions to share knowledge. This will hold even when knowledge can be codified, as long as there is a delay between its discovery and its codification. In this context, distance could matter because local, direct and personal contacts allow a company faster and more successful access to knowledge gatekeepers to discover where and how to access new knowledge (Arundel and Geuna, 2004).

In the same line, several authors (e.g., Morgan, 2004) tend to reject the possibility that the effective transfer of tacit knowledge can be consummated at a geographical distance. Along the same lines, a large body of literature claims that agents that are spatially concentrated benefit from knowledge externalities. Short distances bring individuals together, favour information contacts and facilitate the exchange of tacit knowledge. Accordingly, the larger the distance between agents, the less the intensity of these positive externalities, and the more difficult it becomes to transfer tacit knowledge. This may even be true for the use and dissemination of codified knowledge (although often stated otherwise), because its interpretation and assimilation may still require tacit knowledge and, thus, spatial closeness (Howells, 2002). Several empirical studies (e.g. Jaffe et al., 1993; Audretsch and Feldman, 1996) tend to confirm that knowledge externalities are geographically bounded: firms near knowledge sources show a better innovative performance than firms located elsewhere.

Other authors challenge the idea that geographical proximity matters almost automatically in this respect. Such authors stress the importance of 'communities of practice' that produce, acquire and diffuse knowledge through the use of digital technologies and 'temporary' physical proximity associated with business travel (Breschi and Lissoni, 2002).

Economic geographers have contributed to this debate by pointing out that other dimensions of proximity, such as cognitive, organizational and institutional/cultural dimensions, besides geographical proximity are key in understanding interactive learning and innovation (Boschma, 2005b). Such a view was coined by Bunnell and Coe (2001) as the 'de-territorialisation of closeness' (Gertler, 2003).

For some authors, namely those associated with the French School of Proximity Dynamics (e.g. Torre and Gilly, 2000), proximity meant a lot more than just geography, covering a number of dimensions – geographical, organizational and institutional proximity. Boschma (2005b) presents a critical review of the different proposed dimensions of proximity. According to this author, while geographical proximity is defined as spatial distance between actors, in both an absolute and relative sense, organizational proximity is associated with the closeness of actors in organizational terms. Institutional proximity accounts for the fact that interactions between players are influenced, shaped and constrained by the institutional environment (Kirat and Lung, 1999).

Institutions can be defined here as "… sets of common habits, routines, established practices, rules, or laws that regulate the relations and interactions between individuals and groups" (Edquist and Johnson, 1997: 46). Institutions tend to reduce uncertainty and lower transaction costs by functioning as a sort of 'glue' for collective action (Boschma, 2005b).

The notion of institutional proximity includes both the idea of economic actors sharing the same institutional rules of the game, as well as a set of cultural habits and values (Zukin and Di Maggio, 1990). Formal institutions (such as laws and rules) and informal institutions (like cultural norms and habits) influence the extent to which and the way actors or organizations coordinate their actions. In this sense, institutions are enabling or constraining mechanisms that affect the level of knowledge transfer, interactive learning and (thus) innovation (Boschma, 2005b). A common language, shared habits, a law system securing ownership and intellectual property rights, etc., all provide a basis for economic coordination and interactive learning. A culture of shared trust, for example, is often regarded as a capability that supports learning and innovation: information is transmitted more easily with cultural proximity and a common language (Maskell and Malmberg, 1999). In short, institutional, or more restrict, cultural proximity is an enabling factor, providing stable conditions for interactive learning to take place effectively.

The literature on the importance of proximity in innovation networks and cooperation is presently flourishing. Recently, it has been suggested that although spatial proximity facilitates interaction and cooperation, it is not a prerequisite for interactive learning to take place (Malecki and Oinas, 1999). Due to advanced information and communication technologies (ICTS), networks through which learning takes place are not necessarily spatially delimited. In a study on research projects, Rallet and Torre (1999) showed that tacit knowledge might be transmitted across large distances through other forms of proximity. They demonstrated that the need for geographical proximity is rather weak when there is a clear division of precise tasks that are coordinated by a strong central authority (organizational proximity), and the partners share the same cognitive experience (cognitive proximity).

Some available empirical studies of SMEs' innovation and networking activities show that a firm's innovation networks do not always hinge on geographical proximity (e.g., Britton, 2003; Doloreux, 2003, 2004). Some studies support the rejection of simple models of spatial clusters and localized learning where internal connections are privileged over interregional and international transactions operating either between or within firms. In a study of Toronto's electronic cluster, Britton (2003) argues that knowledge and material inputs, and other knowledge sources in this industry provide both interregional and international sources of specialized inputs. In a study on the spatial patterns of networks of traditional manufacturing firms in Québec, Doloreux (2003) shows that cooperative partners of SMEs in innovation are distributed over various regional levels, and to be innovative, SMEs need to take advantage of international sources of specialized inputs. This is not dissimilar to the findings of Larsson and Malmberg (1999) who conclude in their study of the Swedish machinery industry, that local networking does not have a positive impact on the performance of firms. Suarlez-Villa and Walrod (1997) reinforced the earlier finding by arguing that spatial clustering has not led to greater opportunities for innovation and technological development in the electronic industries of California. Analyzing a set of firms in Ottawa, Doloreux (2004) finds that overall, localized external networking was less prevalent than might have been expected. Indeed, the importance of proximity was not substantiated: firms make use of a mixture of local/regional, national and even international knowledge sources, and that their ability to sustain networks at different regional scales is a key factor for the competitiveness and innovativeness of SMEs.

According to Gentzoglanis (2001), distance does not necessarily have a geographical dimension but it is mostly associated with *culture* and distance in knowledge. The more distant the (different) firms' knowledge base is, the greater their learning potential. Once the network is set up, interactive learning becomes possible through the establishment of procedures, which allow information channels to be shared, and codes of information to be exchanged.

Koschatzky and Sternberg (2000) claim that especially for manufacturing SMEs, borders and thus, the different institutional systems, language and culture act as a major barrier to information and knowledge exchange. The absorptive capacity, or as Cooke and Morgan (1998) put it, the associational capacity of firms, does not seem to enable them to enter and handle networks with partners from other countries on a large scale. Moreover, Koschatzky's (2000) study shows that a different situation holds true for networking among research institutes: national borders play a much less important role in scientific collaboration. It can thus be concluded that spatial proximity might be a prerequisite for certain kinds of innovation networks within national boundaries, i.e. innovation systems, but is outweighed by cultural and institutional distance when spatially close knowledge sources are divided by a national border.

Empirical findings based on the European Regional Innovation Survey (ERIS) (Koschatzky and Sternberg, 2000) highlight the importance of a combination of local, regional and trans-regional networking. According to Capello (1999), firms that are integrated into multi-layered networks, continuously improve their abilities for learning as well as their knowledge base, and concomitantly, the possibility of using new knowledge. As Capello (1996) and others put it, firms need both local networks and trans-territorial networks because regional and global dynamics have an increasingly interdependent relationship.

In the empirical part of this paper we aim at contributing to this debate by providing further and new evidence concerning R&D cooperation in SMEs.

We operationalize geographical and cultural proximity and assess the relationship between technological (and geographical and cultural) proximity in international R&D networks using the HOMALS technique.

Moreover, we analyze to what extent cultural and/or geographical proximity in international R&D cooperation reflects tacit-codified knowledge considerations. Finally, we put forward, based on HOMALS results and using the statistical cluster technique, a typology of international cooperative R&D projects relating technology intensity, cultural and geographical proximity.

4. International R&D alliances: the case of successful CRAFTs

4.1. Some basics on CRAFT projects

In order to enhance the performance of member countries, their organizations and citizens, with regard to R&D and innovation, the EU created, in 1984, the EU Framework Program for Research and Technological Development (FP).[2]

Committed to bridging the gap between SMEs and R&D, the FP6 defines instruments to enhance SMEs' technological capacity. On the one hand, exploratory instruments provide financial aid to project submission (partners research, innovation and market research, viability studies); on the other hand, there is a "cooperative research" instrument allowing consortia involving SMEs from different countries, with low or medium technological capacity and limited research abilities, to entrust research and development activities to scientific institutions (Universities or Research Institutes), while owning the results. CRAFTs are instruments of cooperative research, especially designed for SMEs. Thus, CRAFTs aim at supporting SMEs' R&D needs, facilitate R&D transnational cooperation and encourage cooperation between SMEs and the European research community.

3.2. Describing the data

In this study we analyze a sub-group of CRAFTs, those from the 3rd to 5th FP that have been classified as 'successful'. Information on these projects is available at http://sme.cordis.lu/craft/home.cfm. Based on this information, we construct a database which contains general information on each project, mostly gathered from .pdf files that describe the projects.[3] Although success criterion is not explicit, some contacts with CRAFT national managers convey the information that 'successful' projects were those which a given performer reckons as successful.[4] Regardless of the exact meaning of a 'successful' project, the trend is toward a decrease in the success rate of CRAFTs (Table 2).

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[2] In http://europa.eu.int/comm/research/faq/index.cfm?lang=en&page=details&idfaq=3600, accessed on 22 April 2005.

[3] Santos (2005) provides further details on the construction of this database.

[4] The concept of 'successful' was provided by Margarida Garrido, Portuguese contact person at Cordis.

The 118 successful CRAFTs involve 791 SME from 21 countries (18 from the European Union plus Switzerland, Norway and Brazil). Overall, the CRAFTs under analysis comprise around 118 million euros, which gives an average of 1 million per project. From this total, 52% were financed by the UE, that is, around 61 million euros.

Table 2: Number of projects involved in CRAFT program

	FP		
	3º	4º	5º
Submitted projects	331	1.749	1.071
Contracted projects	172	698	409
Well succeded projects	30	65	23
Success rate	**17%**	**9%**	**6%**

Fontes: Framework Program IV – SME Participacion 1994 – 1998, 1999, European Comission; Framework Program V – SME Participacion April 1999 – April 2001, December 2001; UE, In http://sme.cordis.lu/craft/home.cfm, accessed on 30 April 2005.

With regard to the industrial distribution of successful CRAFTs, the main industrial areas presented are: Machinery and Equipment, Agriculture, Building and Metallic products. High technology activities, such as Telecommunications, Computing and R&D represent a smaller segment. This latter characteristic may result from the fact that the program aims to enhance cooperative research by groups of SMEs with low or medium technological capabilities and a restricted capacity for proper research, thus encouraging SME consortia to entrust research activities to a third party (e.g. University or R&D institutes).

Table 3 Industry distribution of successful CRAFTs

Industry	Nº of projects	Percentage
Machinery	13	11,0
Agriculture	10	8,5
Building	10	8,5
Metallic products	10	8,5
Electric products	9	7,6
Chemicals	8	6,8
Health	8	6,8
Textiles	8	6,8
Wood industries	7	5,9
Other manufacturing industries	6	5,1
Food and beverages	5	4,2
Computing and R&D	5	4,2
Precision tools	5	4,2
Other services	5	4,2
Transports	5	4,2
Telecommunications	2	1,7
Non metallic products	1	0,8
Retail	1	0,8
Total	**118**	**100,0**

Sources: Authors' computations based on data from http://sme.cordis.lu/craft/home.cfm, accessed on 30 April 2005.

Analyzing the country of origin of the SMEs participating in successful CRAFTs, we conclude that 73% of participating SMEs belong to Germany, France Spain, the United Kingdom, the Netherlands and Italy.

Spanish companies (103) are concentrated in 36 projects. That is, when a Spanish SME participates in a project it draws in two additional Spanish companies. Although on a smaller scale than Spain, there is also a relative intensity of internal cooperation between Portuguese partners, as each Portuguese partner seems to engage two other partners from the same nationality. The two countries with the highest number of participating companies, Germany and France, are also those that participate in the greatest number of projects: 64 and 53, respectively.

Generally, cooperation between research institutions of the same country is weaker than between same country SMEs. Austria is an exception, with 3 Austrian institutions per project

The 'successful' CRAFT database identifies the main region where each Project is developed. With few exceptions it is the region where the prime SMEs contractor is located. Although we were not able to identify the region of origin for all participating SMEs, we analyzed the regional origin of the first promoter in order to identify the regions with a higher "promoting" ability.

The regions with a higher promoting capacity in successful CRAFTs are *Noroeste* (Spain) and *Sud-Ouest* (France), both with 7 projects each, *Vlaams Gewest* (Belgium), *Baden-Württemberg* (Germany) and *West-Nederland* (the Netherlands), with 6 projects each. Although the countries' sizes were very different, the United Kingdom and France are the countries with a greater number of promoting regions, 8 and 7, respectively.

4. A typology of successful international cooperative R&D projects

4.1. Description of the variables and proxying proximity

The database constructed presents a large number of variables, the majority of which were based on the information gathered both in the official site and in .pdf files describing each project. We can group these variables into two main sets: variables that characterize the projects in generic terms – number of supporting technologies, financially-related variables, and industry variables – and the countries' weight (in terms of SMEs and RTDs) in these international R&D cooperation projects.

The detailed description of each project provided by CORDIS contains information on the number of support technologies per project (different technological areas associated with the project). Therefore, we take the number of support technologies in a given project as a proxy for the project's technological diversity.

Table 4: Main Characteristics of successful CRAFTs projects

	Description	Unity	Minimum	Maximum	Average
General characteristics	No. of technological areas		1,0	10,0	2,7
	EU funding	€	39,1	76,3	50,2
	SMEs participation	€	23,7	60,9	49,8
	Pavitt's taxonomy		*Scale intensive*		
	OECD's taxonomy		*Low technology*		
	Average cost per SME	€	0,0	5.190.000,0	241.747,3
	Average yield per RTD	€	0,0	1.633.000,0	400.718,4
	No of represented countries		4,0	26,0	9,6
SMEs share (%)	Austria	%	0,0	57,1	1,9
	Germany	%	0,0	75,0	16,8
	Spain	%	0,0	85,7	11,1
	France	%	0,0	66,7	14,2
	Italy	%	0,0	80,0	11,5
	United Kingdom	%	0,0	66,7	10,8
	Belgium	%	0,0	100,0	5,9
	Denmark	%	0,0	60,0	2,2
	Greece	%	0,0	25,0	1,1
	Ireland	%	0,0	37,5	0,7
	The Netherlands	%	0,0	100,0	11,0
	Norway	%	0,0	50,0	2,0
	Portugal	%	0,0	64,3	4,4
	Sweden	%	0,0	75,0	3,6
RTDs share (%)	Austria	%	0,0	100,0	1,2
	Germany	%	0,0	100,0	20,3
	Spain	%	0,0	80,0	8,5
	France	%	0,0	100,0	18,7
	Italy	%	0,0	100,0	6,5
	United Kingdom	%	0,0	100,0	13,2
	Belgium	%	0,0	100,0	3,8
	Denmark	%	0,0	50,0	2,4
	Greece	%	0,0	50,0	1,0
	Ireland	%	0,0	50,0	1,0
	The Netherlands	%	0,0	100,0	11,3
	Norway	%	0,0	50,0	1,8
	Portugal	%	0,0	75,0	3,0
	Sweden	%	0,0	80,0	3,5

Sources: Authors' computations based on data from http://sme.cordis.lu/craft/home.cfm, accessed on 30 April 2005.

Industry variables were originally provided by the NACE codes. Given the wide range of industries involved, we opt to aggregate them into two well-known taxonomies, the OCED and the Pavitt. The OCED taxonomy, based on R&D intensity, groups industries into three main sets: low, medium and high tech industries. The Pavitt taxonomy, somewhat more elaborated, aggregates industry by their degree of technological appropriability and complexity (supplier dominated; scale intensive, specialized suppliers and science based). Both taxonomies provide a characterization of the projects according to their technology intensity.

Based on the variables means from Table 4, it is possible to state that a successful CRAFT involves, on average, about 10 participating entities, generally from Germany and France, in supplier dominated and low technology sectors. In successful projects, SMEs' funding attains 49.8%. The average cost of a standard project is 241 thousand euros, and the average yield of participating research institutions is 400 thousand euros.

In the construction of the *proxy* for 'cultural' proximity, we adopt the following methodology: considering the nationality of the first SME performer, we compute, for each project, the relative frequency of other SMEs and RTDs that belong to the same country as the 1st performer. Thus, we assume that when there are no participants of the same nationality as the 1st performer in a project, 'cultural' proximity is minimal (0). Alternatively, the maximum value that this variable might take on would be 100%, which corresponds to the case where all project participants belong to the same country of origin as the 1st performer.

With regard to the geographical distance proxy, we calculate, for each project, the average distance (in kilometers) between each participant SME and the 1st performer. As information regarding the location of each project participant is not available, distance was computed in reference to each country's capital.

4.2. Using HOMALS and cluster analysis to construct a typology of successful international cooperative R&D projects

In this paper we aim at constructing a typology of successful CRAFT projects that may establish meaningful groups of projects according to relevant dimensions. To this end, a two-step analysis approach, based on the complementary use of HOMALS (Homogeneity Analysis by Means of Alternating Least Squares), and cluster analysis are applied. First, the HOMALS technique is used to understand and to describe the nature of the relationships between the selected variables (Table 5) and associated categories. In a second step, cluster analysis is applied not only to help identify homogeneous groups of CRAFT projects but also to validate the HOMALS results. The application of cluster analysis results in a new categorical variable indicating the final cluster membership of each CRAFT project. Of particular interest to this study, intersecting the new variable with other variables in the database (namely, number of SMEs, number of RTDs, number of participants (SMEs and RTDs), total cost, amount of funding, and percentage of EU funding) produces a detailed description of the obtained clusters.

The choice of the HOMALS technique relates to the categorical/qualitative nature of some variables, namely the OCDE and Pavitt taxonomies. We start by recoding the other three selected variables (technological diversity, cultural proximity and geographical distance) categorically, based on associated the histogram and frequency distribution; Table 5 presents the distribution of CRAFT projects by the categories in the set of variables under analysis.

Table 5: Distribution frequency of CRAFT projects by the set of variables

Variables	Categories/Frequency			
OCDE Taxonomy	***Low tech (L)***	***Medium tech (M)***	***High tech (H)***	
	60	45	13	
Pavitt Taxonomy	***Supplier Dominated (SD)***	***Scale Intensice (SI)***	***Specialized Supplier (SS)***	***Science Based (SB)***
	40	35	20	23
Technological Diversity (n.º of technological areas)	***1***	***2***	***3***	***=>4***
	12	41	53	12
Cultural Proximity (n.º of SMEs and RTDs that belong to the same country of the 1st performer)	***0 or 1 (0,1)***	***2 or 3 (2,3)***	***4 or 5 (4,5)***	***more than 6 (=>6)***
	29	42	29	18
Geographical Distance (average distance- in kilometres - between each project participant and the 1st performer)	***Less than 396 (396])***	***Between 396 and 644,5 (]396;644,5])***	***Between 644,5 and 976 (]644,5;976])***	***More than 976 (]976)***
	30	29	30	29

After observing the behaviour of the eigenvalues – a measure of the importance of the corresponding dimension in explaining variability in the input data – in the set of possible dimensions (14), we decide to retain only two dimensions for interpretation. This decision is due to the fact that the first two dimensions possess greater relevance and the eigenvalues drop very quickly when we pass from a solution with two dimensions to a higher dimensionality solution.

The analysis proceeds with the identification of the more important variables for each dimension (Table 6). In fact, an analysis of the discriminating measures in each dimension reveals that the OECD and Pavitt taxonomies contribute toward an explanation of the first dimension, whereas cultural proximity, geographical distance and project technology diversity explain the second one.[5]

Table 6: Discriminating measures

	Dimension	
	1	**2**
OECD taxonomy	**0,7972**	0,0277
Pavitt taxonomy	**0,8318**	0,0487
Cultural proximity	0,1467	**0,5478**
Geographical distance	0,1203	**0,4435**
Technology diversity	0,1829	**0,5048**
Eigenvalue	**0,4158**	**0,3145**

Figure 1 presents a perceptual map representing the quantification of the categories of the five considered variables. This geometric display helps to interpret the identified dimensions and allows us to identify the relations between the variable categories. The dimensions are interpreted in terms of positive and negative coordinates of the variable categories that are most disparate in each dimension. The spatial distribution of category points reflects associations (for spatially close point categories) or oppositions (for spatially distant and diagonally located point categories).

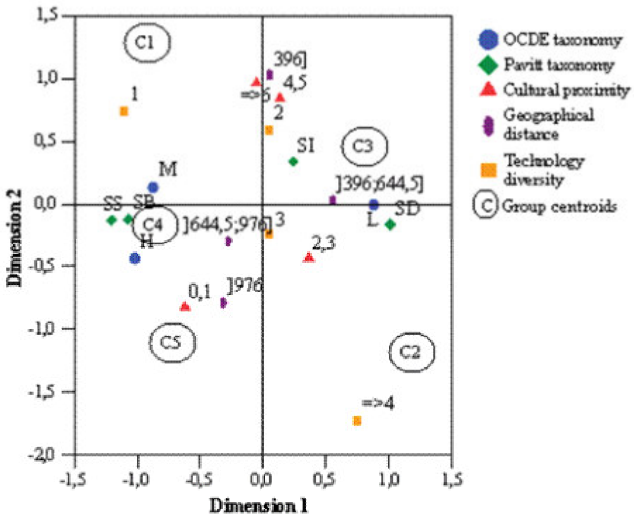

Figure 1: Perceptual map and cluster centroids

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[5] Eigenvalues are the arithmetic mean of the discriminating measures in each dimension; however, variables which have discriminating values which are at least equal to the respective eigenvalues are more relevant.

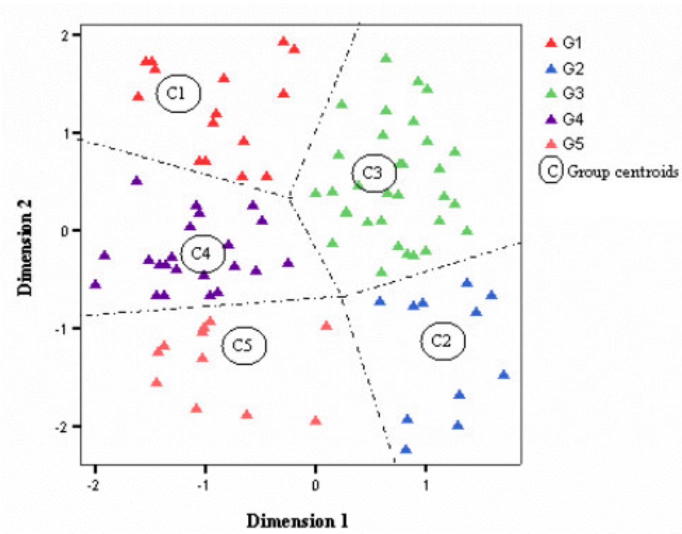

Figure 2: Object scores labeled by project groups

As a result of Figures 1 and 2, the following conclusions can be made:

- Dimension 1, represented by the horizontal axis, essentially distinguishes projects classified as low tech and supplier dominated or scale intensive (with positive coordinates), from those which are profiled as medium or high tech and scale intensive or science based (with negative coordinates);
- Dimension 2, represented by the vertical axis, essentially distinguishes projects characterized by low technological diversity, namely with one or two technological areas, and that are culturally and geographically nearby (with positive coordinates) from those that are technologically specialized and culturally and geographically distant (with negative coordinates).

Next, since our initial objective was to identify a typology of CRAFT projects, and to characterize the resulting groups, we proceed by complementing the use of HOMALS with cluster analysis. That means that we will classify CRAFT projects according to their object scores – composite and continuous variables that are based on the initial set of variables – in the two dimensions retained by HOMALS. The clustering of the 118 projects is accomplished by applying the k-means optimization method (McQueen, 1967). However, so as to select an adequate number of classes (an essential parameter in the algorithm initiation), we previously examined the dendogram and the evolution of the linkage distance obtained from Ward's hierarchical method (Ward, 1963), which suggest the existence of five groups of projects. Figure 1, analysed above, also reveals the position of the five identified clusters illustrated by the group centroids C1, C2, C3, C4 and C5.

Table 7 presents the distribution frequency of the five original variables and confirms that this cluster solution is helpful in characterizing the proposed taxonomy of CRAFT projects, while validating the HOMALS spatial configurations (Figure 1).

The bulk of successful projects (40%) might be classified as low tech, supplier dominated and culturally and geographically closer. Technologically more demanding successful projects (high tech and science based) are characterized as being more culturally and geographically distant. From this typology one might conclude that successful international cooperative R&D projects might be both culturally/geographically closer or distant. It is interesting however to note that (successful) distant projects are technologically more advanced whereas those that are closer are essentially low tech. Such evidence may reflect the tacit-codified knowledge debate. High tech projects tend to comprise more codified-related knowledge, whereas low tech ones rely to a large extent on informal, more tacit based knowledge.

Table 7: Distribution Frequency of the original variables in a five clusters solution

Variable/ Categories	Cluster 1		Cluster 2		Cluster 3		Cluster 4		Cluster 5		Row total
	Abs.	%	Abs.	%	Abs.	%	Abs.	%	Abs.	%	
OECD taxonomy											
L	0	0%	15	25%	43	72%	0	0%	2	3%	60
M	13	29%	0	0%	4	9%	23	51%	5	11%	45
H	3	23%	0	0%	0	0%	4	31%	6	46%	13
Pavitt taxonomy											
SD	0	0%	14	35%	26	65%	0	0%	0	0%	40
SI	5	14%	1	3%	21	60%	5	14%	3	9%	35
SS	5	25%	0	0%	0	0%	10	50%	5	25%	20
SB	6	26%	0	0%	0	0%	12	52%	5	22%	23
Tecnhological Diversity											
1	4	33%	0	0%	3	25%	5	42%	0	0%	12
2	9	22%	0	0%	22	54%	10	24%	0	0%	41
3	3	6%	6	11%	22	42%	12	23%	10	19%	53
=>4	0	0%	9	75%	0	0%	0	0%	3	25%	12
Cultural Proximity											
0,1	0	0%	5	17%	3	10%	13	45%	8	28%	29
2,3	0	0%	9	21%	18	43%	10	24%	5	12%	42
4,5	9	31%	1	3%	16	55%	3	10%	0	0%	29
=>6	7	39%	0	0%	10	56%	1	6%	0	0%	18
Geographical Distance											
[0;396]	11	37%	1	3%	15	50%	3	10%	0	0%	30
]396;644,5]	2	7%	5	17%	16	55%	5	17%	1	3%	29
]644,5;976]	3	10%	4	13%	9	30%	11	37%	3	10%	30
]976;...[			5	17%	7	24%	8	28%	9	31%	29
Number of projects	16	14%	15	13%	47	40%	27	23%	13	11%	
Projects typology	**Culturally and geographically closer**		**Technology diversified**		**Low tech, supplier dominated and near**		**Medium tech science based and distant**		**High tech, diversified and distant**		

Next, in order to examine whether the obtained technological groups differ in terms of the six variables representing project dimension, we perform Kruskal-Wallis tests. According to Table 8 and 9, the following conclusions can be drawn:

- successful CRAFTs differ significantly according to the variables, number of RTDs and percentage of EU funding;
- at least two technological groups present statistical differences relative to the remaining variables (number of SMEs, number of participants, total cost and amount of funding); since the Kruskal-Wallis did not identify how the groups differed, only that they were in some way different, we applied another nonparametric test - the Mann-Whitney test - for pairwise comparisons in the cases in which we found significant differences (cf. Table 8);
- 'Near' projects (Cluster 1) involved the highest number of SMEs and participants, while 'diversified' (Cluster 3) and 'high tech, distant' (Cluster 5) projects are associated with the lowest average values for these variables.
- 'Diversified' projects received, on average, the highest amount of funding and presented the highest total costs;
- 'Near' and 'Low tech, supplier dominated' projects are less expensive than 'Medium tech, science based' and 'High tech, distant' projects.

Table 8: Technological groups and project dimension variables (means and Kruskall-Wallis test results)

	Number of SMEs	Number of RTDs	Number of participants (SMEs and RTDs)	Total cost	Amount of funding	Percentage of EU funding
Cluster 1 - 'Near'	9	3	13	825938	411406	50
Cluster 2 - 'Diversified'	5	3	7	1318468	677898	51
Cluster 3 - Low tech, supplier dominated	7	3	10	911070	488513	50
Cluster 4 – Medium tech, science based	6	3	9	1057627	531918	50
Cluster 5 – High tech, distant	5	2	7	1081521	544718	50
Chi-Square	*17,705*	*6,070*	*20,434*	*22,578*	*22,623*	*4,392*
p-value	*0,001*	*0,194*	*0,000*	*0,000*	*0,000*	*0,356*

The next table indicates, in a pairwise manner, the groups that differ on average in the variable under analysis (i.e., present a *p-value* ≥ 0.05).

Table 9: Technological groups and project dimension variables (pairwise comparisons)

Number of SMEs

Cluster n.º	C1	C2	C3	C4	C5
C1	Z *p-value*				
C2	-3,438 *0,001*				
C3	-1,866 *0,062*	-2,551 *0,011*			
C4	-2,014 *0,044*	-1,949 *0,051*	-0,511 *0,610*		
C5	-3,210 *0,001*	-0,189 *0,850*	-2,278 *0,023*	-1,657 *0,098*	

Number of participants (SMEs and RTDs)

Cluster n.º	C1	C2	C3	C4	C5
C1	Z *p-value*				
C2	-3,597 *0,000*				
C3	-1,772 *0,076*	-2,716 *0,007*			
C4	-2,236 *0,025*	-1,814 *0,070*	-1,006 *0,315*		
C5	-3,263 *0,001*	-0,493 *0,622*	-2,654 *0,008*	-2,068 *0,039*	

Total cost

Cluster n.º	C1	C2	C3	C4	C5
C1	Z *p-value*				
C2	-3,399 *0,001*				
C3	-0,340 *0,734*	-3,897 *0,000*			
C4	-0,892 *0,372*	-2,849 *0,004*	-1,669 *0,095*		
C5	-2,324 *0,020*	-1,497 *0,134*	-2,766 *0,006*	-1,432 *0,152*	

Amont of funding

Cluster n.º	C1	C2	C3	C4	C5
C1	Z *p-value*				
C2	-3,222 *0,001*				
C3	-0,584 *0,559*	-3,905 *0,000*			
C4	-0,704 *0,482*	-2,889 *0,004*	-1,814 *0,070*		
C5	-2,127 *0,033*	-1,659 *0,097*	-2,827 *0,005*	-1,329 *0,184*	

5. Discussion of the main findings: are projects' technology intensity and proximity compatible?

"… *the relevance of proximity is one of the most controversially discussed topics in the context of innovative linkages and networks*." Sternberg (1999: 533)

Networks are commonly regarded as vehicles for knowledge creation and diffusion. Given that networks are defined and demarcated in a non-territorial manner, it does not seem correct to assume that knowledge spillovers are spatially bounded (Bunnell and Coe, 2001). Corroborating this statement, Breschi and Lissoni (2002) found that social networks, based on personal acquaintances resulting from common working experiences, not only constitute the main channels for knowledge diffusion, but also produce the most knowledge. Moreover, they argue that tacit knowledge is a common property or club good that is shared between members of 'epistemic communities' or 'communities of practice', regardless of where they are located (Breschi and Lissoni, 2001; Gertler, 2003).

However, according to widespread opinion, the constraint of geographical proximity remains very strong, even with an intensive use of ICT (Dosi, 1988; Spender, 1996; Leonard and Sensiper, 1998). It should be noted that advantages supplied by physical proximity can also be provided to a certain extent by other means of coordination (organizational proximity) and

ICTs significantly increase the possibilities of remote coordination (Rallet and Torrem, 2000). ICTs increase the possibilities of remote coordination insofar as they are a powerful means to turn tacit knowledge into codified knowledge (for instance, conversion of tacit knowledge into expert systems and know-how databases, storage of organizational knowledge on CD-ROM, automation of routines by means of workflow software). If this was the case, the geographical proximity constraint would become increasingly less significant (Rallet and Torrem, 2000).

However, Rallet and Torrem (2000) argue that the use of ICT tools requires the sharing of common codes and practices of communication which are tacit. For this reason, the tools of remote communication are mainly used by individuals who meet frequently. This is why tacit knowledge will always be used in research and innovative activities. Consequently, face-to-face relations and geographical proximity are highly relevant in these types of activities.

Our empirical work based on successful international R&D projects reveals that different geographical and cultural proximities are in fact (statistically) related. Indeed, the HOMALS analysis provides us with two quite distinct dimensions: proximity versus technology intensity (proxied by the OECD and Pavitt taxonomies). Our first finding concludes that successful international R&D projects may be both (geographically and culturally) closer or more distant. In this vein, we agree with Boschma (2005b), when we claim that geographical proximity per se is neither a necessary nor a sufficient condition for learning to take place. Despite recognizing that geographical proximity facilitates interactive learning, in all probability by strengthening the other dimensions of proximity,[6] Boschma (2005b) argues that neither organizational proximity nor social proximity is required for inter-organizational learning. In principle, effective knowledge transfer does not presume close trust-based or arm's-length interactions between firms. Co-location (or geographical proximity) may be just enough, because it enables local agents to "monitor each other constantly, closely, and almost without effort or cost" (Malmberg and Maskell, 2002: 439).

[6] In fact, geographical proximity may play a complementary role in building and strengthening social, organizational, institutional/cultural and cognitive proximity. This comes close to what Howels (2002) calls 'a more indirect and subtle impact' of geographical of proximity. For instance, spatial proximity facilitates informal relationships (Audretsch and Stephan, 1996). That is, firms located near each other have more face-to-face contacts and can build up trust more easily, which, in turn, leads to more personal and embedded relationships between firms (Harrison, 1992). Geographical proximity may also stimulate the formation and evolution of institutions such as norms and habits that may affect interactive learning and innovation.

Our second finding – international successful R&D projects that are technologically more advanced are both geographically and culturally distant, whereas those located closer are essentially low tech – seems to challenge somewhat current viewpoints.

For instance, Sonn and Storper (2003) state that codified knowledge, or put more simply, information, is not equivalent to economically-useful knowledge, arguing that the latter may experience considerable friction to distance. Along these lines, urban economists and economic geographers have suggested that geographical proximity between people and organizations which produce knowledge may still be an important advantage in the production of economically-useful innovations (Acs 2002; Dicken 1992; Feldman 1994; Storper 1997). According to these authors, innovations with a *high technological content* have been shown to be facilitated by the *physical co-presence* of key scientists and frequent interaction between related workers (Saxenian 1994; Zucker, Darby, and Armstrong 1998).

Although it has been suggested that ICTs, which lower the costs of codifying knowledge, and stronger intellectual property rights are reducing the importance of short distances to access tacit knowledge while simultaneously increasing the ability of firms to obtain knowledge from outside the firm (Antonelli, 1999; Roberts, 2000), Senker (1995) highlights that most rapidly developing and complex technologies will always depend on tacit knowledge and, consequently, on close, interpersonal interactions to share knowledge. This will hold even when knowledge can be codified, as long as there is a delay between its discovery and its codification. In this context, distance could matter because local, direct and personal contacts allow a company faster and more successful access to knowledge gatekeepers to discover where and how to access new knowledge (Arundel and Geuna, 2004).

In our viewpoint, for SMEs in particular to carry out more radical innovations, there is often a need to supplement the informal, tacit knowledge with R&D-competence and more systematically accomplished basic research and development (Asheim and Isaksen, 2002). As such, in the long run, most SMEs cannot rely only on localized learning, but must also have access to more universal, codified knowledge of, for example, national innovation systems. The creation of regionalized, networked innovation systems through increased cooperation with local R&D institutes, or the establishment of some technology transfer agencies, hubs for actual services etc., may give firms precisely the access they need to information and competencies which may supplement local competence and, thus, increase the collective innovative capacity and counteract ‘lock-in’ of, in particular, regional clusters of SMEs.

Our results are also largely in line with the evidence for the Netherlands gathered by Beugelsdijk and Cornet (2002). According to these authors, space is a relative concept; their findings suggest that for a small country “a far friend might be worth more than a good neighbour”. Accordingly, it is not geographic proximity, but rather the attractiveness of a transaction which drives firms to cooperate and learn from each other. The physical closeness of the transacting partner may be considered convenient, but is not a necessary condition for cooperation (Beugelsdijk and Cornet, 2002).

References

Acs, Z.J. (2002), ‘Innovation and the Growth of Cities’. Cheltenham: Edward Elgar.

Antonelli, C. (1999), ’Industrial Organisation and the Production of Knowledge’, Cambridge Journal of Economics, 23: 243–260.

Arundel, A. and Geuna, A. (2004), ‘Proximity and the Use of Public Science by Innovative European Firms’, Econ. Innov. New Techn., 13(6): 559-580.

Asheim, B. T. and Isaksen, A. (2002), ‘Regional Innovation Systems: The Integration of Local “Sticky” and Global “Ubiquitous” Knowledge’, Journal of Technology Transfer, 27, 77–86.

Audretsch, B. and Stephan, P.E. (1996), ‘Company–Scientist Locational Links: The Case of Biotechnology’, American Economic Review, 86: 641–652.

Audretsch, D.B. and Feldman, M. (1996), ‘Spillovers and the Geography of Innovation and Production’, American Economic Review, 86: 630–640.

Barringer, B.K., Harrison, J.S., (2000), ‘Walking a Tightrope: Creating Value Through Interorganizational Relationships’, Journal of Management, 26 (3): 367–403.

Bartels, F. (2000), ‘International Competition and Global Cooperation’, in L. Dana (eds), Global Market Cooperation and Networks, 85-98. New York: International Business Press.

Bayona, C., García-Marco, T. and Huerta, E. (2001), ‘Firms’ Motivations for Cooperative R&D: an Empirical Analysis of Spanish Firms’, Research Policy, 30: 1289–1307.

Becker, W. and Dietz, J. (2004), ‘R&D Cooperation and Innovation Activities of Firms - Evidence for the German Manufacturing Industry’, Research Policy, 33 (2): 209-223.

Beugelsdijk, S. and Cornet, M. (2002), '"A Far Friend is Worth More Than a Good Neighbour": Proximity and Innovation in a Small Country', Journal of Management and Governance, 6: 169–188.

Boschma, R.A. (2005a), 'Editorial - Role of Proximity in Interaction and Performance: Conceptual and Empirical Challenges', Regional Studies, 39 (1): 41–45.

Boschma, R.A. (2005b), 'Proximity and Innovation: A Critical Assessment', Regional Studies, 39 (1): 61–74.

Branstetter, L., Sakakibara, M. (1997), 'Japanese Research Consortia: A Microeconometric Analysis of Industrial Policy', NBER Working Paper #6066, National Bureau of Economic Research, Cambridge, MA.

Breschi, S. and Liassion, F. (2002), 'Mobility and Social Networks: Localised Knowledge Spillovers Revisited', paper presented at: Clusters in High-technology: Aerospace, Biotechnology and Software Compared, Montreal, Canada, November.

Britton, J. (2003), 'Network Structure of an Industrial Cluster: Electronics in Toronto', Environment and Planning A, 35: 983-1006.

Browning, L.D., Beyer J.M. and Shelter J.C. (1995). 'Building Cooperation in a Competitive Industry: SEMATECH and the Semiconductor Industry', Academy of Management Journal, 38: 113–151.

Bunnel, T. and Coe, N. (2001), 'Spaces and Scales of Innovation', Progress in Human Geography, 25: 569–589.

Burgers, W.P., Hill, C.W. L., Kim, W.C. (1993), 'A Theory of Global Strategic Alliances: The Case of the Global Auto Industry'. Strategic Management Journal, 14(6): 419–432.

Capello, R. (1996), 'Industrial Enterprises and Economic Space: The Network Paradigm', European Planning Studies, 4: 485–498.

Capello, R. (1999), 'Spatial Transfer of Knowledge in High Technology Millieux: Learning Versus Collective Learning Processes', Regional Studies, 33: 353–365.

Child, J., Faulkner, D., (1998), 'Strategies of Cooperation: Managing Alliances, Networks and Joint Ventures'. Oxford: Oxford University Press.

Cohen, W.M., Levinthal, D.A., (1989), 'Innovation and Learning: The Two Faces of R&D', Economic Journal, 99: 569–596.

Cohendet, P. e Steinmueller, W. E. (2000), 'The Codification of Knowledge: a Conceptual and Empirical Exploitation', Industrial and Corporate, 9(2): 195-209.

Cooke, P. and Wills, D. (1999), 'Small Firms, Social Capital and the Enhancement of Business Performance Through Innovation Programmes', Small Business Economics, 13: 219–234.

Coombs, R., Richards, A., Saviotti P.P., Walsh V. (1996), 'Technological Collaboration: The Dynamics of Cooperation in Industrial Innovation'. Cheltenham: Edward Elgar.

Corey, E.R. (1997), 'Technology Fountainheads: The Management Challenge of R&D Consortia'. Boston, MA: Harvard Business School Press.

De Bresson, C. (1996), 'Economic Interdependence and Innovation Activity'. Cheltenham: Edward Elgar.

Delgado, A.P., Teixeira, A.A.C. and Santos, P. (2005), 'International Regional Patterns of Successful R&D Alliances: What Regional Innovation Systems Have To Do With It?', Paper presented at the 45th European Congress of the Regional Science Association, Amsterdam, August.

Dicken, P. (1992), 'Global Shift: The Internationalization of Economic Activity'. 2nd ed. New York: Guilford Press.

Dodgson, M. (1993), 'Technological Collaboration in Industry: Strategy, Policy and Internationalization in Innovation'. London, New York: Routledge.

Dodgson, M., (1992a), 'The Strategic Management of R&D Collaboration', Technology Analysis and Strategic Management, 4 (3): 227–244.

Dodgson, M., (1992b), 'Technological Collaboration: Problems and Pitfalls', Technology Analysis and Strategic Management, 4 (1): 83–88.

Doloreux, D. (2004), 'Regional Networks of Small and Medium Sized Enterprises: Evidence from the Metropolitan Area of Ottawa in Canada', European Planning Studies, 12 (2): 173-189.

Doloreux, D. (2003), 'SMEs and the Role of Innovation Systems in Small Regions: The Case of the Beauce in Québec (Canada)', International Journal of Innovation Management, 7: 67-94.

Dosi, G. (1988), 'Sources, Procedures and Microeconomic Effects of Innovation', Journal of Economic Literature, 36: 1126–1171.

Doz, Y., Olk, P. and Smith, P. (2000), 'Ring Formation Processes of R&D Consortia: Which Path to Take? Where Does It Lead?', Strategic Management Journal, 21: 239–266.

Dyer, J.H., Singh, H. (1998), 'The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage', Academy of Management Review, 23: 660–679.

Feldman, M.P. (1994), 'The Geography of Innovation'. Boston: Kluwer Academic Publishers.

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

Fritsch, M. (2003), 'Does R&D-Cooperation Behavior Differ Between Regions?', Industry and Innovation, 10 (1): 25–39.

Fritsch, M. and Lukas, R. (1999), 'Innovation, Cooperation, and the Region', in D.B. Audretsch and R. Thurik (eds), Innovation, Industry Evolution and Employment, pp. 157–181.

García, C. e Velasco, C. (2002), 'Co-opetition and Performance: Evidence from European Biotechnology Industry', paper presented at: EURAM – The European Academy of Management, Second Annual Conference - "Innovative Research in Management", Stockholm, May.

Gentzoglanis A. (2001), 'Networks and Proximity: An Empirical Analysis': MIMEO, University of Sherbrooke.

Gertler, M. (2001), 'Tacit Knowledge and the Economic Geography of Context', paper presented at: Nelson and. Winter DRUID Conference. Aalborg, Denmark. June.

Gertler, M. S. (2003), 'Tacit Knowledge and the Economic Geography of Context, or The Undefinable Tacitness of Being (There)', Journal of Economic Geography, 3: 75–99.

Hagedoorn, J. (1993), 'Understanding the Rationale of Strategic Technology Partnering: Interorganizational Modes of Cooperation and Sectoral Differences', Strategic Management Journal, 14: 371–385.

Hagedoorn, J. (1996), 'Trends and Patterns in Strategic Technology Partnering Since the Early Seventies', Review of Industrial Organization, 11: 601–616.

Hagedoorn, J., Link, A.N., Vonortas, N.S. (2000), 'Research Partnerships', Research Policy, 29: 567–586.

Hagedoorn, J., Narula, R. (1996), 'Choosing Organizational Modes of Strategic Technology Partnering: International and Sectoral Differences', Journal of International Business Studies, 27 (2): 265–284.

Hagedoorn, J., Schakenraad, J. (1992), 'Leading Companies and Networks of Strategic Alliances in Information Technologies', Research Policy, 21: 163-190.

Hagedoorna, J., van Kranenburga, H. and Osbornb R.N. (2003), 'Joint Patenting Amongst Companies - Exploring the Effects of Inter-Firm R&D Partnering and Experience', Managerial and Decision Economics, 24: 71–84.

Hakansson, H. and Shehota, I. (1995), 'Developing Relationships in Networks'. London: Routledge.

Hamel, G. (1991), 'Competition for Competence and Inter-Partner Learning Within International Strategic Alliances', Strategic Management Journal, 12: 83–103.

Harrison, B. (1992), 'Industrial Districts: Old Wines in New Bottles', Regional Studies, 26: 469–483.

Häusler, J., Hohn, H.-W., Lütz, S. (1994), 'Contingencies of Innovative Networks: A Case Study of Successful Interfirm R&D Cooperation', Research Policy, 23: 47–66.

Hladik, K. (1985), 'International Joint Ventures'. Lexington, Massachusetts: Lexington Books.

Hladik, K. (1988), 'R&D and International Joint Ventures', in F.J. Contractor and P. Lorange, (eds), Cooperative Strategies in International Business, pp. 187–203.

Howells, J. (1996), 'Tacit Knowledge, Innovation and Technology Transfer', Technology Analysis & Strategic Management, 8(2): 91-105.

Howells, J. R. L. (2002), 'Tacit Knowledge, Innovation and Economic Geography', Urban Studies, 39: 871–884.

Jaffe, A.B., Trajtenberg, M. and Hendersen, R. (1993), 'Geographic Localization and Knowledge Spillovers as Evidenced by Patent Citations', Quarterly Journal of Economics, 108: 577–598.

Kamien, M., Muller, E., Zang, I. (1992), 'Research Joint Ventures and R&D Cartels', American Economic Review, 82 (5): 1293–1306.

Katz, J., Martin, B. (1997), 'What Is research Collaboration?', Research Policy, 26: 1–18.

Katz, M.L., Ordover, J.A. (1990), 'R&D Cooperation and Competition', in M.N. Baily and C. Winston (eds), Brookings Papers on Economic Activity: Microeconomics, pp. 137–203.

Kirat, T. and Lung, Y. (1999), 'Innovation and Proximity. Territories as Loci of Collective Learning Processes', European Urban and Regional Studies, 6: 27–38.

Kleinknecht, A., Reijnen, J. (1992), 'Why Do Firms Cooperate on R&D? An Empirical Study', Research Policy, 21 (4): 347–360.

Koschatzky K. (2000), 'A River Is a River-Cross-Border: Networking Between Baden and Alsace', European Planning Studies, 8 (4): 429-449

Koschatzky, K. and Sternberg, R. (2000), 'R&D Cooperation in Innovation Systems—Some Lessons From the European Regional Innovation Survey (ERIS)', European Planning Studies, 8 (4): 488-501.

Koschatzky, K, Kulicke, M. and Zenker, A. (2001), 'Innovation Networks: Concepts and Challenges in the European Perspective'. Fraunhofer: Physica-Verlag.

Kurozumi, T. (1992), 'Outline of the Fifth-Generation Project and ICOT Activities', in D. Gibson and R. Smilor (eds), Technology Transfer in Consortia and Strategic Alliances, pp. 173–191.

Larsson, S. and Malmberg, A. (1999), 'Innovations, Competitiveness and Local Embeddedness: A Study of Machinery Producers in Sweden', Geografiska Annaler, 81: 1–18.

Leonard, D. and Sensiper, S. (1998), 'The Role of Tacit Knowledge in Group Innovation', California Management Review, 40: 112–132.

Levy, J.D., Samuels, R.J. (1991), 'Institutions and Innovation: Research Collaboration as Technology Strategy in Japan', in L.K. Mytelka (eds), Strategic Partnerships and the World Economy: States, pp. ????

Li, J. and Zhong, J. (2003), 'Explaining the Growth of International R&D Alliances in China', Managerial and Decision Economics, 24: 101–115.

Link, A.N., Bauer, L.L. (1989), 'Cooperative Research in US Manufacturing: Assessing Policy Initiatives and Corporate Strategies'. Lexington, MA: Lexington Books.

Link, A.N., Teece, D.J., Finan, W.F. (1996), 'Estimating the Benefits From Collaboration: The Case of Sematech', Review of Industrial Organization, 11: 737–751.

Lorenzen, M. e Foss, N.J. (2003), 'Cooperation, Networks and Institutions in Regional Innovation Systems'. UK: Edward Elgar Publishing Limited.

Lorenzoni, G. and Baden-Fuller, C. (1995), 'Creating a Strategic Centre to Manage a Web of Partners', California Management Review, 37(3): 1–18.

Lundvall, B.-A. (1992), 'User–Producer Relationships, National Systems of Innovation and Internationalization', in B.-A. Lundvall (eds), National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning, pp. 45–67.

Malecki, E. and Oinas, P. (1999), 'Making Connections. Technological Learning and Regional Economic Change'. Aldershot: Ashgate.

Malmberg, A. and Maskell, P. (2002), 'The Elusive Concept of Localization Economies: Towards a Knowledge-Based Theory of Spatial Clustering', Environment and Planning A, 34: 429–449.

Martin, S. (1996), 'Public Policies Towards Cooperation in Research and Development: The European Union, Japan and the United States', in W. Comanor, A. Goto and A. Waverman (eds), Competition in a Global Economy.

Maskell, P. et. al. (1998), 'Competitiveness, Localised Learning and Regional Development. Specilisation and prosperity in small open economies'. London/New York: Routlegde.

Mathews, J.A. (2002), 'The Origins and Dynamics of Taiwan's R&D Consortia', Research Policy, 31: 633–651.

McQueen, J. (1967), 'Some Methods for Classification and Analysis of Multivariate Observations', proceedings of Fifth Berkeley Symposium on Mathematical, Statistics and Probability, 1: 281-97.

Miyata, Y. (1996), 'An Analysis of Cooperative R&D in the United States', Technovation, 16 (3): 123–131.

Morgan, K. (2004), 'The Exaggerated Death of Geography: Learning, Proximity and Territorial Innovation Systems', Journal of Economic Geography, 4: 3-21.

Mowery, D.C., Oxley, J.E., Silverman, B.S. (1998), 'Technological Overlap and Inter-firm Cooperation: Implications for the Resource-Based View of the Firm', Research Policy, 27: 507–523.

Nooteboom, B. (1999), 'Innovation and Inter-firm Linkages: New Implications for Policy', Research Policy, 28: 793-805.

Perrow, C. (1992), 'Small-Firm Networks', in N. Nohria and R.G. Eccles (eds), Networks and Organizations: Structure.

Polanyi, M. (1966), 'The Tacit Dimension'. Garden City, NY: Doubleday & Co.

Porter, M. E. (1998), 'On Competition'. Boston: Harvard Business Press.

Porter, M.E., Fuller, M.B. (1986), 'Coalitions and Global Strategy', in M.E. Porter (eds), Competition in Global Industries, pp. 315–343.

Powell, W.W., Brantley P. (1992), 'Competitive Cooperation in Biotechnology: Learning Through Networks?', in N. Nohria, R.G. Eccles (eds), Networks and Organizations, pp. 366–394.

Powell, W.W. (1987), 'Hybrid Organizational Arrangements: New Form or Transitional Development', California Management Review, 30: 67–87.

Powell, W.W., Kogut, K.W. and Smith-Doerr, L. (1996), 'Inter-organizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology', Administrative Science Quarterly, 41: 116–145.

Rallet, A. and Torre, A. (2000), 'Is Geographical Proximity Necessary in the Innovation Networks in the Era of Global Economy?', GeoJournal, 49: 373–380.

Ring, P.S. and Rands, G. (1989), 'Sensemaking, Understanding, and Committing: Emergent Transaction Processes in the Evolution of 3M's Microgravity Research Program', in A. H. Van de Ven, H. Angle and M. S. Poole (eds), Research on the Management of Innovation: The Minnesota Studies, pp. 337–366.

Roberts, J. (2000), 'From Know-How to Show-How?: Questioning the Role of Information and Communication Technologies in Knowledge Transfer', Technology Analysis and Strategic Management, 12: 429–443.

Robertson, T., Gatignon, H. (1998), 'Technology Development Mode: A Transaction Cost Conceptualization', Strategic Management Journal, 19: 515–531.

Sakakibara, M. (1997a), ‘Evaluating Government-Sponsored R&D Consortia In Japan: Who Benefits And How?’, Research Policy, 26 (4/5): 447–473.

Sakakibara, M. (1997b), ‘Heterogeneity of Firm Capabilities and Cooperative Research and Development: An Empirical Examination of Motives’, Strategic Management Journal, 18: 143–164.

Sandoz, W. (1992), ‘High-Tech Europe: The Politics of International Cooperation’. Berkeley, CA: University of California Press.

Sawhney, M., Prandelli, E. (2000), ‘Communities of Creation: Managing Distributed Innovation in Turbulent Market’, California Management Review, 42 (4): 24–54.

Saxenian, A.L. (1991), ‘The Origins and Dynamics of Production Networks in Silicon Valley’, Research Policy, 20 (5): 423–438.

Saxenian, A.L. (1994), ‘Regional Advantage: Culture and Competition in Silicon Valley and Route 128’. Cambridge, MA: Harvard University Press.

Senker, J. (1995), ‘Tacit Knowledge and Models of Innovation’, Industrial and Corporate Change, 2: 425–447.

Shing, K. (1997), ‘The Impact of Technological Complexity and Interfirm Cooperation on Business Survival’, Academy of Management Journal, 40 (2): 339–367.

Sigurdson, J. (1986), ‘Original Working Paper Industry and State Partnership in Japan: The VLSI Project’. Lund: University of Lund.

Sigurdson, J. (1998), ‘Industry and State Partnership: The Historical Role of the Engineering Research Associations in Japan’, Industry and Innovation, 5 (2): 209–241.

Sinha, D., Cusumano, M. (1991), ‘Complementary Resources and Cooperative Research: A Model of Research Joint Ventures Among Competitors’, Management Science, 37 (9): 1091–1106.

Sonn, J.W. and Storper, M. (2003), ‘The Increasing Importance of Geographical Proximity in Technological Innovation: An Analysis of U.S. Patent Citations, 1975-1997’, paper presented at: What Do we Know about Innovation? In Honour of Keith Pavitt, Sussex, November.

Spence, A.M. (1984), ‘Cost Reduction, Competition and Industry Performance’, Econometrica, 52: 101–121.

Spender, J. (1996), ‘Competitive Advantage from Tacit Knowledge? Unpacking the Concept and Its Strategic Implications’, in B. Moingeon and A. Edmondson (eds), Organizational Learning and Competitive Advantage.

Steensma, H.K. (1996), ‘Acquiring Technological Competencies Trough Inter-organizational Collaboration: An Organizational Learning Perspective’, Journal of Engineering and Technology Management, 12: 267–286.

Steinmueller, W.E. (2000), ‘Will New Information and Communication Technologies Improve the ‘Codification’ of Knowledge?’, Industrial and Corporate Change, 9 (2): 361-376.

Sternberg, R. (1999), ‘Innovative Linkages and Proximity: Empirical Results from Recent Surveys of Small and Medium Sized Firms in German Regions’, Regional Studies, 33: 529–540.

Storper, M. (1997), ‘The Regional World: Territorial Development in a Global Economy’. New York: Guildford Press.

Storper, M. (1993), ‘Regional “Worlds” of Production: Learning and Innovation in the Technology Districts of France, Italy and the USA’, Regional Studies, 27: 433–455.

Suarlez-Villa, L. and Walrod, W. (1997), ‘Operational Strategy, R&D and the Intra-metropolitan Clustering in a Polycentric Structure’, Urban Studies, 34(9): 1343–1380.

Teece, D.J. (1992), ‘Competition, Cooperation and Innovation: Organisational Arrangements for Regimes of Rapid Technological Progress’, Journal of Economic Behaviour and Organization, 18: 1–25.

Tether, B.S. (2002), ‘Who Co-operates for Innovation, and Why: An Empirical Analysis’, Research Policy, 31: 947–967.

Tidd, J. (1997), ‘Complexity, Networks and Learning: Integrative Themes for Research on Innovation Management’, International Journal of Innovation Management, 1 (1), 1–21.

Torre, A. and Gilly, J.P. (2000), ‘On the Analytical Dimension of Proximity Dynamics’, Regional Studies, 34: 169–180.

Tsang, E. (1998), ‘Motives for Strategic Alliances: a Resource Based Perspective’, Scandinavian Journal of Management, 14 (3): 207–221.

von Hippel, E. (1988), ’The Sources of Innovation’. New York: Oxford University Press.

Vonortas, N.A. (1997), ‘Cooperation in Research and Development’. Boston, MA.: Kluwer Academic, Publishers.

Wang, J.-C. (1994), ‘Cooperative Research in a Newly Industrialized Country: Taiwan’, Research Policy, 23: 697–711.

Ward, J.H. Jr. (1963), ‘Hierarchical Grouping to Optimize an Objective Function’, Journal of American Statistic Association, 58: 236–244.

Welsh, D., Welsh, L., Wilkinson, I. and Young, L. (2000), ‘An Export Grouping Scheme’, in L. Dana (eds), Global Market Cooperation and Networks, pp. 59-84.

Wright, R. and Dana, L.-P. (2003), ‘Changing Paradigms of International Entrepreneurship Strategy’, Journal of International Entrepreneurship, 1: 135-152.

Zaheera, A. and George, V.P. (2004), ’Reach Out or Reach Within? Performance Implications of Alliances and Location in Biotechnology’, Managerial and Decision Economics, 25: 437–452.

Zedtwitz, M. e Gassmann, O (2002), ‘Market Versus Technology Drive in R&D Internationalization: Four Different Patterns of Managing Research and Development’, Research Policy, 31: 569-588.

Zucker, L.G., Darby, M.R. and Armstrong, J. (1998), ‘Geographically Localized Knowledge: Spillovers or Markets?’, Economic Inquiry, January 65.

Zukin, S. and Di Maggio, P. (1990), ‘The Social Organization of the Economy’. Cambridge: Cambridge University Press.

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