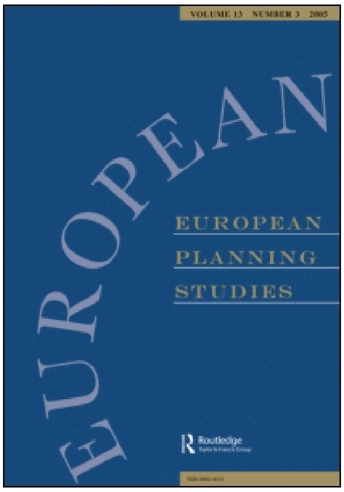

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International R&D Cooperation between Low-tech SMEs: The Role of Cultural and Geographical Proximity

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International R&D Cooperation between Low-tech SMEs: The Role of Cultural and Geographical 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 focussing on R&D cooperation by low-tech firms, especially small and medium-sized enterprises (SMEs). Providing further and new evidence based on a recently built database of CRAFT projects, this study analyses the relationship between technology and proximity in international R&D networks using 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 information and communication technology (ICT) "revolution" emphasized by the prophets of the "Death of Distance" and the "End of Geography".*

Introduction

> ... 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, p. 17, emphasis added)

The trend toward formalized cooperation—in the shape of inter-firm alliances, joint ventures, R&D and other agreements—has been on the rise (Hagedoorn & Schakenraad, 1992; Powell & Brantley, 1992; Dodgson, 1993; Coombs *et al.*, 1996; Hagedoorn

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et al., 2003; Li & Zhong, 2003; Fontana *et al.*, 2006). 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; Rutten, 2004).

The literature on the relationship between cooperation behaviour and innovation activities suggests that cooperation should be conducive to innovation processes (Fritsch & Lukas, 1999; Fritsch, 2003; Kaufmann & Wagner, 2005; Medda *et al.*, 2006). In fact, Tether (2002) points out that cooperating firms are generally engaged in higher level innovative activities. With regard specifically to R&D cooperation, a number of empirical studies (e.g. Klomp & van Leeuwen, 2001; Faems *et al.*, 2005; Cincera *et al.*, 2004; Belderbos *et al.*, 2004) have found that engaging in this type of cooperation has a positive impact on innovation performance. Studying small and medium low-tech firms[1] from Denmark, Ireland and Wales involved in "distant" R&D linkages, Cooke and Wills (1999) pointed out that a large percentage claimed to have achieved improvements in business performance, innovation and knowledge promotion derived from the newly established international R&D linkages. As Lambooy (2004) notes, R&D linkages may constitute a source of competitive advantage and have enduring effects on firm performance.

Despite generally recognizing the importance of cooperative innovation linkages on the performance of firms, the relevance of proximity in such a context remains the subject of wide debate (Sternberg, 1999; Arndt & Sternberg, 2000; Sapsed *et al.*, 2005). It is argued (e.g. Koschatzky, 1998; Amara *et al.*, 2005) that geographical and cultural proximity can play a decisive role in reducing uncertainty and improving access to critical input factors when it comes to the successful introduction of innovations. Moreover, it is recognized that networking for innovation often involves a great amount of tacit knowledge exchange (Cooke & Wills, 1999; Hilpert, 2006), which is frequently associated to geographical proximity (Dosi, 1988; Leonard & Sensiper, 1998). In contrast, codified knowledge exchange tends to be feasible at a distance (Audretsch & Lehmann, 2006).

In their study of 10 European regions, Arndt and Sternberg (2000) found that small firms are more likely to cooperate with their neighbours. They did, however, emphasize the need for both intraregional and interregional networks, especially in the case of knowledge-intensive firms. Bastian (2006) and Hilpert (2006) note that science-based processes, which tend to have a higher component of formalized, codified knowledge (Audretsch *et al.*, 2004), rely to a greater extent on international collaborations.

To our knowledge, there is very little evidence on R&D cooperation by low-tech small and medium-sized enterprises (SMEs) [some noteworthy exceptions are Cooke and Wills (1999) and, more recently, Delgado *et al.* (2005)], that is, firms with limited or no in-house research, technological development (RTD) and innovation capability (European Commission, 2004), with fewer than 250 employees, and an annual turnover not exceeding €50 million (European Commission, 2005). Existing studies in this domain do not deal directly and explicitly with the relation between R&D cooperation and (cultural and geographical) proximity. Additionally, recent evidence (Breschi *et al.*, 2003; Garcia-Vega, 2006) highlights that quality improvement may require some level of intensity and diversification of the firms' technology base. Thus, it seems highly pertinent to analyse the extent to which technological intensity and diversification is related to (geographical and cultural) proximity.

The present paper aims therefore to provide further evidence on the relationship between technological, geographical and cultural proximity and R&D cooperation in low-tech SMEs. It presents a typology of international cooperative R&D projects relating these three items, and evaluates the extent to which cultural and/or geographical proximity in international R&D cooperation reflects tacit-codified knowledge considerations.

Given this aim and our focus on low-tech SMEs, CRAFT (Cooperative Research Action for Technology)[2] projects were the most appropriate and straightforward choice for the empirical analysis. CRAFTs are a special instrument developed for SMEs within the European Union's (EU's) Framework Programmes (FPs) which enable a limited number of firms from different countries with a common challenge or problem, but with limited or no in-house RTD capability, to assign a significant part of the research and technological development to RTD performers (e.g. research centres or universities) (European Commission, 2004). Moreover, such an instrument provides SMEs with an opportunity to set up international partnerships. Departing from a list of successful CRAFT projects (from the third to fifth FP, covering the period 1990–2002), we built a database comprising 118 projects, that contains general information on each project, involving 791 SME from 21 countries.

The paper is structured as follows. The next section surveys the theoretical and empirical literature on cooperation, proximity, and technological intensity. Then, section three details the empirical analysis of successful R&D alliances by outlining some essential features of CRAFT projects. The fourth section details the typology of successful international cooperative R&D projects using HOMALS and the statistical cluster analysis approach. Finally, in the fifth section, we present the main conclusions.

R&D Cooperation, Proximity and Technological Intensity: The Case of SMEs

The creation of value through inter-organizational relationships, and the capacity to capture a "relational advantage" has become a topic for sustained inquiry (Saxenian, 1991; Child & Faulkner, 1998; Dyer & Singh, 1998; Barringer & Harrison, 2000).

SMEs are increasingly regarded as a source of dynamism in the knowledge economy, and a growing number are either directly or indirectly involved in research, innovation and the generation of knowledge (Cooke, 2004). Technology-based SMEs are seen as a key component in the innovation system (European Commission, 2005), facilitating the emergence of new products and markets. However, low- and medium-tech SMEs, with little or no research capability, also need to reinforce their knowledge and research intensity, expand their business activities into larger markets, and internationalize their knowledge networks (European Commission, 2004, 2005). Networking and cooperation has long been identified as one of the most effective ways to achieve these goals (Doloreux, 2004).

The importance of R&D cooperation has risen steadily as a result of growing complexity, risks and costs of innovation (Hagedoorn & Schakenraad, 1992; Dodgson, 1993; Coombs *et al.*, 1996). Therefore, for small firms, partnering with other firms and institutions through various forms of collaborative arrangements has become imperative due to a lack of resources and the need to achieve world-scale efficiencies (Wright & Dana, 2003). Innovation is seen as increasingly more distributed (Becker & Dietz, 2004), as fewer firms are able to "go it alone" in technological development (Tether, 2002). Indeed, most innovation activities involve multiple actors. 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 (von Hippel, 1988; De Bresson, 1996; Nooteboom, 1999; Bastian, 2006). The exchange of information and resources with different partners are important factors in the innovation process.

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 (Medda *et al.*, 2006). By engaging in R&D alliances, firms are able to obtain the necessary complementary technology, achieve economies of scale in R&D, and monitor their competitors (Powell, 1987; Burgers *et al.*, 1993; Belderbos *et al.*, 2004). SMEs in particular have been able to take advantage of R&D consortia in order to overcome diseconomies of scale (Kleinknecht & Reijnen, 1992; Sigurdson, 1986, 1998). The aim is primarily to enhance the firms' absorptive capacity, and thus, provide them with potential access to a broader range of technological options (Cohen & Levinthal, 1989; Vence *et al.*, 2000; Fontes, 2005).

Following the course of the 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).

It has long been thought that when people and organizations work in close geographical proximity, the likelihood that they will collaborate together increases dramatically (Finholt, 2003; Olson & Olson, 2003; Audretsch *et al.*, 2006). Recently, however, it has been suggested that although geographical proximity facilitates interaction and cooperation, it is not a prerequisite for interactive learning to take place (Malecki & Oinas, 1999; Boschma, 2005; Bastian, 2006). Some empirical studies on SMEs' innovation and networking activities (e.g. Britton, 2003; Doloreux, 2003, 2004) show that a firm's innovation network does not always hinge on geographical proximity. Various studies support the rejection of simple models of spatial clusters and localized learning where internal connections are favoured over interregional and international transactions operating either between or within firms. Focusing on 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. Studying 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 to some extent in line with the findings of Larsson and Malmberg (1999), who concluded 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. Analysing 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 in the competitiveness and innovativeness of SMEs. As mentioned earlier, empirical findings based on the European Regional Innovation Survey (ERIS) (Koschatzky & Sternberg, 2000) highlight the importance of a combination of local, regional and transregional networking. Firms that are integrated in multi-layered

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 & Bauer, 1989; Hagedoorn, 1993; Wang, 1994; Amir *et al.*, 2003; Fontes, 2005
		To achieve scale and scope economies and to respond rapidly in the market place despite technological uncertainty	Teece, 1992; Häusler *et al.*, 1994; Hagedoorn & Narula, 1996; Katz & Martin, 1997; Tidd, 1997; Robertson & 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 & Gatignon, 1998; Shing, 1997; Belderbos *et al.*, 2004; Medda *et al.*, 2006
		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; Camagni, 1991; Tsang, 1998; Porter & Fuller, 1986; Dodgson, 1992a; Hagedoorn, 1993; Das & Teng, 2000
		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 & Cusumano, 1991

(*Table continued*)

Table 1. Continued

Motivations	Details	Studies
	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 & 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; Benfratello & Sembenelli, 2002
	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; Vence *et al.*, 2000
	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 & Fuller, 1986; Hladik, 1988; Dodgson, 1992a; Hagedoorn, 1993; Miyata, 1996

networks, continuously improve their abilities for learning as well as their knowledge base, and consequently, the possibility of using new knowledge (Capello, 1999). According to Capello (1996), firms need both local networks and trans-territorial networks because regional and global dynamics reveal an increasingly interdependent relationship.

This ambiguity regarding the effect of proximity on knowledge sourcing tends to be intimately related to the nature of the knowledge involved—tacit versus codified (Audretsch & Lehmann, 2006). Tacit knowledge comprises knowledge that cannot be articulated, as captured by Polanyi's (1966, p. 4) famous statement, "we can know more than we can tell". In Foray and Lundvall's words (1996, p. 21), "tacit knowledge refers to knowledge which cannot be easily transferred because it has not been stated in an explicit form". In contrast, explicit or codified knowledge covers formalized knowledge that can be transferred in a depersonalized manner through technical blueprints and operating manuals, etc.

An important empirical result that has consistently emerged in the literature is that, although geographical proximity seems to be less important for codified knowledge (Arora & Gambardella, 1994; Fontes, 2005), it seems to be more important for tacit knowledge (Feldman, 1999; Audretsch *et al.*, 2006). It is assumed then that codified knowledge can be exchanged regardless of distance by using communication technologies (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 (Howells, 1996; Maskell & 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 (Maskell *et al.*, 1998; Gertler, 2001; Koschatzky, 2000).

Boschma (2005) and others (Torre & Gilly, 2000; Bunnel & Coe, 2001; Breschi & Liassion, 2002; Gertler, 2003) claim that geographical proximity *per se* is neither a necessary nor a sufficient condition for learning to take place. Moreover, too much (as well as too little) proximity might be disadvantageous to interactive learning and innovation. Important, however, is the fact that proximity tends to facilitate interactive learning by strengthening the other dimensions of proximity (cognitive, organizational, social, and institutional) (Boschma, 2005; Bastian, 2006).

Additionally, due to advanced information and communication technologies (ICTs), several authors argue that networks through which learning takes place are not necessarily spatially delimited. Antonelli (1999) and Roberts (2000) argue 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. In a study on research projects, Rallet and Torre (1999) showed that tacit knowledge can be transmitted over large distances through other forms of proximity, namely organizational and cognitive 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).

However, other authors (e.g. Senker, 1995; Bastian, 2006) suggest that the 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, thus enabling them to discover where and how to access new knowledge (Arundel & Geuna, 2004). Morgan (2004) also rejects the possibility that the effective transfer of tacit knowledge can be consummated at a geographical distance. Nevertheless, Nonaka and Takeuchi (1995) show, by developing a transformation model that describes how knowledge is created through continuous transformation between tacit and codified knowledge, that tacit knowledge exchanges can occur without geographical proximity.

As Gentzoglanis (2001) recognizes, however, 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, languages and cultures, 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 reveals 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 geographical 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.

The notion of institutional proximity (Kirat & Lung, 1999) 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 & Di Maggio, 1990).[3] 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, 2005). 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 & Malmberg, 1999). In short, institutional, or more restrict, cultural proximity is potentially an enabling factor, providing stable conditions for interactive learning to take place effectively.

Innovation and improvement in product quality tend to require some level of diversification of the firms' technological base (Breschi *et al.*, 2003; Garcia-Vega, 2006). Firms that are more technologically intense and diversified may have certain advantages in competitive markets as they are likely to benefit from new technological possibilities (Nelson, 1959). Furthermore, they can obtain higher levels of cross-fertilization between different, yet related technologies (Granstrand, 1998; Suzuki & Kodama, 2004). Since many innovations are designed to solve unrelated problems, companies that are more diversified may have more to profit from their own research activities and from R&D cooperative networks, because they may at some stage capture more of the social benefits deriving from their innovations (Garcia-Vega, 2006). Although focus has been brought to bear on the relation between the technological intensity and diversity of projects and the firm's innovativeness in recent research (Suzuki & Kodama, 2004; Piscitello, 2005; Garcia-Vega, 2006), to the best of our knowledge, an empirical study has yet to be conducted on the link between technological intensity, the type (tacit versus codified) of knowledge involved, and geographical and cultural proximity. Notwithstanding, Bastian (2006) and Hilpert (2006) (cited in Hilpert, 2006) have noted that science-based processes, which tend to have a higher component of formalized, codified knowledge (Audretsch *et al.*, 2004), rely to a greater extent on international collaborations.

Based on the earlier literature review on the role of (geographical and cultural) proximity and the nature of the knowledge involved in cooperative relations, we hypothesize that, "Culturally and geographically distant projects tend to involve a higher degree of codified knowledge and are relatively more high-tech".

In the empirical part of this paper, we put forward a typology of international cooperative R&D projects relating technological intensity, cultural proximity and geographical proximity, based on HOMALS results and using the statistical cluster technique. This then serves to test our main hypothesis, namely analysing to what extent cultural and/or geographical proximity in international R&D cooperation reflects tacit-codified knowledge considerations.

International R&D alliances: the case of successful CRAFTs

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 the EU Framework Programme for Research and Technological Development (FP) in 1984.[4]

Committed to bridging the gap between SMEs and R&D, the FPs have defined 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, the CRAFT programme aims to support the SMEs' R&D needs, facilitate R&D transnational cooperation and encourage cooperation between SMEs and the European research community (Cooke & Wills, 1999; European Commission, 2004).

Describing the Data

In this study, we analyse a subgroup of CRAFTs, those from the third to fifth 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 have constructed a database which contains general information on each project, mostly gathered from pdf files that describe the projects.[5]

Although the success criterion is not explicit, some contacts with CRAFT national managing authorities revealed that projects are classified by the first performers. "Successful" projects are completed CRAFT projects, which are in general associated to a new product/service being commercialized or in a nearby market stage.[6] In their work, Cooke and Wills (1999) also used successful CRAFTs as their empirical basis. As can be seen in Table 2, the success rate of CRAFTs has tended to decline in the last few years. Although a comparison with non-successful projects could have generated interesting insights into the true nature of successful cooperative projects, no public information on the former is available. Nevertheless, given that our main aim here is to assess the relation between technological, geographical and cultural proximity in international R&D cooperation projects, restricting our selection to successful projects does not represent a significant hindrance to the analysis.

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

With regard to the industrial distribution of successful CRAFTs, the main industrial areas presented are: Machinery and Equipment, Agriculture, Building and Metal products. High technology activities, such as Telecommunications, Computing and R&D represent a smaller segment (Table 3). This latter characteristic may result from the fact that the programme aims to enhance cooperative research by groups of SMEs with low or medium technological capabilities and a restricted capacity for in-house research, thus encouraging SME consortia to entrust research activities to third parties (e.g. university or R&D institutes).

Analysing the country of origin of the SMEs participating in successful CRAFTs, we conclude that 73% of participating SMEs belong to Germany, France, Spain, the UK, 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 of 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.

Table 2. Number of projects involved in the CRAFT programme

	FP		
	Third	Fourth	Fifth
Submitted projects	331	1749	1071
Contracted projects	172	698	409
Well succeeded projects	30	65	23
Success rate	17	9	6

Sources: Framework Program IV—SME Participation 1994–1998, 1999, European Commission; Framework Program V—SME Participation April 1999–April 2001, December 2001; UE, in http://sme.cordis.lu/craft/home.cfm (accessed 30 April 2005).

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

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

Generally, cooperation between research institutions of the same country is weaker than between same country SMEs. Austria is an exception, with three 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 it was not possible to identify the region of origin for all the participating SMEs, the regional origin of the first promoter was analysed so as to identify the regions with higher levels of "promoting" ability.

The regions with the highest number of project leaders in successful CRAFTs are Noroeste (Spain) and Sud-Ouest (France), both with seven projects each, Vlaams Gewest (Belgium), Baden-Württemberg (Germany) and West-Nederland (the Netherlands), with six projects each. Although countries varied greatly in terms of size, the UK and France revealed a higher number of promoting regions, eight and seven, respectively.

A typology of successful international cooperative R&D projects

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 from the official site and the pdf files describing each project. This diversity among projects cannot be easily reduced to a general framework. This extreme variability requires the use of a typology or taxonomy, a classification system that can be used to identify the many variables that might be in play. Taxonomies classify and label many different items into groups or clusters that share common traits. A useful taxonomy is one that reduces the complexity of empirical phenomena to a few and easy to remember categories (Jeroen *et al.*, 2006). Taxonomies of cooperative R&D projects in particular provide an empirically-based framework that can assist in understanding the relation between technology, geographical and cultural proximity, and may ultimately guide science and technology policies (Pavitt, 1984; Archibugi, 2001).

These variables can be grouped 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 supporting technologies per project (different technological areas associated with the project). Therefore, we take the number of supporting technologies in a given project as a proxy for the project's technological diversity.

Industry variables were originally provided by the NACE codes. Given the wide range of industries involved, they have been aggregated 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 (OECD, 1999). The Pavitt taxonomy, somewhat more elaborated, aggregates industries by their degree of technological appropriability and complexity (supplier-dominated; scale-intensive, specialized suppliers and science-based) (Pavitt, 1984). Both taxonomies provide a characterization of the projects according to their technological 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, funding for the SMEs attains 49.8%. The average cost of a standard project is 241 thousand euros, and the average yield/income of participating research institutions is 400 thousand euros.

When constructing the *proxy* for "cultural" proximity, the following methodology has been adopted: considering the nationality of the first SME performer, the relative frequency of other SMEs and RTDs belonging to the same country as the first performer is computed for each project. Thus, it is assumed that when there are no participants of the same nationality as the first performer in a project, "cultural" proximity is minimal (0). Alternatively, the maximum value that this variable could take on is 100%, which corresponds to the case where all project participants belong to the same country of origin as the first performer.[7]

With regard to the geographical distance proxy, the average distance (in kilometres) between each participant SME and the first performer is calculated for each project. As information regarding the location of each project participant is not available, distance was computed with reference to the corresponding country's capital.

Using HOMALS and Cluster Analysis to Construct a Typology of Successful International Cooperative R&D Projects

In this paper, we aim to construct 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 is applied, based on the complementary use of HOMALS

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
	UK	%	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
	UK	%	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 30 April 2005).

(Homogeneity Analysis by Means of Alternating Least Squares) and cluster analysis. 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 use 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) yields a detailed description of the obtained clusters.

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

Variables	Categories/frequency			
OECD taxonomy	*Low tech (L)* 60	*Medium tech (M)* 45		*High tech (H)* 13
Pavitt taxonomy	*Supplier dominated (SD)*	*Scale intensice (SI)*	*Specialized supplier (SS)*	*Science based (SB)*
	40	35	20	23
Technological diversity (no. of technological areas)	*1*	*2*	*3*	*= >4*
	12	41	53	12
Cultural proximity (no. of SMEs and RTDs that belong to the same country of the first 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 first 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

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

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), only two dimensions for interpretation were retained. This decision has to do with the fact that the first two dimensions are more relevant and the eigenvalues drop very quickly when we pass from a solution with two dimensions to one including a higher number.

The analysis proceeds by identifying the most 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 towards better explaining the first

Table 6. Discriminating measures

	Dimension 1	Dimension 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

dimension, whereas cultural proximity, geographical distance and the projects' technological diversity explain the second one.[8]

Figure 1 presents a perceptual map representing how the categories of the five considered variables have been qualified. This geometric display helps to interpret the dimensions considered and the relations between the variable categories can thus be identified. 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).

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).

In order to identify a typology of CRAFT projects, and to characterize the resulting groups, the HOMALS was then complemented with cluster analysis. That means that CRAFT projects have been classified 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

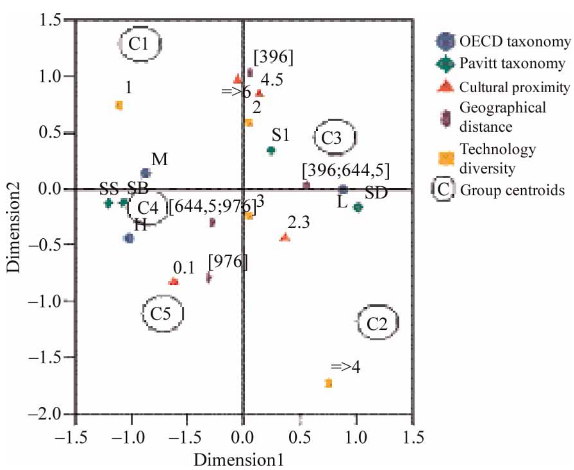

Figure 1. Perceptual map and cluster centroids

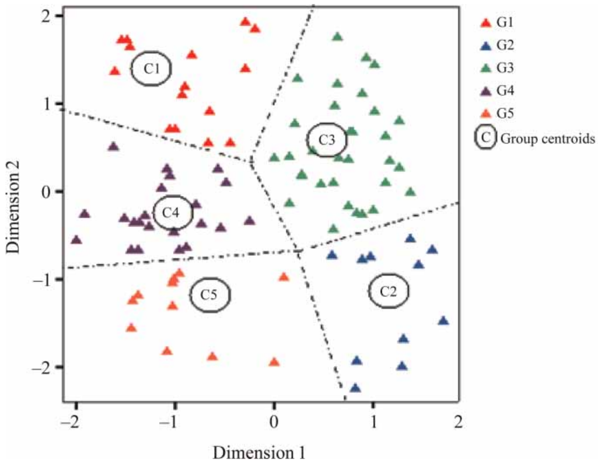

Figure 2. Object scores labelled by project groups

Ward's hierarchical method (Ward, 1963), which suggest that there are five groups of projects. Figure 1, analysed, 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%) can 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, it can be concluded that successful international cooperative R&D projects might be both culturally/geographically closer and 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 seems to reflect the tacit-codified knowledge debate. Indeed, as noted by Hilpert (2006), high-tech projects, by comprising more codified-related knowledge, tend to be feasible at distance, whereas low-tech ones, relying to a large extent on informal, more tacit-based knowledge, require closer relations. In this vein, our main hypothesis, "Culturally and geographically distant projects tend to involve a higher degree of codified knowledge and are relatively more high-tech" seems to be corroborated by the data.

In order to examine whether the obtained technological groups differ in terms of the six variables representing project dimension, Kruskal–Wallis tests were performed.

Accordingly (cf. Table 8), the following conclusions can be drawn. Successful CRAFTs do not differ significantly according to the variables, number of RTDs and percentage of EU funding. In contrast, 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.[9] "Nearby" projects (Cluster 1) involved the highest number of SMEs and participants, whereas "diversified" (Cluster 3) and "high-tech, distant" (Cluster 5) projects were associated with the lowest average values for these variables.

Table 7. Distribution frequency of the original variables in a five clusters solution

	Cluster 1		Cluster 2		Cluster 3		Cluster 4		Cluster 5		
Variable/categories	Abs.	Percentage (%)	Abs.	Percentage (%)	Abs.	Percentage (%)	Abs.	Percentage (%)	Abs.	Percentage (%)	Row total
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 or 1	0	0	*5*	*17*	3	10	*13*	*45*	*8*	*28*	29
2 or 3	0	0	*9*	*21*	18	43	10	24	5	12	42
4 or 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		

Note: Figures in italic are the highest percentage(s) within each variable/category. Figures in italic and bold text are the highest percentage(s) of all.

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— "Nearby"	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-squared	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

Finally, "Diversified" projects received, on average, the highest amount of funding and presented the highest total costs whereas "Nearby" and "Low-tech, supplier-dominated" projects were less expensive than "Medium-tech, science-based" and "High-tech, distant" projects.

Discussion of the Main Findings: Are the Projects' Technological 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, p. 533)

The growing complexity, risks and costs of innovation have boosted R&D cooperation among firms. For small firms particularly, collaborating with other firms and institutions has become an imperative due to a lack of resources and the need to achieve world-scale efficiencies. Even though the importance of cooperative innovation linkages for firms' performance is generally recognized, the relevance of proximity in this context is by no means consensual. Some authors (e.g. Koschatzky, 1998; Amara *et al.*, 2005) argue that, so as to achieve successful innovation, geographical and cultural proximity is likely to play a vital role. In fact, as reviewed earlier, it is recognized that networking for innovation often involves a great amount of tacit knowledge exchange, which is often associated to geographical proximity. An important empirical result that has consistently arisen in the literature is that, although geographical proximity seems to be less important for codified knowledge, it seems to be more important for tacit knowledge. Codified knowledge is assumed to be exchanged regardless of distance, namely by using communication technologies, whereas the transfer of tacit knowledge requires a sharing of common work experience through face-to-face relations.

In this line, we hypothesized that culturally and geographically distant projects tend to involve a higher degree of codified knowledge and are relatively more high-tech. Thus, focusing on R&D cooperation in low-tech SMEs, we have presented here a typology of international cooperative R&D projects aiming to assess the extent to which cultural and/or geographical proximity in international R&D cooperation reflects tacit-codified knowledge considerations.

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 technological 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 and more distant. In this vein, we agree with Boschma (2005), 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,[10] Boschma (2005) 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. Geographical proximity may be all that is required, because it enables agents to "monitor each other constantly, closely, and almost without effort or cost" (Malmberg & Maskell, 2002, p. 439).

Our second finding—successful international R&D projects that are technologically more advanced are both geographically and culturally distant, whereas those located closer to each other are essentially low-tech—seems to challenge some 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 (Dicken, 1992; Feldman, 1994; Storper, 1997; Acs, 2002). According to these authors, innovations with a high technological content have been shown to be facilitated by the physical co-presence and frequent interaction between related workers (Saxenian, 1994; Zucker *et al.*, 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, thus enabling them to discover where and how to access new knowledge (Arundel & Geuna, 2004).

In our viewpoint, especially when it comes to boosting the SMEs' ability to carry out more radical innovations, there is often a need to supplement informal, tacit knowledge with R&D-competence and more systematically accomplished basic R&D (Asheim & 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 the "lock-in" of regional clusters of SMEs in particular.

Although dealing with a cross-country sample, 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 some countries, "a far friend might be worth more than a good neighbour" (p. 169). Accordingly, it is not geographical proximity, but rather the attractiveness of a transaction which drives firms to cooperate and learn from each other. Geographical proximity of the transacting partner may be considered convenient, but is not a necessary condition for cooperation.

On the basis of the present study, several interesting avenues of research emerge—some of these resulting from the study's inherent limitations—, which might increase our knowledge of cooperation between small and medium-size firms with low technological capabilities. A major potential research path would be to directly survey all the partners involved in these CRAFTs projects. This would allow more in depth and rigorous insights on the "success" degree of the projects. Moreover, such comprehensive analysis would permit to construct alternative proxies for the several dimensions of proximity referred in the literature, and relate them with projects' and firms' characteristics, namely technology intensity and diversification.

Notes

1. One hundred and fifty-three successful SMEs participate in CRAFT (Cooperative Research Action for Technology) and SPRINT (Strategic Programme for Innovation and Technology Transfer).
2. By May 2006 the CRAFT designation changed to "Cooperative Research".
3. 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 & Johnson, 1997, p. 46). Institutions tend to reduce uncertainty and lower transaction costs by functioning as a sort of "glue" for collective action (Boschma, 2005).
4. In http://europa.eu.int/comm/research/faq/index.cfm?lang=en&page=details&idfaq=3600 (accessed 22 April 2005).
5. Santos (2005) provides further details on the construction of this database.
6. The concept of "successful" was provided by Margarida Garrido (Cordis).
7. "Cultural proximity" could have been measured in a different way. Perhaps a better and more informative option would have been to determine in each project which is the highest number of partners from one country, and then count how many remaining partners came from different countries. Nevertheless, this new variable which in fact would provide a proxy for the projects' "cultural distance" is strongly and negatively correlated with the original proxy for "cultural proximity" as detailed in the paper. Indeed, the estimate of the linear Pearson coefficient between the two alternative proxies is 0.68 (p-value = 0.000). Moreover, the direction of results (detailed later in the paper) does not change by using the alternative proxy. We acknowledge one of the referees for such an insightful suggestion.
8. Eigenvalues are the arithmetic mean of the discriminating measures in each dimension; however, variables which have discriminating values that are at least equal to the respective eigenvalues are more relevant.
9. Since the Kruskal–Wallis test did not identify how the groups differed, only that they were in some way different, we applied another non-parametric test—the Mann–Whitney test—for pairwise comparisons in the cases in which we found significant differences. Table A1 in the Appendix presents such results.
10. 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 Howells (2002) calls "a more indirect and subtle impact" of geographical of proximity. For instance, spatial

proximity facilitates informal relationships (Audretsch & 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.

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Appendix

Table A1. Technological groups and project dimension variables (pairwise comparisons)

Cluster no.	C1	C2	C3	C4	C5
Number of SMEs					
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 particpants (SMEs and RTDs)					
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					
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)	
Amount of funding					
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)	