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The Microgeography of University-Industry Collaboration: The Case of Joint Laboratories of Telecom Italia

Maral Mahdad
Scuola Superiore Sant'Anna
Institute of Management
m.mahdad@sssup.it

Marcel Bogers
University of Copenhagen
Department of Food and Resource Economics
marcel@ifro.ku.dk

Andrea Piccaluga
Scuola Superiore Sant'Anna
Institute of Management
a.piccaluga@sssup.it

Abstract

The purpose of this study is to understand the influence of geographical proximity on other proximity dimensions within university-industry cooperative research centers. Many aspects of the relationship between proximity and innovation have been researched, but the interplay between geographical proximity and other proximity dimensions in this particular socio-economic setting has not been deeply investigated. To advance our understanding in this context, our multiple-case study addresses the question of how geographically proximate university and industry influence cognitive, social, organizational, institutional, and cultural proximity within university-industry joint laboratories. Our results are derived from 53 in-depth interviews with laboratory directors and employees, and representatives from both the company and the university within eight joint laboratories of Telecom Italia (TIM). We find that geographical proximity helps to shed light on the performance of university-industry collaboration by influencing proximity dimensions. We specifically identify the significant role of geographical proximity on social and cultural proximity specifically at micro level. Our qualitative analysis draws on a conceptual framework for proximity dimensions and university-industry cooperative research centers. Our findings provide specific insights that advance the literature in proximity as well as university-industry collaborations.

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Abstract

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1. Introduction

Universities, in the past years, changed their role from being knowledge generators to entities with more active involvement in industrial research. Consequently, many universities take a proactive role in enriching linkages with knowledge users and facilitating technology transfer (Etzkowitz et al., 2000). Hence, academic engagement with industrial research activities is not a new incident and has a traditional literature. Partners in such collaborative settings pursue their interests in a broader way that lead to innovation and creativity. Feleming and Sorenson (2004) showed that industries that create linkages with universities might perform more productive research and innovation. Given the growing attention to the role of universities in innovation activities of firms, there has been a strong body of literature on this issue. A subset of this research focuses on the geographical proximity of university-industry collaboration and its positive impact on collaborations (Abramovsky et al., 2007; Arundel and Geuna, 2004; Braunerhjelm, 2008). Taking into account the importance of geographical proximity in university-industry collaboration, this paper highlights the effect of geographical proximity on other proximity dimensions such as cognitive, institutional, social, organizational, and cultural within university and industry cooperative research centers. The interplay between proximity dimensions in different socio-economic context has been an interesting field in economic geography to investigate (Boschma, 2005) and it could therefore have important implications for university-industry collaboration as well.

Furthermore, there is an increasing scholarly interest in the question of the effects of permanent geographical proximity in knowledge transfer and learning processes, although it is not yet fully understood (Torre, 2008). In this article, we investigate how permanent spatial closeness of actors influences other proximity dimensions within university-industry joint

laboratories. Exploring influences of geographical proximity on other proximity dimensions helps to understand dynamics between actors within a spatially-close environment. Cantner et al. (2015) suggested that to better understand the complex linkage between geographical proximity and project success one has to study interdependencies between proximity and other contextual factors as well. Steinmo and Rasmussen (2016) in their recent work on the evolution of proximity dimension and innovation call for future research that can further elucidate the conceptual development of the different proximity dimensions and the relationships between them.

In this paper, we aim to address this underexplored issues by focusing on cooperative research centers between university and industry–which are one specific mode of collaboration– on one side and by investigating proximity dimensions in these settings on the other side. We base our analysis on 53 in-depth interviews with different stakeholders among eight joint laboratories of Telecom Italia with five major Italian universities during 2014-2015. We explore the relation between geographical proximity and different types of proximity by in-depth analysis of each case.

This article is organized into six sections. Section two presents a background of the influence of geographical proximity on innovation processes, followed by a review on the role of geographical proximity in university-industry collaborations. We finish this section by highlighting the interplay between proximity dimensions. Section three presents the case-study and methodology used in this empirical analysis. In Section four, we discuss and analyze the results obtained. Section five presents our theoretical contribution, and Section six concludes by highlighting the main findings, implications, and limitations.

2. Conceptual background

2.1 Geographical proximity: an arrangement for innovation?

One of the most frequently used dimensions of proximity in literature themes is geographical proximity. Many scholars have introduced the definition of geographical proximity. Boschma (2005) defined geographical proximity as the spatial or physical distance between economic actors. The aim of this paper is to examine the significance of geographical proximity on other proximity dimensions in the university-industry settings. Although spatial proximity has long been studied in geography, the relevance of this subject in the fields of economy and innovation is a recent trend (Cooke and Morgan, 1994). Scholars emphasized the importance of geographical proximity in innovation and collaboration studies by highlighting the relevance of face-to-face interactions of actors and its role in fostering knowledge transfer, especially tacit knowledge between actors (Katz, 1994; Torre & Gilly, 2000; Ponds et al., 2007).

In addition, interpretation of codified knowledge in innovation settings requires tacit knowledge and thus spatial closeness (Howells, 2002). Torre and Rallet (2005) distinguished the difference between co-location and geographical proximity. They claimed that permanent co-location is not necessary for activities where physical interactions play an important role in coordination such as knowledge-intensive activities or R&D activities. However, the need for face-to-face interactions can vary according to the phase of the technology transfer processes (Gallaud and Torre, 2005). Geographical proximity might only be required at certain phases of the collaboration process between firms, such as negotiation or when tacit knowledge acquisition is relevant (Knoben and Oerlemans, 2006).

Our data consists of university-industry jointly established laboratories, where the actors have very different knowledge bases, to foster innovation and R&D activities. This lies in the

concept of permanent geographically proximate units with intense face-to-face interaction. Hazir and Autant-Bernard (2011) found that geographically proximate actors are more prone to connect as they have a higher awareness of each other and can more easily observe their respective capabilities and opportunities compared to those of more remote actors. They also added the ex-ante effects of geographical proximity on collaboration process as it may increases actors' expectations from collaboration with proximate partners. Capo-Vicedo et al. (2008) studied the negative impacts of geographical proximity on innovation: over-density in the relationships among actors can generate spatial block-in situations which are detrimental for learning interactions. But according to Boschma (2005), that happens when actors focus exclusively on the internal network, threatening their capacity to respond to new external sources of knowledge. However, the existing dynamics within geographically proximate actors in a specific innovation system like university-industry joint laboratories could be explored to shed more light on this literature.

2.2 Geographical proximity and university-industry collaborations

In the previous section, we discussed the role of geographical proximity on innovation collaboration. The central role of geographical proximity in shaping the relationship between different units is an undeniable role. University and industry collaborations cannot be excluded from the effects of geographical proximity. Scholars have found evidences for the existence of spatially bounded spillovers from university research to industry innovation. Arundel and Geuna (2004) found that the importance of proximity for sourcing knowledge from public research increases with the quality and output of domestic public research organizations and the importance given to public science. Likewise, Laursen et al. (2011) suggested that being located

close to a lower-tier university reduces the propensity for firms to collaborate locally, while co-location with top-tier universities promotes collaboration. Feldman (1994) found correlation between regional innovativeness and geographical concentration of industrial and university R&D expenditure. All these researches confirm the importance of geography in shaping innovative environment. Rosenberg and Nelson (1994) found that a geographically proximate university–industry allows firms access to the research community's 'information network' – the local university partner being the necessary point of entry, which builds the goodwill and trust necessary for learning and productive knowledge sharing.

D'Este and Iammarino (2010) investigated the frequency of university-firm relationships in the UK and the geographic distance therein. They observed that geographical proximity fosters the frequency of interaction between university and industry in applied research (engineering disciplines) but not in basic research. Although a strong body of literature focuses on the geographical proximity of university and industry at regional level, the influence of actors' closeness at the micro level requires more attention. In addition, research on geographical proximity and university–industry collaboration mostly focus on the decision of co-location, while the present study builds on geographically proximate university-industry collaboration and the influence of spatial closeness on other proximity dimensions.

2.3 Geographical proximity and other proximity dimensions

Boschma (2005) stated that the impact of geographical proximity in interactive learning and innovation cannot be assessed in isolation: it should always be examined in relation to other dimensions of proximity that may provide alternative solutions to problems of co-ordination and lock-in.

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In this section, we review the studies about the influence of geographical proximity on other proximity dimensions: cognitive, institutional, social, organizational, and cultural.

Geographical proximity and cognitive proximity

According to Wuyts et al. (2005), cognitive proximity is commonly defined as the similarities in the way actors perceive, interpret, understand, and evaluate the world. Also, the capacity of actors or firms to absorb new knowledge or sharing the same knowledge or technological base and expertise can identify cognitive proximity. This is why there are similarities in the concept of technological proximity and cognitive proximity. Notteboom (2000) stated that a tradeoff needs to be made between cognitive distance for efficient absorption of new knowledge. Maskell (2001) studied the relationship between geographical proximity and cognitive proximity. Maskell stated that a geographical cluster might fulfill the prerequisites of cognitive proximity.

Geographical proximity and institutional proximity

Institutional proximity is associated with the institutional framework at the agents level (Boschma, 2005). Scholars divided two types of institutions: formal (law and rules) and informal (cultural norms and habits). Given this distinction, institutional proximity includes the idea of actors sharing the same rules, as well as values (Zukin and Di Maggio, 1990). Boschma (2005) stated that the influence of geographical proximity on institutional proximity varies according to the type of institutions involved.

Geographical proximity and social proximity

Social proximity refers to actors that belong to the same space of relations (Oerlemans and Meeus, 2005), which means socially embedded relations between agents or actors such as trust formation and structural equivalence. According to Boschma (2005), the capacity of organizations to learn and innovate requires social proximity. This could be considered as a prerequisite of interactive learning. Gordon and McCann (2000) found that agglomerations could compensate for negative impacts of social proximity.

Geographical proximity and organizational proximity

The difference between organizational and geographical proximity are not well distinguished in the literature. Torre and Gilly (2000) stated that organizational proximity is based on two main similar logics: economic actors being involved in an organizationally proximate relation when they belong to the same relational framework or when they share the same knowledge and capacities. In another definition by Boschma (2005), organizational proximity is the extent to which relations are shared in organizational arrangement either within or between agents. Capaldo and Petruzzelli (2014) studied the interplay between organizational and geographical proximity within strategic alliances. They found geographic distance and organizational proximity are contingent upon one another in their effect on the innovative performance of alliances and that distance (proximity) in one dimension can be bridged (overcome) by proximity (distance) in another dimension. To conclude, organizational proximity motivates collective learning in the joint creation of innovative projects (Kirat and Lung, 1999).

Geographical proximity and cultural proximity

The least used concept in proximity dimension literature is cultural proximity. The use of this dimension in our research is the divergence culture of university and industry. Pettigrew (1979) defined culture as the pattern of thoughts, feelings, behaviors, symbols, and so forth that give meaning to actions and behaviors, and provide interpretations of situations for people. Studying cultural proximity at the level of organizations creates some overlap with organizational proximity. However, the term can be used at the micro (individual) level: the interaction between two individuals from different organizational culture. Geographically proximate actors share common routines, this allows organizations to interpret and give meaning to actions without making all these difficult interpretations explicit (Knoben et al., 2006).

According to Boschma (2005), in addition to the issue of interplay between proximity dimensions that represent a gap in the literature, understanding which proximity dimensions matter more in which socio-economic context can potentially contribute to the proximity literature. However, as noted by Frenken et al. (2009), it is important to examine multiple proximity dimensions simultaneously because they are often correlated, which implies that the effect of a certain form of proximity can only be properly determined when controlling for the others. Crang (2002) calls for more qualitative approaches in economic geography for seeing economic activity as a set of lived and dynamic practices and codes of behaviors.

Our research contributes to the gaps that have identified in the literature by answering the question of how geographical proximity of university and industry joint laboratories influences other proximity dimensions by analyzing the interplay between these dimensions in this specific socio-economic setting.

3. Data and methodology

3.1 Research design

In order to answer the question of how geographical proximity of university and industry influence other proximity dimensions, we chose an exploratory multi-case study approach. This approach was selected according to the need to gather in-depth, data rich information on the phenomenon (Yin, 2003). As Eisenhardt (1989) indicated, the qualitative approach is useful for understanding the rationale or theory underlying relationships. Exploratory research is also appropriate here since the interplay between proximity dimensions in the university-industry collaboration settings is not a well-researched subject.

The multi-case study approach allows us to understand differently emerged phenomenon along with the different circumstances for them (Silverman, 2000). Our research relies on theoretical sampling. In other words, the selected cases are chosen for theoretical, not statistical, reasons. As Pettigrew (1990) suggested, considering the limited number of cases that can usually be studied, it makes sense to choose cases such as extreme situations and polar types. Our research was carried out in 2014 and 2015 in Italy. We compared and contrasted findings based on eight in-depth case studies. As mentioned earlier, our research was focused on spatially proximate university and industry actors that work together in jointly established laboratories placed in universities.

3.2 Data collection

The main data collection method was semi-structured interviews using an open-ended interview protocol. The semi-structured interviews allowed the interviewees to express their comments freely; therefore, in-depth data and insights were collected. In total, we performed 53

interviews with different representatives from university and industry such as company employees, lab directors, and PhD students (Table 1). In designing the interview questions, we focused on a selected set of dimensions extracted from the literature. However, as is common in case study research, new dimensions started to reveal themselves in the course of the interviews. In our face-to-face interviews, we asked interviewees to describe the process they go through on day-to-day basis. In particular, we asked them to describe daily interactions with different actors and their engagement level, and then we asked them to explain how co-location influenced their routine job, interaction, and communication. Interview data was transcribed and combined with questionnaire and archival data, including published and unpublished reports from each laboratory.

Insert Table 1 about here

3.3 Data description

To address prior researches and contribute to the history of university-industry collaboration and proximity, we conducted 53 interviews within eight joint laboratories of Telecom Italia. Joint Open Laboratories are research and innovation laboratories set up within universities, as a result of partnership between TIM and the major Italian universities in the specific fields of scientific and technological competencies. Since 2012, eight JOLs were formed among five major Italian universities. This idea was raised to bring possible innovative proficiencies at the same center. The classic model of innovation adopted by TIM changed to agile model of innovation, which enhances co-creation and co-development. Agile open

innovation framework of TIM takes a step forward to get closer to adopt open innovation paradigm and collaboration.

The data collected in this research discovers "how" interactions and dynamics within geographically proximate university and industry can foster innovativeness and creativity by influencing proximity dimensions. The true value of microgeography of such innovation setting can emerge from this research. Furthermore, not only the advantages but also barriers of university and industry living under the same roof will be explained.

3.4 Data analysis

We started our analysis by deep diving into each case as a stand-alone entity. An extended case report was then written for each case. Descriptive codes were used to identify, label, and cluster data related to each construct. The interview data was analyzed using three steps which included: (1) steps in analysis, (2) within-case analysis, and (3) cross-case analysis. The interviews were recorded and transcribed by the authors as part of the data analysis process. Based on the interviews, we wrote a case description for each laboratory. The data analysis was based on a triangulation of data sources for each case, followed by cross-case comparisons. From the analysis, we were able to obtain a comprehensive picture of how geographical proximity influenced other proximity dimensions. After codifying the data[1], we made an explanatory effects matrix for each case that highlighted the summary of the case. This matrix allowed threads of causality to emerge. Two matrixes were built upon our analysis that describe: (1) laboratory profile (Table 2), and (2) proximity dimensions profile (Table 3).

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[1] Nvivo software was used as a qualitative data management and analysis tool. Nvivo allows researchers to identify trends, build and test theories, manage code, and interpret and analyze qualitative data by eliminating the need for many of the manual tasks traditionally associated with qualitative analysis (Sorensen, 2008). Using Nvivo, we systematically coded and analyzed the data within a single repository. We summarized coded segments per case. The process of analyzing the relationships between different codes included looking into the co-occurrence of codes to obtain indications for identifying patterns in the data.

In the laboratory profile, we report some of the most relevant features of the laboratory. Table 2 summarizes the main characteristics of each case. Our data consists of eight U-I jointly established laboratories within five major Italian universities' sites. These laboratories are in different distances from any of the company's sites.

Insert Table 2 about here

Table 3 briefly describes proximity dimensions in terms of cognitive, institutional, social, organizational and cultural proximity within each laboratory.

Insert Table 3 about here

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4. Results

In the proximity profile of our data, we focused instead on the influence of geographical proximity on cognitive, institutional, social, organizational, and cultural proximity. The description of results can be seen in Table 4. Our exploratory multiple-case design allows us to investigate the distinct phenomena of microgeography of university-industry collaborations and how it influences relevant dimensions of proximity, which may lead to an innovative space.

Insert Table 4 about here

Our empirical data indicated that pre-existing geographical proximity influences the formation and creation of other proximity dimensions, and this relation is most strongly visible for social, cognitive, and cultural proximity. Geographical proximity also has a moderating role between actors and proximity dimensions, and it thus facilitates university-industry collaborative projects. The existence of geographical proximity provided a particular setting to investigate the interplay between proximity dimensions within university-industry joint laboratories. Analyzing our dataset, we found that permanent geographical proximity occurs in two different levels: individual (micro) and organization (macro), thus influences proximity dimensions differently. We identified different patterns in micro and macro level of geographically proximate institutions and actors. Many scholars noted the importance of considering the different levels of geographical proximity while studying collaborations. From the perspective of locations and actors, geographical proximity underpins their connectivity and positionality, both in a more objective (what is easy and affordable to reach) and subjective sense (what feels near) (Lagendijk & Lorentzen, 2007). This differentiation that has emerged from our results is in line with the study of Torre and Rallet (2005) who defined geographical proximity as the kilometric distance that separates three units: individuals, organizations, or towns. In our research, the terms 'far from' or 'close to' determine the spatial distance of individuals or institutions (e.g., laboratory and the company distance). Our results also confirm that face-to-face interactions between actors from both parties at an individual level create generally an enjoyable routine, thus improving

collaborative projects. The proximity profile table (Table 4) explains the general trends and relationships that we found between geographical proximity and other proximity dimensions in our multiple-case study.

4.1 Geographical proximity and cognitive proximity

Our results show that geographical proximity of individuals within laboratories impacts on cognitive or technological proximity. Interviewees claimed that daily interactions with the representatives of other party (university or industry) help them learn and absorb new knowledge. The high frequency of informal interactions leads to a dynamic environment for learning and, accordingly, collaborations.

> *"The relationship with PhD students is stimulating and never boring." (Internal TIM employee) "We exchange knowledge and share ideas and sometimes I really don't feel I am a different PhD student compared to my colleagues." (PhD student)*

However, we found differences between laboratories. Laboratories with more similar background and knowledge base at the individual level benefit more from spatial closeness. This might be because of more effective and easier communication flows.

Spatial distance between the laboratory location and any company's site has a partial impact on cognitive proximity of these two entities. The laboratories that are located closer to any company's site have a higher communication frequency with the company as a unit compare to the ones that are distant. However, the company doesn't necessarily get involved in the process of learning and knowledge exchange. The issue of company's readiness for absorptive

capacity is a well-established concept in the literature. Boschma (2005) suggested that benefiting from geographical and cognitive proximity that can be complementary requires a capacity to absorb and process knowledge filed.

> *"The interaction sometimes is beneficial because all the colleagues that we meet at the company's site are very interested in our activities." (The Laboratory is proximate)*

> *"We have some activities that there are potential clients to buy the solution but we do not know how the company can put this service in the line. The REASON might be: JOLs were born with new activities, new market, and disruptive projects but a big company like TIM with a different core-business has to search for a lot of different markets before launching such initiatives." (The Laboratory is distant)*

4.2 Geographical proximity and institutional proximity

North (1991) introduced the definition of institutions- Institutions are the humanly devised constraints that structure political, economic, and social interaction. Institutions consist of both informal constraints; (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights). We analyzed the effect of spatial closeness only at the organization level (macro). Laboratories that are located closer to a company site tend to follow and adopt their institutional routines to the ones of the company. This created an institutional proximity between these agents. However, in our dataset, we observed more informal institutional proximity than formal. Although the laboratories that are located far from

the company may struggle in low institutional proximity that can lead to opportunism (Boschma, 2005), our data includes only one case of too-low institutional proximity.

This is in line with Boschma's (2005) statement that shared informal institutions are often much more localized because of the community that actors are located in and its micro-geographical level of interactions.

4.3 Geographical proximity and social proximity

We found strong evidences of social proximity within laboratories at individual (micro) level. In 53 interviews, we did not find any evidences on the issues of trust and knowledge sharing among individuals. Numerous times our interviewees reported interactions with proximate individuals where they were able to determine structural equivalence.

> *"Working with people from university is an amazing experience because they are more available welcome in this kind of collaboration […] and they even use 'Tu instead of Lei' which is less formal." (Company employee)*

Geographically proximate units in our dataset enabled the social sense of communication and embeddedness among actors.

However, at the organization (macro) level, we did not find any evidence to support social proximity of the laboratories and the company. Literature suggests that it may not be even necessary for organizations to be socially proximate. According to Malmberg and Maskell (2002), effective knowledge transfer does not presuppose close trust based or arm's-length interactions between units: permanent geographical proximity may be just ledge enough, because it enables local agents to 'monitor each other constantly, closely, and almost without effort or cost.'

4.4 Geographical proximity and organizational proximity

We identified two levels of organizational proximity analyzing our data: dyadic and structural. Geographically proximate individuals at micro level influence organizational proximity at dyadic level. Spatial closeness of actors within these laboratories creates specific but common relationship among actors. Some laboratories have their own organizational arrangement that is designed based on the relationship among actors within laboratories. Actors both from university and industry see themselves as part of a unique organization with shared relationships. Even though there are diverse missions and goals among actors, spatial closeness framed these interactions as a team following a common mission.

> *"We often perceive ourselves as a spinoff the company, or a startup team to innovate and reach our mission." (Company employee)*
>
> *"The venture that TIM created with universities is very important but from practical point of view TIM sees us as company employees yet." (PhD student)*

However, here the question arises of whether too high organizational proximity is favorable for these types of collaboration. Frenken and Valente (2002) showed that the tighter and more dependent the relations are in an organizational arrangement, the less initiatives are rewarded which has a negative impact on flexibility and innovation. This might not be the case of joint laboratories but another problem rises in too-high organizational proximity. On the one hand, the supportive company may undertake the situation as an independent actor, thus not providing enough support for these laboratories. On the other hand, having clear missions and

common goals in a separate entity with its own organizational arrangement embrace collaboration.

At macro level, closeness of the laboratories and company's unit influenced structural organizational proximity. We have to note that here our data consists of four laboratories and a company branch in one city. These laboratories tend to perceive themselves as members of a network of actors. In this particular situation, geographical proximity empowers organizational proximity thus collective organizational learning. For example, the company is more informed of the activities of closer laboratories compared to those that are distant. Christopherson (2008) suggested that large focal firms could play a significant role in coupled network by orchestration and power. This may lead to real change and innovation. In our dataset, the laboratories closer to the main R&D site enjoy more the power and coordination of the company. Therefore, the organizational arrangement is embedded within this network.

4.5 Geographical proximity and cultural proximity

The cultural divide between university and industry plays an important role in collaboration. We found evidences that support the positive effects of geographically proximate university and industry at micro level in overcoming the cultural gap. We analyzed the influence of spatial closeness in three types of cultural gap between university and industry suggested by Rohrbeck and Arnold (2006): divergent missions and goals, conflicting interest and confidentiality issues, and different languages and assumptions.

> *"There are some differences in working in such environment. When you are in a company you are in a more standard environment where you have some objectives, deadlines, specific role and you are more concentrated on your tasks*

while here you do not have the stress of typical manufacturing company and you can think about many ideas, and innovate [...] Universities have to pay more attention to the industry's goal which is producing something and not only publishing [...] Filling the gap by knowing the gap [...] The close contact with universities made this possible." (Laboratory director)

"Compared to universities we have quite different points of view but it is very interesting to create the bridge in our day-to-day job." (Senior employee)

The existence of various formal and informal communication channels within geographically proximate actors encourages actors to learn about their differences. The first element for making an effective collaboration with diverse partners is individuals' awareness of such differences in the network.

"Professors' approach is still old-style toward innovation. They want to publish and we want to produce. I think JOL is like a bridge between the university and industry. The difficulty is to find a way for the company to speak the language of the university and vice versa."

The reported challenges usually are solved with effective communication and accessibility of partners. The effect of geographical proximity on cultural proximity at the organization (macro) level is overlapping with the definition of organizational proximity that has been already discussed.

5. Permanent geographical proximity within university-industry joint laboratories

We suggest the model that can be seen in Figure 1 based on our explorative multiple-case

study. The model represents the interplay between geographical proximity of university and industry joint laboratories and other proximity dimensions. We find that spatial closeness of actors within these laboratories have a significant influence on social and cultural proximity at individual level. These two dimensions of proximity considered being crucial in success of collaborative projects by creating high level of trust that leads to facilitate knowledge sharing and transfer of information. We believe social and cultural proximity of university and industry is an undeniable success factor in collaboration on these actors.

We also find that in some cases, geographical proximity has a negative impact on other proximity dimension especially in this socio-economic setting. Sometimes too much proximity creates a lock-in effect among actors (Boschma, 2005) and actors might loose motivation to act with priority to this collaboration. In our data, we did not find any evidence on the support of the relationship between geographical proximity and social proximity at macro level. Geographically proximate university and industry in the form of joint laboratory can enable dyadic organizational proximity at micro level and structural organizational proximity at macro level. Spatial closeness at organization level has a limited influence on cognitive proximity while it has major influence at individual level due to the collective learning and knowledge flows within laboratories.

Insert Figure 1 about here

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6. Conclusions

This research discovers the influence of geographical proximity on other proximity dimensions in the university and industry joint laboratories. Our exploratory case study approach contributes to theory in many aspects. The rich interview data shows that geographical proximity can either enable the positive effects of other proximities within and between university and industry.

Although the effectiveness of these types of collaboration requires an optimal level of proximities, our data reveals benefits and possible drawbacks of the interplay between geographical proximity and organizational proximity. Controlling for geographical proximity in our data set, we analyzed the dynamics of proximity dimensions (Boschma, 2005). University-industry collaborations in the form of joint laboratories can foster innovation when optimal levels of organizational, cognitive, and cultural proximity co-exist and are enhanced by geographical proximity. However, Werker et al. (2014) showed that research collaborations are driven by (individual or organizational) goals, and these can be realized only when an optimal cognitive complementarity between collaborators exists. In the formation of jointly established laboratories (permanent spatially proximate partners) between university and industry, the role of cultural proximity should not be underestimated. Although the awareness of such differences between partners is a crucial step, a proactive role in overcoming this gap is essential to build an efficient collaboration. Geographical proximity at the micro level can be considered as a prerequisite of establishing a successful collaboration between university and industry, but the absorptive capacity and preparedness of both university and industry could not be neglected in establishing these laboratories. Eventually, the optimal level of proximity dimension can be achieved with controlling for the right mix and proposing balanced interactions within or between units. The role of individuals, especially leaders, is undeniable in achieving the optimal

level of proximity. Therefore, the core theoretical implication of this study is that proximity dimensions within university-industry cooperative research centers are highly influenced by geographical proximity. The extent of these influences is presented in our conceptual framework.

Future empirical research should consider this interplay and the relationship between proximity dimensions controlling for geographical proximity in different socio-economic settings such as science parks and incubators. Further studies need to investigate and measure the outcomes of geographically proximate university and industry taking into account the influence of proximity dimensions on outcome.

Another avenue for further research is "open innovation." One can investigate the interplay between proximity dimensions in open innovation settings. Open innovation settings are formed based on collaboration between organizations and individuals where the issue of trust plays a significant role. In addition to mentioned future research, the role of individuals and human resources should be considered in shaping, accelerating, or discouraging any proximity dimensions when actors are geographically proximate. This might be beneficial for firms initiating collaboration projects with universities in cooperative research centers.

Our results are driven from a limited number of interviews with representatives of both university and industry among eight laboratories of a large enterprise and speak for a limited number of cases, thus cannot be generalizable. The replication of this study in other settings or countries may discover new features and explain some unanswered questions. The aim to validate this initial conceptualization more extensively with qualitative and quantitative data can further contribute not only to proximity theory but microgeography of innovation phenomenon. Microgeography of innovation could therefore be defined as influential localization of actors (agents or individuals) within innovation ecosystems at micro level.

Finally, we suggest that the findings can offer managerial advice when choosing a model for collaborating with universities. Many firms struggle in exploiting the knowledge produced by universities. The important role of proximities in relevant mode of collaboration and finding the tools to control for an optimal level of proximity dimensions help managers to benefit from collaborations efficiently. However, it is necessary to consider the interplay between proximity dimensions when orchestrating this setting for achieving an optimal level in collaboration.

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Figure 1: Permanent geographical proximity within university-industry joint laboratories
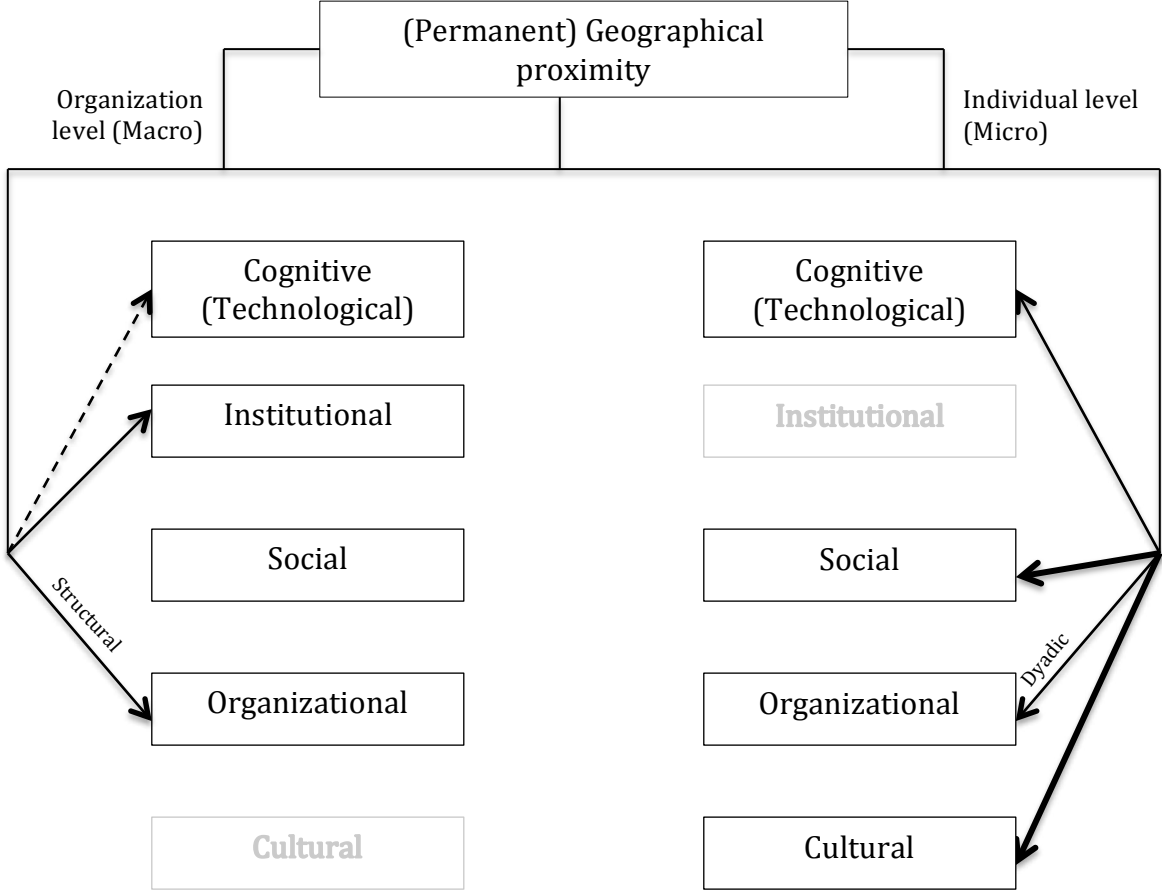
Table 1: Number of key data sources and interviews for each case

Case	Lab1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 6	Lab 7	Lab 8
Lab director	1	1	1	1	1	1	1	1
Company representatives (employees)	7	6	3	2	2	2	2	5
PhD students	1	3	2	2	2	3	0	3

Table 2: Laboratory profile

	Age	Size	Focus	Location (University based)	Distance from the closest company site
Lab 1	4	20-25	Semantic-big data	University of Trento	Distant: the closest company site is located in different region
Lab 2	3.5	20	Health technology	SSSUP, Pisa	Distant: the closest company site is located in different region
Lab 3	4	15-20	Smart solutions	Polytechnic University of Milan	Close: A branch of HQ is located in Milan
Lab 4	2	15-20	Robotic apps	Polytechnic university of Turin	Close: TIM R&D center is located in Turin
Lab 5	2	20	IoT	Polytechnic university of Turin	Close: TIM R&D center is located in Turin
Lab 6	2	10-15	Augmented reality-visual research	Polytechnic university of Turin	Close: TIM R&D center is located in Turin
Lab 7	2	10-15	Mobile services-social scene	Polytechnic university of Turin	Close: TIM R&D center is located in Turin
Lab 8	3	20	Wireless apps	University of Catania	Distant: the closest company site is located in different region

Table 3: Laboratories' proximity dimensions

	Cognitive (technological)	Institutional	Social	Organizational	Cultural
Lab 1	Distant: Unsuccessful communication due to knowledge and expertise gap between actors	Distant: Both formal (rules) and informal (cultural norms) institutions were distant	Distant: Lack of formal and informal communication channels	Distant: Lack of coordination and support from the company	Low proximity: No predefined routine between actors
Lab 2	Close: Challenges in interpreting and examining the results of a project	Low proximity: Divergent perception of what the "Product" of R&D	Distant: Lack of formal and informal communication channels	Close: Sharing the same organizational structure between actors	Distant: Lack of common language, different mission and goals
Lab 3	Close: Dynamic involvement of actors in projects	Low proximity: Distinction between sets of norms (more informally)	Close: Embedded relations	Low proximity: No evidence of	Close: Common spoken language, shared and clear missions
Lab 4	Close: Mutual learning and continues knowledge exchange	Close: Close perception of rules and norms	Close: Shared organizational routine	Close: Coordination and project management	Low proximity: Divergence in language
Lab 5 Malihe	Close: Effective knowledge exchange	Low proximity Lack of acceptance for results generated by the partner	Close: Effective communication and frequent meetings	Close: Sharing the same organizational attitude between actors	Low proximity: Divergent language but mutual goals
Lab 6	Close: Constant and effective	Close: Mutual perception of	High: Strong social ties between	Low: Lack of knowledge	Close: Team recognition

	knowledge exchange	what the "Product" of R&D	actors	about the partner and his processes	with mutual goals and effective communication
Lab 7	Close: Horizontal approach for communication	Close: Mutual perception of what the "Product" of R&D	Close: Embedded relations	Low: Lack of knowledge about the partner and his processes	Close: Focus on mutual interest
Lab 8	Close: Mutual learning and continues knowledge exchange	Close: Mutual perception of what the "Product" of R&D	High: Constant communication and embedded relations	Close: Sufficient ordination and project management	High: Common and clear goals, common interest and shared language

Table 4: The influence of permanent geographical proximity on other proximity dimensions

Proximity dimensions	Cognitive (Technological)	Institutional	Social	Organizational	Cultural
Geographical proximity at individual level (micro)	Interviewees agree that being proximate with other actors from university/industry is important in absorbing new knowledge and may assert a positive effect on collaboration. The closeness with university actors creates an ambitious environment for employees to learn and innovate.	Institutional proximity can be analyzed only at the organizational level. Geographical proximity of actors at individual level cannot determine any kind of institutional proximity.	Interviewees both from the university and the company reported high level of trust formation as a consequence of daily face-to-face interactions. This accordingly impacts social proximity hence high level of knowledge sharing in the process of collaboration.	Our data confirms that spatial closeness of actors from different organizations lead to organizational proximity (more dyadic than structural). We found dyadic level of organizational proximity, which facilitates the transfer of tacit knowledge between actors.	Although actors in these laboratories came from different culture (university and industry), permanent co-location of these members bound them together to shape a group with a common behavior, feelings, and symbols, thus it eases the process of collaboration.
Geographical proximity at organization level (macro)	The company does not necessarily become specialized or close in the technological field of the laboratory if they are located close to each other. Spatial closeness of the company and	According to our data, the existence of various communication channels between university and industry when these units are located in the same region facilitate institutional closeness (more informal	Laboratories that are closer to a company site do not necessarily become a part of the company community structure or network of actors.	Laboratories that are located in a closer distance to any company sites see themselves as more a part of the same organizational network (the same company in our case).	Cultural proximity at the organizational level is overlapping with organizational proximity.

	the laboratory has limited influence in cognitive closeness of these units.	than formal).			