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THE MICRO PROCESSES UNDERLYING SMALL FIRMS' INTEGRATION INTO TERRITORIAL INNOVATION DYNAMICS – A KNOWLEDGE BASED PERSPECTIVE

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ABSTRACT

The paper is concerned with the process of SMEs' insertion into innovation projects within regional clusters. The objective is to contribute to a better understanding of this process by examining the underlying mechanisms of territorial innovation dynamics. A particular attention is given to the interplay between the features of territorial dynamics of innovation identified, and SMEs' capacity to participate to collaborative innovation projects.
In this perspective, the article analyse the front-end process of territorial inter-organizational innovation, i.e. the early stage during which partners negotiate and establish collaborative innovation projects. Rather than investigating how clusters facilitate the access to new resources and knowledge, the crucial question here is how clusters allow the combination of different component of knowledge among heterogeneous actors.
First, our findings reveal the key underlying role of architectural knowledge in local innovation processes. Second, they suggest that the nature of architectural knowledge inside the cluster influences the capacity and the motivation of SMEs to participate to local innovation projects. These findings contribute to theory by developing a grounded model of territorial dynamics of innovation and of SMEs integration into localised innovation projects.

Key words: clusters, SMEs, architectural innovation, knowledge, local innovation projects

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INTRODUCTION

A significant amount of studies has been developed on geographical clusters during the last twenty years. In these studies researchers emphasise the positive effects of clusters on the competitiveness of the "participating" firms. The literature links clusters to competitiveness, with a specific attention to innovation. In the knowledge-based-economy context, competitiveness is considered as resulting from innovation rather than from the ability to reduce transaction costs (Waxell and Malmberg, 2007). However, as the innovation process requires collaboration and social exchange between actors, the level of analysis becomes more relevant when focusing the attention on localised networks of firms, or geographical clusters. Evidence is particularly given concerning small-and-medium-sized enterprises (SMEs) suggesting that clustering help them raise their competitiveness (Camagni and Capello, 2000; Keeble and Wilkinson, 2000).

The studies on SMEs' innovation highlight that SMEs are generally facing limited resources to get involved into innovation projects. In this context, cooperation is considered as a mean to complete SME's internal learning and innovation processes. Cooperation also represent fors SMEs a significant way to find new market opportunities and update their knowledge (Huet, 2006). Nevertheless, among reports and studies at national and European levels cooperation as an engine of innovation is assumed rather than questioned (Huet and Lazaric, 2008)

The paper is concerned with the process of SMEs' insertion into innovation projects within regional clusters. The objective is to contribute to a better understanding of this process by examining the underlying mechanisms of territorial innovation dynamics. A particular attention is given to the front-end process of territorial inter-organizational innovation, i.e. the early stage during which partners negotiate and establish collaborative innovation projects. Rather than investigating how clusters facilitate the access to new resources and knowledge, the crucial question here is how clusters allow the combination of different component of knowledge among heterogeneous actors. More specifically we focus on the interplay between the features of territorial dynamics of innovation identified, and SMEs' capacity to participate to collaborative innovation projects.
Our article will lean on a specific research design conducted inside the Pôle SCS. We used a case-study-based research design with an inductive methodology to capture the richness of the phenomenon and identify patterns for theory generation.
The argument in this paper is organised as follows. First, we explore the underlying mechanisms of knowledge clusters dynamics. Subsequently, we describe the methodology adopted in this paper. The argument then turns to a case study conducted in the Pole SCS. We compare two distinct knowledge cluster dynamics and their effects on the insertion of SMEs in collaborative innovation projects. Finally, the findings from this case study are discussed and implications for future research are explored.

KNOWLEDGE CLUSTERS DYNAMICS: THE KEY DIMENSIONS

While earlier studies were focusing on key static factors for successful clusters (Castell and Hall, 1994), recent studies have evolved towards a more dynamic approach of clusters (Garnsey and Longhi, 2004) focusing on social interactions as the main locus of knowledge generation.
This new perspective had started to receive attention in the academic literature only recently and particularly focuses on knowledge and on the development of innovative capacities as a result of

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interaction (Maskell, 2001). Referring to interaction highlights the importance of the systemic aspect of clusters. But, what are interesting about this general assertion are the micro foundations that would explain the dynamics of interactions at work and how they leverage territorial innovation.

In this perspective, among studies of clusters developed in the fields of economic geography and new economic sociology, three particular dimensions of interaction are highlighted: the structural dimension, the relational dimension and the cognitive dimension of interaction.

Structural dimension

The structural dimension of cluster has spurred significant work emphasising on how regional advantage derive from the existence of dense interaction between actors. It is suggested that the analysis of the density of linkages (Rychen and Zimmermann, 2006), the type and centrality of actors (Powell et al, 2010; Whittington et al, 2009), and the position in a network (Burt, 1992) can facilitate our understanding of the way actors' access relevant knowledge for innovation. Here, the benefit of geographical proximity of firms is found in knowledge spillovers advantages (Audretsch and Feldman, 1996; Breschi and Lissoni, 2001), which support and enhance firms' innovation.

However the type of benefits differs depending on the structure of the network, i.e, the type of linkages as well as the type of actor involved. The type of links fostered, whether strong or weak (Granovetter, 1985) has an influence on the outcome of networks. Capaldo (2007) outlines the superior performance of innovative capabilities deriving from a "dual network" structure. The dual network refers to a network structure wherein a small core of strong ties is integrated with a larger periphery of weak ties. While weak ties speed up innovation by expanding network diversity, strong ties stimulate knowledge transfer as well as protection of inter-organizational settings. In the same line of thought, Owen-Smith and Powell (2004) distinguish two types of links: "open channels" or more proprietary conduits. The innovative capabilities of networks also depend on the position of actors in the network. Powell, Koput, and Smith-Doerr, 1996 show the importance of being central to the network; centrality here refers to the number and importance of strategic alliances that connect organizations. Owen-Smith and Powell (2004) enrich these results by showing that the benefits of the actor's position in a network depend on the institutional characteristics of key members of the network: whether public (open channels) or private (proprietary conduits).

Finally, the literature on network and innovation emphasizes the key role of one or more hub actors in a cluster that helps to enhance systemic innovation (Carbonara, 2004; Lazersona, Lorenzoni, 1999). These actors both co-ordinate the inter-organizational processes and sustain the innovative processes taking place within the cluster.

Relational dimension

The influences of geographical proximate networks are beneficial only when strategic alliances link local actors (Almeida and Kogut, 1999). This perspective is based on the arguments that regular relationships create and support new markets, networks enable information flows deriving from social linkages that connect employees from different companies. Local interaction is based on social relations territorially embedded. The embeddedness structure derives from untraded interdependencies (He, 2006; Bathelt, 2008) and face-to-face interaction. In fact as claimed by Storper and Venables (2003) local buzz constitute a privileged channel for knowledge flows

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particularly when they are tacit. Tacit knowledge are argued to be « sticky context-laden » (Asheim, Gertler 2005) and therefore need physical proximity to be transmitted. The authors show that there is a significant qualitative difference between local and global networks (Witthington et al, 2009) by suggesting that in the local buzz « the information and communication ecology is created by numerous face-to-face interactions (…). This buzz consists of specific information and continuous update of this information; intended and unanticipated learning processes in organized and accidental meetings, the application of the same interpretative schemes and mutual understanding of new knowledge and technologies; as well as shared cultural traditions and habits, which taken together makes interaction and learning less costly » (Malmberg and Maskell, 2006).

Another crucial insight into the relational dimension of cluster is collective identity. The literature claims that collective identity in clusters constitutes a positive aspect for innovation and internal coordination mechanisms (Lee and Saxenian, 2008). Based on the works of Romanelli and Khessina (2005) cluster identity can be defined as the shared understanding of specific businesses that already exist and thrive in a cluster. According to Kogut (2000), an organizational identity represents a norm that gives exploration trajectories, but as a consequence, due to its inherent specialization, overshadows some paths. Romanelli and Khessina (2005) show that cluster identity is obtained from the personal identification of individuals, based on their perceptions of similarity or membership in groups. Sammarra and Biggiero (2001) extend this conception and advocate that, in the cluster organizational context, social interaction may also enact identification processes based on perceived complementarity. But these authors also claim that if complementarity is a cognitive basis for categorization it represent a less immediate factor of identity than it is the case for similarity among actors consequently sharing same goals and mutual needs.

However, as stated by Staber (2010) about cluster identity, if the local character of tacit knowledge may be an explanation to the decision of a firm to co-locate in a cluster, “this does not mean that they will all strongly associate with the cluster or that they will closely cooperate”. The geographical proximity of actors does not imply systematic cooperation: cognitive proximity (Noteboom, 2005; Rallet and Torre, 2005) is central to the emergence of effective interaction.

Cognitive dimension

Arguably cluster research has evolved towards a cognitive approach of clusters. In this emergent body of research, contributions to the problem of cognitive proximity can be presented as threefold.

First, the question of cognitive proximity has highlighted the major issue of the *cluster knowledge base*. Cooke (2006) has pointed out that clusters accumulate knowledge within a global value chain that throughout time becomes a rich knowledge base, which he refers to as “leading knowledge”. Henceforth, firms are attracted by the leading knowledge created, and may decide to establish in the cluster in order to capture knowledge spillovers (Hervas-Oliver and Albors-Garrigos 2008). The cognitive proximity derives from a shared understanding of the activity. Indeed, cluster knowledge base highlights the role of geographical proximity altogether with other types of proximity. Central to this idea, the school of proximity - *l’école de la proximité* - (Pecqueur, Zimmermann, 2004; Rallet, Torre, 2005) has developed other notions of proximity. They introduce the notions of “organisational proximity” referring to it as the ability of an organisation or an institution to make their members interact, and also, “organised proximity” that relies on the emergence and development of a shared repository, or “cognitive proximity”, that improve the

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capacity to exchange knowledge. Knowledge association is shown to require cognitive proximity. This issue is also expressed in research on the degree of similarity or complementarity of companies' knowledge base (Rogers, 1983). Boschma (2005) explains that people sharing the same knowledge base may learn from each other: this cognitive proximity is a condition to innovation because collective learning becomes possible. Conversely, Malmberg and Maskell (2006), argue that knowledge creation requires complementarity. Complementarity of actors and sectors encourage collaborations.

The second issue related to cognitive proximity in clusters concerns the *degree of complexity* of the knowledge base of the cluster. It is shown that, the more complex the knowledge base, the more difficult it can be transmitted. When the knowledge base is highly complex knowledge mainly flows between some firms only, while others may remain cognitively isolated from the cluster (Giuliani and Bell, 2004). In this situation, cluster networks can represent either open channels or more proprietary conduits (Sorenson, 2006), depending on the degree of cognitive proximity. The transmission of knowledge between proximate actors is easier when the underlying knowledge is of moderate complexity. This shows how transmission and exchange of knowledge could be difficult in the situation of complexity. However, few is actually said on the problem of combination of knowledge in the situation of complexity.

This third main aspect of the cognitive dimension of interaction regards the *combination of knowledge*. Clusters are mainly viewed as channels for diffusion of knowledge. Nevertheless, scant research deal with cluster as a lever for the combination of knowledge within effective collaborations as it is the case for localised innovation projects. Yet, knowledge association is highly linked to the degree of complexity of the knowledge base. The management of the complexity of the knowledge base in localised innovation projects is even more entangled. Some insights have however been provided by Carrincazeaux (2001) who suggests that the complexity of the knowledge base in R&D projects is of two different types: *combinative complexity* when there is a pregnant necessity to map the distinct competencies involved, and *technological complexity* when new knowledge is required. He has developed the notion of critical interface arguing that combinative complexity raises the need for critical interfaces that hold the know-how of the different possible combination of knowledge.

This distinction between two types of knowledge complexity has been analysed in the literature on innovation in the works of Henderson and Clark (1990). The authors assume that the development of a product involves the management of two types of knowledge: component knowledge and architectural knowledge. Thus, in architectural innovation theory, a product is understood in terms of a set of components (Andersson et al, 2008). Architectural knowledge therefore relates to the organisation of a system and the structure and routines for organising its component knowledge for productive use (Matusik and Hill, 1998). Pinch et al (2003) suggest that architectural knowledge is therefore concerned with the relationship between an individual piece of component knowledge and an overall system of knowledge and point out that several aspects of architectural knowledge have been conceptualise in the literature but with other terms "including: routines (Nelson and Winter, 1982), organizational resources (Barney, 1991), core competencies (Prahalad and Hamel, 1990), and dynamic capabilities (Teece et al., 1997) which all relate to the ability to adapt and develop architectural knowledge". After a process of negotiation, when a dominant architecture emerges, it is defined as "dominant design". The dominant design enhances the specificity of an innovation (Henderson and Clark, 1990).

Andersson *et. al.* (2008), outline the role of architectural knowledge in inter-organizational

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innovation. Stemming from Henderson and Clark's (1990) original formulation of architectural knowledge, the authors propose to define architectural knowledge as "the knowledge developed and enacted in innovation processes of aligning heterogeneous business and technical elements." They identify four dimensions of architectural knowledge: technology capability awareness, use context sensitivity, business model understanding and boundary-spanning competence. According to these authors, these dimensions possess an explanatory power that can help identify conditions for network-centric innovation.

Thus, in the context of clusters where the complexity of the knowledge base is high and where actors are increasingly heterogeneous, the combination of knowledge is proved to be central. All the more as over time, clusters may develop a specific form of architectural knowledge that would enhance the rapid dissemination of knowledge throughout the cluster by increasing the learning capacity of proximate firms and thereby conferring cluster specific competitive advantages (Pinch et al, 2003). Therefore the micro processes underlying the emergence and the management of architectural knowledge becomes a key issue**.**

RESEARCH SETTING

The paper has the objective to analyse the interplay between the 3 dimensions of cluster interaction and how they influence SMEs' integration into local dynamics of innovation. In the literature the level of analysis still remains conducted in a rather macro perspective, focusing on cluster industry group linkages in the economy as a whole. Precisely, what is missing in general approaches of the dynamics of innovation, is the details and micro mechanisms underlying the way SMEs can better integrate into local dynamics of innovation. Such investigation requires a context able to provide fine-grained insights.
In this perspective we used a case-study-based research design (Eisenhardt, 1989; Yin, 2003) with an inductive methodology. We focus on Localised innovation projects as the locus of innovation. The specific analysis of localised innovation project (R&D projects) seems to represent a relevant way to investigate the underlying mechanisms of the innovation capabilities of a cluster in the context of open innovation (Chesbrough*,* 2003). In fact, R&D activities were traditionally operated internally and in a closed manner. The author points out how companies can adopt an open approach to innovation by allowing external access to their innovation processes. Companies are nowadays conscious that in order to keep a high innovation performance, their internal resources have to be complemented by those held in the external environment. In this context, clusters' localised collaborative R&D projects can represent one of the different strategies that can be selected for both technological acquisition as well as exploitation (Minshall, Mortara et al. 2007).

The case study research is conducted in the context of the French Poles of Competitivess policy (*pôle de compétitivité*). The innovation policy, launched in 2005, focus on R&D to reinforce main existing national assets. Major part of this strategy consists in encouraging the creation of R&D-led innovation clusters that possess a critical mass of actors in a specialised area of expertise, able to strengthen the region's economy and make it visible at the global level. Three major axes summarise Poles' objectives: reinforce the specialisations of regional economy, strengthen the attractiveness of the territory and favour the emergence of new activities via synergies between research and industry. To achieve this, the policy's main tool is clearly to support R&D projects initiated by economic and academic actors in a given region. Local actors need to ask for a Pole label at the national level. In order to be selected, they have to draw from their local resources

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and economic potential to present their R&D and innovation capacities, the nature of actors existing in the region, as well as their involvement or potentiality of involvement in global innovative networks. Once a region succeeds in getting the Pole label, they are able to ask for R&D projects funding. Indeed, the Pole has been defined as a "forum for the creation of collective innovation projects" between companies and research centres. The ultimate end is to create incentives to improve interaction between local actors in the definition and emergence of innovation processes, in order to build specific local capabilities. In 2010, 71 poles have been created in different regions of the country and in several different areas of expertise.

Studying the micro processes of territorial dynamics of innovation and the mechanisms of SMEs integration into localised innovation projects required a research setting that allows an analysis of a cluster comprising interactions between various actors with complex and diversified knowledge bases. Among the 71 poles, the Pole SCS (Pole Secured Communicating Solutions) had several features that made it suitable for this purpose.

First, the Pole SCS provided a case with rich micro processes of innovation related to its history of development. The Pole SCS has been created thanks to the merging of two different local clusters both located in the in the Provence-Alps-French-Riviera Region in the southeast of France, and created under former national industrial policies. On the one hand, the cluster of Rousset located near by Marseille the third largest city in France, derives from the 1970's governmental strategy to develop the microelectronic sector. Three main firms are nowadays located in the cluster: STMicroelectronics, ATMEL, and GEMALTO (former Gemplus) and constitute one of the main pool of microelectronic activity in Europe. On the other hand, in the French Riviera, near by Nice, a second cluster emerged in the context of the French Government's 1980's strategy of decentralisation of activities to the benefit of regions. This has given rise to Sophia-Antipolis Science Park among the best-known centres of high technology activity in Europe. Lot of companies operating in the telecom and computer sector, decided to locate their branch facilities on the site. They were primarily attracted by the quality of the infrastructure made available to them (Garnsey and Longhi, 1998). IBM, Amadeus, HP, France Telecom and Cadence are among others. The two clusters created *ex nihilo* have however evolved under the pressure of economic crisis that have conducted them to construct their own local specificities. From an exogenous creation they managed to become clusters with two distinct endogenous dynamics of innovation. The Pole SCS by unifying them provided an excellent opportunity to gain insights into rich micro processes at work unfolding within two different clusters but supported by the same current policy**.**

Second, the case presented a situation of a cluster with a very complex and diversified knowledge base. The Pole SCS' ambition is to foster the convergence between four different sectors: microelectronics, telecommunications, software and multimedia existing in both clusters. In fact, the Pole has been founded on the idea to go beyond these 4 different activities in order to federate the complementarities of actors throughout the added value chain. The idea is to combine competences from silicon to uses, and from the conception of the product to the market. This ambition induces a great complexity related to the variety of the nature of knowledge, competencies, and management specific to each activity. As far as our research focuses on the cognitive dimension, the richness of the cluster knowledge base as well as its complexity and ambition of synergy and complementarity provided us with a unique setting to study the problem of combination of knowledge.

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Third, within the Pole SCS, there is a great variety configuration of interaction. In fact, the Pole SCS constitutes a cluster fostering a wide variety of actors, and mainly SMEs. More than half members of the Pole are SMEs. Besides, many multinational firms (MNFs) from around the world have located their branch in the cluster endowing it with a great variety of sectors, but also related institutions and associations as well as research centres and universities. This heterogeneity of actors altogether with the long history of emergence as well as the complexities related to diverse knowledge base, create a cluster fostering highly diverse structure of interaction: different types of relationships and alliances that made the case even more valuable for our investigation. The Pole SCS was therefore an ideal site to study innovation dynamics of cluster with a cognitive perspective.

METHODS

We used a case-study-based research design (Eisenhardt, 1989; Yin, 2003). In fact, "case study research is a strategy that enable the exploration of unknown and complex phenomenon with the goal to capture the richness of the phenomenon and identify patterns for theory generation" (Eisenhardt, 1989; Dougherty, 2002; Yin, 2003; Musca, 2006). The case study research is therefore well suited for analysing the mechanisms underlying the way SMEs can better integrate into local dynamics of innovation. The case study was conducted with an inductive methodology and a grounded approach by following established research practice (Goia, 1994; Nag et al, 2007; Siggelkow, 2007). This method gives an important role to the informants' experience and their point of view. However, researchers are the ones assuming the structuring, analysis and interpretation of the data with the help of contextual factors as well as well as reiteration with the literature in order to contribute to theory by developing a final emergent model (Nag et al, 2007).

In the objective to map out the Pole SCS's dynamics of innovation and understand how SMEs integrate in the project they foster, a case-study design was used (Eisenhardt, 1989). The research was carried out in two stages. In the first stage we conducted a quantitative exploratory research in order to identify the general characteristics of territorial innovation dynamics within the Pole SCS. In the second stage, a qualitative analysis was developed to explore the underlying mechanisms of the dynamics identified and how they influence SMEs integration into LIPs. The final objective is to develop a grounded model of the territorial dynamics of innovation identified and of SMEs integration into LIPs.

Collection and analysis of quantitative data

Quantitative data were collected through two main sources. A questionnaire drawn up to focus on the identification of the main characteristics of SMEs' innovation related to the territory. In order to tackle this issue the questionnaire was structured around three main topics: the specificities of SMEs, the nature of the SME-territory relations and how SMEs get involved into the collaborative projects of the Pole. The questionnaire was sent to all SMEs members of the cluster. Around 50% of the SMEs have replied (48 SMEs). The answers were analysed through simple descriptive statistics. Besides, a comprehensive database listing all the localised innovative projects labelled and funded by the Pole from 2006 to mid 2009, totalling 190 pages was also collected. It aimed at examining configurations of relations, mainly through the analysis of the links between the nature of actors, their location and the type of project. Quantitative data were collected for an exploratory study of the cluster dynamics. These two sources provided us with a preliminary general picture of the territorial dynamics of the Pole and how SMEs are linked to the actors and

to the projects of the territory. This preliminary analysis of the questionnaire and the database evidenced the existence of two different territorial dynamics and put forth the argument that there are two different populations of SMEs in the same Pole located in two different clusters of the same Pole. Two distinct level of integration of SMEs into the local collaborative projects is also shown. We call the first one "MRG" standing for "Marseille-Rousset-Gemenos"(Rousset being the location of STMicroelectronics, and Gemenos the location of Gemplus. Both are largest firms of the cluster). The second cluster is referred to as "NSA" for "Nice-Sophia-Antipolis" geographical area.
However, the picture of the main patterns of interaction does not give any insights into the micro processes and mechanisms explaining such a difference.

Collection and analysis of qualitative data
In the second stage, we engaged in a series of semi-structured interviews with members of the Pole, in order to obtain more fine-grained insights into the question investigated. The interviews discussed both the elements concerning the cluster proper innovation dynamics and the question of SMEs integration into LIPs.
Over 24 interviews were conducted with SMEs, with pivotal figure of the territory such as Bruno Delepine the vice-president of Pole SCS, with members of the governance structure of the Pole and with directors of main associations and institutions of the territory. The interviews lasted between 45 minutes and 2 hours and were recorded (over 25 hours in total) and transcribed totalling 335 pages. In the first part of interviews, questions were asked about the SME's type, activities, location and director's education. The second part was dedicated to the links between SMEs and their territory: the companies they are working with, the nature of knowledge they exchange or seek to exchange, their attachment to the territory. In the last part we discussed the integrations of SMEs into projects: their motivation and the difficulties or positive aspects they encountered in the process. For members of the governance structure these parts were slightly modified: they were mainly asked to outline territorial innovation features according to these three parts. They usually founded their answers on their experience in the territory and the projects they were involved in. The overall research process was highly iterative (Miles and Huberman, 1984). There was no influence from any a priori theory. The insights emerged from the data and then we referred back to the literature to search for concepts that would help to explain connections. In fact, while we were collecting data we started the analysis. Some features of innovation dynamics began to emerge as well as interaction between these features. The links identified in the data and the reiterative process followed by going back and forth between the data and the literature helped to analyse the data. This process also served as a starting point to subsequent interviews: we decided to modify the broader parts of the interviews questions, in order to focus more on the micro processes that emerged such as the focus on cluster's architectural knowledge.

The literature on territorial dynamics of innovation was used only to structure the data collection and helped to analyse the data. Nevertheless, the insights we gained emerged from the data. As suggested by Goia (2007), we analysed the data simultaneously to their collection so as to follow the constant comparative techniques (Glaser and Strauss, 1967). This technique is very helpful for a rigorous data collection and analysis as it enable to update and determine what are the next data to collect. Moreover such technique facilitates the process of identification of the main dimensions emerging from the data and provides the basis for the set up of a data structure (Corley and Gioia, 2004). The data structure was developed iteratively by identifying the

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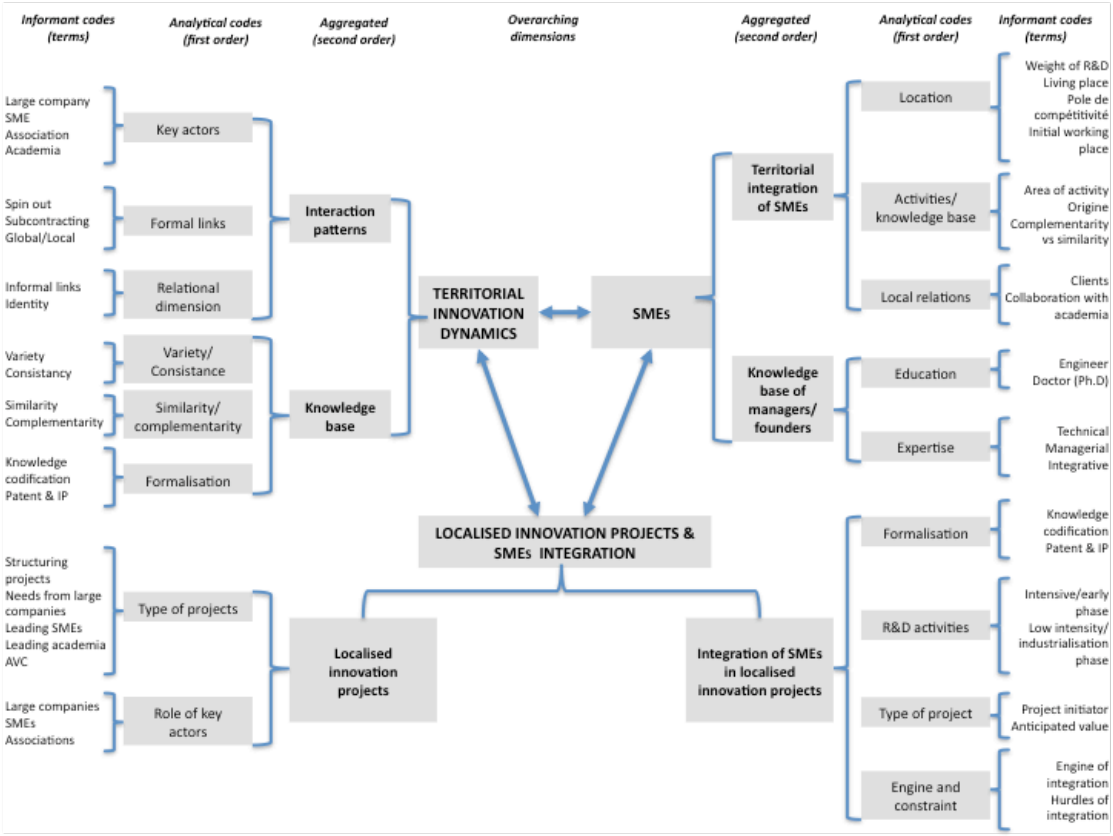
quotations from interviews that supported first and second-order concepts. First, through the double coding of each interview separately and drawing from informants' words, we detected similar ideas that we merged. From this, we established preliminary categories.

While developing them, links between concepts appeared and allowed us to merge them into distinct theoretical groups, or first order concepts. We gave them analytical codes to recognize them. As noted by Goia (1994, 2007) the first order concepts are more abstract concept induced by researchers but using the informant terms. Then the first order concepts were assembled into second order concepts, or aggregated dimensions. This step was crucial to build our theoretical model as the second order concepts are linking the different phenomenon that derived from the data. Indeed, as recommended by Goia, the data analysis technique was not followed in a linear manner. On the contrary, the technique was developed in a processual way, i.e. we continued the collection as well as the analysis of data until we had a clear view on the theoretical emerging links. The following Figure 1 presents the final data structure and shows the central dimensions or "overarching dimensions" from which we drew our model to analyse the integration of SMEs into LIPs.

Figure 1: Emerging Analytical categories and dimensions



Through the analysis of data, two broad patterns of territorial innovation dynamics emerged: the territorial dynamics of innovation of Marseille-Rousset-Gemenos (MRG) and the territorial dynamics of innovation in Nice Sophia-Antipolis (NSA).

In order to induce the patterns of territorial innovation dynamics and the integration of SMEs, we used the data structure we have built and we defined the 2nd order concepts as well as the aggregate dimensions (presented in the data structure). The second order concepts and aggregate patterns defined for both narratives unfold as follows: about the territorial dynamics of interaction we analysed the patterns of interactions (Key actors, Formal links, Relational dimension) as well as

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the knowledge base of the cluster (Variety, Consistency, Similarity, Complementarity, Formalisation). Then, we focused on localised innovation projects (Type of project, Role of key actors of localised projects, Role of large companies), we also focused on some main elements of SMEs that may influence their innovation (Integration of SMEs in the local territory, SME's manager's knowledge base). Eventually, our last focus was the integration of SMEs into LIPs (R&D activities, Type of project, Engine and hurdles to integration)

FINDINGS

Quantitative analysis

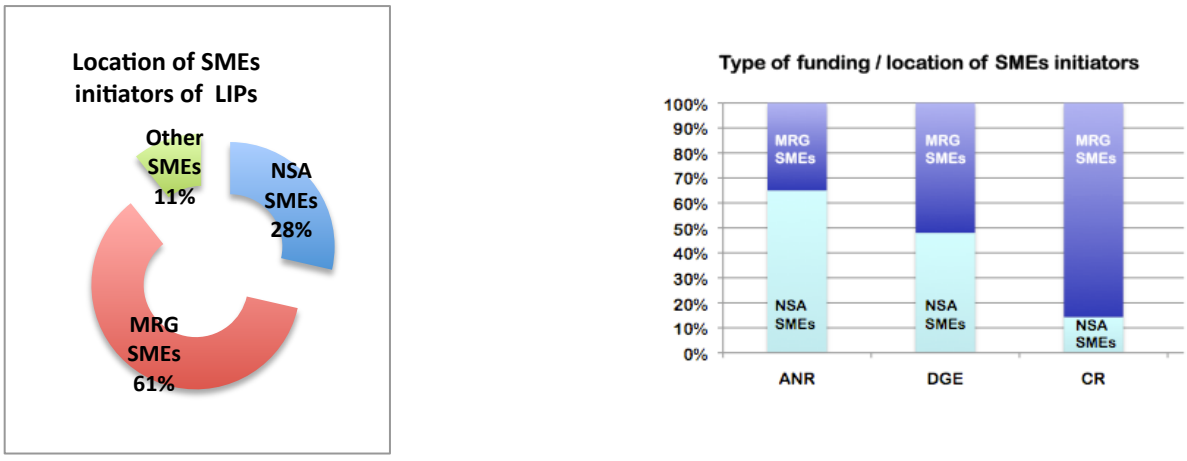
While a review of empirical studies coupled with the review of the territory history of development (Daviet, 2003; Mendez, 2008; Garnier, Lanciano-Morandat, 2008; Gadille, Pelissier, 2009; Dang, Longhi, 2009) has evidenced that the Pole SCS actually results from two different clusters, some updated and more detailed insights into such difference were still needed. Besides, in these studies no element was given concerning SMEs integration into LIPs.

The results of the quantitative analysis confirm the existence of two clusters in the same Pole. More important, it revealed the existence of two different territorial innovation dynamics with differing modes of integration of SMEs. The two dynamics have been captured through the analysis of the type of LIPs. The main interesting results came from whether the projects were coming from NSA or MRG initiators (intra cluster projects), or if there were projects in collaboration with the two clusters (inter cluster projects), the nature of actors involved (SMEs, research institution, MNFs) as well as the type of funding (local, regional or national source).

The LIPs involve a diversity of actors including SMEs (35%), Universities, research centres and institutions (39%) as well as MNFs (24%) throughout the value chain and sectors. The results show that a slightly greater number of projects initiated by MRG actors have been successfully funded (42%) comparing to NSA (34%).

This difference is even more striking when looking at the selected projects initiated by SMEs: more than half projects have been initiated by an SME from MRG cluster (61%), while only 28% of projects initiated by an SME from NSA have been selected for funding. The SMEs from MRG cluster appear to be more successful.

Figure 2 and 3: SMEs initiators of projects and type of projects according to the location



In order to gain insight into these differences of SMEs success in integrating into LIPs, the type of project funding was analysed. Three main types of projects exist depending on the type of

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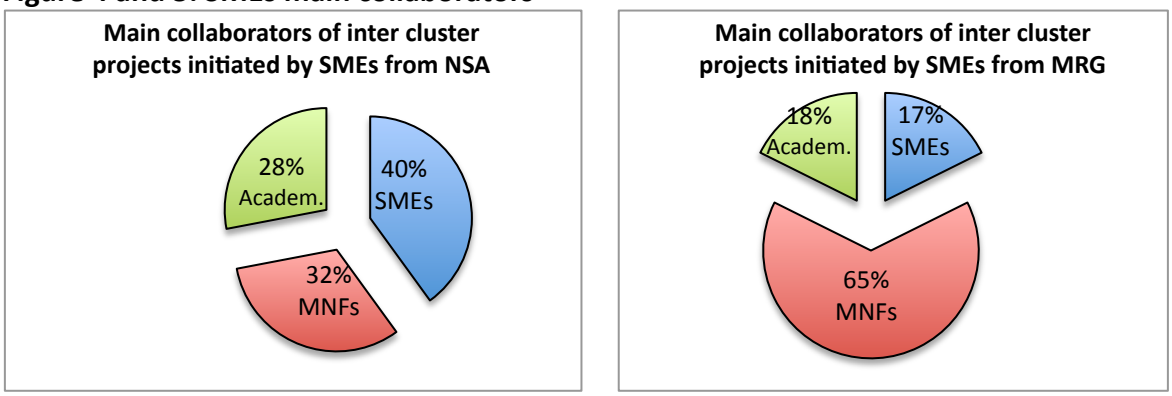
funding: “ANR” (Agence Nationale de la Recherche) which are projects funded by the Ministry of research for research-oriented innovation projects; “DGE” (direction générale des entreprises) are projects funded by the Ministry of Finance and Economy for industrially oriented innovation projects and therefore more applied innovation; and “CR “ (Conseil Régional) whose funding come from the regional council administration.

The results demonstrate that according to their location SMEs are integrated in different types of projects. SMEs from MRG address successively CR, DGE, and then ANR projects, while SMEs from NSA address ANR, DGE and then CR. These numbers have significance in so far as they show that SMEs from MRG are closer to local/regional funding, revealing their close link to the territory and the fact that they operate in industrially oriented projects. One third of MRG projects are funded by the Region administration (in NSA only 16%). Conversely, NSA foster more projects funded by ANR (65%), which means that they are more linked to academics and research oriented projects than it is the case for MRG (35%).

It is therefore interesting to analyse the nature of relations within LIPs. To this purpose, we looked at the patterns of relations internal to the cluster (Intra cluster) and relations between the two clusters (Inter cluster). First for inter and intra clusters projects for the whole Pole and then second, for inter and intra clusters projects initiated by SMEs. In both situations: projects regardless of the type of initiators, and projects specifically initiated by SMEs, it emerged that most projects participants are working with partners from the same cluster. Few projects are inter cluster projects. The links are therefore quite restrained to the immediate geographical area. Broadly a quarter of total relations concern intra cluster relations, while the three other quarters of relations are intra cluster relations. The collaboration between actors throughout the value chain, sectors and region is therefore only in construction. This shed the light on the question of the nature of relations between the two clusters. The idea is to investigate the type of collaborators SMEs are searching to work with and why.

Figure 4 and 5: SMEs main collaborators



Inside the cluster, SMEs of MRG were having MNFs as main partners, and in NSA, SMEs have academics as main partners. Instead, when focusing on inter cluster projects relations, the pattern is totally opposite. It appears that SMEs from MRG cluster work mainly with academics from NSA. Similarly, SMEs from NSA are searching for what they don’t have in their immediate environment: MNFs that collaborate with them.

Overall, the findings of the quantitative analysis show that the success of SMEs in integrating projects differ according to the type of projects and the nature of collaboration. This distinction is related to the specific local dynamics of innovation, highlighting the relevancy to look at the interplay between the dimensions of interaction in clusters and their influence on SMEs. Besides,

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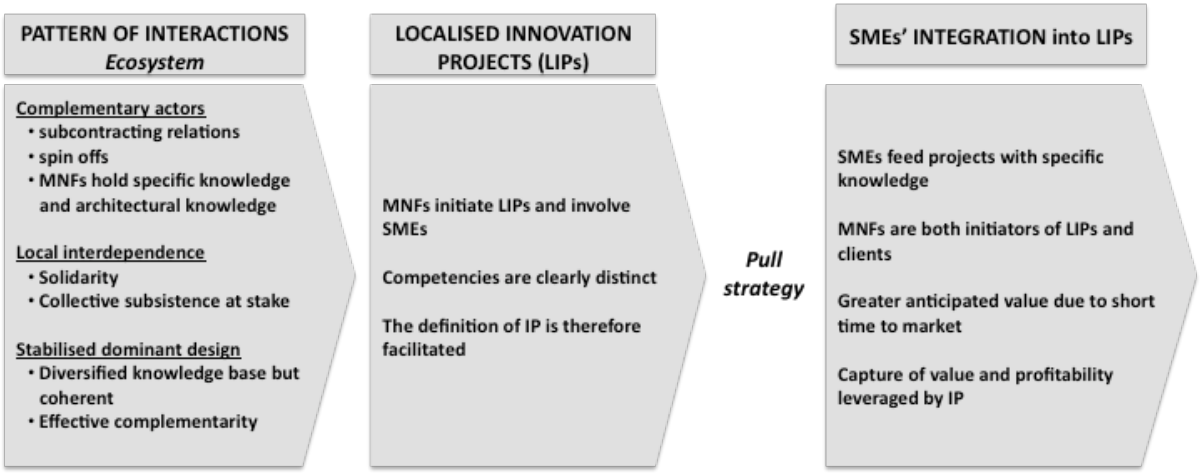
if some SMEs with same traditional constraints (resources, time) are able to succeed while others have far more difficulties, this means that other elements than their weaknesses play and have to be explored. The question of the cognitive dimension reveals to be even more important after the quantitative results.
The results from the quantitative analysis have evidenced highly distinctive territorial innovation dynamics but the mechanisms explaining the difference are lacking. This is the starting point of our qualitative analysis.

Qualitative analysis
We present the findings about the Pole SCS case study thanks to two distinct narratives.
Through the main analytical codes, themes, and dimensions built from the qualitative data, as well as some insights from the results of the quantitative analysis, it subsequently became obvious that two distinct territorial dynamics of innovation were emerging, and that the modes of integration of SMEs were totally differing. We labelled the two "narratives": Narrative 1: *MRG's territorial dynamics of innovation* and Narrative 2: *NSA's territorial dynamics of innovation*.

While figure 1 described our structure of data and how the links were made between the method and the data, the next two figures (Figures 2 and Figure 3) provide explanations about the links made between our data and the emergent-grounded theory. They allow demonstrating the close connections that has been made among method, data, and the grounded emergent theory in the terms used by Goia (1994). This is the reason why the presentation of the findings will follow the narratives' structures illustrated in figures 2 and 3. Within each dynamics of innovation three wider dimensions emerged and were mutually having an influence on the process of integration of SMEs into localised innovation projects (LIPs). The three dimensions were also able to describe and give insights into the success or eventual failure of the process: the *characteristics of territorial dynamics of innovation*, of *Localised Innovation Projects (LIPs)* and of *SMEs integration into the LIPs*. These three overarching dimensions highlight key critical underlying mechanisms that needed to be captured to understand how SMEs integrate into LIPs.

<u>Narrative 1</u> analyse the dynamics of innovation of MRG cluster and shows that a real ecosystem is thriving in the cluster, enhancing SMEs integration into projects.

Figure 6. (1st Narrative) **MRG's territorial dynamics of innovation** (Marseille-Rousset-Gemenos)



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Pattern of interaction

The first column focuses on the cluster pattern of interaction. The Hub-and-spoke metaphor (Markusen, 1996) can somehow illustrate MRG pattern of interaction: Key actors are large multinational firms (MNFs) in the microelectronic sector. They constitute the core of the cluster and act as a focal point from which several small suppliers companies working in complementary or related activities spread around it. The Manager of ARCSIS the main microelectronic association of the pole says that "Here (in MRG) we are under the domination of STMicroelectronics, Gemplus and Atmel. They give a lot of work to companies operating in activities like machine cleaning and in technical competencies related to microelectronics." The centrality of a few large firms (Gemplus, STMicroelectronics and Atmel) and the presence of complementary small firms supplying them, characterise the pattern of interaction in MRG cluster.

MNFs' needs have underpinned the emergence of a whole networks of SMEs specialised in supporting activities. Their direct needs are addressed by specialised complementary specialised SMEs such as those developing smartcards designs and applications specific to Gemplus' needs. But MNFs' needs are also addressed by SMEs that decide to position themselves on complementary services for foundries (Manufacturing fabs) such as production machines or chemical products for the maintenance of equipments. As underlined by the Director of ARCSIS: "Large firms give birth to SMEs in the microelectronic sector. However these SMEs remain subcontractors, or get specialised in side areas of expertise that are not core to the competence of MNFs". The manager of the SME Realviz adds: "In Marseille-Rousset there are very big companies such as STMicroelectronics or Gemplus, which have a spreading effect. Which means that a lot of SMEs started to work for these important groups." (Realviz' director)

In this context, large firms are the one deciding at the local level for the technological orientations and new services to develop. The Director of SMEs department at Pôle SCS states "Most SMEs from the western part of the Region perceive their network as something oriented towards the MNF decision-makers. Recently in the Pole SCS board of directors meeting, we precisely observed that there are top decision makers that leverage the development of a network of SMEs derived from clearly defined technical requirements specifications, or from know-how nurtured by some individuals in a MNF and developed in small firms or from a small firm to another". Thus **MNFs are the one who hold specific knowledge** about the products, services as well as the technology roadmap. Also, **they hold architectural knowledge** necessary to combine the territorial expertise or the missing product or service to develop.

The majors have encouraged **spin offs**, and with them, the creation of a real ecosystem enhancing the **interdependence of actors**. The subsistence and success of each actor of the ecosystem is a collective issue. This is the reason why solidarity and identity thrive in the cluster, making the director of ARCSIS says that "in the microelectronics industry, cooperation relations are very well established and stabilised, solidarity exists". He keeps on by giving an example of solidarity: "Let's imagine: ATMEL can has had a technical problem: a machine was broken due to an empty pump. ATMEL called ST and the company lend ATMEL a pump. ATMEL will definitely return the favour. Thus, there is competition but also collaboration".

MRG's pattern of interaction is characterised by established architectural knowledge. This has entailed a « ***stabilised dominant design*** » resulting from the presence of complementary actors and local interdependence, as described above. The specialisation of the cluster fosters complementary actors in the microelectronics sector, and specifically in the microelectronic manufacturing process. This leads to a ***diversified but consistent knowledge base.*** As claims the innovation director of STEricsson: "There are a lot of fields: gas purification, automation, mechanics, it's an amazing ecosystem!" SMEs operate as complementary actors enriching the

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microchip production process activity. "At Rousset, the manufacturing field has attracted a specific type of SMEs. These SMEs' activity is more based on materials, chemical products, maintenance, machine conception (to produce smartcards, tests of unique implementation etc…) In manufacturing, large groups necessarily need maintenance, need people who have the knowledge of machines, people who know about innovating materials. (Director of ARCSIS). **Thus the pattern of interaction in MRG relates to a real ecosystem that fosters effective complementarities**.

Localised innovation projects (LIPs)

The second column of Figure *2* tackles the specific issue of ***localised innovation projects*** in MRG cluster. MRG cluster's features identified conduct to a specific type of LIPs. Most of them are in fact initiated by MNFs according to their needs. For example, in the microelectronic sector, an SME that produces plastic injection machines for the manufacture of smartcards that need to be thinner and lighter, are actually not the ones who had had the innovation idea. Generally, Gemplus is the one who has told them "Well, I need a smartcard that would be thinner and lighter, 500 mg less…etc." as reported the Director of SMEs Department of Pole SCS and former director of Gemplus's fab. MNFs initiate the project and involve SMEs in the process. Even though officially, SMEs are presented as initiators, in most projects the technology or service developed has generally been decided or at least clearly oriented by MNFs. For instance, OSIRIS is a project selected by the Pole SCS and lead by a small firm called CEPRIM technology. The project aims at developing a cleaning machine and an electrochemical micromachining through selective gate etching. ARCSIS director suggests that: "SMEs are the one who officially initiate the project even though the idea is originated by a MNF. Usually, this type of project, such as OSIRIS, aims at developing maintenance of equipments like testers for MNFs. The small firm project leader of OSIRIS project has already worked as a subcontractor for ST and ATMEL for 8 years and is now collaborating with universities to improve its services and tests the result in a MNF". The need is clearly defined and the client-testor of the product is already known prior to the end of the project. Nevertheless, SMEs hold specific competencies and they are led to develop them over time along with the innovation projects in which they are involved. Besides, the knowledge invested in the project are clearly delineated and distinct from the other members of the project. As a result, the definition of the intellectual property (IP) surrounding the project is facilitated. It becomes clear that these features of the LIPs fostered by MRG cluster require SMEs to follow a **pull strategy**: MNFs express their needs and shed the light on their technological orientation; the need addressed by SMEs is already expressed before the innovation project is set up, and SMEs develop innovations under the watchful eye of MNFs.

Integration of SMEs into LIPs

The third column deals focuses on the **integration of SMEs from MRG cluster into LIPs** by presenting the induced aspects of the process. The following quote by the Pole SCS vice-president is fairly representative of this process "There are therefore innovative SMEs that don't have to wonder how to get integrated in an innovative project as they know their role and place. The cost of entry is therefore diminished. In the manufacturing process, everything is very well organised, you know in which process you are and what's the next. The manufacturing rules are very well defined". As the cluster is specialised in microelectronics and focus on the manufacturing activity, the uncertainty is indeed lowered and facilitates SMEs global view on the innovation process. Furthermore, MNFs are both the clients and the initiator of the project (as described in the previous part), this shortens the time to market and the outcome is easy to anticipate according to the director of ARCSIS « SMEs are looking for this type of collaboration: they will try to involve

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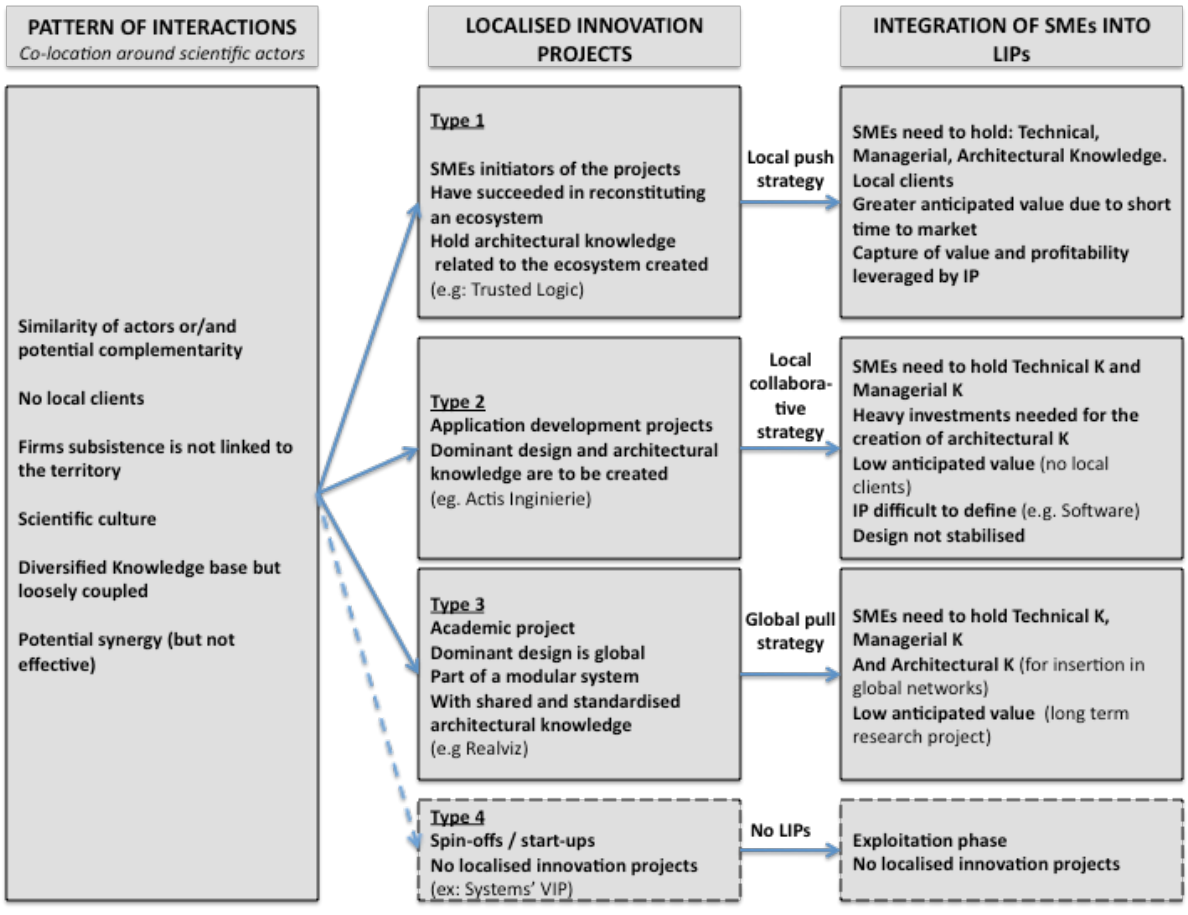
large firms in projects as far as they want to develop innovations that will meet large firms' needs. MNFs are their first client and first tester». Unquestionably, thanks to MNFs' architectural knowledge, SMEs are led to know what, where and when will be their contribution to a local innovation project. They know they will feed projects with their specific knowledge, in particular areas of expertise that enrich the microelectronic manufacturing stage. This conducts the actors of the cluster to have a better anticipation of the value created through the collaboration. Besides, due to the heavy investments required by the sector, the dynamics of innovation in MRG need to be constantly active in order to keep products and machines up to date "Machines loose value, processes change… As a consequence, industrial sites are more active in order to survive. There is a whole network of companies that stimulates the participation of local companies into Localised Innovation Projects, even hiring skilled people in charge of setting up localised innovation projects." (Vice-President of Pole SCS). Finally, the capture of the value is assisted by clear defined IP. "It is easier for SMEs from MRG to enter in collaborative projects. This leads us to think about the Industrial Property issue: how to protect an innovation. In Microelectronic manufacturing sector, IP is very clearly defined. But for a software start-up company, participating to a collaborative project with large groups, IP constitutes a burning issue. The question of trust and contracts become very important" (Trusted Logic Director).

Overall, these features (SMEs holding specific knowledge, MNFs holding architectural knowledge, MNFs being both clients and initiators of projects, and the greater anticipated value related to an interdependent ecosystem) made for potential hurdles SMEs usually face when trying to integrate into LIPs.

Narrative 2 (NSA) focuses on the dynamics of innovation of NSA cluster

Figure 7. Second Narrative: **NSA's territorial dynamics of innovation** (Nice-Sophia-Antipolis cluster)



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Similarly to the first narrative, the results of analyses of Narrative 2 are illustrated in Figure 7 and the 3 blocks of the figure structures our presentation of findings.

The patterns of interaction

As indicated in the first column of Figure 3; from the patterns of interaction of NSA cluster, a main characteristic emerges: in contrast to MRG cluster where actors are complementing each others, the *actors of* ***NSA cluster exhibit a lot of similarity***. And yet, in some cases, there could be complementarity, but the ***complementarity is only potential***, not effective.

NSA fosters a wide variety of actors acting in multiple sectors but at the same time no linkages have been built overtime: "In the software field in which most of the companies of Sophia-Antipolis are working, there is no ecosystem. Thus, [in the case of Sophia Antipolis], we closely studied IBM and AMADEUS' cases and it appeared that they do have subcontractors: computing services companies. Subcontractors are not asked to be specialised or to have knowledge on industrial property. On the contrary these large firms try to avoid having their know-how deprived by computing services companies. There isn't either this culture to work with SMEs" (Trusted Logic Director).

Clearly, the MNFs and SMEs are not working together on the local basis. There are indeed subcontracting relations, but the nature of such subcontracting relations is only found in the flexible work contracts: a question of critical human resources needed. This relation would not create any added value to the recruiter. In fact exchange is limited and MNFs are even carefully protecting their internal core competencies from subcontractors. No complementarities actually derive from these relations. Furthermore the local history of NSA shows that local MNFs are actually totally exogenous: in the context of the development of Sophia-Antipolis science park, MNFs in the microelectronic, telecommunications and software sectors have progressively open their branch facilities (NXP, Texas Instrument, Infineon etc.) under the impulsion of public policies looking to attract investments in the region and capture local markets (Longhi, 1999).

In this perspective, the weak cooperation between companies of the cluster could be explained by the local MNFs having their branch facilities located in the cluster but at the same time their head office external to the cluster with main decision taken from outside, limiting the potential for local synergies and local collaboration." Here, in Sophia, the lack of a dynamic is still pregnant. (…) When there are some links, we are still in logic of exchange: social networking, exchange of tips etc. But there is no logic of cooperation yet. In Sophia, main cooperation are still with external actors", points out a business intelligence manager at department council of Nice. As a result, companies are quite independent and don't have any linkages with upstream and downstream local suppliers nor with other local competitors. Instead, the actors of the cluster are inserted in external networks and have their main relations with distant partners.

This is also due to the intrinsic feature of the sector as noted by the Trusted Logic Director: "In the software field we have an access to a worldwide network, while in the microelectronic field companies need to be nearby to be able to work. People from the software field and with whom I am working have the ambition to become world leaders and not only followers of large influencing firms of the region. They would certainly work with large firms but with the goal to have references and to be leader. So it is really not the same way of thinking at all!"

Thus the ***sustainability of the cluster does not depend on the territory***. There is no interdependence among local actors or with the immediate environment.

Furthermore, key actors of the clusters appear to be academics: the research centres are the main actors to initiate collaborations projects. "The asset of the cluster was the presence of INRIA and of the research department of "Ecole des Mines of Paris". The opening of universities such as

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UNICE, ENST (…) has allowed the promotion of uses and services of the future, related to ICT" (Garnier, Lanciano- Morandat, 2008). Clearly, academics have the intent to become the cluster asset and have at least succeeded in conveying a real scientific culture oriented towards research and development, as noted by two SMEs: NSA conveys "A scientific and academic culture, definitely less industrial. Sophia conveys a scientific image and by the way more focus on research and less oriented towards the development of new products. In Sophia, it's green and clean. (Scientific Expert at System's VIP). Together with this, academic have also originated spin-offs supporting the scientific culture identity thriving in the cluster. Realviz is in fact a "spin off" from 'INRIA Sophia-Antipolis and System's VIP is mainly constituted of employees holding a PhD and the young company seeks to commercialise results of the research done within CNRS.
Overall, the scientific culture reinforces the global aspect of the cluster. Academics deal with worldwide relations and mainly address global networks. But, the point is that research centres don't fulfil their role as focal actors that stimulate local innovation, as it is the case in high tech clusters that grow around academic actors. As for example Cambridge Science Park, strongly linked to the University of Cambridge, the latter constituting the focal actor of the cluster.

As a consequence the knowledge base of NSA cluster is ***diversified but loosely coupled***. Indeed, the NSA cluster is characterised by a *diversified knowledge base* including software, microelectronics, telecom and multimedia activities: "In the regions, we can clearly see the predominant fields of work! Here in Sophia, software sector is predominant, but also multimedia and telecoms sectors. In Marseille-Rousset, microelectronics sector is predominant. Here in NSA there is microelectronic too but more oriented towards software such as simulation software, like Cadence for example. The manufacturing process and competences related, such as physics, are located in Marseille, Rousset or around. (Director of Realviz).
NSA cluster presents a multitude of different sectors and activities without any dominant firm or institution that would lead the orientations of the cluster. Among them software, telecom and multimedia companies are mainly driven by the development of technology applications and uses. However, the modularity of these sectors reduces the need of interdependence. Regarding microelectronics sector, in NSA companies operate in the design process: "The competences in design are located in Nice Sophia-Antipolis (…), SMEs that work in maintenance won't be attracted by the cluster." (Director of ARCSIS). According to him, "within the design process, collaboration are more difficult than in the production process in so far as developing a new design consists in adding a new solution on the market that would compete with another type of design". In addition, the collaboration in this domain is too risky; the Director of innovation at STEricsson even claims that in his firm the design competencies are considered as the "apple of the eye".

Nevertheless, few SMEs have managed to be an exception to the rule: despite the similarity of their activity with MNFs, and above all the complexity of knowledge required, they have managed to establish themselves as leaders in the NSA dynamic of innovation. It is the case for Trusted Logic an SME that became the leading provider of open, secure software for smart cards, terminals & consumer devices, and creates the foundations for converging digital services at the crossroads of telecom, banking, transport, and government. The director of Trusted Logic underlines that his company combine software expertise to secure smartcards. Their knowledge is specific and complementary as well as very clearly defined and codified "We have an Intellectual Property culture, we have precisely patented 30 innovations" and they are involved in several local collaborations.

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Therefore, the pattern of interaction in NSA relates to a co-location of cluster members around scientific actors with only potential synergy.

Localised innovation projects and the integration of SMEs

The second column (dealing with localised innovation projects), and the third column (dealing with the integration of SMEs into localised projects) will be analysed successively for each type of project. In this way it is possible to describe and analyse each type of LIP fostered by the cluster and with it, the analysis of the induced strategy and mode of insertion of SMEs.

While in Narrative 1 (MRG) the only type of project induced was clear with somehow simple features, this Narrative 2 (NSA) is far more complex: **4 types of *Localised Innovation projects*** (LIPs) emerge: (i) SMEs initiators of projects, (ii) Application development projects, (iii) Academic projects, and finally, in some configurations, (iv) Absence of project.

NSA type 1 project

In the first type of project (second column, first box of the figure), ***SMEs are initiators of localised innovation project***. As noted above, even though hardly the case, some SMEs initiate innovation projects. What characterise such projects? Why some SMEs initiate projects while others fail? Trusted Logic is involved in 7 different projects fostered by the Pole of competitiveness, for example, the Maxssim project that aims to develop a Secure Solution for Mobile Internet Multimedia. Although operating on microelectronic product design, the company has managed to add value to the end product of the microelectronic design: "For the smart cards, our speciality is to develop software layers t within smart cards. (…) It is not exactly the same than what ASK, Gemalto or Oberthur are producing, it is rather complementary (…). On the value chain, there is the silicon manufacturer, and we come and add high added value software. We work like this with ST, NXP, SAGEM. ST and NXP are both our clients and partners while SAGEM are their clients." To be able to do so, he confesses that such a company needs a very high degree of innovation and R&D investment and strong links with research. "Trusted Logic insures its lead thanks to sustainable innovation (more than 60% of R&D on its equity capital)(…) I have always been doing some research and I generally work with people holding a PhD". The managerial competence and prospective attitude needed in a company with such a positioning, is more ingrained among highly skilled employees like PhDs, as far as they have stronger links with research. Trusted Logic has deeply investigated the area of activity addressed gaining an exhaustive view of his possible contribution to the value chain. The director even claims that the company has two main areas of expertise: technological expertise, the security, and the second one, managerial expertise concerns the knowledge of collaborators and clients 'activity. In a more general way, he adds "I think that SMEs should create a reduced ecosystem of partners where they can act as integrators, retailers, developers of more sophisticated and richer systems than those which are elaborated by them alone."

Overall, Trusted logic has succeeded in reconstituting its own ecosystem of partners and clients and hold the architectural knowledge related to the specific ecosystem the company has created.

The integration of SMEs of NSA into type 1 project

The third column considers the integration of SMEs into NSA first type of project. In line with the description of type 1 project in which SMEs are initiators, the integration of SMEs derives from a local *push strategy*. "Creating its own ecosystem gives more value to a product, reduces investment costs because the company pre integrate with a partner or another, and agrees with the chosen partner. As a result, the components are not bought separately which is very costly.

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(Trusted Logic Director). In such configuration, SMEs as the offered or supplier need to *"push"* their products and services towards the consumers. This means that successful SMEs are the one who hold three types of knowledge: technical knowledge incorporate in the product or the service, managerial knowledge for the project management as well as the development of relational skills to get inserted in relevant networks, and architectural knowledge. "The more firms know how to master combinative knowledge, the more they would get funded" asserts the Pole SCS VP. Architectural knowledge is the most critical, particularly for small firms who are usually in the situation of limited resources and time. And architectural knowledge allow to master simultaneous knowledge of heterogeneous actors, their expertise, the company's contribution and the identification of market needs. Thus, architectural knowledge requires high qualifications and skills "Because those who have the mission to combine frequently have an academic background with high qualifications, they need to be able to discuss in a complex or uncertain environment. We talk about innovation and of things that don't exist yet. So we are no longer in an engineer scheme where we just receive specifications and develop them" (Trusted Logic Director). The small firm becomes a critical interface managing all this complexity. But, in this type of project SMEs have local clients that work and collaborate with them. This implies a greater anticipated value due to short time to market. Finally, as already noted by the director of Trusted Logic: "Our company has a strong Intellectual Property culture - 30 innovation patents. The patents delineate our expertise and therefore make the capture of value and profitability easier." This type of project is the most valuable for SMEs participating in a cluster.

NSA type 2 project

The second type of project emerging from NSA cluster (second column, second box) is called ***application development projects***. These projects are generally transverse to the sectors present in the cluster but focused on new applications of technologies and new services. In this kind of project combination of knowledge are in essence potential. If the complementarity of knowledge is high, the effective combination of knowledge and technologies is far to be easy to identify. Indeed, competences that are mostly oriented toward services, uses, and the application of technologies can conduct to the development of a multitude of different markets. Each actor has a competence, in several areas of expertise. For instance, the FIRE project labelled by the pole SCS, is an application development project. FIRE is designed to help protect natural environments often threatened by forest fires. Portable sensors are installed in sensitive zones, which collect information for transmission to a remote location through a highly secured system for further analysis and treatment. The data gives fire fighters real-time intelligence allowing them to determine the best plan of action for rapid and secure fire extinction. So that Fire fighter safety and security could be assessed and improved. The project involves local SMEs in microelectronics (SPS), and in IT Services and Consulting (@ctis ingienierie), mainly interested in new technology applications. It also involves large firms (Cryptyris) and academics (Ceren etc.). As the director of @ctis says « our collaboration in the project called FIRE, interested us mainly for the business and industrial outcome. Not for the R&D aspect. I do think that the future of technologies stems from new uses and new applications. However, before the implementation of the Pole programme, there was no opportunity neither than visibility to work on the future of uses and on the related competencies. This is the reason why I am integrating into the project ». The informant statement makes clear the problem of visibility of the local expertise. It also highlights the problem of combination of knowledge and the absence of a lead institution, or cluster design orienting the application of technology activities. In this type of project the design is clearly contingent, and both the design and the architectural knowledge are to be built.

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Integration of SMEs in NSA type 2 project

Coming together, these features show that the integration of SMEs in the second type of project draws on a **local collaborative strategy**. SMEs work with local partners, and need a strong collaborative strategy to go beyond the difficulties of combining expertise and identify applications. In order to integrate into this second type of LIPs, SMEs has to possess strong technical and managerial knowledge. In addition, they need to invest in the coproduction of an architectural knowledge. Besides, application development projects address worldwide customers. Indeed, the market targeted by technology applications is therefore global rather than local. For SMEs, value is therefore more difficult to anticipate with distant and uncertain clients, than in the case of predefined and proximate clients. Moreover, in the telecom and multimedia sectors intellectual property is difficult to delimitate. IP is particularly ill-suited to software. This last aspect also enhances the difficulty for SMEs to anticipate the value created.

NSA Type 3 project

The third type of project emerging from NSA cluster (second column, third box) is concerned with ***academic projects***. The academic project type is typically driven in a global perspective with the ambition to have an influence on the progress of global research. Therefore the design of academic projects is totally global. Furthermore, this type of project is directly related to a modular system with independent actors developing an innovation that could be divided into a group of sub innovations that other academics can arrange into various combinations according to their personal research abilities. Within this type of project, partners share a standardised architectural knowledge. It is therefore crucial for potential partners to be aware of the dominant design linked with the modular aspect of the environment of the project. Moreover they have to get involved in global networks related to the academic "world". As noted by Realviz's director: "Realviz had a very big collaborative structure for R&D. We made 4 to 5 collaborative R&D projects each year. We have even initiated at least 4 projects funded by the ANR and Europe."

The integration of SMEs into NSA type 3 project

In this context, the integration of SMEs into LIPs depends on a **global pull strategy**; very often these projects are initiated by academics. However, to involve SME this type of project has to be focus on innovation that are not too far from the exploitation potential: "In general, the projects where SMEs are well integrated are projects where the time to market is short. (…) There is a project led by an SME from Sophia called NEUROCOM. They are the 1st leader in France for the field of hearing aid and are the 3rd in a global scale. They had the idea to improve their product with INRIA. It is really innovative but at the same time, there is an immediate application." (Pôle SCS VP). Besides, both the need for insertion in global networks and having clients and partner external to the cluster, are definitely one of the most common statement of informants involved in the academic project type. Realviz directror says "With 20 employees, we had been able to address 20 000 clients in 71 countries. (…) But, zero local client. We never had a single client in Sophia Antipolis. All our clients are somewhere else, we have always worked a lot with the United States, 50% of our turnover and 90% of our turnover derive from exportations. For the 10% left, it is in France overall with clients from Paris. But no local client."

As a result SMEs' integration in academic project typically require holding technical knowledge and managerial knowledge, and possessing architectural knowledge, mostly in order to get inserted in global networks. In addition, as few short-term exploitable outputs can derive from academic projects, the anticipation of value is low.

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NSA type 4 project

Finally, the last configuration does not deal with a type of project, but rather, an absence of project (Figure 2, second column, fourth box). This particular situation mainly concerns young spin-offs and start-ups. While MRG fosters spin-offs from MNFs, NSA fosters more academic spin offs. Such young companies have explored their innovation for several years before setting the company. As a consequence, they don't need to get involved in LIPs. Instead, they need to commercialise their innovation and put their research activity on standby. "At the moment, our priority is to win contracts or subcontracts. When it will be the case, we will then think to integrate projects of the Pole with credibility," says a scientific expert of System's VIP. For them, research only wears an informative aspect to capture the tendency of markets. "Today, what is interesting for System's VIP in research, is to know what are markets orientations". The company already have a portfolio of academics contacts and are well inserted in academics networks. Rather, through the cluster, they search for business contacts: "I have a very good academic network thanks to my PhD Degree but it is thanks to the pole programme that today, I have contacts with industrials and institutionals." Consequently, this type of SME doesn't want to integrate into LIPs as they are still in their early exploitation stage**.**

DISCUSSION

SMEs' integration into local innovation projects is closely related to the type of territorial innovation dynamics fostered by the cluster. The role of architectural knowledge in these dynamics is particularly important. Our data in the study of Pole SCS shed the light on the role of architectural knowledge and suggest that, as a matter of fact, cluster's type of innovation dynamics is actually closely linked to architectural knowledge, in such a manner that their existence or absence affect the ways SMEs get involved into local innovation projects. This part, presents the grounded model that emerged. The grounded model illustrates the major links between key concepts to understand this issue in theoretical terms.

Figure 8. Grounded model of local innovation dynamics: Narrative 1

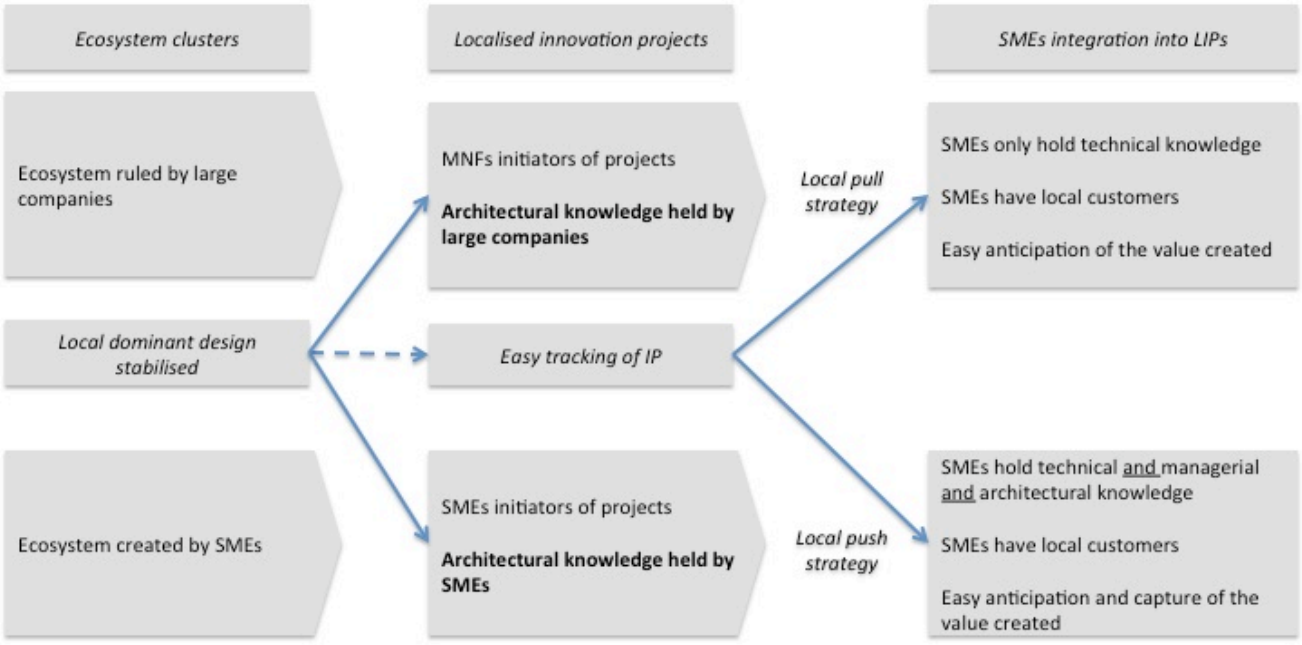
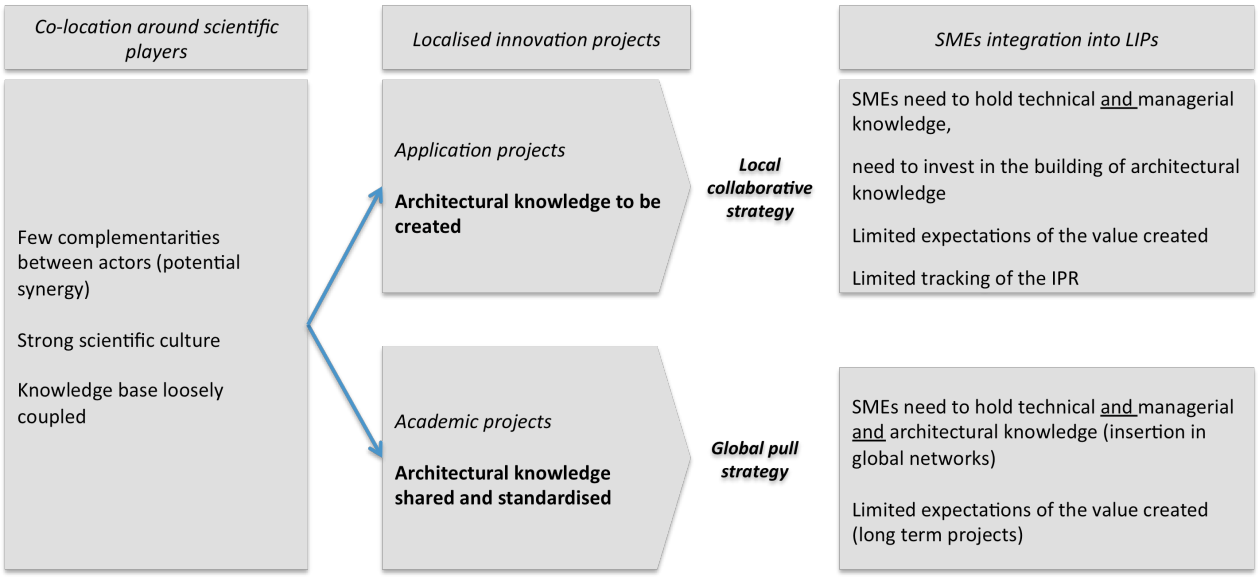


Figure 9. Grounded model of local innovation dynamics: Narrative 2



Architectural knowledge and local innovation dynamics

Academics outline the positive effects of local networks on channelling information and resources and on locating members in a dense social network of overlapping affiliation and obligations (Owen-Smith and Powell, 2004). In this perspective, tacit and informal knowledge flows, supported by dynamic socialization processes, play a fundamental role in the innovation process. Nevertheless, these flows are not sufficient for the purpose of sustaining open innovation based on the combination of knowledge among different partners. In this line, Carbonara (2004) shows the role of key actors who co-ordinate activities within a cluster: "both leader firms and meta-managers manage the innovation processes" (Carbonara, 2004, p.18).

These actors, by coordinating activities support the mechanisms of knowledge combination. However, these mechanisms are complex; indeed, the collective achievement to align heterogeneous actors and technologies in an innovation process is based on the development of architectural knowledge (Anderson et. al., 2008). Our case reveals the role of architectural knowledge in local innovation processes.

According to Henderson and Clark (1990) when a set of core design concepts corresponding to the major functions performed by the product, as well as the product's architecture is stable, dominant design is defined. In the same line, cluster with a specific value chain is characterized by a dominant design when architectural knowledge and relationships are stabilised, such as it is the case in eco-systems. Cluster with dominant design favours innovative projects. In this case architectural knowledge is developed and managed by key actors who initiate innovative projects.

At the opposite situation, when no specific dominant design characterizes a cluster, innovative projects are more difficult to realize. In this case, heterogeneous actors have to co-produce new knowledge about architectural relationships between socio-technical elements. In other terms, partners have to invest in the co-production of architectural knowledge. In the case of ICT applicative projects, the design is contingent, evolving for each application of technology; projects are therefore fewer. The necessity to invest in the co-production of architectural knowledge and

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the difficulty to anticipate the value created in the project decrease the motivation of the potential partners.
By examining the role of architectural knowledge in innovation dynamics, our study also provides new insights into the role of space. Sorenson et. al. (2006) outline the effectiveness of spatial and social proximities when the knowledge base is complex. In this case the proximities facilitate high fidelity transmission. In the same line, when the interfaces between component knowledge are complex, the need for face-to-face exchanges is important. Thus, proximity plays a significant role when the architectural knowledge is complex. Our case study shows that when the architectural knowledge is stabilized and standardized, as it is the case in the ICT field, the projects are of global nature and therefore space doesn't play a significant role. Indeed, standardized architectural knowledge reduces the effective interdependence between components of knowledge. Thus, each actor can independently work on his or her own component knowledge.

Architectural knowledge and SMEs insertion in local innovative projects
Our findings suggest that the nature of architectural knowledge influences the capacity and the motivation of SMEs to participate to localised innovative projects.
In a cluster characterized by a stabilized dominant design, collaborations are easy: first the complementarity of knowledge is clearly determined, making easier the evaluation of intellectual property. Second, the clients to address and the needs to compensate for are already identified. Thus, the value created by the project is easy to anticipate. Moreover, when the architectural knowledge is holding by the majors, SME need only to possess specific technological knowledge. But, when SMEs have to create their own eco-system, this requires further capabilities: such as entrepreneurial and cognitive ones.
At the opposite, when no dominant design characterizes the cluster, the difficulties for SMEs are high: first SMEs have to co-produce architectural knowledge, which requires time and cognitive capabilities. Second the uncertainty about the way to combine the diverse knowledge components increase their difficulty when negotiating intellectual property and to anticipate the value added of the project, two main factors that considerably limit SMEs motivation.
Finally, global projects also require cognitive capabilities in order to be able to integrate a worldwide network. Moreover these projects are very often led by academics. Far from the market (exploitation phase), the value created by these kinds of projects is difficult to anticipate, which reduces the motivation of SMEs.

LIMITATIONS AND CONCLUSION

This study has however several limitations. First, the role of architectural knowledge developed in this study has not yet been fully tested in another setting. Second, given the purpose of this paper, we did not describe the aspects related to the control of architectural knowledge; however architectural knowledge is a mean for innovation and control (Andersson & alii, 2008). Third we did not analyze the link between SMEs capabilities to create or co-produce architectural knowledge and the education of SMEs' managers. Our case suggests that managers able to develop architectural knowledge are often doctors (holding a PhD).
Notwithstanding, the approach taken in this paper, by examining the underlying mechanisms of local innovation dynamics opens up new avenues of research and ways to understand SMEs insertion into local innovative projects. Our findings suggest that the studies of local innovation dynamics should take into account the importance of architectural knowledge. Few, if any, studies specifically examine the nature and the role of architectural knowledge in such processes.

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In all cases, the development and the control of architectural knowledge are significant factors to understand SMEs' integration into innovative projects.

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