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Rani Jeanne Dang, Christian Longhi, Karine Roux, Damien Talbot, Catherine Thomas

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### TERRITORIAL INNOVATION DYNAMICS: A KNOWLEDGE BASED PERSPECTIVE

Karine Roux

CEREFIGE

3, place Edouard Branly 57070 Metz

Rani J. Dang

GREDEG UMR 6227

250 rue Albert Einstein Sophia Antipolis 06560 Valbonne France

Catherine Thomas

GREDEG UMR 6227

250 rue Albert Einstein Sophia Antipolis 06560 Valbonne France

Christian Longhi

GREDEG UMR 6227

250 rue Albert Einstein Sophia Antipolis 06560 Valbonne France

Damien Talbot

GREThA UMR 5113

Avenue Léon Duguit 33608 Pessac France

#### Abstract

A great deal of studies has focused on the role played by geographical location on the emergence and the building of localised learning capacities (Maskell, Malmberg, 1999). In this perspective, empirical studies have demonstrated that innovation dynamics of clusters results from the quality of interactions and coordination inside the cluster as well as interactions with external, often global, networks. In this context, knowledge exchange between firms and institutions are claimed to be the main drivers of spatial agglomeration (Canals et al, 2008). Hence, cluster policies have followed the main idea that geographic proximity facilitates collective innovation in so far as firms can capture knowledge externalities more easily. This idea is in fact very attractive but contains some limits (Suire et Vicente, 2007): if some clusters are successful others seem to decline. Therefore, in order to understand the territorial dynamics of clusters, the analysis of the specific nature of knowledge and information flows within a cluster is crucial.

The objective of the paper is to enhance the analysis of the role of cognitive and relational dimensions of interactions on territorial dynamics of innovation. We focus on the key sub process of innovation: knowledge creation, which is above all a social process based on two key complex social mechanisms: the exchange and the combination of knowledge (Nahapiet and Ghoshal, 1996). We suggest building a theoretical framework that hinges on these two key mechanisms. In this perspective, we mobilise Boisot's I-Space model (Boisot, 1998) for the diffusion and exchange of knowledge and suggest completing the model by introducing the concept of architectural knowledge (Henderson and Clark, 1990) so as to take the complexity of the combination process into consideration. This analysis is conducted through the illustrative analysis of three different case studies. We will draw upon the case of Aerospace Valley Pole of Competitiveness (PoC), The Secured Communicating Solutions PoC, and Fabelor Competence Cluster. The cases show that the existence of architectural knowledge is pivotal to territorial innovation.

**Key words:** Architectural Knowledge, I-Space Model, Territorial Innovation, Geographical Clusters

## Introduction

A great deal of studies has focused on the role played by geographical location on the emergence and the building of localised learning capacities (Maskell, Malmberg 1999). A crucial phenomenon has particularly been pointed out: usually globalisation implies the harmonisation of international markets, the reduction of transport costs as well as a rather even spread of similar companies around the world (Steinle, Schiele 2002). But paradoxically, in the globalisation context, some regions within nations are becoming central in terms of industrial innovation, giving a renewed importance of the immediate environment in which companies are located (Porter 1998, Asheim, Gertler 2005), and to the “territorialisation” of activities (Longhi, 2005). The recent implementation of the French Pole of Competitiveness (PoC) policy, or “*Pôles de compétitivité*”, has precisely been developed in this perspective. The Pole of Competitiveness, and the cluster policies in general, are indeed the main current model fostered by the European Union for the development of sectoral economies. Therefore, European countries are trying to structure their local economies thanks to cluster strategy.

The main idea of cluster policies is very simple: geographic proximity facilitates the collective innovation as far as firms can capture knowledge externalities more easily. Indeed, some sorts of knowledge are still sensitive to face-to-face interactions, particularly when tacit knowledge is involved. In this context, it is claimed that geographical proximity improves knowledge diffusion and enhance collective innovation. This idea is very attractive but contains some limits (Suire et Vicente, 2007). Empirically, if some clusters are successful others seem to decline. Theoretically, the definition of knowledge externalities often remains a black box. In order to understand the territorial dynamics of clusters, it is therefore crucial to analyse the nature of knowledge and information flows. All the more as knowledge exchange between firms and institutions are the main drivers of spatial agglomeration. Consequently, the way knowledge is managed, structured, diffused and with what degree of formality (Canals, Boisot, Mac Millan 2008) plays a key role in our analysis of territorial cluster dynamics.

The purpose of this paper is to enhance the analysis of the interactions that support the territorial innovation dynamics, by focalising on the relational and cognitive dimensions of these interactions. Therefore, we suggest mobilising Boisot’s Information-Space (I-Space) analytical framework (1997, 1998). In the I-Space model, Boisot proposes a dynamic analysis of knowledge and information exchanged. The application of the framework aims both at characterising the nature of the knowledge exchanged (concrete – not codified / abstract – codified) and the governance features that influence the knowledge exchange in a given territory. Notwithstanding, analysing knowledge through the only lens of tacit-codified is insufficient. The reality is more complex as can attest the example of the management of scientific codified knowledge in which the processes of production and translation involve a great part of tacit knowledge (Heyraud, 2003). This is the reason why, in this paper we suggest to enlarge the analysis of knowledge by distinguishing two types of knowledge: technological knowledge and architectural knowledge.

The main contribution of the paper is to improve the comprehension of cognitive and relational interactions on territorial knowledge creation dynamics through the illustrative analysis of three different case studies. We will draw upon the case of Aerospace Valley PoC, The Secured Communicating Solutions PoC, and Fabelor Competence Cluster.

To begin, we first provide a brief literature review (section 1) and the theoretical framework (section 2) and introduce our methodology (section 3). The next sections are presenting the results in each cluster: Aerospace Valley PoC, The Secured Communicating Solutions PoC - subdivided in two clusters studies-, and Fabelor Competence Cluster. For each cluster we provide a brief historical background and analyse the nature of transactions and knowledge flows. The discussion and implications in terms of challenges and possibilities for future research conclude this opening paper.

## **1. Review of literature**

It has been convincingly documented that in our knowledge-based economy, innovation and knowledge creation have become fundamental for the sustainability of economic processes (Solvell and Zander 1998, Spender 1996), and that the returns of agglomeration economies or the location are of strategic importance (Feldman, Martin, 2005). Clusters, local systems have increasingly focused the attention and triggered a huge strand of literature. This part summarizes the main stages of development of this literature, and underlines the remaining main issues at stake. In fact, the highly intensive competition between companies and the extremely fast pace of technological change increase the need for companies to innovate. To achieve this, companies need to have an efficient management of their internal resources as well as their external relationships, and need to manage increasing specialisation while at the same time exploring new opportunities of innovation. Therefore, cooperation in a cluster, where companies will be able to combine their resources and their knowledge assets is viewed as an efficient mean for successful innovation process (Preissl, 2003). Many studies have underlined the centrality of physical proximity and the benefits of geographical clusters. It is assumed that territories are not interchangeable and therefore the choice of location will be driven by specific advantages in terms of competencies embedded in regions, cities or any local systems.

The advantages of clustering have been abundantly argued theoretically as well as empirically starting from the seminal work of Marshall (1920). Marshall's conceptualisation of the industrial districts shows how the benefits of agglomeration comes from the substitution of internal economies with external economies thanks to three main sorts of economic externalities: technological externalities, market input intermediaries and the specialized local labour. Agglomeration is basic to economic development, but an important distinction should be made between geographic concentration of production and location of innovation. While knowledge externalities are certainly basic in the last case, the home market effect (Krugman, 1991) and the size is more decisive to the first. When externalities arise, they are the result of specific unique capabilities that are built up over time and cannot be transferred or replicated. They form the basis of sustainable

advantage for both firms and industries (Feldman, Martin, 2005). Still, the organisation of production and the management of knowledge are not independent of the nature of interactions related to the organisation.

Michael Porter has inaugurated the modern age of clusters, in the literature as well as in public policies. For Porter (2000), clusters are "Geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions in particular fields that compete but also co-operate". Still, his empirical analysis of clusters is mainly restricted to a static analysis of industrial specialization (Martin, Sunley, 2003). The recent studies on clusters highlight the crucial role of interactions between the actors of a same territory in the development of innovative capacities. They are the cradles of confidence and reciprocity; they favour the reduction of uncertainty, the coordination of actors and enhance learning capacities (Camagni, Capello 2000). Therefore, recent lines of thoughts focusing on clusters tend to stress more and more on social dynamics of interactions rather than on traditional key success factors (Bahlmann, Huysman, 2008).

In this perspective, the approach focusing on proximities (Pecqueur, Zimmermann, 2004; Rallet, Torre, 2005) provides a first valuable contribution to the analysis of interactions. The concept of geographical proximity is used to account for agglomeration externalities and for the question of clustering. Malmberg and Maskell, (2005) state that the interactions between localised knowledge foster learning; indeed, some sort of knowledge are still sensitive to face-to-face interactions, particularly when tacit knowledge is involved. Furthermore, some knowledge exchanges are related to cognitive repertoires shared by a same community. Boschma (2005) explains that people sharing the same knowledge base (cognitive proximity) may learn from each other: this cognitive proximity is a condition to innovation because collective learning becomes possible. Carrincazeaux (2001) has enriched this analysis of the link between geographical proximity and knowledge creation by integrating the notion of "complexity of the knowledge base". This complexity is of two different types: combinative complexity when there is the necessity to map distinct competencies, and technological complexity when new knowledge is required. These two types of complexities generate several possible configurations of proximity relations. As far as technological complexity is linked to new knowledge created and in perpetual renewal it is assumed to require face-to-face relations, i.e. physical proximity. On the other side, the combinative complexity raises the need for critical interfaces in terms of possible combinations of knowledge; this latter combination would consequently be facilitated when the actors possessing this different but complementary knowledge are co-located.

However, geographical proximity is not sufficient to generate agglomeration economies in terms of knowledge exchange. An "organised proximity" is also needed (Torre, 2006). Organised proximity refers to the capacity of an organisation or an institution to make their members interact. On a one hand, the organised capacity relies on the development of a relational proximity, that is to say the sense of belonging developed with the sharing of common identity, values and rules that foster the motivation to exchange and combine knowledge. On the other hand, this organised proximity relies on the emergence and development of a shared repository (cognitive proximity) that improve the capacity to exchange and combine knowledge.

Nevertheless, if organized proximity is important, different designs can be thought, diversity is indeed the

main characteristics of clusters. Current cluster research studies show that a territory cannot be simply analysed as a container, but should also be analysed in terms of the intensity of interactions they allow among actors (Markusen 1996, Garnsey 1998a, Longhi, 2005, Zimmerman 2006) highlighting the importance of the systemic aspect of clusters and their patterns of interactions. In this perspective of identifying the organisational territorial patterns at work in clusters and how they enhance innovation, contributors to the field have developed convincing empirical accounts. Markusen's taxonomy (1996, 2000) of the different organisational forms of cluster interactions in the production process, Saxenian's comparison (1994) between Silicon Valley and Boston Route 128, or Garnsey and Longhi's comparison (1998) of the development of two major European high-tech clusters (Cambridge and Sophia-Antipolis), are among convincing examples.

These work have empirically emphasised that innovations in clusters do not only emerge from geographical proximity: organisational patterns of interactions (Becattini, 1991, Rallet and Torre, 2005) and cognitive proximity (Noteboom, 2002;) are essential to their emergence. In this context Giuliani and Bell (2004) focus on intra-cluster knowledge systems arguing that the link between innovation and geographical clusters can only be understood by identifying the different cognitive roles played by cluster firms (leaders, knowledge gatekeepers, isolated firms etc.). The firms located in the cluster don't have automatically access to the local knowledge bases, and have varying difficulties to get involved in innovative networks. Therefore, the overall cognitive structure of the knowledge systems, how they work, and how they evolve across time may clarify cluster success or failure. Thus, geographical, relational, and cognitive proximity provide first insights into the set-up of an analytical framework aiming at analysing the interactions that support the innovation dynamics within a territory.

Location mitigates the inherent uncertainty of innovation. The significance of localized knowledge spillovers as inputs to firms' innovative activities suggests that their most creative and value added activities does not proceed in isolation, but depend on their access to localized accumulation of knowledge (Feldman, Martin, 2005). Still, location can be said as a necessary but not sufficient condition to access local networks of innovative activities. The access to the knowledge resource base, the insertion in local networks of knowledge creation is not obvious and can vary tremendously from a location to another.

## 2. Theoretical Framework

The objective of the paper is to improve our understanding of the role of cognitive and relational dimensions of interactions on territorial dynamics of knowledge creation, a key sub process in the process of innovation (Pavitt, 2004). According to Kogut and Zander (1992), Moran and Ghoshal (1996) and Nahapiet and Ghoshal (1998), the creation of organisational knowledge is above all a social process based on two key mechanisms: **the exchange** and **the combination** of knowledge (even though the authors confess that other processes may exist particularly at the individual level...). The process of combination and exchange are complex social processes. They reflect the embedded forms of knowledge within an organisation capable of creating, sharing, coordinating and structuring knowledge. We propose to build a theoretical framework that hinges on

these two key mechanisms: the exchange and the combination mechanisms. In this perspective, we mobilise Boisot's framework on the diffusion of knowledge: the Information Space (I-Space) and suggest to complete the model by introducing the concept of architectural knowledge (Henderson and Clark, 1990) in order to take the complexity of the combination into consideration.

Boisot's I-Space framework (1999) has been created to explore knowledge flows between companies so as to identify the strategies of creation and diffusion of knowledge. As the diffusion is a precondition to exchange and combination, the framework focuses on the diffusion of knowledge. The I-Space model starts from the proposition that the more structured the knowledge, the more rapid, large and easier the diffusion, by focusing on the link between the nature of knowledge and its capacity of diffusion.

Before presenting the framework, we introduce the key concepts involved.

The structure of knowledge depends on its level of codification and abstraction.

Codification<sup>1</sup> is the process of creating perceptual and conceptual categories in order to facilitate the classification of a phenomenon. If codification lowers the cost of data processing by grouping them, abstraction<sup>2</sup>, in turn, reduces the number of categories whose boundaries need to be defined. Abstraction is a form of reductionism, as the process tends to focus on the structure, causal or descriptive, that emphasises the data. Codification and abstraction both working together, have the effect of making knowledge more articulated and easy to manipulate and therefore more shareable (p.51). In other terms, abstraction and codification are cognitive processes that favour communication and consequently diffusion of knowledge within a company as well as outside the company.

The "I-Space" model can be briefly described as follows: the graphical representation of the model is structured with three different axes. Each axis characterise the nature of knowledge: the axis (a) tacit/codified, (b) concrete/abstract, (c) diffused/non-diffused. The author suggests merging the axis 1 tacit/codified with the axis 2 concrete/abstract to enable a better understanding of diffusion and exchange of knowledge in the space.

Thus, the "I-Space" model is built on these above key concepts. In fact, one of the axis characterise the structure of knowledge while the other axis presents its level of diffusion. According to the level of structuration and diffusion of knowledge, four modes of governance<sup>3</sup> of knowledge emerge: bureaucracy, market, clan and fief as presented in the below figure.

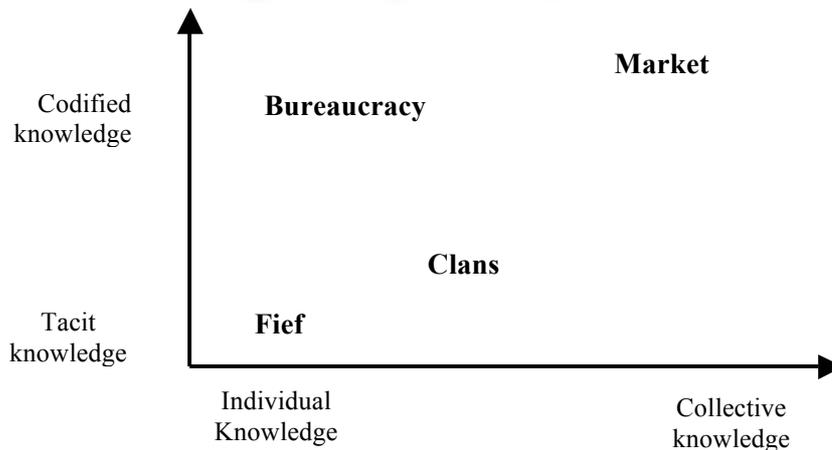
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<sup>1</sup> « Codification can usefully be thought of as a process of giving form to phenomena or to experience » (Boisot, 1998, p.41).

<sup>2</sup> « Abstraction is a process of discerning the structures that underlie the forms » (Boisot, 1998, p.41).

<sup>3</sup> Boisot avance que la gouvernance de la connaissance est fonction de la culture, à savoir la structure et le partage des connaissances sociales.

**Figure 1 : I-Space Model (Boisot, 1999)**



As far as each knowledge governance structure is linked with specific levels of structuration and diffusion of knowledge, it is possible to mobilise the model in a static way, to explain the nature of interactions between actors, in the knowledge creation process as well as in the diffusion process.

The four modes of governance of knowledge are characterized as follows: First, **Bureaucracies** are characterised by codified and abstract knowledge but which diffusion is limited and controlled by the direction. Therefore, the coordination is of hierarchical nature. Secondly, in **Markets** organisation structures, knowledge is codified, abstract and rapidly diffused. The coordination is auto-regulated. Thirdly, the **Clan** is an organisation structure in which knowledge is not codified and concrete. Its diffusion is therefore limited due to the lack of codification and abstraction. Relations between actors in such a configuration are personal and the goals are defined and shared after a negotiation process. And finally, the **Fief** is characterised by codified and concrete knowledge, but the diffusion of knowledge is limited as well. In this interaction structure, personal relations between members are essential for the confidence and the building of shared values. The authority is personal and hierarchical and charismatic. The two processes of territorial exchange and diffusion of knowledge may be analysed thanks to Boisot's model. However it doesn't enable to grasp the complexity of the combination process. As pointed out by Carrincazeaux (2001), the mobilisation of knowledge bases conducts to technological complexity (complexity resulting from the application of new knowledge bases), or combinative complexity (complexity that results from the necessity to find the connections between distant knowledge). In other words, the **critical interfaces between several knowledge bases are crucial to the effective combination process.**

In order to enrich the analysis of the nature of the knowledge essential to the understanding of territorial knowledge creation process, we are applying the I-Space model and make the distinction between two types of knowledge: **technological knowledge and architectural knowledge**. This distinction refers to the works of Henderson and Clark (1990). The authors emphasize on the fact that a product can be considered as a set of "components" or as a "system" (the product as a whole). Taking this distinction into account the authors assume that the development of a product involves the management of these two types of knowledge

(technological and architectural knowledge). Technological knowledge deals with the components of the products and more specifically on the knowledge utilized in their conception and manufacturing. Architectural knowledge is “*the ways in which the components are integrated and linked together into a coherent whole*”. By adopting a dynamic point of view, Henderson and Clark explain that innovations are subject to **dominant design** cycles: « *A dominant design is characterized both by a set of core design concepts that correspond to the major functions performed by the product and that are embodied in components and by a product architecture that defines the ways in which these components are integrated*”(Henderson and Clark, 1990, p. 14).

When dominant design has emerged and has been accepted, the architectural knowledge is stable and tends to be incorporated into a company’s rules and practices.

### **3. Methodology**

The theoretical framework proposed above, will be developed and illustrated thanks to the comparative analysis of three different territorial clusters: the aerospace cluster named Aerospace Valley Pole of Competitiveness (PoC), with the case of Airbus and its network of subcontractors. The cluster is located in the Southwest of France; The Secured Communicating Solutions (SCS) Pole of Competitiveness, located in the PACA Region in the French Riviera, and the Fabelor Competence Cluster located in the Lorraine Region in the Northeast of France. Each one of these three clusters is specialised in a different scientific and technological area: the aeronautical and spatial industries for the first one, the IT for the second one (microelectronics, telecom, multimedia and software), and finally Environment and life sciences and technologies for the third cluster (forest- agribusiness-life sciences and environment).

We have developed different empirical researches regarding these clusters: Aerospace cluster is based on two projects. The first project was a European project, Interreg IIIb Sudoe, entitled "EADS and the territorial strategies in Southwest Europe" run in 2005. Actually, a second project is concerning the organization of this aeronautic cluster in general, and the role of hub firms more specifically. Aquitaine and Midi-Pyrénées Regions finance this research. The third research study is funded by the PACA Region and developed under the scope of a doctoral research project which work is in progress. The doctoral research project is on the theme of the involvement of SMEs into collaborative R&D projects and aims at identifying the territorial innovation dynamics within French Pole of Competitiveness, and how they work, and then combine this analysis with the intrinsic features of SMEs to better understand how they get involved in the dynamics.

Finally, the fourth project, started in 2007, is funded by the Lorraine Region and is still in progress for the Fabelor cluster. The study is conducted on the “Project number 2” (SBU 2) of the Fabelor cluster: “biotechnology, food and health”.

In these 3 different empirical studies, numerous open and semi-directed interviews have been carried on: 15 interviews for the aeronautics PoC, 19 interviews for the SCS PoC, 12 interviews for Fabelor and 3 collective meeting on architectural knowledge identification and formalization.). For the SCS PoC, a quantitative analysis has also been conducted through a questionnaire addressing SMEs members of the SCS

PoC on the one hand (SMEs constitute the main actors of the Pole in number), and through the building of a database listing all R&D projects of the SCS PoC on the other hand

Based on the previous theoretical framework, our research was designed to gather and analyze data concerning: actors, transactions, proximities, and knowledge. The collected raw data were condensed by means of a codification system. The code categories were created on the basis of the four framework variables: actors (type, nature of governance), transactions (nature – personal or not, links density – strong and weak), proximities (geographic, relational and cognitive), knowledge (technological – codified or not, diffused or not, architectural - codified or not, diffused or not.)

Codes defining the four categories of variables were enriched through iteration between theory and empirical research. The process of codifying allowed us to line up data concerning the same variable and therefore facilitated and clarified its analysis and the comparison among clusters.

Our cases are employed as illustration of the role of architectural knowledge in the territorial dynamic of innovation. As Siggelkow (2007) points out, case research allows us to get closer to conceptual constructs (architectural knowledge), and is better able to illustrate causal relationships (here, interactions between firms and firms and academic researchers). As the research became iterative, going back and forth between data and theory, the progression of case events then became a source of inspiration for new ideas refining and enriching architectural knowledge framework and its role in building territorial innovation.

## **4. Results**

### **Aerospace Valley Pole of Competitiveness (PoC)**

#### *History of the Aerospace Valley PoC*

The Aerospace Valley PoC - formerly called “Aeronautics, space and embedded systems” - results from the cooperation between the French Government and the Midi-Pyrénées Region and was labelled PoC in July 2005. The local industrial firms and particularly Airbus, have played a determining role in the creation as well as governance of the PoC, that is also chaired by the European aircraft company. Currently, the PoC has 530 members: MNFs, SMEs, research centres, economic development associations and public territorial bodies. This PoC results from a strong local history of development and has been founded on already very rooted, old and dense relationships that were very hierarchical and revolving around main local leaders. Historically, most linkages were based on subcontracting relations giving less importance to relations between SMEs and public research centres. One of the PoC’s objectives is therefore to diversify the type of relations existing, in order to enhance collective innovation by bringing together industrial and scientific actors. In this perspective, the PoC selects projects in 9 different strategic business areas that include technologies such as elements of structure, embedded systems, modules integration, orbital infrastructure, power stroke, etc. Over 200 collaborative projects have thus emerged, among which the more important ones

are conducted by local MNFs, but geographical proximity reveals not to be a constraint: more and more selected projects are calling for partners located outside the PoC.

A preliminary report of the projects shows that they focus on two main technological areas very important for Airbus: a composite material, embedded systems, the latter associates actors from distinct sectors.

### *The nature of transactions*

The nature of transactions is mainly contractual with customer-provider relations. An actor dominates the transactions: Airbus. Indeed, the Aerospace Valley PoC has implemented a recombination of its supplying pyramid: Airbus' number of the direct suppliers has been drastically reduced, from 650 in 1987 to roughly 200 in 1993; today suppliers directly linked to Airbus are estimated to be less than one hundred, basically "hub firms" which organize the relations with the others subcontractors in the network (Jarillo, 1988, Miles et Snow, 1992, Longhi, 2005, Kechidi et Talbot, 2009). This cut in the number of direct subcontractors has resulted in a pyramidal organisation of the network, organized in four levels (Kechidi et Talbot, 2009):

- 1- The *sub-system integrator*: the firms which are involved in the conception and realization of the technical sub-systems on which they have the responsibility, not only regarding the production, but basically for the innovation process. They master the architectural knowledge pertaining to a module.
- 2- The component manufacturers: they supply either an independent technical (an engine for instance) either a unit to be integrated in a more complex module (a air conditioning system for instance).
- 3- The specialized subcontractors: these firms endowed with specific assets in a given domain
- 4- The subcontractors: the small firms only selected on market criteria

We can notice that this hierarchy is mainly based on the mastering of the architectural competences displayed by Airbus and the sub-system integrator.

### *The nature of knowledge flows*

Airbus is involved in several R&D projects fostered by the PoC, which account for its dominant leader role and its capacity to combine different knowledge bases necessary to the conception and the manufacturing of an airplane. The possession of architectural knowledge is central in this PoC as demonstrated in the analysis of Electromagnetic Compatibility Platform for Embedded Applications (EPEA) R&D project. The EPEA is a major structuring project, started in 2007 and supported by Aerospace Valley during 3 years in order to develop a simulation platform (as a "virtual plateau") of electromagnetic compatibility between all electronics components integrated in the product.

Thanks to a budget of 6 millions €, this project joins 16 participants, in majority localised in Aquitaine or Midi-Pyrénées Regions in the Southwest of France. Thanks to a budget of 6 millions €, this project gathers 16 participants, in majority localised in Aquitaine or Midi-Pyrénées Regions (cf. map below). Because architectural technologies are crucial, architects integrators are the one who lead the EPEA project: Airbus

France (aircraft, belonging EADS) is the principal leader, Astrium (belonging to EADS) and Thales Alenia Space are integrators for satellites. They are all localised in Toulouse. Several sub system integrator are participating to the project: Thales (aerospace) in Pessac and Siemens VDO (car industry, belonging to Continental) in Toulouse. Humirel, Nexio and Flomerics are component manufacturers or specialized subcontractors. Among most important academics or research centers, CNES, Onera, Lattis, EADS-IW are implanted in Toulouse.

The multinational firms (MNF), Airbus, Thales Alenia Space, Astrium, Siemens-Vdo, Thales, are the owners of architectural knowledge and play a central role by defining the industrial needs in the aeronautic, spatial, automotive sectors as well as delineating the models. The other industrial or academic partners bring their specific technical knowledge: the CEM measurement techniques, the establishment of integrated circuits' patterns, the software solution required for the platform. Here, the complementarity of specialised group of partners (or fiefs) is essential and become effective thanks to the fact that the combination capacities exist within the industrial MNFs (or bureaucracies) embedded systems developers.

## **The Secured Communicating Solutions (SCS) Pole of Competitiveness**

### *History of the SCS Pole*

The Secured Communicating Solutions (SCS) pole of competitiveness is located in the region Provence-Alpes-Côte d'Azur (PACA). The pole intends to become the worldwide reference for hardware-software integration to transmit process and exchange information in a reliable and secured way. It aims to foster convergence between four different related sectors significantly located in the region: microelectronics, telecommunications, software and multimedia. Its slogan, "from silicon to uses", reflects the project to federate the complementarities of actors throughout the added value chain from microelectronics to address the markets.

The case of SCS PoC is quite interesting because empirical studies (Daviet, 2003; Mendez, 2008; Garnier, Lanciano-Morandat, 2008; Gadille, Pelissier, 2008; Dang, Longhi, 2008, 2009) coupled with the review of the territory history of development has evidenced that the SCS PoC actually results from 2 different clusters of firms specialised in ICT located in the same Region with two distinctive dynamics of innovation. Furthermore, the two clusters results from of the French industrial and regional traditional policies, driven by exogenously centralized processes.

Indeed, the two clusters have grown independently according to very different organisational designs: one driven by internal oriented processes, the other by external oriented processes.

The cluster located in the Western part of the Region (13) – **Marseille cluster** – was born from a voluntarist policy, typical of French industrial policies, aiming at developing the microelectronic sector. The 'national champions' have been requested to achieve this goal; a firm, Eurotechnique, has been created with US partnership to supply the technology. The merger of these activities with an Italian group has given birth to

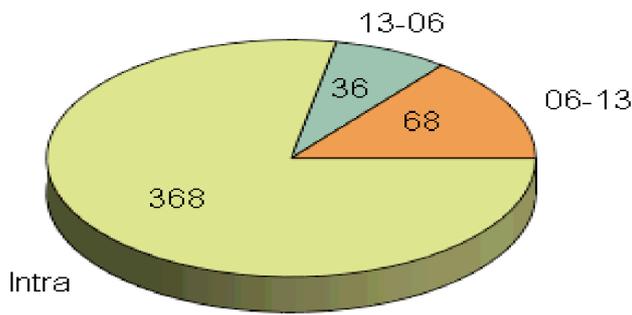
ST Microelectronics; rapidly a group of engineers from ST has created Gemplus, Atmel has also been created from acquisitions of the original seed (Zimmermann, 2000; Daviet, 2003). Thus, leaders of microchip fabrication, cards, digital security activities, leadership mainly built from innovations, have endogenously emerged from the original public investment, resulting in a cluster of complementary large firms built on a common knowledge base. These large firms have built an important network of subcontractors, usually SMEs involved in the production process.

The cluster located in the Eastern part of the Region (06) – the French Riviera, (**Sophia-Antipolis cluster**) – was born from the creation of Sophia-Antipolis in the 1970's. The “technopolis” was created to attract high value added activities in the region, to implement a new local development strategy to strengthen an economy driven by tourism. The project was strongly supported by the public policy of decentralisation with substantial public investments in telecommunication and transports infrastructure. Nevertheless, contrarily to the Western part, the initiative has been developed without any precise technological project (Longhi, 1999). After the decentralization of large French (public) firms, an international marketing strategy has matched the ongoing globalization and succeeded to attract multinational companies in the microelectronic, software and telecommunication industries (Texas Instruments, Philips, Infineon, HP). Research centres, and higher education institutions followed the implementation of multinational companies. In this sense, the cluster is a ‘false’ science park, it is mainly build on large international firms, attracted by infrastructures as well as the perspective of penetrating European markets. This is why the cluster is rich of external linkages, but deprived of internal relations between the firms, largely involved in stand-alone local activities. The crisis of the nineties, the rise of the Internet and mobile technologies, on which many actors are involved, have given rise to the beginning of internal processes in the cluster.

The PoC provides the incentives for the firms of the cluster to formalize R&D projects in order to pretend to the subsidies attached to the policy. It plays in some sense the role of enlightener of the innovative capacity of the clusters, of the nature and location of the firms involved in these innovative processes, of the eventual obstacles to build projects from ‘silicon to uses’ and to merge the two original clusters into a new one. The analysis of the database of the R&D projects labelled by the governance structure of ‘SCS’ PoC and eventually financed is informative. The R&D projects database constitute a quantitative material informing on the type of actors involved in the projects, their number, sector and location, which give some first insights into the innovation dynamics of the cluster (Dang, Longhi, 2009). Since 2006, and until 2008, the PoC has labelled 157 R&D projects, but only 47 have been selected for funding. Among them, 64% of the PoC funded projects have a leader located in Marseille cluster. This reveals that Marseille cluster have a far better dynamic of collaboration when analysing PoC's R&D projects.

Another information is very important; it concerns the location of the partnerships in the project. The following charts summarizes this information:

**Figure 2: Location of R&D project partnerships**



**13 - 06:** Projects in partnership between the 2 clusters who leader is located in Marseille cluster and whose members ( in total) are in Sophia-Antipolis cluster

**06 - 13:** Projects in partnership between the 2 clusters who leader is located in Sophia-Antipolis cluster and whose members (68 in total) are in Marseille cluster

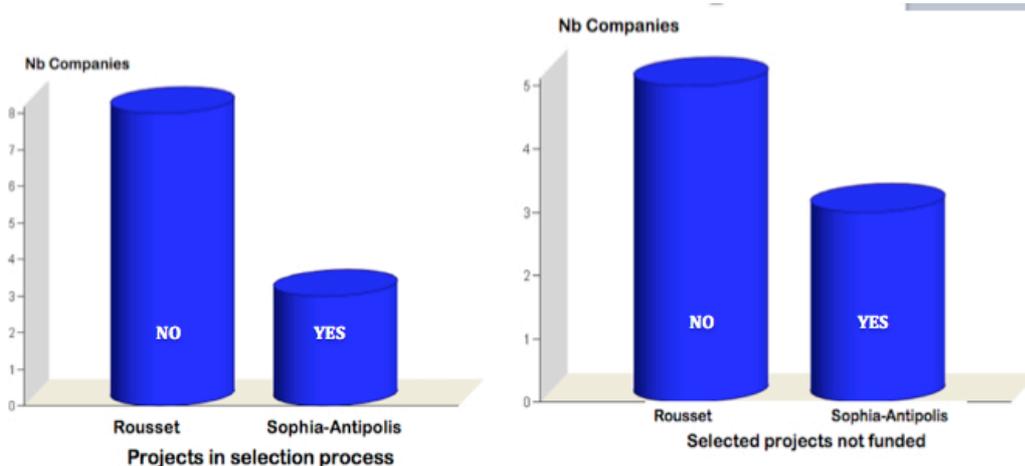
**Intra:** Projects in partnership only between actors from the same cluster, i.e., 06 or 13. (368 members in total)

The chart shows that the R&D projects are mainly intra-cluster projects. In fact, very few projects involve partnerships between the two clusters: on the total number of 368 partners involved in PoC projects, only 36 partners from Sophia-Antipolis cluster are involved in a project led by Marseille cluster, and only 68 partners from Marseille cluster are involved in a project led by Sophia Antipolis cluster.

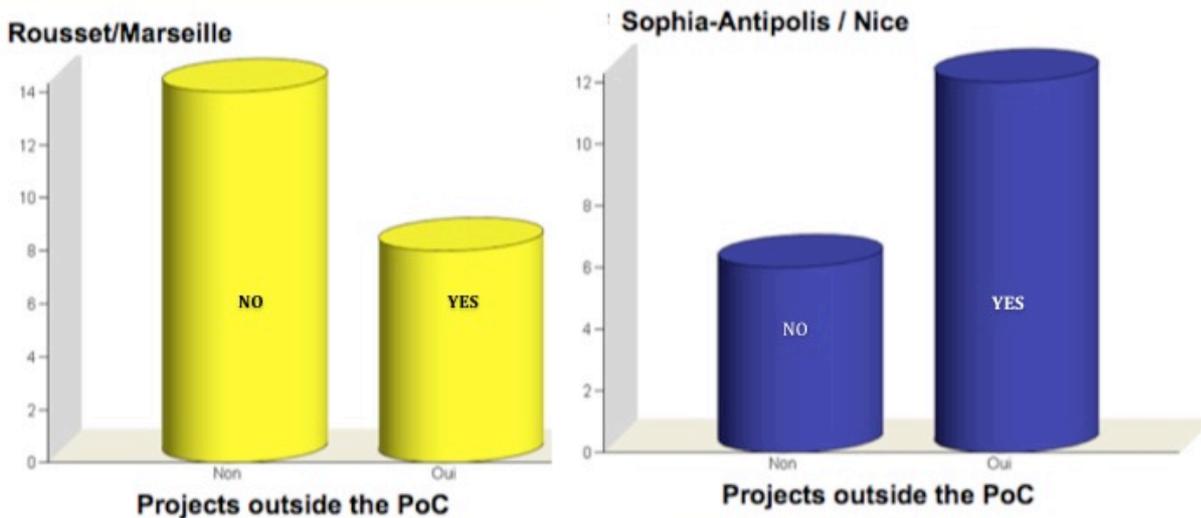
The results show that the western cluster of Marseille is more efficient in getting supports from the public policies. This is particularly true when considering SMEs. SMEs from Marseille are traditionally involved in subcontracting processes, and can easily join R&D cooperative projects. The same is not true in Sophia Antipolis where the involvement of SMEs in local projects is more difficult. Traditionally, SMEs in Sophia Antipolis are open to external linkages, just like the large firms. A large part of the innovative activity run in Sophia Antipolis is thus not necessarily captured in the SCS PoC activity.

The following charts, built from a survey of the SMEs from the two clusters, attest this fact:

**Figure 3: R&D projects fostered by SCS PoC (SMEs survey)**



**Figure 4: R&D projects outside of SCS PoC scope (SMEs survey)**



Surprisingly enough, when it comes to innovation projects that are outside of the PoC programme, then, the configuration is completely reversed. Sophia-Antipolis SMEs are involved in a substantial number of projects “outside” of the PoC programme (mostly european projects) while Marseille SMEs are less.

The analysis of the nature of the transactions and of the knowledge flows related to the R&D projects and innovative activities in the cluster can explain these facts.

### ***The nature of transactions and knowledge flows within Marseille cluster***

#### *The nature of transactions*

The nature of transactions in Marseille cluster is mainly on a local customer-provider basis on the one hand, and technological on the other. The specificity of the Marseille cluster lies on the fact that contractual and technological transactions specifically concern the microelectronic manufacturing process.

The transactions are indeed structured by vertical interactions in the microelectronics sector and revolve around the “fabs”, the microchip fabrication plants.

*“There are in fact Multinationals firms (MNF) such as GEMPLUS, ST, ATMEL that are like AIRBUS, i.e. surrounded by a network of SMEs. There is a whole network of subcontracting SMEs that provides almost everything they need !”*

Mr Luc Jeannerot, Director of ARCSIS<sup>4</sup>

Gemplus’s development underpins the creation of SMEs specialised in smartcards that develop designs and applications specific to Gemplus’s needs, but also SMEs that decide to position themselves on complementary services for foundries such as production machines or chemical products for maintenance of equipments as underlined by Mr Jeannerot:

*« MNF give birth to SMEs in the microelectronic sector. However these SMEs remain subcontractors, or get specialised in side areas of expertise outside the microelectronic industry that are not on the core competence of MNF.*

<sup>4</sup> ARCSIS is the trade association for the microelectronics and semiconductor activities in the Provence-Alpes-Riviera (PACA) region

*Small firms will develop MNF needs such as maintenance of equipment, providers of retrofit equipments necessary to MNF's fabs performance »*

The nature of transaction can therefore be characterised as mainly technological in order to develop new markets or new technologies in new firms (spin-outs), or contractual (subcontracting) transactions between few major companies (Gemplus, STMicroelectronics and Atmel) that decide at the local level for the technological orientations and new services to develop. For this matter, the R&D projects database shows that on 157 selected projects of the whole region, 66 projects are initiated or involve at least one of the 3 companies (11 projects for Atmel, 16 projects for GEMALTO (ex-Gemplus) and 33 projects for STMicroelectronics) which represent a striking number when considering the projects involving the western part of the PoC. Mr Jeannerot adds:

*"I do think the hierarchy rule works here. It's clear that Marseille MNFs have established themselves as the leaders. The coordination modes are clearly hierarchical"*

Besides, the nature of transactions accounts for the density of local interactions: there is a high level of cognitive proximity and cooperation is well established making the director of ARCSIS says that *"in the microelectronics industry, cooperation relations are very well established and stabilised, solidarity exists"*.

#### *The nature of knowledge flows*

Thus, figures are sometimes misleading. When the survey shows that SMEs from Marseille are far more integrated into innovative projects than SMEs from Sophia, it appears that the 3 MNFs firms actually foster most of R&D projects of the western part of the PoC even though SMEs are the one who officially initiate them.

*"I think that the criteria given by funding commissions are so restrictive that in each project there should be a MNF that manage SMEs. Of course SME's competences are very valuable, but MNF are the one who decide in the sector"*

Mr Jean-Marc Sarat<sup>5</sup>

The main reasons why SMEs are integrated in lot of R&D projects is not only their innovative capabilities but result from underlying mechanisms: Firstly, the relational dimension of interactions have shown that major firms are the local leaders and emphasised their power of knowledge attraction and central role in innovation decision making. Secondly, the nature of knowledge flows is specific: the vertical interactions characterising the transactions between the 3 MNFs, the "majors", and local SMEs are actually of two different kinds.

On the one hand, they are complementary, that is to say that SMEs - mainly derived from spin-offs- develop technologies complementary to the majors' and clearly defined with the majors:

*"Most SMEs from the western part of the Region perceive their network as something oriented towards the MNF decision- makers. Recently in the SCS PoC board of directors meeting, we precisely observed that there are top*

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<sup>5</sup> Manager of SMEs department of the governance structure of the SCS PoC

*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 a small firms or from a small firm to another”*

Mr Vincent Prunet <sup>6</sup>

On the other hand, some SMEs have identified side services for foundries with complementary knowledge in completely different areas of expertise for the maintenance and well functioning of the fabs, such as chemistry or optic expertise as it is the case in OSIRIS, a project selected by the PoC and led by CEPRIM technology that aims at developing a cleaning machine and an electrochemical micromachining through selective gate etching. Mr Jeannerot part of the selection commission explains how the project idea was born: *“SMEs are the one who officially initiate the project even though the idea is originated by a MNF. This type of project, such as OSIRIS, aims at developing maintenance of equipments axis like testers. The small firm project leader has already worked for ST and ATMEL for 8 years and is now collaborating with universities to improve their services and test the result in a MNF”*

Thus, SMEs forming a dense ecosystem around the 3 major firms tend to bring a piece of competence that completes decision-makers competencies. This is the reason why, the SMEs expert, Mr Sarat says that: *“Subcontracting companies are hardly innovative. For example, in the microelectronic sector, an SME that produce plastic injection machines for the manufacture smartcards that would be thinner and lighter, for GEMPLUS, are actually not really innovative. Gemplus is the one who have told them “ Well, I need a smartcard that would be thinner and lighter, 500 mg less...” etc.”*

Nevertheless, the competence developed by the firm that cooperate with the “majors” exclusively follows the need of the majors. In other words, the 3 main corporations are developing partnerships with surrounding firms to develop what they need but don’t want to develop, or cannot develop:

*“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 entry cost 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”*

Mr Bruno Delepine <sup>7</sup>

The nature of architectural knowledge is thus the diffusion is controlled. The “dominant design” heading the knowledge flows in such interactions is clearly defined and stabilised in the manufacturing and production processes of the microelectronic sector: the 3 major companies hold the architectural knowledge enabling the existence of a stabilised dominant design. The dominant design makes collaborations easier as the complementarity of knowledge is clearly determined; moreover, the clients to address and the needs to compensate for are already identified.

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<sup>6</sup> Director of strategy at Trusted Logic

<sup>7</sup> Innovation strategy director at ST-Ericsson (formerly NXP semiconductors), and the former vice-president of the governance structure of the SCS PoC

In fine, the nature of transactions within the Marseille cluster clearly evidence fief and bureaucracies. In this interaction structure, relations between members of the clusters are based on established and clear vertical partnerships, a clear roadmap, and shared but controlled knowledge by few main heading companies (bureaucracy) that hold architectural knowledge and handle a whole network of SMEs followers (fief) with specific and complementary knowledge.

### ***The nature of transactions and knowledge flows within Sophia-Antipolis cluster***

#### *The nature of transactions*

Within Sophia-Antipolis cluster, the nature of transactions is characterised by a very wide variety of relationships accounting for the large range of sectors located in the cluster. In fact, Sophia is characterised by transactions in the other phase of the microelectronic sector: the design process. It is also characterised by the software, telecom and multimedia sectors. In these sectors, the nature of transactions is mainly driven by the development of technology applications. Sophia-Antipolis cluster presents a multitude of actors in different sectors without any dominant firm or institution that would lead the cluster orientations.

The nature of transactions in the microelectronics design process is quite particular: very few, almost absent technological collaborations. Indeed, by focusing on projects and in processing interviews, it appears that design activities constitute a specialisation of Sophia microelectronics firms. But, they hardly cooperate. According to the Director of ARCSIS, in the design process, collaboration are more difficult than in the production process in so far as proposing a new design consists in adding a new solution on the market that would compete with another type of design. Mr Jeannerot confirms that:

*“in microelectronics design process, each small firm conceives its own new design, so how can others contribute to ? Firms like Cadence or Synopsis can add their software added value. But except from that the other design SMEs cannot collaborate because whether they are not doing the same thing at all so they cannot be complementary, or they are doing the same thing and they become competitors. On the contrary, in the fabs, MNF necessarily need knowledge in the maintenance of machines, new materials, innovative materials”*

This renders knowledge sharing more difficult and explains why technological partnerships transactions are almost inexistent.

In the 3 other sectors, (telecom, multimedia, software) Sophia cluster has developed very dense external interactions driven by external markets but with very poor local interactions. The lack of local interactions has been a long-standing issue that have given crucial importance to associations such as SAME or Telecom Valley created to clearly display Sophia-Antipolis' specific competences. Henceforth, internal interactions started to occur, and the dynamic of interactions finally emerged thanks to clubs and associations, but the dynamic of cooperation is still weak.

*“ Here, in Sophia, the lack of a dynamic is still pregnant (...) We are still in a logic of exchange: social networking, exchange of tips etc. But there is no logic of cooperation yet. In Sophia, main cooperation are still will external relations”*

Claire Behar<sup>8</sup>

### *Nature of knowledge flows*

In the microelectronic design process, the complexity of knowledge is high: a small firm can actually only propose simple designs or very specialised ones with market applications that are very easy to penetrate as claimed by Mr Delepine:

*“SMEs are developing more simple designs et often very specialised comparing to MNF designs, and the application of their design is often easier as well”*

The complexity of knowledge at stake in the design process has conducted large firms to internalize as well as giving more and more value to the capacity to combine knowledge. In fact, it is not without purpose if the design of the core of a microprocessor is called “the architecture”. *“It is the integrator’s role to master architectural knowledge. MNFs are the ones who have such a knowledge on how to combine expertise”* says Mr Delepine that also claims that in his firm the design competencies are considered as the *« apple of the eye »*. This self-explaining quote shows how risky it is to share knowledge, except perhaps, when it comes to the applications.

This is an insight into why fewer PoC collaborative projects are leaded by Sophia cluster compared to Marseille cluster. The core knowledge of microelectronic design process cannot be shared. Instead, two types of projects emerge from Sophia-Antipolis cluster.

Firstly, projects that are focused on a specialisation that ads value to the end product of microelectronic design (integrated circuits, microprocessors...). For example, R&D projects such as MaXssim, a project that aims to develop a Secure Solution for Mobile Internet Multimedia, involves microelectronics SMEs such as Trusted Logic. The small firm is a 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 firm is involved in 7 different projects fostered by the PoC and have signed several collaborations with other microelectronic companies.

Mr Prunet the strategy manager of the company underlines that Trusted Logic 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”* declares the strategy manager.

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<sup>8</sup> Economic Intelligence manager at « Syndicat Sophia Alpes Maritimes » (SAM)’s mission is to help local actors develop global, concerted economic strategies for the territory.

Collaboration is therefore effective only when the interest lies into the personalisation or specialisation of integrated circuits, moreover. “It is more difficult to create a new circuit than writing some lines of codes that personalise a circuit” according to Mr Sarat.

The intrinsic nature of the design process, outlined by a system that contains several sub-units that should be controlled simultaneously by a critical interface, makes the collaboration tough. This complexity requires architectural knowledge. Consequently architectural knowledge becomes precious and therefore not diffused or shared.

Secondly, the projects that are transverse to the sectors present in the cluster (telecom, software and microelectronics) but focused on new application 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 dominant design structure 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. Besides, the applications of technology work at the opposite way to microelectronics design process: the system is modular, i.e. that when there is an innovation, the new ways of combining knowledge in a sub-system doesn't change the overall system. Therefore there are as many design structures, as there are possible combinations. There is no stabilised design that would leverage collaboration by structuring the cluster innovation dynamics. Mr B. Delepine, confess that contrarily to the microelectronics fab activities, in the applications of technology activities, it is not easy to know how to collaborate, with who, for what market and when: “*in the fabs it is true that the need easily defined, while for technology application, it's far more difficult*”. The combination of complementary knowledge become quite tricky and implies lot of difficulties in creating a real local dynamic of collaboration. Moreover, the output of the project is far less guaranteed than fab oriented projects. This also explains why less project from Sophia cluster are selected.

In fine, this clusters presents Market-like interaction structures where knowledge and information are codified and abstract as well as rapidly diffused thanks to informal transactions channels, “reversed spin-offs” and efforts of codification and standardisation of knowledge through different institutions implemented (ETSI for the ICT industry, W3C for the Internet). The coordination is auto-regulated with no major firm or institution heading the cluster neither than stabilised architectural knowledge, that notably explain the lack of local dynamic of interaction.

## **The Fabelor Competence Cluster**

### *Fabelor pole history*

The Fabelor competence cluster, « Forêt-Agroalimentaire-Biotechnologie-Environnement Lorraine », created in 2007, is the most recent cluster. Its overall objective is to coordinate research, universities and industry. The cluster is divided into 3 Strategic Business Units (SBU); the analysis focus on the second SBU

entitled “food safety and expertise”. This second SBU has the main objective to evaluate the effects of a diet on health, notably through the analysis of antioxidant biomolecules. Two main projects form the SBU. The first theme, “Agrival”, aims at evaluating the effects of chemical or biological field contamination on the end consumer. The second project « Nutrivigène », contributes to the understanding of links between food and diseases throughout the different stages of life.

The SBU is composed of 15 research teams from academia, mainly from 2 research institutions: - l’INPL and the CHU – located on proximate geographical area. The 15 research teams are divided as follows (according to Agrival or Nutrivigène projects):

- 6 teams in Biology and 1 in Physics from INPL, work on Agrival
- 7 Healthcare teams, from CHU, work on Nutrivigène
- 1 Computer Science team, with researchers from INPL and CHU, get involved from time to time in Agrival or Nutrivigène project on specific points.

The teams working on each project have high cognitive proximities (biology for Agrival and Health for Nutrivigène) and high organisational proximity (INPL institute for Agrival and CHU Institute for Nutrivigène). It is possible to point out that from a project to another, the area of expertise is very different as well as the work cultures.

Moreover, it should be underlined that besides the 15 research teams, 5 food industry companies (St Hubert, Milk cooperative, Euroserum, Nestlé Waters, Alliance Fromagères) are members of the project but will only actually take part to the project on the last stage of the programme.

#### *The nature of transactions*

Globally, the transactions between the members of the project are of scientific nature: exchange of information and knowledge, sharing of scientific protocols, and sharing of experimental equipments. However, it should be noted that the constitution of R&D projects also often results from the idea of obtaining subsidies. In the first kind of transactions, the relations are mainly interpersonal and informal; in the second, the relations are contractual and in general involve the directors of research institutions. Within each research institution, researchers work together on numerous projects and publish joint articles on their scientific results. The relations between researchers are very dense. The different research institutions of the INPL institute involved in Agrival project have developed very dense work relations for a long time: co-direction of graduate students or doctoral students, cooperation relations between projects. These cooperations are necessary when the projects involve distinct know-how and mobilised at different stages of the projects. The teams from CHU involved in Nutrivigène project have similar characteristics. Nevertheless, a main characteristic make them differ: at INPL the collaborations between research centers are initiated by the researchers themselves, while at CHU the decision to collaborate is centralised by the directors of the research centers.

It is important to point out that it is the first time that teams from INPL and from CHU are cooperating on the same project. And it is particularly necessary for the project to have efficient cooperation as Fabelor cluster

is funded 7 billions euros on 7 years. The Fabelor Manager precisely says *“the heads of research centers [at INPL] are coming to the meetings when there is an evaluation of the investments planned. (...), JL Guéhan always attended the meeting for the purchase of materials (...), we discuss with JL Guéhan when there are decisions concerning first investments for the CHU”*.

One of the head of research center contributing to Agrival project explains that *“Stéphane Désobry [Fabelor Manager] gathers people to discuss about the priorities of investments, and of what is required by the region. Then Stéphane informs about the budget, and altogether we are deciding how the budget should be allocated to science”* (G. Rychen).

### *The nature of knowledge flows*

The research and development activities within each research center involved in Agrival and Nutrivigène projects are principally mobilising specific knowledge, i.e. technological knowledge. This knowledge is partly codified in the form of publications. Nonetheless, each research centre has important know-how, of more tacit nature, notably in the choice of methods and experimentation protocols. If the partnership culture is more developed at INPL, so in Agrival, the capacity to combine knowledge and know-how from different research centres in specific projects are however neither codified nor capitalised. Furthermore, these current projects are the first to have involved such a number of researchers and research centres so far, and for such a general and long term objective: i.e. the conception of antioxidant bio molecules that would have positive effects on health, through food.

In fine, even within Agrival project, the architectural knowledge is very partial, distributed and tacit.

The DAS 2 project of Fabelor has therefore been developed to enhance potential synergies between the research centres headed by INPL and CHU, with the idea that each research centre could contribute in his own area of expertise to the conception, the characterisation and the tests of these antioxidant molecules.

In reality, the combinations reveal to be difficult to realise, and the cooperation on the project are have not really been activated yet. The director of a research centre at INPL and manager of one of the Agrival subprojects says that *“all people in the research centre are involved in Fabelor by giving synthesis notes and reports of the scientific production. However, they are not directly involved in the research activities because there is no link with the other teams of the project, scientific coordination and animation is missing (...) currently, more links with external research centers are observed, and there is no joint project with another research centre coming from Fabelor cluster”* (G. Rychen).

More than 6 months, 6 individual interviews, and 3 collective meeting were necessary for the emergence of shared collective design and combination of knowledge for the effective run of Agrival project. Another Agrival subprojects manager explains that Fabelor cluster *“is however not supported by any practice of capitalisation of knowledge. If we know all the teams and their competences in biology (those who have the same scientific knowledge bases as much as those who have complementary knowledge), we however don't really know about the competences in Health. It is a very good exercise for us to stand back; we really don't take enough time to think about it and we don't have anything to help us to capitalise”* (Ch. Sanchez). This is

a first step into the formalisation of architectural knowledge, essential to support the development of this project.

To conclude, it should be underlined that, to date, cooperation between Agrival and Nutrivigène projects is still faltering because actors have difficulties in concretely identifying relevant cooperation's (total lack of architectural knowledge).

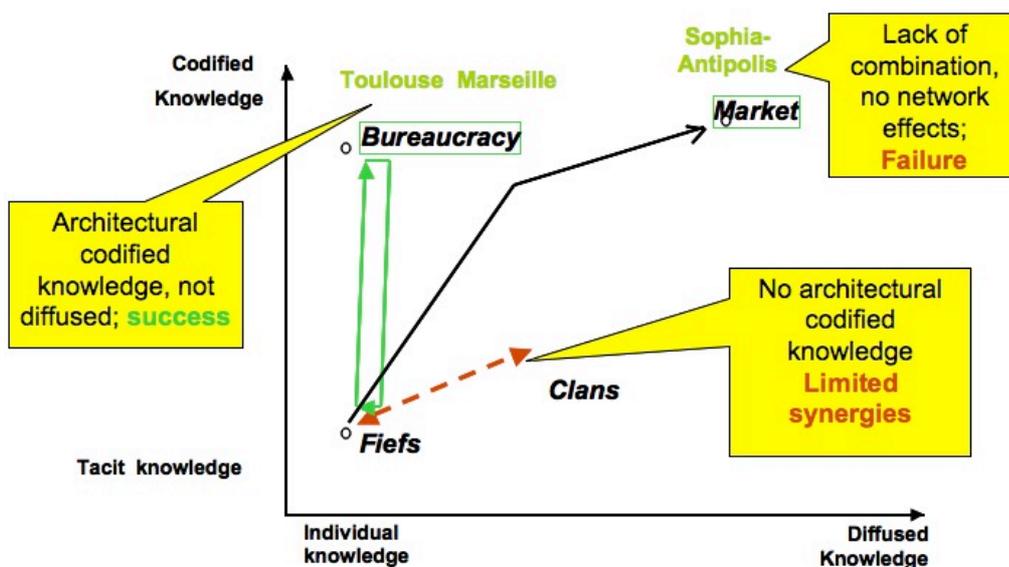
An important fact is that the difference of culture when comparing the two projects constitutes restraints the build-up of collective and shared architectural knowledge. The manager of Fabelor claims that the organisation of a scientific reporting day “ would make the CHU researchers come and would enable to see what is in progress in Nutrivigène project” (S. Desobry).

### Discussion and conclusion

The first results evidence the existence of highly different territorial dynamics, and the importance of the concept of architectural knowledge to analyze and characterize them. The analysis of architectural knowledge enables to enrich the concept of combinative complexity introduced by Carrincazeaux (2001).

The following provides a brief summary of these territorial dynamics: Three main distinctive dynamics can be identified, depending on the nature of the interactions implemented locally. The first one, seemingly quite efficient, characterize the aerospace pole of competitiveness (PoC), and well as the Marseille side of the SCS PoC (West side of the SCS PoC geographical area), the second one refers to Sophia Antipolis, located in the East side of the SCS PoC geographical area, and the third one to the Fabelor pole. These dynamics can be schematized through the following figure:

Figure 5: Characterization of territorial innovation dynamics



The Toulouse and Marseille poles are made of large firms, of SME and institutes of research. Their knowledge bases are characterized by the existence of a codified dominant design controlled by the large

firms included in the poles (Airbus – aeronautics in Toulouse, ST Microelectronics, Gemplus and Atmel in Marseille); they organize the combination of the SMEs' various technological knowledge which are represented as many Fiefs. The aerospace pole is illustrative of this phenomenon. Indeed its hierarchy is mainly based on the mastering of the architectural competences displayed by Airbus and the sub-system integrator. On the contrary, Sophia Antipolis, for instance, is characterized by highly varied knowledge bases, from microelectronics to computer science. This variety increases the combinative complexity and, in fine, few synergies are locally achieved (Lazaric, Longhi, Thomas, 2008). The cluster has no specific dominant design and most of its industrial and academic actors are involved in projects of innovation outside the pole. Moreover, the cluster is oriented towards services, uses, and IT applications conducting the cluster to make significant efforts in codifying knowledge; notably through its standardization. Indeed this codification process is carried by the creation of main European institutes such as ETSI, the European Telecommunications Standards Institute, located in Sophia-Antipolis, seeks to produce the telecommunications standards that will be used throughout Europe and beyond, or like the development of W3C, The World Wide Web Consortium, who develops interoperable technologies (specifications, guidelines, software, and tools) to lead the web to its full potential; and by doing so, the cluster has reinforced market relations.

The Fabelor cluster is more recent; contrarily to the others generally constituted of firms, it is mainly composed of public institutes of research. The teams involved predominantly belong to two institutions from Nancy, the INPL<sup>9</sup> and the CHU<sup>10</sup> (from l'UHP<sup>11</sup>). The first interviews conducted show that these institutions correspond to two clans where the actors belonging to the institutes of research, (fiefs) are used to cooperating. The combination of knowledge between these clans is today critical, as underlined by a first evaluation of the Fabelor project made by the Region in November 2008. It is useful to emphasize that even within a single clan, architectural knowledge are fragmented and tacit, making effective combinations difficult to realise. In order to improve these capabilities to combine, actors from INPL specialised in the conception, formulation, characterization and analysis of new molecules biodisponibility; have attempted to formalise this process: in short to codify a dominant design. Different meetings have been necessary and the design is not yet stabilized. It is also planned to better organize the process within the teams from CHU and between the two clans so as to formalise the process in its whole. Once this realised, the codification of architectural knowledge will deeply modify and improve the process of innovation in this cluster.

In the different case, the existence of architectural knowledge is pivotal to innovation. The holding of this knowledge by a specific category of actors is a source of power and grows as a structural element of the cluster innovation dynamics (aeronautics PoC and Marseille cluster). Their codification and sharing seems to be, as in the Fabelor case, a key condition of the implementation of an effective local innovation process.

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<sup>9</sup> INPL - Institut National Polytechnique de Lorraine – one of the three universities from Nancy.

<sup>10</sup> CHU : Centre Hospitalier Universitaire.

<sup>11</sup> UHP – Université Henry Poincaré – one of the three universities from Nancy, Nancy I.

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