Knowledge Synthesis

French "pôles de compétitivité" as accelerators of collective learning between public research and industry.

Do they create spaces for new forms of knowledge production?

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Abstract

In our work we focus on the politics of French competitiveness cluster (FCC) which we think stand out from others and also in terms of mobilization of the actors of innovation. In particular, by analyzing the evolution over time of this initiative we describe a collective learning process leading to the construction of cognitive proximity in local innovation networks that these clusters represent.

FCCs have become a source of meeting and collaboration between public research organizations and SMEs who were not part of these networks before. This form of meta-governance promotes the expression of a plurality of interests and has enabled SMEs to put forward their specificities. In terms of collective strategy, this has resulted in recognition of their needs and their intellectual property rights and an adaptation of the paradigm of innovation support to enterprises of small and medium size.

The originality of the FCC lies in the fact that they have fostered, through the principle of democratic participation, meeting spaces and partnerships between public research organizations and SMEs, contributing to a certain co-construction of knowledge between communities, and thus a more diffuse distribution of knowledge in the national economy. Thus, the poles are more than linear structures for technology transfers; they favor the existence of feedback between firms and public research, not only at the individual and team level but also at the whole organizational level, which brings them closer through interactive innovation structures and the innovative services they provide.

Résumé

Dans notre travail nous nous intéressons à la politique des pôles de compétitivité qui nous semble se démarquer des autres en termes de mobilisation des acteurs de l'innovation. En particulier, en analysant l'évolution dans le temps de cette initiative nous décrivons un processus d'apprentissage collectif qui a débouché sur la construction de la proximité cognitive dans les réseaux locaux d'innovation que sont les pôles de compétitivité.

Les PC sont devenus un lieu de rencontre et de collaboration entre les organismes de recherche publique et les PMEs qui ne se fréquentaient pas auparavant. L'organisation des instances de gouvernance qui favorise l'expression de la pluralité des intérêts a permis aux PMEs d'affirmer leurs spécificités. En ce qui concernela stratégie collective, cela s'est traduit par la reconnaissance de leurs besoins et de leurs droits de propriété intellectuelle et une adaptation du paradigme de soutien à l'innovation au profit des entreprises de petite et moyenne taille.

L'originalité des PC réside donc dans le fait qu'ils sont devenus, grâce au principe de participation démocratique, des espaces de rencontre et de partenariat entre les organismes de recherche publique et les PMEs, contribuant à une certaine co-construction des connaissances entre les milieux, et ainsi à une distribution plus diffuse de connaissances dans l'économie nationale. Ainsi, les pôles sont plus que des structures de transfert technologique linéaire ; ils favorisent l'existence de rétroaction entre les entreprises et la recherche publique, ce qui les rapproche de structures d'innovation interactives.

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Executive summary

The present work highlights conditions and mechanisms that favor successful collaboration between public research and academia in the French “pôles de competitivité” (French competitiveness clusters, (FCC)) using a synthesis of the available literature on this initiative.

The French competitiveness clusters are locally embedded networks composed of private large and small-sized enterprises, public research organizations, universities and vocational training institutions. They are a policy response to bridge the gap between academic research and industry, and particularly to promote applications of public research.

The aim of our contribution is to provide answers to the following question: what are the conditions and mechanisms favoring successful public-private R&D collaboration in the French “pôles de compétitivité?

We present the conceptual and theoretical framework to describe the policy of the French clusters. In management science, the FCCs are defined by the concept of “territorial networks of organization” (TNO). The organizational structure of the FCCs creates conditions for feedback loops between public R&D and universities, industrials and governmental institutions, at regional, national and European levels. In this sense, the FCCs are in line with the neo-Schumpeterian vision of innovation as an interactive process between actors of innovation.

Interaction implies inclusion of a temporal dimension in our analysis. Three main phases are highlighted in the evolutionary path of the FCCs:

a) structural conditions, referred to as “ecosystem of the poles” in official documents, i.e. structural characteristics of the members of the network that influence in fine the pattern of development of the FCCs, construction of its self-coordination, reflected in governance bodies, and outcomes of the collective endeavor

b) governance embedded in strategic and operational governance bodies reflects distribution of strategic power between the actors of the network, risk sharing related to collective endeavor and innovation and resource allocation.

c) outcomes of collective endeavor : this refers to the number and intensity of completed cooperative research projects and their end results (patents and other types of IPRs, innovative products, scientific publications), but also refer to the development of new mutual services to innovation, associated to new processes of collaboration, of learning, etc. , which appears as important to us as the possible end products or IPR.

Evolution of the FCCs can be conceived as a recursive loop of these phases.

The peculiarity of the FCC policy is that it does not simply rely on the “bottom up” dynamic. Self-coordination of the members of the poles is followed, and sometimes initiated and corrected by policy-makers at national and regional levels. In reality, national support is given to self-organized regionally anchored initiatives. Additionally, interventions of local authorities complement the national policy, by spurring organization of local actors into regional networks, by providing support specific to local needs and by coloring the “top-down” national policy prescriptions with objectives of regional development. The FCC policy construction is reflected in hybrid organizational forms of the FCCs characterized by a) reflexive self-governance of the networks of independent and, at the same time, interdependent “users” of the national policy prescriptions, i.e. firms, research and higher education organizations b) governance of self-governance, referred to as meta-governance (Jessop (1999)).

The deployed means of meta-governance are i) the delivery of the official label[4] "Pôle de competitivité"; ii) financial support to self-organized networks which are in line with the governmental strategy; iii) strategic roadmaps and "performance contacts"[5] that the FCCs present to the national Government and iv) official evaluations.

The FCCs as meta-organizers of collaboration share the risks intrinsically related to innovation, in particular by securing investment in R&D and providing spaces for IPR negotiations. The relational dynamics of the French poles and their evolutionary construction process result in creation of new social artifacts - social conventions, norms, institutional routines, policy tools that represent social capital that shape and reshape innovation milieux and innovation dynamics. Construction of social capital is a product of collective learning processes occurring when actors involved in the local innovation networks go through the evolutionary phases identified above. Innovation synergies arise when this process is effective.

Collective learning occurs in several relational configurations: intra-industry learning, public-private learning and societal learning.

Our report describes intra-industry learning process. At the inception phase, structural characteristics of each individual pole and strategic interactions between firms shape their governance bodies. Two main governance types emerge: governance by anchor firm and inclusive governance. The choice of governance has a considerable impact on emergence of collaborative synergies and number and intensity of collaborative projects between industry and science. Many pôles governed by anchor firms were counterproductive in terms of emergence of collaborative projects. Their performance was assessed as poor in 2008 and they had to undergo an in-depth reconfiguration. Clusters who adopted inclusive governance were positively assessed in terms of governance and innovation performance. Further, the most original result of the inclusive governance is that innovation policy initially conceived in the "top down" logic is reviewed and modified under the influence of the "bottom up" dynamic. The FCCs as inclusive meta-organizations have brought to light that SMEs have innovative behaviors and strategies different from those of large companies. Therefore, the tools in support of collaborative innovation have been progressively adjusted to take into account these specificities.

The experience of the clusters characterized by inclusive governance also shows that it is necessary to take into account the specificity of SMEs in the short and medium term to guarantee their sustainable membership in the program of collaborative research. At the same time, specific actions should be taken to enhance their technical competences.

In our report, we bring into focus the interactive learning process of public research in public-private R&D collaborations. Construction of cognitive proximity between public research and industry requires time, human, cognitive and financial resources. Actions of the "pôles" as meta-organizers are crucial in accelerating mutual discovery and construction of a common cognitive background on which future collaborations will be based. As an outcome of this process public research organizations and universities better identify the potential of their partners. This in turn helps public researchers to better understand industrial problems and to work more effectively upstream, doing the research, i.e. to move to the "mode 2"type of knowledge creation.

With respect to the SMEs, interactive learning results in a better understanding of the specificity of small-sized industrial partners. Less endowed with technical innovation capacities (few or no engineers or doctors in their teams), they need longer and more detailed exchanges to translate their industrial problems into research problems. Thus, the pôles represent a shift in the national innovation policy

[4] This also differentiates these organizations from the Canadian clusters (see appendix 4.3 and the articles and books referred to in the bibliography).
[5]for the FCCs which did not perform well in 2005-2008

towards facilitation of linkages between public research and SMEs and a better distribution of knowledge between economic actors.

Many competences of social sciences and humanities are transversal to all thematic research axes of the FCCs. Focusing on the issue of collective learning, research in social sciences has two missions: to assist and legitimate the pôles in their mission of coordination of the innovative networks and to accompany inter-organizational cooperative innovation projects. Challenges however remain for the SSH to build cognitive proximity with the other actors of innovation to be able to support technological innovation with social innovation.

As a major outcomes of the public-private learning process, collaboration within the FCCs has brought a new logic of co-conception of innovative projects. It implies that the architecture of the FCCs goes beyond the logic of unilateral technology transfer and linear innovation model.

We consider learning within public research institutions as a part of societal learning. First, we point out that increase in project-based funding increased the proportion of administrative paperwork in the working time of researchers. The administrative overload is mainly due to relatively weak organization of the funding system and redtape in application procedures. Second, in the context of increasing share of project-based R&D activities as well as diversity of thematic calls for projects coherently defined research agendas have been transformed in "portfolios" of diversified and complementary research themes and activities. Some evidence exists on the difficulty of researchers to go off the tracks from the commonly supported research areas in the context of project based-funding. In sum, project-based support contains a risk of lock-in effect in mainstream technologies and commonly admitted research agendas, through the imposition of thematic frameworks and selection process of applications.

On the positive side, public-private R&D collaborations inform public researchers about opportunities of commercialization of the results of their activities, specifically enterprise creation. Contacts with industrial partners tend to encourage mobility of researchers to private companies which in turn is expected to increase firms' technological absorptive capacities.

In our paper, we also discuss the areas where challenges remain and further learning is needed to advance on efficiency and sustainability of the FCC policy. They concern IPR negotiations within collaborative consortiums, and in particular sharing of the ownership of the results of collaborative research between academic research and private firms. Another issue is about better representation of public research in the governance bodies of the French clusters to find a balanced approach to innovation, i.e. balance between fundamental and applied research to avoid a lock-in in mainstream technologies and incremental innovation strategies. Moreover, specific actions need to be undertaken to articulate the "pôles de compétitivité" program with other knowledge transfer initiatives. To generate sustainable results, these changes need to be accompanied by a revision of the status researchers within public research institutions towards a better recognition of their participation in collaborative ventures. Lastly, the inclusion of the SSH into the FCC program remains a challenge and is conditional on a revision of the definition of innovation to better integrate society and human (well-)being.

1 Introduction and methodology

1.1 Context and motivation

In the context of increasing pressure of globalization forces, high-income countries have made the choice of innovation-driven competitiveness policies. The commonly newly admitted rhetoric is that firms have to be able to absorb, understand and handle existing knowledge derived from public research as well as to co-create new knowledge with academia to keep the competitiveness advantage. To improve on this, new policy initiatives are envisaged to bridge the gap between university research and industry, particularly to promote applications of public research. At the beginning of its existence the French policy of competitiveness clusters was rather oriented towards a model of support to R&D collaborative projects in general. Progressively it has evolved to policy in support of public-private R&D collaboration, paying more attention to cooperation between small-sized enterprises and public research institutions, and leading to a higher level of co-construction of knowledge including the mutualisation of new services to contribute to co-constrution of innovation between the two environments (public-private) on a given territory.

Canadian research agencies have already applied different strategies to target expenditure on R&D in the sector of higher education to stimulate innovation, for example, support of cross-sectoral partnership, pluriannual large-scale networks encouraging collaboration with private sector that generate economic short and long run benefits. Some Canadian cities such as Montreal also have a policy of technological clusters articulated with regional innovation policies. However, it appears to us that the French policy is more centered on the process of meta-governance linked to novel organizational forms in the building of cooperation between SMEs and public research. We also observe that it provides for modes of governance of IP (intellectual property) issues as well as budgets attached to calls for research proposals, which are not found in Canada, at least not as specifically to develop public-private cooperation and not in such a territorial perspective. This leads to developing a common language, research projects and learning, between the public research sector and private firms (and this is particularly original with SMBs, more often left out of such cooperation).

In this context, it appears that the French experience of "pôles de competitivité" (French competitiveness clusters – FCCs thereafter) can give new insights about allocation of resources into the higher education and research sector to stimulate innovation in the short and long term., as well as favor a certain « territorialization" of research projects and public-private cooperation, which can lead to more long term relations.

Historically, the French national innovation policies were based on industrial and technological definitions of innovation and focused on the needs and objectives of major national enterprises - "champions nationaux". The national concept was rather unfavorable to technological and process innovation in small-and medium-sized enterprises (Younès (2011)). As a consequence, public-private collaborative ventures were concentrated in a reduced number of large enterprises and national research organizations. Relationships between SMEs and academia were quasi-inexistent.

Meanwhile, the small and middle sized firms employ 55% of active population and generated 2.3 million new jobs in total 2.8 million over last 20 years[6]. Therefore, innovation of French SMEs is crucial for maintaining technology-driven competitiveness and growth of the French economy.

Although the FCC initiative is not the only program promoting public-private collaborative research, it has progressively positioned itself as a major policy response to the phenomenon of weak collaborations between small-sized enterprises and public research institutions, and the weak distribution of funds across the different actors of innovation (cf. detailed discussion in appendix 4.2). It also contributes to identify one or a few major sectors for a territory to concentrate its research and innovative activity,

[6] http://www.oseo.fr/a_la_une/actualites/les_pme_et_l_emploi_en_france visited 27.03.2012

thus favoring a grouping of territorial actors and a more dynamic territorial system of innovation, which can also contribute to prevent delocalization.

The aim of our contribution is to provide answers to the following question: ***what are the conditions and mechanisms favoring successful public-private R & D collaboration in the French "pôles de compétitivité?*** Our operational approach is to synthesize literature on this program, taking into account economic and political peculiarities of France.

The French policy of "pôles de compétitivité" – French competitiveness clusters (FCCs)

The French competitiveness clusters are locally embedded networks composed of private large and small-sized enterprises, public research organizations, universities and vocational training institutions. There are 71 officially registered "pôles de compétitivité" scattered around the national territory and encompassing main economic sectors: agriculture and agribusiness, healthcare, textile materials and chemistry, transport and logistics, electronics and software, renewable energy, sustainable development, nuclear energy, household equipment, aviation and space, security risks, mechanics, optics and photonics, financial services and trade.

The FCCs are given the legal status of non-profit organizations defined by the 1901 law. They have official governance bodies which are typically composed of a board of trusties, an operational governance body (animation team) and in some of them, a scientific council. Each institutionalized network has defined its development strategy and organizes actions that stimulate the emergence of multi-party cooperative research. Typically, projects that emerge within the FCCs involve at least two enterprises and one research center.

The strategic goal of the FCC policy is to "to strengthen the industrial potential of France, to create favorable conditions for the emergence of new competitive activities and thereby to improve the attractiveness of local territories and to prevent delocalization". The State invested 1.5 billion euros during the first phase (2005-2008); this budget was renewed for the second phase (2009-2012). In addition to the State funds local authorities allocated 750 million euros in 2005-2011. Between 2005 and late 2011, more than 3,000 R&D collaborative projects were subsidized. They totaled 4.9€ billion **in** expenditure**s** (public and private) and mobilized more than 20,000 researchers. In 2010, almost 1300 collaborative projects were completed, 40% of which resulted in commercialization of new products and processes.

The FCCs are accountable to the central and local governments. Two representatives of the State - the central Government representatives in regions and local authorities- supervise their functioning. Moreover, representatives of local authorities are often involved in the FCCs governance bodies as founders and/or active members. The FCCs have signed "contracts of performance" which clearly state their objectives and actions necessary for their development as well as implementation schedule and indicators for monitoring their achievements. Furthermore, they are evaluated every three years. The first official evaluation took place in 2008, the second official evaluation is ongoing. (cf. appendix 4.1)

1.2 Methodological approach

We have opted for a systematic narrative method considered as the most appropriate for reviewing qualitative literature (Jones (2004)). The narrative is the most appropriate for our exercise. Our ambition is not to establish if the French policy of competitiveness clusters is effective. We seek to gain understanding of the process of the policy intervention, to "open the black box" of the construction of the French innovation clusters and to identify elements transposable to the Canadian context.

For search and selection of contributions we have followed the guidelines of Petticrew and Roberts (2006). The selection process is organized into three steps : scoping review, refining search and set up of the core of relevant contributions, manual search of bibliography. Our decision to include "grey literature"[7] in the selection processes is motivated by the fact that the public policy is relatively recent with important decisions taken in 2009 and 2011. Such contributions are susceptible to bring a greater understanding of the policy, its context and its implications for end-users, which is crucial for our investigation.

To locate the relevant literature we have used the following methods i) search in electronic databases, ii) manual search in the library of the University of Aix Marseille and iii) contacts with experts[8].

To be included into the synthesis publications, books, thesis or grey literature have had to satisfy three criteria : to have its content fit one of the scoping review key words or themes, to show scientific quality for both conceptual or more empirical contributions (classified into three levels such as A, B, C) and to present "socially robust knowledge"[9] relevant for public policy implementation (classified into three categories such as low, medium or high level of operationalization).

- **First step: scoping review**

During the first stage we have searched systematically in every database using the key words « pôle de compétitivité » and « cluster innovant » present in the title or/and abstract for the French sources. To locate contributions in English, we have used the equivalents « competitiveness cluster » and « innovation cluster ».

At this early stage, in order to be considered as relevant, contributions should explicitly cover at least one of the following topics :

- a French competitiveness cluster;
- a review of literature on innovation clusters (in France or abroad);
- a theoretical concept of innovation clusters;
- the role of public research in innovation clusters.

The next taskwas to identify themes commonly debated in the preselected literature through quick reading and to group the literature around themes relevant to our review. At this stage the quality of contributions was not evaluated. We have determined 6 groups:

1. Governance within the FCCs (French competitiveness clusters), innovation capacity of SMEs as factors influencing the emergence of collaborative research;
2. Issues of human resource management in collaborative R&D projects;
3. The FCCs as a means of commercialization and dissemination of the results of public research and their links with other policy initiatives, "entrepreneurial university", the emergence of a "Mode 2"type of knowledge creation in public research;
4. Assessment and classification of the FCCs and history-dependent paths of their performance;
5. The humanities and social sciences as an intermediary who brings social innovation within the FCCs;

[7] Literature that is not found in peer reviewed journals and made up of practitioner journal literature, conference papers, books, literature from a range of public, private and voluntary sector bodies, and government publications.
[8]Two experts are members of the reviewing team. They provided grey literature not visible in search engines and sources which may not be indexed in electronic databases because they don't contain exactly the key words of the primary search. This is especially the case for theoretical, conceptual literature.
[9] According to Gibbons and his co-authors' words (Gibbons et al., 1994), chapter 11.

6. Concepts and theoretical models that describe the FCCs: clusters, networks, Triple Helix, meta-governance, collective learning.

At the end of this exercise we felt we had enough information objectified by the knowledge of the policy context to state a relevant question as well as to decide on the inclusion/exclusion criteria. We have also appraised heterogeneity of papers within each group to eliminate the bias toward a particular viewpoint. For this reason, theme 2 was eliminated. The papers are all written by a group of co-authors who use the same observation field. Despite interesting conclusions, we judged they were not illustrative enough to be included in the review. We decided to exclude theme 4 as a separate question and to handle it as a transversal issue complementary to themes 1 and 3.

- **Second step: refining search and set up of the core of relevant contributions**

To complement the themes of the review, we launched a new systematic search in the electronic databases using the following key expressions: "collaboration AND université AND industrie", "université entrepreneuriale", "recherche AND public-privé", "production AND connaissances AND mode 2", "Triple Hélice", "méta-gouvernance", "governance AND réseau", "governance AND cluster" and their equivalents in English "university industry collaboration", "entrepreneurial university", "public-private research", "mode 2 knowledge production", "Triple Helix", "meta governance", "governance AND network", "governance AND cluster".

- **Third step: manual search of bibliographies**

We have screened the bibliographical references in the core of the relevant literature to locate studies we may have overlooked. We identified 10 additional documents through this process.

The selection procedure produced the final set of 39 relevant contributions. Table 1 summarizes the selection process and its results.

At the end of the process each contribution obtained a combined note in terms of academic excellence and social robustness. To be selected the contributions had to be quoted « A » or « B » or « 2 » or « 3 ». Thus, our selection process is roughly open to the extent that we have not eliminated, as recommended by Higginson et al. (2002)[10], some contributions showing fragilities in their design: « There may be some articles in which the design is suspect […] but the findings appear important ».

Table 1. Selection of documents, by type of documents and steps

		Electronic search	Institutional reports and websites	Manual search	Contacts with experts
Step 1	Documents located during scoping review	832	24	4	4
	Set of studies after preliminary selection	97	10	3	4
Step 2	Refined search and selection within adequate themes	54	14	1	2
	Set of studies definitely included int the review	33	24	1	6
Step 3	Studies found and selected within bibliographic references of the selected documents	5	1	0	1
	Total	38	25	1	7

[10]Higginson, Finlay, Goodwin, Cook, Hood, Edwards, Douglas, & Norman (2002), p. 99 cited by Jones (2004)

2 Survey results: collective learning as an underpinning process of public-private R&D collaboration in the French « pôles de compétitivité »

2.1 Conceptual and applied framework: what conditions of success of the French "pôles de compétitivité" ?

From the viewpoint of social and political sciences, a number of alternative paradigms and concepts have arisen to describe the expanding phenomenon of connectedness and collaboration between public research and firms, state- or market-driven: "Mode 2" knowledge production (Gibbons *et al.* (1994), Nowotny et al. (2003)), "Mode 3 university" (Youtie and Shapira (2008)), Triple Helix (Etzkowitz and Leydesdorff (1998), (2000), Etzkowitz and Viale (2010)), territorial innovation systems (Morgan (1997), a detailed review is provided by Moulaert and Sekia (2003) and more recently Depret and Hamdouch (2009)).

To grasp the essence of the French policy of innovation clusters we draw on three conceptual paradigms. The structure of the clusters is described with the concept of territorial innovation networks (2.1.1). Self-organization and orchestration of the pôles are explained with the concepts of network meta-organizer and meta-governance (2.1.2). To understand the evolutionary dynamic of the French "poles" we use the concept of collective learning (Lundvall (1995), De Maillard (2004) and (2007)). Sustainability of collaborative ventures spurred by the FCC program is conditional on the existence of learning collective learning processes which result in construction of cognitive proximity and pave the way for "mode 2" knowledge production(2.1.3).

2.1.1 FCCs as territorial innovation networks and their evolutionary pattern

In management science, the FCCs are defined with the concept of ***"territorial networks of organization" (TNO)***, that is an original synthesis of territorial innovation approaches. TNO refer to "coordinated groups of heterogeneous, geographically proximate actors"[11] who for "various reasons (external constraints pushing companies to group together, seeking partnership for a better exploitation of resources, etc.)"[12] have built "market and non-market relationship, thereby creating sustainable interdependence but preserving their autonomy at the same time."[13]

Compared to unilateral technology transfer structures from university to industry, in which innovation is conceived as a sequential process from research to marketing, the architecture of the FCCs is broader and goes beyond the linear model of innovation. The FCCs create an opportunity for ***feedback loops*** between public R&D and universities, industrials and governmental institutions, at regional, national and European levels. In this sense, the FCCs are in line with the neo-Schumpeterian vision of innovation as an ***interactive process*** "between firms and the basic science infrastructure, between the different functions within the firm, between producers and users at the interfirm level and between firms and the wider institutional milieu" (Morgan (1997)).

Interaction implies inclusion of a temporal dimension in our analysis. Dynamic analysis brings a clear understanding of how the structure of the French innovative networks and relational interactions between their actors influence the construction of their self-governance, which in turn affects outcomes of the collective actions of their members. Furthermore, structural characteristics of the actors of the networks directly impact the capacity and willingness to engage in cooperative R&D projects.

Diagram 2 highlights ***three main phases*** in the evolutionary path of the FCCs:

[11] Ehlinger et al. (2007), p. 156
[12] *Ibid.*
[13] *Ibid.*

a) ***structural conditions,*** referred to as "ecosystem of the poles" in official reports, i.e structural characteristics of the members of the network that influence *in fine* the pattern of development of the FCCs, construction of its self-coordination, reflected in governance bodies, and outcomes of the collective endeavor. They include

a.1) *characteristics of the members* of the network: size of enterprises, intra-industry relations (sub-contracting, independent enterprises, sector activities…) and public-private relations (previous experience of collaborative research or not); the degree of integration of SMEs in the network and their technological maturity, i.e. readiness for collaboration with public research

a.2) *available resources* (cognitive, technological, political financial, social), *assets* (mutualizing inputs, educational offer to build a pool of local competences, business services) and *risks* as well as risk sharing and asset and resource allocation within the network;

a.3) type of *initiative* : can initially emanate from officially recognized and institutionalized network of heterogeneous actors; or emanates from public institutions, local authorities or public research trying to involve private actors ; or emanates from private enterprises with active support and intervention of local authorities

b) ***governance*** embedded in s*trategic* and *operational* governance bodies reflects distribution of strategic power between the actors of the network, risk sharing related to collective endeavor and innovation and resource allocation. Strategic governance bodies decide about development pattern of the network, its strategic axes and construction of collective assets . At the inception of the FCCs, two major types of strategic governance have emerged: coordination by an anchor firm and self-coordinated network of SMEs. They have progressively evolved towards a more inclusive form of governance (i.e. towards more equal distribution of strategic influence and allocation of resources) coordinated by the central state and local authorities. Operational governance bodies carry out animation activities to favor emergence of collaborative research and provide administrative support for projects that are set up.

c) ***outcomes*** of collective endeavor : this refers to the number and intensity of completed cooperative research projects and their end results (patents and other types of IPRs, innovative products, scientific publications), but also refer to the development of new mutual services to innovation, associated to new processes of collaboration, of learning, etc. , which appears as important to us as the possible end products or IPR.

and ***three intermediary phases****:*

i) *"jeux d'acteurs"*[14], a relational component which includes the degrees of influence and involvement of various stakeholders, their individual objectives and strategies, their willingness to cooperate, trust shaping the structure of the governance bodies. The architecture of governance is thus "an expression of power relations between different stakeholders"[15].

ii) *collaborative research processes and collective actions* in support of collaborative innovation decided and implemented by the governance bodies, in particular, pooling resources to build a common set of assets, sharing the risks related to this process, and asset allocation. Regarding SMEs, this includes policy tools in support of SMEs' expansion, their technological upgrading to achieve maturity, as well as (inter-)mediation of relations between enterprises, especially SMEs and public research.

iii) *self-assessment* of the outcomes of the collective endeavor and *corrective actions* that bring changes in structural conditions, modify the "jeux d'acteurs" and the architecture of governance which in turn affect the cooperation processes, collective actions and final outcomes.

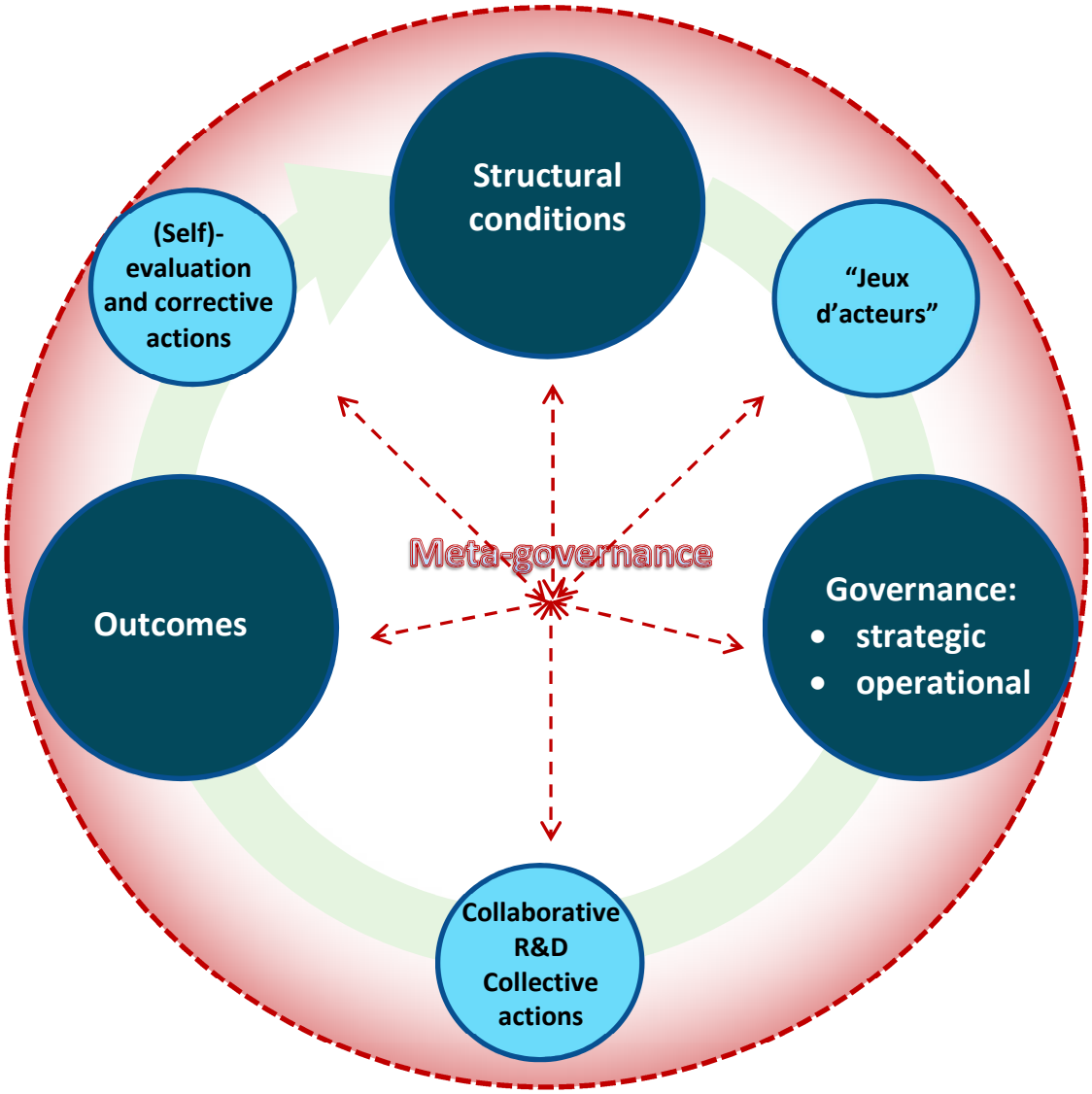
[14] players' games, terminology proposed by Ehlinger *et al.* (2000). This refers to the interactions between actors, their power relations and other forms of relations between them.
[15] Chabault (2011), p.40

Evolution of a FCCs can be conceived as a recursive loop composed of the main and intermediary phases.

The peculiarity of the FCC policy is that it does not simply rely on the "bottom up" dynamic. Self-coordination of the members of the poles is followed, and sometimes initiated and corrected by policy-makers at national and regional levels. Thus, the French concept of territorial networks is different from clusters in the sense defined by Marshall or Porter, since it implies existence of an active and mobilizing operational center that gives impetus to the core dynamics of the network. The main goal of this "organizational management" is "to define a global strategy, to coordinate the actors and to monitor cohesion of the network"[16]. Also, the FCCs have a clear research objective, and budgets to be distributed to projects.[17]

However the managerial approach does not specify, from a theoretical viewpoint, the role of public actions in these networks and their juxtaposition with private action. To fill this gap, we adopt the concept of meta-governance used in political sciences.

Diagram 2. Collective learning process in the French "poles de compétitivité"



[16] *Ibid.*

[17] This probably favours a more active collaboration than is observed in other, more "spontaneous" clusters, as those observed in the ISRN research on clusters (except for cases where there may have been research budgets)

2.1.2 Meta-governance of the FCCs and its influence on their evolutionary pattern

This centralized national policy intervention rests on and takes into account the "bottom-up" dynamics. In reality, national support is given to self-organized regionally anchored initiatives. Additionally, interventions of local authorities complement the national policy, by spurring organization of local actors into regional networks, by providing support specific to local needs and by coloring the "top-down" national policy prescriptions with objectives of regional development. The FCC policy construction is reflected in ***hybrid organizational forms*** of the FCCs characterized by a) reflexive self-governance of the networks of independent and, at the same time, interdependent "users" of the national policy prescriptions, i.e. firms, research and higher education organizations b) governance of self-governance, referred to as meta-governance (Jessop (1999)) or, alternatively, governance by contract (Gaudin (2007)).

The policy is implemented in the form of indirect steering of relatively autonomous stakeholders in contrast to command and control through bureaucracy. The meta-governance establishes "the ground rules for governance and the regulatory order in and through which governance partners can pursue their aims"[18]. The deployed means are i) the delivery of the official label[19] "Pôle de competitivité"; ii) financial support to self-organized networks which are in line with the governmental strategy; iii) strategic roadmaps and "performance contacts"[20] that the FCCs present to the national Government and iv) official evaluations. In other words, the Government keeps "a relative monopoly of organizational intelligence and information with which to shape cognitive expectations"[21].

From an institutional viewpoint, the innovative networks are public-private organizations. In socio-economic sciences, the concept of "network meta-organizers" (Rullani (2000)) perfectly describes this hybrid organizational form. The "network meta-organizers "carry the power emerging from functional necessity of relations that have to coordinate diverse interests."

On the dynamic side, it means, meta-governance influences the evolutionary pattern of the networks; self-coordination occurs "in the shadow of hierarchy"[22], illustrated by dashed red lines in diagram 2. This conceptual framework gives us understanding of the role a State or local authorities can play with respect to the network meta-organizers. They can be "substitutes" and can "stand against the role of old monopolistic powers being transferred" (Rullani (2000)) by enabling communication within the networks and ensuring universal rights and access.

Furthermore, meta-governance endowed with accountancy and performance assessment tools cannot be reduced to policy strategy for achieving the "'3Es' of economy, efficiency and effectiveness"[23]. Increasing fuzziness of hierarchical relationship between State authority and civil society opens opportunities for policy advice on the practice of meta-governance from the latter. ***The FCCs appear as interactive spaces for firms, public research and higher education organizations, orchestrated by national and regional authorities, which at the same time provide them with feedbacks about the policy effectiveness.*** This idea joins recent works in political science on governance of public policy networks (Bevir and Rhodes (2010)) and unveils the notion of meta-governance operating in a context of "negotiated decision-making" (Jessop (2007)):

[18]Jessop (1999)
[19] This also differentiates these organizations from the Canadian clusters (see appendix 4.3 and the articles and books referred to in the bibliography).
[20]for the FCCs which did not perform well in 2005-2008
[21]Jessop (1999)
[22]Scharpf (1994) cited by Jessop (1999)
[23]Bevir and Rhodes (2010)

> "…meta-governance does not eliminate other modes of co-ordination. Markets, hierarchies, and heterarchies still exist. On the one hand, market competition will be balanced by cooperation, the invisible hand will be combined with a visible handshake. On the other hand, the state is no longer the sovereign authority. It becomes just one participant among others in the pluralistic guidance system and contributes its own distinctive resources to the negotiation process."

The relational dynamics of the French poles (within the networks as well as between the networks and the State – representatives in regions and regional authorities) and their evolutionary construction process result in creation of new *social artifacts* - social conventions, norms, institutional routines, policy tools that represent ***social capital*** that ***shape and reshape innovation milieux and innovation dynamics***. Construction of social capital is a product of ***collective learning processes*** occurring when actors involved in the local innovation networks go through the evolutionary phases identified above. Innovation synergies arise when this process is effective. Social capital is a basis on which ***cognitive proximity*** is built. Regarding collaboration between public research and industry it is a prerequisite for ***"mode 2" of knowledge production***.

2.1.3 Collective learning towards cognitive proximity and "mode 2" of knowledge production

We claim that in FCCs as network meta-organizers and spaces of meta-governance, collective learning occurs in several relational configurations: intra-industry learning, public-private learning and societal learning[24].

a) ***Intra-industry*** learning is about construction of cooperative attitudes between firms, along the same supply chain (between small and medium sized sub-contractors and big companies they supply) as well as between firms operating in distinct sectors and at different technological levels, referred to as **cognitive proximity**. This process is embedded in shaping and reshaping representation in the self-governance bodies of the FCCs. Depending on their composition and the degree of influence of their members the governance bodies instill a long-term vision (strategic governance) and organize specific actions to stimulate emergence of collaborative projects (operational governance). Consensus legitimized by all members is found through repeated interactions, learning about hidden agendas, building strategic alliances, lobbying individual interests and negotiating concessions. Thus, ***the first policy stake*** of this learning process can be formulated as follows: **collective learning results in an increased consideration of the needs of SMEs in collective strategies and actions** and gradual increase of the innovative projects led by SMEs (section 2.2).

b) ***Public-private*** learning refers to situations where science and the economic sphere are gradually becoming "mutually invasive and invaded"[25], leading to co-innovation as opposed to linear technology transfer processes. The FCCs are spaces of gathering and mutual discovery between actors who have never collaborated before, specifically between SMEs and public research organizations.

On the firm's side, the learning process results in enterprises, especially small- and medium-sized enterprises, becoming aware about public research, and reconsidering their innovation capacities and competitiveness strategies.

On the public research side, it is reflected in a **move to "Mode 2" of knowledge production**, understood as generation of scientific knowledge "in the context of application"[26]. This brings us to the formulation of ***the second policy stake***: **the FCCs create a cognitive space where economic actors, especially small-**

[24] Lam (2000).
[25] Gibbon et al. (1994), p. 54
[26] Gibbon et al. (1994), p. 1

sized enterprises, "speak back to science" through new institutionalized representative processes[27] and suggest "problem-inspired and problem-oriented research"[28] (section 2.3)**.**

At the national level, these transformations induce a shift from concentration of R&D subsidies and collaborative activities among few big corporations and public research centers to a much greater diversity of participants and beneficiaries of public support to innovation (medium- and small-sized firms, universities, smaller research centers). Our analysis of the literature included in the synthesis suggests the FCCs contribute to a more equal distribution of knowledge across economy and society[29].

c) ***Societal learning*** refers here to learning of public institutions about their relation with society. It includes at the national level the self-reflexive mechanisms of the meta-governance of the FCCs: official assessments and monitoring at the local level through coordination with local governments and representatives of the central State in regions. Official assessments provide collective feedback about functional linkages and material interdependencies among different spheres of action, relative coherence among diverse objectives, spatial and temporal horizons, actions and outcomes of the policy arrangements. Increased visibility and voice of certain groups of actors in the FCC governance bodies reshape the architecture of the policy intervention. Conclusions and propositions of official evaluations and impact studies induced adjustments in policy formulations and practices. The evaluators themselves have been conducting retrospective self-assessments and questioning their methods[30].

At the regional level, local authorities have gradually learned their dual position as umbrellas of self-governance and at the same time as actors in the self-regulation of the innovative networks.

On the public research side, interactive learning is about articulation of collaborative ventures with scientific research. The ***third policy stake*** **is recognition of cooperation with industry as a part of the research profession** by researchers, public research institutions and authorities in charge of research policy**, a greater fuzziness of boundaries between research and innovation** (sections 2.4 and 2.5).

2.2 Intra-industry learning and emancipation of SMEs

This conceptual framework gives the bases to apply a more empirical and detailed literature analysis of learning processes bridging the gap between industry and public research. Case studies of 9 "pôles de compétitivité" found in the related literature illustrate this evolutionary pattern. Selection was made taking into account the three classes of "pôles" defined by Boston Consulting Group in their evaluation work[31] commissioned by DIACT[32]:

- SCS (Solutions Communicantes Sécurisées - Secured Communication Solutions specialized in micro-electronics, telecommunications, software and multimedia)[33] and Cosmetic Valley (perfume sector)[34], Mer PACA (maritime security and safety, ship and nautical industry, marine energy and biological resources, environmental and coastal management)[35]and Pégase

[27] *Ibid.* p. 54
[28]*Ibid*., p. 76
[29]Big industrial players will largely benefit from the Great Loan program financing infrastructure and research directed to "national champions" organized into Institutes of Technological Research within the FCCs. Is France losing its opportunity to reshape its old system of research and innovation to a more democratic and more inclusive representation?
[30]http://www.institut.minefi.gouv.fr/sections/modernisationgp/repp/repp5?igpde_lang_redirect=1 visited on April, 19th
[31]DIACT (2008)
[32]DIACT, currently DATAR - Délégation interministérielle à l'Aménagement du Territoire et à l'Attractivité Régionale Interministerial Delegation to Local Planning and Regional Attractiveness
[33]Gadille et Pelissier (2009),
[34]Chabault (2011)
[35]Mendez et *al.* (2008)

Aéronautique et Spatiale (aerospace sector)[36] classified as world-class clusters that achieved the objectives of the FCC policy;

- Arve-Industries (complex machining and precision engineering)[37] PEIFL (Pôle Européen d'Innovation Fruits et Légumes- European Cluster for Innovation Fruits and Vegetables)[38] classified as national-class clusters that partially met the objectives of the FCC policy;

- PASS (Parfums, Aromes, Saveurs et Senteurs - Perfumes, Aromas, Flavors and Fragrances, cosmetics sector), PNB (Pôle Nucléaire Bourgogne - Nuclear Cluster of Bourgogne, nuclear energy sector) and S2E2 (Science et Système de l'Energie Electrique- Science and Electrical Power System, electrical energy technologies and smart grids in the service of energy management)[39] were evaluated as national-class clusters that need in-depth reconfiguration.

A comparative study of the evolution of these clusters highlights how differences in structural conditions (section 2.2.1) and divergent relational dynamics reflected in the architecture of governance systems result in differences in their performance (section 2.2.2). The advantages and risks associated with these governance processes are discussed in section 2.2.3.

2.2.1 Structural conditions

Structural factors determine the development pattern of a FCC as well as the outcomes of collective endeavor. They include the initiative on which a FCC is built and characteristics of firms that are members of the innovative network.

The ***type of initiative*** implies existence or absence of relationships between private enterprises and public research organizations that preceded official registration. Three scenarios are documented in the literature.

i) ***Private initiative***. Collaboration has long preceded official creation of a pôle, registration formalized pre-existing relationships. These relationships were embedded in entities such as technology transfer units, regional development agencies, professional associations or RRITT[40]. The objective of this initiative is to strengthen existing ties, to capture public funds, to widen the circle of partners through greater visibility of the network. The clusters PNB, and S2E2 fall into this category.

ii) ***Public initiative***. In some cases, clusters do not rely on historical partnership. Its creation is initiated by a local political actor with the aim to structure the economic sector, to make it more competitive through greater collaboration and to contribute to local development. Examples of this initiative are the pôles Arve-Industries and PASS[41]. Previous cooperative relations existed long before the construction of a pôle but their dynamic was insufficient. The project came into existence thanks to strong implication of local officials. The cluster PEIFL followed this logic.

[36]Gadille (2008)
[37]Boquet et Mothe (2008), Boquet et al. (2009)
[38]Mendez et *al.* (2008), Fulconis et Joubert (2009), Messenghem et Paradas (2009)
[39]Chabault (2011)
[40]Réseaux de recherche et d'innovation technologique – Networks for research and technological innovation. Created in 1998 they gather actors of innovation of the same technological area : research centers, universities and engineer schools, large companies and SMEs, professional associations, economic interest groups, technological centers.
[41]It should be noted that this institutional actor is also an important economic actor in the sector. This factor played an important role in constitution of governance bodies of the cluster and its performance outcomes

iii) ***Joint initiative***. In the case of the pôle SCS, actors of a pre-existing knowledge network started the project of self-organization into a competitiveness cluster. Local authorities have encouraged the network to open up to other sectors and networks to increase their innovative potential and to structure the local territory. The network that preceded the creation of the pôle Cosmetic Valley had a predominantly industrial logic. Stimulated by local authorities, the network extended its priorities to include R&D.

From the perspective of the ***firm size and their cognitive endowments***, three characteristic situations are observed:

1. Pôles with a strong predominance of "non-science based" SMEs, i.e. SMEs whose innovation strategy is not based on technological research: PASS, Arve-Industries, PFEIL.

2. Pôles organized in a "bunch of grape": a large "anchor firm" with SMEs hanging around, mainly subcontractors, "non-science based" or with research potential limited by the needs of the large company: PNB and S2E2.

3. "Diversified pôles": large companies, "science based" and "non-science based" SMEs which have multiple and combined (sub-contracting or not) partnerships: SCS, Cosmetic Valley, Mer PACA and Pégase Aviation and Space.

The available literature on networks emphasizes the concepts of ***cognitive proximity*** and ***cognitive distance*** ((Dang and Longhi (2009)), Mendez and Bardet (2008) and the ***complementarity of knowledge*** (Gadille and Pelissier (2008)) to explain the ease or the difficulty of the competitiveness clusters to breed collaborative innovation projects.

With respect to cognitive proximity, one can distinguish two types of proximity: ***i) public research – industry proximity*** i.e. cognitive proximity between research organizations and industrial firms and ***ii) intra-industry proximity,*** i.e. cognitive proximity between private firms. Regarding ***intra-industry proximity***, observed difficulties are related to the status and mode of knowledge management of SMEs:

- ***Non-patentability of research results***. Cooperation may be difficult to envisage in sectors that do not use the legal instruments for protection of inventions. This is the case in the cluster PASS where the culture of secret is an instrument of protection. This issue is also raised by M. Gadille in her analysis of the pôle SCS. This question seems to be relevant for all sectors. The most sensitive question is the fragility of "non-science based" SMEs with respect to large companies and other SMEs who register patents. Sharing of results of collaborative research in their model of knowledge production and marketing is a complex issue (especially if one takes into account that there is no Small Business Act in France). Thus, the role of the meta-organization is crucial in this area (Nkoudou Bessala (2012)).

- ***Contradictory competitiveness strategies***. A proportion of the small- and medium sized enterprises members of the cluster in Pégase consider collaborative R&D as an opportunity "to emancipate from their sub-contracting network" and "to diversify their markets including international markets"[42]. In the supply chains of clusters S2E2 and PNB and to a lesser extent in the cluster SCS, sub-contracting dominates other forms of inter-firm cooperation. A large firm, the final client of small sub-contractors attempted to monopolize or effectively monopolized decisions about strategic orientation of the cluster, to serve its interests.

- ***Innovation strategy of enterprises is not based on technological R&D ("non-science based" firms)***. Most of small and middle-sized enterprises of the clusters and PASS and PFEIL possess neither the skills nor the technological resources to start a dialogue with public research. Their

[42]Gadille et Valette (2012), p.9

short-sighted strategy is in contradiction with requirement of relatively long-term investment for collaborative R&D with public organizations.

- ***Suspicion of SMEs vis-à-vis large companies***. Given the previous factors, the presence of large companies in the network meta-organizer sometimes dissuades SMEs. They remain suspicious vis-à-vis the system of support to innovation proposed by the cluster that they judge too focused on the needs and goals of large groups and conducive to strengthening of their dominant position. For example, this attitude was observed in the Cluster Mer PACA[43] but it is illustrative of many pôles that "were initially organized around large industrial groups and research centers in the spirit of "factory of projects", sometimes to the detriment of development of tools specific to SMEs or to the detriment of consideration of their stakes in defining strategic priorities of the pôle." Mendez et al. (2008) emphasize that funding options available for collaborative projects within the FCCs favor collaborative research projects between large companies and public research organizations. The report on behalf of DIACT (2008) confirms this argument: "a significant proportion of small and medium-sized members of the clusters have [..] no ability or interest to invest in ambitious projects like FUI[44]."[45]

Gadille and Pelissier (2008) draw on the work of Antonelli (2003) on the concept of ***complementarity of knowledge*** to offer an alternative vision of proximity. Some types of technological knowledge can be combined to a limited number of other bricks of knowledge to produce new blocks of knowledge. It implies that companies with complementary competences are more predisposed to create ties within a cluster. Other types of knowledge are "fungible" as their potential field of application extends to a wide variety of sectors. Their knowledge is not in strict complementarity to other innovative companies of the cluster. Articulation of their knowledge with the "dominant technological paradigm" is delicate. For example, companies member of the cluster SCS specialized in multimedia content and business software were virtually absent in collaborative projects at early stages of the existence of the pôle, namely because of the fungibility of their knowledge with respect to the mainstream strategy. Local authorities involved in the cluster considered this as an opportunity to renew the technological system of network and to open new avenues for innovation. At the same time, representation in the governance bodies of these firms raises the questions of legitimacy vis-à-vis historical incumbents.

The issues discussed above underscore ***challenges that the FCCs face as initiators and meta-organizers of cooperation between actors who have different systems of representation, individual strategies, and heterogeneous cognitive resources***:

- finding an optimal balance between cognitive proximity and cognitive distance,
- organizing coexistence of firms with complementary and fungible knowledge to stimulate innovation,
- finding a compromise between interests of large companies and sub-contracting SMEs,
- letting "non-science based" firms into the logic of technological innovation,
- elaborating a collective strategy and actions convenient for all actors of innovation.

Under initial conditions specific to each cluster, they have built their own governance systems. During the period between 2005 and 2008, two major types of governance are distinguishable: governance by anchor firm and inclusive governance.

[43]Mendez *et al.* (2008) Ch2 , p.. 134
[44]Fond Unique Inteministériel – Unique Interministerial Fund – the main agency that funds clusters' collaborative projects
[45] DIACT (2008), p. 24

2.2.2 Two major types of governance of the « pôles de compétitivité » and their performance gaps

Construction of the governance system of a FCC depends on the initial structural characteristics of the network and on strategic "jeux d'acteurs". The latter can be qualified as a relational component which includes the degree of influence and involvement of various partners, their individual objectives and strategic stakes. The architecture of governance reflects relational equilbria that actors find progressively through repeated interactions. Governance is "an expression of strategic influences between different stakeholders." [46]

During the time span between 2005 and 2008, different types of governance have been identified by academics leading to complex typologies[47]. According our main question, we can say that these different types can belong to two major types of governance, governance by anchor firm and inclusive governance. The choice of governance proved to have a considerable impact on emergence of collaborative synergies and number and intensity of collaborative projects between industry and science. The outcomes of the collective actions decided by and collaborative innovation projects supported by governance bodies of the FCCs were assessed during official evaluation in 2008 of each FCC.

- ***Governance by anchor firm*** is defined as a situation when a large-sized company acts as an expanded strategic center structure around which the pôle as meta-organizer is constructed.

This type of governance emerged in the pôles S2E2 and PNG as well in the pôle PASS in the early stages of its existence. The potential advantage of this type of governance, in particular mentioned the work of Mendez and Bardet (2008) is that the leader ensures consistency of collective actions, promotes and maintains collective dynamic that guarantees the sustainability of the venture.

The case of the pole S2E2 perfectly illustrates this configuration: "STMicroelectronics holds the central place in the "pôle". Besides hosting the cluster's animation team and providing with many resources (material and immaterial), the company is active in various governance positions (President of the Council of Foresight and Strategic Orientation, Vice-president of the Board)"[48].

"Monopolizatoin" of decision-making power leads to adaptation of strategic collective vision to individual needs of leading enterprises. This proved to be counterproductive in terms of emergence of collaborative projects.

The strategic objective of the pole S2E2 "to sustain a core that works well and to expand it" defined by the leading firm has not been sufficiently open and legitimate to attract new actors and to create collaborative synergies. Its results in terms of innovation were assessed as poor during official evaluation in 2008. Similarly, the specialization choice of the pôle PNB produced an effect of adaptation of its strategy to industrial needs of the group AREVA. This assimilation of PNB to AREVA proved "counterproductive vis-à-vis some national granting organizations, such as ANR, who refused to finance projects explicitly linked to a large public company." [49] Indeed, during the period between its creation in 2005, and evaluation in 2008, only two projects obtained State funding. Its performance was evaluated as poor.

- ***Inclusive governance*** is defined as "a process of confrontation and adjustment of systems of representations and actions of groups of actors who are geographically close but may have different organizational and institutional backgrounds with the objective to run a local

[46] Chabault (2011), p.40
[47] Caillou et al. (2012)
[48] Chabault (2011) 46
[49] Fen Chong et Pallez (2008), p.15

development project"[50]. "Public authorities may act as agents of coordination, arbitration or communication between companies, associations, trade unions, scientific and technological organizations."[51]

The main advantage of inclusive governance is that it is open to a plurality of views. Expression of individual views and confrontation of interests leads to a consensus, definition of a collective strategy legitimated by all actors. Openness and inclusiveness of networks is a guarantee for integration of new actors. Potentially, it increases possible combinations of diverse knowledge and thereby opportunities for innovation. Involvement of public authorities is seen as a prerequisite for inclusiveness to emerge in in the governance systems of territorial networks.

The pôles Mer PACA, Cosmetic Valley and Arve have collectively agreed at the very beginning of their creation to build an inclusive governance system. "No one is left aside"[52]. In the pôle Mer PACA, for example, small and medium-sized enterprises have as many representatives in the strategic governance body as large companies and public research centers. Such construction of the collective coordination system enables for differentiation of the needs of enterprises, depending on their cognitive and technological endowments and adoption of actions taking into account these differences. In the pôle Arve Industries, for example, this is illustrated in the strategic choice to "protect inventions of enterprises, including the tiniest ones, thereby giving them incentives to innovate"[53]. The choice of the clusters proved to be effective: Mer PACA and Cosmetic Valley confirmed their position as world-class clusters which achieved the objectives of the FCCs policy. Arve Industries was classified as a national-class cluster which partially achieved the policy objectives. Its performance can be compared against that of the pôle PASS since they share similar structural characteristics.

The pôle SCS represents a similar configuration with a major specificity that local authorities invited the network of actors specialized in microelectronics to open up to "non-science based" enterprises specialized in multimedia content and software for business activities. The ***ambition to create cognitive proximity*** in theory brings together complementary skills to create new synergies between different partners and between different technological systems. In practice however, collaborative projects between the software producers and firms specialized in microelectronic devices are still rare. Even though their implication has inspired a new dynamic in the sector and has unveiled collaboration areas, actors acknowledge that "there is still progress to be made to get partners involved."

To complete the picture, it should be noted that the FCCs that have been initially coordinated by an anchor firm are now converging to the mode of inclusive governance. ***National authorities, in their role of meta-governors*** have initiated this adjustment process ***using the contractual mechanism of subsidies and official assessments***.

2.2.3 Performance assessment: advantages and risks of governance by anchor firm and of inclusive governance

On the one hand, absence of a plurality of strategic visions, a recurrent characteristic of governance by an anchor firm, contains a major risk of lock-in in counter-productive strategic choices and activities. Meta-governance of the FCCs reduces this risk of asymmetry of representations, which is an important contribution of the FCCs.

On the other hand, a too strong dependence of a cluster on public initiative may is associated with the risk of the failure of the meta-organizer to initiate collaboration between highly heterogeneous actors whose knowledge representations are too distinct and who do not have experience of collective work in the past. In other words, effective proximity and cooperation cannot be ordered. They are to be built.

[50] Ehlinger *et al.* (2007), p. 165
[51] *Ibid.,* p. 166
[52] Boquet et Mothe (2008), p. 115
[53] *Ibid.*, p. 118

This construction is time consuming, at risk for the pôle as a network meta-organizer, to fail to generate effective collaborative projects within time frame defined by the Government.

Further, the existence of a network meta-organizer ***is not automatically synonymous with inclusive governance that takes into account the interests of SMEs***. The governance of the pôle Mer PACA is in principle open to small enterprises. They have as many representatives to the Steering Committee of the pole as large companies and public research organizations. The system has evolved to better take into account their specificities. However, historically defined patterns are sometimes difficult to overcome: individual interviews run in 2008 pointed out that small enterprises tended to be discriminated against in favor of large companies if they present similar projects (Mendez *et al.* (2008)). The official assessment (DIACT(2008)) highlights that SMEs accounted on average for of 30% of pilots of collaborative projects but this proportion declines in world-class clusters where the influence of large groups is more pronounced. The results of the forthcoming official evaluation will provide with more nuances on this subject.

Effective inclusiveness occurs when ***SMEs are self-organized into lobbies supported by local authorities***. In the pôles SCS and Pégase, classified as world-class clusters, analysis reveals that the presence of a lobby of SMEs defending their interests and implication of local government in the clusters' design made it possible to avoid the risk of monopolization of governance by the anchor firm.

To sum up the lessons to be learnt from these experiences, ***the most original result of the inclusive governance*** is that innovation policy initially conceived in the "top down" logic is reviewed and modified under the influence of the "bottom up" dynamic. The ***FCCs as inclusive meta-organizations give evidence that SMEs have innovative behaviors and strategies different from those of large companies***. Therefore, ***the tools in support of collaborative innovation have been progressively adjusted to take into account these specificities***.

Taking into account the needs and interests of all private actors, however, could pose ***a risk of "bringing down" the performance of a network from the viewpoint of technological innovation, at least in the short and medium term***. For example, the collective vision of the members of the pôle Arve-industries converge to the consensus that network performance does not necessarily imply ambitious research partnership[54]. But some of the members of the governance recognize that "a systematic use this view [...] could mask a lack of results." [55]

This vision raises two important questions concerning the evolution of the FCCs policy. The first is about ***definition of innovation***, more precisely, consistency of the definition with actual innovation practices of SMEs that are not necessarily built on the "science based" innovation model.

The synthesis of available knowledge brings us to conclude that ***it is necessary to take into account the specificity of these SMEs in the short and medium term to guarantee their sustainable membership in the program of collaborative research. At the same time, specific actions should be taken to enhance their technical competences as it was done in the pôle Pégase Aéronautique et Spatiale***. A strategy to support expansion of SMEs was concluded between them and the pôle. Initially subsidized by public authorities it is now partly self-financed. It seems vital for the SMEs to be able to engage in collaborative projects with public research organizations in a longer run.

A better representation of SMEs at the regional level has important implications for collaboration with public research. We will see below that the FCCs offer spaces where SMEs and public research organizations can meet and collaborate. It is a real shift in the French innovation policy.

[54]Boquet et Mothe (2008), p. 115
[55]*Ibid.*, p. 113

2.3 Interactive learning of public research in public-private collaborative projects

Collaborative projects with industry have become a vital necessity for public research facing gradual cuts in permanent public subsidies. The FCCs provide financing to embark on ambitious collaborative projects, favorable conditions for enhancing contacts and networking, especially with SMEs and opportunities for social sciences and humanities to take part in cross-disciplinary projects (2.3.1). Cooperation with private enterprises backed by the pôles creates cognitive proximity between public research and industry, a crucial element for renewal of collaboration (2.3.2). Research in SSH is important to accompany technological collaborative innovation which requires innovative approaches in social organization (2.3.3). Among outcomes, the FCCs managed to create and enhance sustainable collaborative dynamics, beneficial for public research financially but also in terms of new partnership with SMEs and stimulation of the logic of co-production of knowledge (2.3.4)

2.3.1 Structural conditions conducive to public-private research collaborations and factors that hinder it

Financial support to public research has been evolving from the mode of regular core allocations to public research to the mode of project-based support. In 1982, public research was mainly financed via the channel of permanent resource allocations; Thèves et al. (2007) show that its scope shrank considerably by 2002, while project-based support achieved 43% of total resource allocations. Substitution of permanent support by project-basis subsidies brings researchers to seek for external resources, in particular for collaborative contract with firms in the competitiveness clusters.

The financial support provided by the FCCs program serves as ***a stimulus for public research organizations to seek to enhance their pre-existing relations with industry***. ***The generous State subsidies*** seem to create a slight ***eviction effect***, at least for the period between 2005 and 2007[56]. Two thirds of the directors of the public research organizations reported the FCCs contracts were substitutes of direct collaboration contracts with industrial firms[57].

It would be wrong to qualify the public funds as substitutes of private investment in R&D. ***The FCCs as meta-organizers of collaboration share the risks intrinsically related to innovation, in particular by securing investment in R&D and providing spaces for IPR negotiations***. Thus, they are a new opportunity for actors of innovation ***to embark on more ambitious projects than they could have done without public intermediation*** (Erdyn (2010)).

Furthermore, the FCCs provide conditions for ***construction and enhancement of local networks:*** most representatives of academia interviewed point that they expect the pôles to identify and enhance partnerships with local actors of innovation and to build them around promising research axes (Erdyn (2010)).

Focusing specifically on social sciences and humanities, the FCCs provide favorable conditions to become active partners in cross disciplinary research projects. It has become commonly admitted that successful innovation requires combination of multidisciplinary knowledge and skills not only of the natural sciences but also of the social sciences and even of the humanities (Gibbons *et al.* (1994)). Conversely, "industry is also becoming a more serious player in social science research – for example on issues related to public health, sustainability of natural environment, risk perception, alternative dispute resolution, the operation of informal economies and the ethics of research"[58].

[56] *Ibid.,* p. 12
[57] Erdyn (2010), p. 39
[58] Gibbons *et al.* (1994), p. 72

Despite the attractiveness of the windfalls of the FCCs policy, rich opportunities for local and cross-disciplinary partnership, ***cognitive distance*** between public research and private enterprises needs to be reduced to unlock collaborative synergies. Three sensitive areas are identified.

- ***Distance in research areas.*** Specialization of public research centers, including universities, located in the same territory of a pôle may only partially coincide with industrial strategies of local enterprises. As a consequence, local public research institutions encounter a risk not to be recognized as partners who possess potentially valuable cognitive resources (Case of Nuclear Cluster Bourgogne). ***This is a major problem for research in social sciences and humanities***. As an example, the governance team of the French pôle "Cancer Bio Santé" (Cancer Bio Health) is seeking to initiate collaborations of medical and industrial partners with SSH[59]. Until now the former have neither been aware about competences of SSH partners nor about possible gains that collaboration with SSH can bring. Conversely, the SSH researchers have not identified yet their potential with respect to the research areas of the cluster. The lack of identification on both sides results in ***isolation of the SSH partners from the partners with core competences***.

- ***Innovation strategy of enterprises is not based on technological R&D ("non-science based" firms)***. When most of small and middle-sized enterprises members of a pôle are poorly endowed with skills and technological resources a dialogue with public research is difficult to get going. Firms' reliance on marketing and organizational innovation as competitiveness drivers is in contradiction with requirement of relatively long-term investment for collaborative R&D with public organizations. This cognitive distance is reflected by weak presence of public research organizations in the governance bodies, since industrial partners who are able to carry out research activities are not numerous (pôles PASS (perfume sector) and PFEIL (agricultural industry)).

- ***A priori judgments*** that actors have one about other, and issues of language and cultural codes. This obstacle was underlined in the report of C. Blanc (2004): "Language is too complex to establish". "Concerns, time horizon, and often initial training are very different. This sociological difference is very difficult to overcome."[60]

Facing cognitive barriers to collaboration at the beginning of the program, the members of the FCCs naturally tend to enhance and structure relations with partners they had worked with in the past. This observation is confirmed in the official evaluation report[61] : 54 out of 71 "poles de compétitivité" rely on pre-existing collaboration dynamics. Many applications submitted at the early stages of the FCCs policy contained projects which had been conceived before (DIACT (2008)). Thus, as in intra-industry configuration, construction of cognitive proximity requires time, human, cognitive and financial resources. The FCCs' experience reveals that public research and private firms naturally do not tend make such investments since future gains are uncertain. ***Actions of the "pôles" as meta-organizers are crucial in accelerating mutual discovery and construction of a common cognitive background on which future collaborations will be based***. Animation and coordination by the pôles launch collective learning processes that result in creation of cognitive proximity between public research and industry and stimulates new logics of innovation.

2.3.2 Interactive learning through collaboration: building up cognitive proximity

At the early stage of public-private research collaborative projects, *universal factors* such as commitment and trust are found to be the ground on which collaboration relies. Initial motivation of the teams to take up technological challenge brings collaboration at the inception phase. *Prior experience of*

[59] Poulain *et al.,* Rapport du pôle CBS
[60] Blanc (2004), p. 65
[61] DIACT (2008), p. 14

working together and prior experience of collaboration are reported as important (Barnes et al. (2002)[62]) although not necessary factors. Mutual discovery and ***gradual construction of common background and language*** are ***key processes*** that drive public-private R&D cooperation at later phases (Calamel et al. (2012)). The collection of participants' impressions illustrates this point: "We've had to spend a lot of time sharing competences and definitions". "All that time we spent in meetings seemed a bit much, but it was time well spent getting to understand each other and equipping ourselves with a common language". "We took 6 months to get up to cruising speed. (…) Now we're on the same wavelength"[63].

As collaborative projects advance, ***cultural issues*** reported as "refreshing" at the start ***can become increasingly binding and drag down the cooperation dynamics***. The issues vary from minor points as managing differences in people's work schedules (academics' relatively flexible working time arrangements versus industrial rigid schedules) to major disagreements about project ***priorities and timescales***. Industrial partners are more concerned with elapsed time while academic researchers put an emphasis on detail and in-depth investigation to ensure that correct and robust conclusions are drawn. One of the participants of the study of Calamel *et al.* (2012) qualifies academia as slow moving and wishing "to go further in seeking understanding, to go right to the heart of things in order to understand them better, and sometimes they have to be restrained because we don't always need to understand things better!"[64]

At this delicate moment, ***interactive learning of partners about each other is important to move further in collaboration***. ***The pôles are third parties who provide an institutional frameworks conducive to and accelerating learning.*** The learning process occurs ***at three levels - individual, collective and organizational***.

At the individual level, collaborators identify other collaborators' values and accept cultural differences. For example, researchers learn that the product aspect is important for their industrial partners. Managers learn to coordinate inter-organizational projects: "I adapted, tried in the follow-up meetings, how shall I put it, to take everyone's interests into account"[65]

At the team level, teams from different organizational structures improve their ability to work together, recognize their complementarities and find a consensus about the common objective and time-scale. "Things are changing and evolving on both sides as we are gradually acquiring a better understanding of each other"[66].

At the organizational level, firms and research organizations become "aware of a real desire for partnership; [the private company] recognizes the value of [the research institute]"[67]. For public research, the interactive learning results in a "better knowledge of how [the partner private company] approaches things in terms of advanced development and industrialization"[68].

In more general terms, ***public research organizations and universities better identify the potential of their partners. This in turn helps public researchers to better understand industrial problems and "to work more effectively upstream, doing the research***"[69].

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[62] longitudinal observation of two collaborative projects carried out by Calamel et al. (2012) within of the French cluster Minalogic - « MIcro Nanotechnologies et LOgiciel Grenoble-Isère Compétitivité ». Its strategic goal is to establish a center for intelligent miniaturized products and solutions for industry by pooling resources in micro and nanotechnologies and software technologies

[63] Calamel *et al.* (2012), p. 52

[64] *Ibid.,* p. 55

[65] *Ibid.,* p. 55

[66] *Ibid.* p. 54

[67] *Ibid.* p. 54

[68] *Ibid.* p. 55

[69] *Ibid.* p. 55

The learning of public research is also reported in the study of Erdyn (2010). About one third of researchers and directors of research divisions recognize that collaborative work in the FCCs has brought them ***to define new research axes in accordance with industrial needs and with the needs of local firms***. Furthermore, with respect to the SMEs, interactive learning resulted in ***a better understanding of the specificity of small-sized industrial partners***. Less endowed with technical innovation capacities (few or no engineers or doctors in their teams), they need longer and more detailed exchanges to translate their industrial problems into research problems. The FCCs provided a framework for this dialogue which is rather "well taken" by academic researchers.

From a conceptual viewpoint, ***at the end of a learning cycle, the individual researchers, research teams and research organizations possess cognitive and social capital*** essential for achieving successful results and for embarking on new cooperative projects. In other words, the ***FCCs are spaces where cognitive proximity can be built between public research and private enterprises***.

2.3.3 Transversal competences of SSH serving the FCCs as meta-organizers of cognitive proximity

Many competences of social sciences and humanities are transversal to all thematic research axes of the FCCs. Focusing on the issue of collective learning, research in social sciences has two missions: 1) to assist and legitimate the pôles as meta-organizers and coordinators of the innovative networks (Gadille (2008) and Gadille and Valette (2012)) and 2) to accompany inter-organizational cooperative innovation projects (Calamel *et al.* (2012)).

1) Assistance in construction of collective self-coordinating innovative networks

The FCCs policy is built on the principle of meta-governance where the State intervenes "in the shadow" to orchestrate interactions between diverse actors of the innovative clusters. Interactive learning implies the actors shape and reshape their relational schemes and build new identities and social codes. It is obviously a key process that drives self-coordination and evolution of "poles de compétitivité". However, the hypothesis that the actors have the innate self-coordination capacity may not hold, especially when their individual interests are too heterogeneous (Gadille and Valette (2012)).

In this context, social sciences and humanities can offer their transversal competences to mediate complex relations between interdependent actors of the clusters who have divergent individual strategies and legitimate the action of the pôles as network meta-organizers. The SSH facilitate collective understanding of conditions for construction of self-governance rules and for evolutionary dynamic of the networks. ***Their strategic "neutrality" confers them a role of intermediary, of third party (Gadille (2008)), or of "watch-dog" who guarantees confrontation of diversity of opinions and collective deliberation. The outcome of the collective dialogue is a new legitimate vision accepted by all members of a network***.

In the cluster Pégase (aerospace cluster), intervention of social scientists led to rebalancing of strategic influence between the large company Eurocoptère and small and medium-sized enterprises. The interests of the latter were explicitly stated. The collective innovation strategy has been modified to take into account their peculiarities and to reform local educational offer. A human resource manager was hired to satisfy the recruitment needs of the SMEs and a convention was signed between the cluster and the national employment agency. ***The implication of social sciences modified collective rules that govern technological innovation networks which in turn modified social practices***. Social innovation went hand in hand with technological innovation.

2) Accompanying inter-organizational cooperative innovation projects

The official evaluation report (DIACT (2008)) and the report on good practices (CM International et ARCessor (2008)[70]) emphasize that the issue of human resource management has been moved to the background. Most clusters have been reported to have neither a precise HRM strategy nor tools for its implementation. This is hardly surprising since a "collaborative project management manual is still to be written"[71].

Based on a longitudinal observation of two collaborative projects within the Minalogic cluster, Calamel *et al.* (2012) bring into focus critical moments in public-private innovative process that need specific HRM interventions. The authors classify HRM actions into "defensive" and offensive". Defensive are measures that ensure that HRM does not create tensions inside and between collaborative teams. A question already mentioned by Barnes *et al*. (2002) is how to prevent large differences in remuneration from creating tensions that limit collaboration, and to harmonize group bonuses. "Offensive" actions concern performance of collaborative projects. They include creation of conditions favorable to the development of collaboration, as for example cohesion meetings to enable each partner to identify the other's "world".

Social (micro-)innovation is a necessary component of technological innovation in the FCCs as spaces of cooperative R&D. ***Implication of SSH gives collective understanding of collaboration processes, favors finding legitimate consensus and leads to elaboration of new forms of social organization, indispensable for sustained functioning of innovative networks***. ***Social scientists accompany the FCCs as meta-organizers in their mission of acceleration of collective learning and enhancing cognitive proximity.***

The role of "service provider" to actors of technical innovation implies abandoning the role of "neutral observer", not directly concerned with the stakes of social interactions (Xhauflair and Pichault (2009)). Recruited for a specific mission their aim is to produce operational knowledge for solving concrete problems. Plurality of interdependent and independent actors who sometimes have divergent interests implies that these solutions must be legitimized and appropriated by the stakeholders. In other words, the FCCs have created a new social context that requires revision of scientific methods and professional attitudes. Felix *et al.* (2009) and Gadille and Valette (2012) opt for participatory inquiry adapted to the peculiarities of the "pôles de compétitivité".

The participatory research modifies the mode of interaction between researcher and people he/she observes which can be summarized as ***"research with people"*** in contrast to "research on people"[72]. Its objective is to create a collective vision of the reality through participatory dialogue; then, through collective self-reflexive process, to construct new social categories and collective action agreed by all participants. Thus, ***stakeholders become co-authors of social innovation***.

An intrinsic characteristic of this cooperative approach in research is that knowledge is produced to solve a concrete problem. De facto, this knowledge does not come from pre-existing normative theories. Knowledge is thus contextualized, empirically robust, because it comes from the "grassroots" (Felix et al. (2009)).

Furthermore, new knowledge is co-produced not only in the area of, but also in the scientific field. Participatory research transforms reality and produces knowledge about these transformations (Gadille and Valette (2012)). Although the researcher and his "co-researchers" are on the same basis, the researcher has the responsibility to ensure the stability of conditions for participation. He/she must be capable of assuming the functions of consultant, participant in the research and researcher. Cooperative

[70] CM International and ARCessor CM (2008), p. 25
[71] Yves Jongen, head of Mecatech, Belgium innovation cluster, 03/03/2009, Liege quoted by Calamel et al. (2012)
[72] Reason (1998) quoted by Felix et al. (2009)

inquiry is therefore ***a permanent challenge for researchers***: they have to find a good balance between these different roles. Thus cooperative inquiry favors collective learning on both sides, it concerns the stakeholders of research and researchers themselves; it favors construction of common spaces for cognitive construction and mutually agreed actions (Felix et al. (2009)).

2.3.4 Benefits and outcomes of involvement in the FCCs and collaboration with industry

Public research organizations and universities are major beneficiaries of the subsidies distributed via the FCCs initiative. While they represent on average 15% of the members of the FCCs, they pilot the major proportion of collaborative projects. They perceived 48% of the 733 million euros directed towards national-class clusters in 2005-2007 and 38% of the 888 million euros allocated to world-class clusters and clusters with world-class potential (DIACT (2008)). Public research institutions received 44% of 1.07 billionf euros of subsidies channeled through the FCCs in 2010.

The pôles are open and visible spaces to establish new contact and to find new partners. Interviewed representatives of public research recognize that they could ***build new partnerships with private enterprises within the pôles*** (Erdyn (2010))**.** Research centers with no or little collaborative experience report that the FCCs have helped them to create ties with big companies. Additionally, half of the researchers consider the FCCs as a ***complementary tool to start complex projects that could not be imagined in direct partnership and to diversify partners*** (Erdyn (2010)). Animation of collective brainwork, assistance in preparation of applications for subsidies, negotiation of IPRs, financial engineering are some of the tools the FCCs animation teams have used to favor the emergence of complex cooperative ventures.

In 2008, three years after the launch of the policy, several policy analysts warned about a risk of slowdown. Their argument was that the early dynamic relied on submission of projects incubating prior to the FCCs initiative. The challenge the clusters faced was ***to consolidate the early synergy and to make it sustainable***. Seven years later, statistical evidence that the FCCs succeeded in stimulating their members to embark upon new projects collectively elaborated within clusters. ***In 2006, the number of registered collaborative innovation projects was 949. In 2009, it reached 3053, 735 of which were completed; in 2010 this amount attained 3872, 2579 of which were completed.***

Some of the researchers interviewed (about 10%) believe collaboration within the FCCs has brought ***a new logic of co-conception of innovative projects*** (Erdyn (2010)). It shows that ***the architecture of the FCCs goes beyond the logic of unilateral technology transfer and the linear innovation model.*** They create interactive spaces where feedback loops between public research institutions and industrials are possible and even desirable to make collaboration sustainable. Thus the efficiency of collaboration and the quality of its results depends on the intensity of implication of firms and on their technological maturity.

An important originality of the FCCs, recognized by researchers, directors of research divisions and directors of the research organizations and universities is that they have facilitated linkages with SMEs. "New contacts are merely SMEs. Big companies already know us; they know how to approach labs when they need collaboration"[73] Thus***, the pôles mark a shift in the national innovation policy towards facilitation of linkages between public research and SMEs and a better distribution of knowledge across economic sectors and regions***. This is a new opportunity for SMEs to build their competitiveness on innovation co-constructed with public research.

[73] *Ibid., p. 44*

2.4 Learning within public research institutions

The impact of inter-industrial research collaboration goes beyond the interactive learning and co-innovation. It modifies the daily routine of researchers and management of their research agenda (2.4.1), hierarchical relations and status of doctorate students (2.4.2) and career considerations (2.4.3).

2.4.1 Changes that the public research profession undergoes as a result of intensification of collaborative project

Barrier (2011) and Jouvenet (2011) conducted separately studies of organization and functioning of two public research laboratories specialized in nano-technologies. The compiled evidences confirm that the ***reduction of permanent support and*** the ***increase in project-based funding increased the proportion of administrative paperwork in the working time of researchers***[74]:

> "I am an administrative animal. I spend my 35 hours in the laboratory to do administrative management. Obviously, a researcher works much more than 35 hours, rather twice this time, so little room is left for pure research" (Barrier (2001), p. 522)

It seems that the administrative overload is mainly due to relatively weak organization of the funding system and redtape in application procedures. Multiple policies in place since 2004 such as Competitiveness Clusters and Thematic Networks for Advanced Research have increased the number of agencies where competition for public resources takes place. The reverse side of this overlap of funding opportunities is that they all have different and not harmonized application processes, often qualified as too complex and long. This seems to be the major source of concern: the ***administrative length and rigidity of application processes*** transform scientists into "bureaucrats". ***Many researchers judge this situation as detrimental to their scientific activities*** and define it as "a waste", "a true catastrophe" or "a dispersion of energy" (Jouvenet (2011)).

The interviewed researchers report to be prisoners of this system. Not to join a new initiative launched by public authorities pose a risk to be excluded from local synergy, to miss an important opportunity:

> "The awkward side of the system is the multiplication of funding agencies, which is extremely hard to handle. I'm involved in the governance bodies and in the research area Y of the competitiveness cluster X and at the same time I am in charge of the research theme Z in the thematic network W [...]. Each laboratory, with its specificities, has to be represented, in order to promote its activities or its research axes. If you are not represented in these different organizations you may give impression that your team does not really care. We are somehow obliged to do it [...]. He who is absent is always in the wrong" (Jouvenet (2011)).

The national Government recognizes the complexity and overlap of the project-based programs in support public-private collaborative research. ***Studies and discussions are ongoing about a better coordination of these initiatives to reduce administrative burden of applicants***.

The presence in all innovative networks is a ***strategic necessity for maintaining a pool of potential partners***. Public researchers mobilize this "latent network" as their research objectives evolve over time or when new funding opportunities arise. Conversely, the membership in local institutional networks increases their visibility and chances to integrate projects led by other partners.

[74] This is a familiar situation in Canada, where there is little equivalent to what used to be the permanent funding of university research teams, as we have been functioning with project-based funding for some time. And Canadian researchers also live with the reduction in funding and need to tap on a more diversified base of research funding. What is interesting in the FCCs is the development of networks, but we mention the negative dimension as well as it does come out of the litterature review.

In the context of an increasing share of project-based R&D activities as well as diversity of thematic calls for projects, ***coherently defined research agendas have been transformed into "portfolios" of diversified and complementary research themes and activities***. To advance on them, researchers mobilize a large variety of sources of financing (Barrier (2011)).

At the same time, what is interesting in this transformation is that resource diversification opens up spaces for strategic maneuvering in managing research topics and new possibilities for cooperation. Teams seek to mix contracts that are binding in terms of results and technological realizations with contracts that allow for a more "discretionary" use of financial support. In other words, they use a surplus made with "food contracts" that may represent little scientific interest in order to finance their activities that cannot be financed on a contract basis ("masked activities"). Alongside the main research areas - possibly broken into of various projects pursuing specific objectives – research teams maintain secondary research axes that include either basic "food" research activities or emerging research themes that are not supported by State funds ((Barrier (2011)) and Jouvenet (2011)).

With regard to new research areas, Jouvenet (2011) has complied some evidence about ***the difficulty of researchers to go off the tracks from the commonly supported research areas***: "Basically, we know that if there is no word "nano" somewhere, the project has much less chances to be financed. Inevitably, we are trapped".

This sensitive issue has been raised by Krauss (2011) in his analysis of institutional support to innovative projects in the high-tech sector of Bade-Wurtemberg. He observed that institutional support tends to be directed towards technology areas already dominant in the regional economy, as well as to incremental innovation at the expense of radical innovation, which is by definition more risky.

Thus, "governance by contract" ***contains a risk of lock-in effect in mainstream technologies and commonly admitted research agendas, through the imposition of thematic frameworks and selection process of applications***. The logic is even more twisted as researchers claim that these "off track" projects they start on their own funds are the most original and have more chances to be supported later, once some results have been achieved. To conclude, a right balance between a permanent versus project-based support is yet to be found, but the new format for research does present important compensation in terms of new avenues for research cooperation even if there are some downsides in terms of paperwork.

2.4.2 Shifts in hierarchical relations and the role of doctoral students

The FCCs contracts and in a broader sense all collaborative contracts alter hierarchical relations within research teams. Expansion of project-based funding contributes to "***empowerment" of researchers from their hierarchy*** (Barrier (2001)), to "***freedom of the individual researchers"*** (Jouvenet (2011)).

Relational hierarchic organization has evolved to a more decentralized organization based on the notion of partnership. Scientific teams are less organized around the "boss" or hierarchical leader of the research; it is rather ***an association of peers who share common interests and manage collectively financial, physical and cognitive resources to ensure collective scientific performance***: "We are all responsible. We're colleagues. We must come up with good ideas, to have to create a better environment for everyone. This is more efficient" (Barrier (2011)).

Hierarchical shifts and modifications in access to financing directly affect young researches, in particular doctoral students. First, the expansion of administrative paperwork has given no choice to directors of the laboratories and to experienced researchers but to entrust higher responsibility to young researchers. The role of doctoral students within research teams has thus evolved. Although researchers believe that the PhD exercise has as primary objective to learn how to do research, doctoral students are becoming increasingly involved in realization of collaborative contracts. Their work supports the activities of permanent researchers and contributes to realization of specific-term contracts. This

sometimes poses a problem of match between their competences and contract requirements, and can reduce the liberty to choose a thesis subject; at the same time, students are not obliged to participate in these contracts and they can also give them a better feel for the "real" world of research, as well as help them to develop a network for future work. Barnes *et al.* (2002) nevertheless advocate for clearly stated guidelines for deployment of doctoral students in such projects.

On the basis of an interview with a senior scientist, Jouvenet (2011) indicates that this situation encourages ***young researcher to adopt "short-sightedness" relatively to their careers***: "They will not project themselves into the life of the lab, over a greater length of time, but rather concentrate on a project to prepare an experiment which will give results in 5 years. When they start a contract, they must already they think of the next one".

2.4.3 Redefinition of career paths

Intuitively, collaborative ventures with industry would lead to some academic researchers formulating alternative career plans. This issue is related to two important policy stakes.

First, ***public-private R&D collaborations sensitize public researchers about opportunities of commercialization of the results of their activities, specifically enterprise creation***. In 2004, official statistical data revealed that less than 15% of academic researchers of hard sciences were interested in taking part in the creation of an enterprise[75]. The most mentioned obstacles are "technical" – insufficient competences for running business – and "cultural" – perception that private business is not compatible with research activities. Learning about the functioning of private enterprises that occurs during collaborative projects can contribute to reduce the cultural gap.

Second, ***greater mobility of researchers to private companies is expected to increase firms' technological absorptive capacities***. This is a highly important issue for SMEs. On average, they possess relatively limited technological innovation capacities to be involved in continued collaborative research. Experience of public-private cooperation in the FCCs reveals that small-sized firms need time to incorporate the results of co-produced innovations in their products and services and to collect profits from their investment before engaging in a new collaborative R&D venture. Three to five year intervals are typically observed (Erdyn (2011)). "Soft" collaborations that imply professional mobility of researchers seem to be an appropriate solution, for example, internships of doctorate students, "innovation assistants", technical and business consultancies, etc. It opens new perspectives in technology transfer as a professional field and in career paths for public research employees and university students.

Culié (2008) has interviewed several researchers involved in collaborative projects within the Minalogic cluster. His objective was to determine whether academia-industry collaboration influences perceptions about career perspectives and modifies career trajectories, with a focus on mobility of academic researchers to private enterprises. He found that half of researchers interviewed perceived collaborative projects within Minalogic as broadening the range of their career opportunities. Some envisaged moving from the public to the private sector and some thought about creating their own businesses. However the limited scope of this study only gives some indications about the effect of innovative clusters on career mobility of academic researchers. Broader studies are still to be undertaken to provide more generalized conclusions and to support eventual policy orientations.

2.5 Further learning and challenges ahead

The membership of public research in the competitiveness clusters initiated the process of collective learning that creates common cultural background for successful academia-industry collaborations. This

[75] *Les chercheurs publics en sciences dures et la création d'entreprise*, Note de recherche 04.05 http://idep:8000/dpd/reperes/default.htm

process goes beyond interactive spaces of the FCCs leading to transformations within research institutions and professions. After 7 years of functioning, the FCCs bring out future challenges to public research. Whether or not they will be solved depends on the outcome of further interactive learning between public research and the other members of the competitiveness clusters as well as within research institutions themselves. These issues at stake include distribution of IPR (2.5.1) and affirmation of strategic interests of public research institutions in the FCCs (2.5.2). They are related to the broader question of recognition of participation in collaborative ventures in the performance assessment of researchers (2.5.3). Finally, the inclusion of social sciences and humanities in the FCC program can be envisaged only if the technology-based definition of innovation is broadened to include society and human well-being (2.5.4).

2.5.1 Distribution of IPR benefits generated in public-private collaborative ventures

Collaborative R&D raises the question of the ownership of the results of invention. In 2010, cooperation between academic institutions and industry within "pôles de compétitivité" resulted in registration of 365 patents, 17 out of which are co-registered. The current legal conditions in most of cases is full transfer of ownership of co-created knowledge from public research to industry. This phenomenon has drawn little attention until now. ***As the period of massive public support to the clusters comes to an end and the issue of their self-financing appears on the policy agenda, potential areas of tensions over the ownership of co-produced knowledge come to light***.

Corbel et al. (2011) shows in a case study of the cluster System@tic (specialized in software and complex information systems) that there is a "structural gap" in strategic positions of private enterprises and public research institutions that curb negotiations of IPR between them. Private firms expect from R&D collaborations support in "upstream research" that they cannot carry out on their own. The results are incorporated in products or processes in a patchy way with a time lag. Public research institutions seek to collect royalties ***based on the belief that products commercialized by their industrial partners are direct applications of inventions made in the context of cooperation***. Inevitably ***these differences in representations creates tensions***, well summarized by one industrial partner: "they [public research organizations] are a little out of touch with industrial reality, because one can believe when listening to people that once a patent is registered, product commercialization is already on the agenda one or two years later"[76]. However, transformation of an invention into a product or a process requires significant investments and time: "***there are phases that must be explained to these organizations; between results of R&D and sales of products there are phases of industrialization, validation, and commercialization***."[77]

These differences in representations lead to ***differences in the amount of royalties public partners want to obtain and their industrial partners are ready to pay***. Industrials often find royalties demanded by public research not necessarily justified. The main argument is that additional costs and those incurred in the initial R&D phase are significant: "There are still many things to do, a lot of investment. Particularly in the health sector, there are regulatory aspects, clinical trials, etc.. So, I've seen people who are not realistic about the value of their [research], about what they could finally get from industrials"[78].

The second area of tensions is about legal clauses of exploitation of intellectual property rights. Increasingly aware about the importance of commercialization of R&D, public research organizations insist more often on inclusion of property right clauses in collaborative contracts. In general, this change is negatively perceived by industrials who seek solid industrial property without constraints to return on investment: "For them, patent is a title. It is a publication. For us, patent incurs a cost". It prevents the innovative solution and prevents competition. Co-ownership of property rights is considered by

[76] Corbel et al. (2011), p.155
[77] *Ibid.* p. 155
[78] *Ibid.* p.156

industrials as a necessary evil and accepted only when private companies keep control over the use of the co-registered patent.

Collective learning that occurs during collaborative projects within the FCCs creates cognitive proximity between public research organizations and private companies with a potential positive effect on negotiation of property rights. First, clusters tend to support applied projects. That brings to public laboratories a stronger vision of "downstream" phases of innovation processes. Better understanding of industrial reality makes them more realistic about negotiation of royalties. Second, ***conditionality and accountability of public-private cooperation within FCCs exercise a social pressure towards partners who are more predisposed to finding a compromise***: "If we work with a laboratory, we define from the beginning how we get organized, what can be published. Well basically, we've addressed the major issues"[79].

With respect to collaboration of public research with SMEs, ***the pôles play the key role as intermediaries reducing the cost of IPR negotiation***. Most of French small-sized enterprises have limited competences with respect to IPR protection. It renders IPR negotiations more complex and time-consuming compared to large companies. Some French clusters propose trainings in IPR protection and management for their members that facilitates negotiation of consortium agreements between public research and SMEs (Pégase and CapEnergie (alternative energy sector)). Learning of SMEs and academia in the field of intellectual property organized by the pôles ***reduces potential sources of tensions over the share of benefits of collaborative research.***

2.5.2 Affirmation of strategic interests via better representation in governance bodies of the FCCs

Geuna and Mascio (2009) bring to the forefront concerns about adverse effects of intense public-private R&D collaboration: "Some authors consider that the pendulum has swung too far to the side of policies encouraging commercialization, to the point of endangering the open-science culture of universities and their reputation for good basic research"[80].

The principle of democratic representation of all parties within the French institutionalized innovation networks is a chance for academic research to express its interests and to integrate them in collective strategy and research orientations. The study conducted by the consulting group Erdyn emphasizes that less that 10% of researchers and director of research divisions and about 25 % of directors of research institutions report having an influence on thematic orientations of the clusters they belong to.

Thus, to have a firm say in the definition of the clusters' thematic axes and in a broader sense to reduce the risk of institutional "lock-in" in dominant technologies and incremental innovation strategies, academic institutions need to strengthen their representation in the governance bodies of the FCCs. It implies ***a new public-private and institutional collective learning cycle requirese to find a balanced approach to innovation***. Further, on the policy-making side, specific actions need to be undertaken to articulate the "pôles de compétitivité" program with other knowledge transfer initiatives[81] (DIACT (2008), Erdyn (2011), Lefebvre et al. (2011) and Lefebvre (2008)).

To generate sustainable results, these changes may need to be accompanied by a revision of the status of researchers within public research institutions towards a better recognition of their participation in collaborative ventures.

[79] *Ibid.,* p.158
[80] Geuna and Mascio (2009), p. 103
[81] For example, R.T.R.A. and R.T.R.S., S.C.R, institutes "Carnot" see annex 4.2 for more details

2.5.3 Recognition of participation in collaborative ventures in performance assessment of researchers

Encouragements to public-private cooperation found in innovation policy do not find a coherent translation in the national research policy. Involvement in the FCC is not included in the research strategies of public institutions (DIACT (2008)). Furthermore, performance assessment of researchers still largely relies on scientific publications and gives little importance to involvement into collaborative projects with industry. The last example is the creation of a premium for scientific excellence that tends to discriminate against activities related to industrial application and commercialization of research.

Along with generalization of project-based funding, administrative work, i.e. diffuse set of tasks that comprise preparing applications, reporting on use of funds, and finding new funding opportunities, has been taking an important share of working time. It is essential to ensure continuity of academic research. However, it is not valued by researchers and it is considered as accessory to research activities.

With respect to SHS, the report of the cluster « Cancer Bio Santé » highlights the fact that the contribution of SHS to medical research ***is not recognized as central in the scientific production of researchers***. Involvement in cross-disciplinary projects creates an opportunity for numerous publications in medical journals. They are assessed as useful by evaluators because they reflect the level of credibility of a researcher in his/her respective field. However, these publications are still considered as secondary.

Thus, ***the success of public-private R&D cooperation will depend on reduction of the cultural divide between pure scientific activity and innovation-oriented research activities within public research institutions.*** Collective learning processes seem to be ongoing in organizations which have a relatively long history and culture of cooperation with industry. In CEA[82], which until recently used to carry out about two thirds of collaborative contracts with industry[83] the management indicates that it does take into account collaboration with private firms: "I know this is hard work for you to get this money, to set up projects. But now it is work that is widely recognized at CEA". "We will rather support someone who will fight to get external funding"[84]. Recruitment criteria also tend to evolve towards recognition and even requirement of administrative competencies: "Now, in one's CV to get a job, to say that one was involved in a contract, prepared an application [or] got a contract … is obviously an advantage"[85].

2.5.4 Challenges for SSH as independent actors of innovation

With the exception of economics and finance, the FCC policy does not explicitly support social sciences and humanities. This position has been criticized and there have been accusations of giving "monopoly to life sciences and materials" and of creating "unfair competition against other scientific fields", because the SSH are "less "profitable" in the short run, which makes them more vulnerable"[86]. Some local actors blame central State funding agencies for having adopted short-sighted and simplistic definition of national development.

To illustrate this, applications that did not obtain the official label of a competitiveness cluster and public support include for example:

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[82] Commissariat à l'énergie atomique et aux énergies alternatives - French Alternative Energies and Atomic Energy Commission

83« Les coopérations public-privé pour innover en France » Note d'information du Ministère de l'enseignement supérieur et de la recherche 15 mars 2008

[84] Jouvenet (2011) p. 248

[85] *Ibid.*

[86]

- *management of (inter)cultural heritage*: project of the PACA region (Marseille area) dedicated to digital broadcasting, virtual Mediterranean library, virtual sculptures; project of the Aquitaine region (Biarritz, Basque Coast) dedicated to tourism and sea sports;
- *art crafts*: project of the Bourgogne region devoted to image and digital engineering; project of the Ile de France and Centre region for development of jewelry and silverware; project of Ile de France dedicated to musical instruments;
- *knowledge and cultural industries*: 2 projects of the Poitou-Charentes region dedicated to distance learning and cultural industries for youth.

The PACA region project was supported by local authorities in the framework of the regional clusters program (financed by the European Fund FEDER). The Cluster of Cultural Industries and Heritage has been labeled as PRIDES (PRIDES – Pôles Régionaux de l'Innovation et de l'Economie Solidaire – Regional Innovation and Solidarity Economy Clusters). This illustrates that a gap exists between regional policies, by definition closer to local actors, in particular in cultural and artistic fields, and the competitiveness-oriented vision of the central State which invalidated the "bottom up" initiatives. ***A better and more comprehensive inclusion of the SSH sector into the FCC program is conditional on a revision of the definition of innovation which would give a better place to research on society and human (well-)being at the central state level, while maintaining its stronger presence at the decentralized level of projects*** .

3 Conclusions and policy perspectives

The present work highlights conditions and mechanisms that favor successful collaboration between public research and academia in the French "pôles de compétitivité" using a synthesis of the available literature on this initiative.

The FCCs are a policy response to bridge the gap between university research and industry, particularly, to promote applications of public research. Their organizational structure, referred to as meta-governance relies on "bottom up" local networks of economic actors, interventions of local authorities providing support to local needs and "top down" national policy prescriptions. Such architecture allows for a better representation of the interests of small-sized firms who used to be at the margins of the mainstream technology-based innovation policy logic. The inclusiveness has shifted the focus of the FCC policy towards a greater consideration of the specificities and needs the SMEs, particularly their less technology-intensive competitiveness strategies, lower endowments in R&D resources and their vulnerability in the area of IPR protection. Thus, the originality of the pôles is that they are interactive spaces facilitating contact, networking and partnership between local actors of innovation - public research institutions and SMEs. Therefore, the FCCs contribute to a more equitable distribution of knowledge across economic actors and sectoral activities through exchanges between the actors, the development of a meta-governance favorable to the development of joint research projects, and also some work on the treatment of IP in such contexts.

The relational dynamics of each pôle illustrates a complex process of collective learning occurring in three configurations: intra-industry – between private firms, public-private – between public research institutions and firms and societal – within public institutions, in particular within public research organizations and universities. Regional embeddedness and collective learning result in construction of common background and language, referred to as cognitive proximity, a necessary condition for sustainability of collaborative research ventures. Further, the FCCs are fostering a new logic of co-innovation which implies that the architecture of the FCCs goes beyond the logic of unilateral technology transfer from academia to firms. The innovation model of the pôles is close to that of interactive innovation, where feedback loops between public research and industry induce transformations in research professions, eliminating or reducing the boundaries between research and innovation. Although the social sciences are not present in all projects or poles, the role of research in social sciences and humanities is critical for understanding these processes and for bringing social innovation to accompany cooperative technological innovation.

The experience of the French pôles de competitivité as a form of support to public research is instructive for Canada and for Montreal with respect to several issues.

- Hybrid organizational structures relying on "bottom up" dynamics and incentives as well as corrective "top down" policy interventions can be interesting. Clusters composed of a large number of small-sized enterprises pursuing their individual objectives may experience difficulties in spontaneous self-coordination and building collective actions. The role of local authorities is crucial for organizing the heterogeneous actors and giving them incentives to cooperate. The policy tools are various, including financial incentives for collaborative projects, contracts specifying roadmaps of collective actions and evaluations.

- Focus on innovation. The French clusters favor knowledge-driven competitiveness strategies of enterprises which seems to be the only solution against delocalization. Other aspects of competitiveness are also supported, including reformulation of educational offer to match the needs of local enterprises, export development, mutualization of resources. Linking local industries with academia is beneficial not only in terms of innovation gains but also with respect to international business expansion. Academic research is integrated in global networks. Local partnership with academia is likely to bring foreign business partners through a spill-over effect from international academic networks.

- Support is given to open innovation projects gathering at least two enterprises and one public research institution located in the same territory. Thus, the pôles are spaces for open innovation Moreover, the FCCs are spaces of co-innovation as opposed to relations where industry sub-contracts research to academic institutions. Gains from these relations exceed financial gains from contracts for public research and technology transfer for private firms. They embrace construction of cognitive proximity through collective learning during collaboration and interactions within the pôles, a key component for sustainable and more efficient cooperation in the future.

- Shift of the focus of the innovation policy towards differentiation of the needs of the small and middle-sized businesses. More specifically, the needs of "non-science based enterprises" are better understood: their reliance on relatively low technology-intensive inventions (which at the same time provide with high value added content) and greater vulnerability regarding protection of their inventions, since their inventions are not patentable or not patented because of unbearable costs. Strategies of "science based" enterprises to emancipate out of sub-contracting are also supported. Greater visibility and inclusion of SMEs creates new opportunities for public-private R&D collaborations that were not possible without the FCCs.

- The place given to social sciences and humanities as providers of new social rules (social innovation) that accompany technological innovation. Specifically, the SSH assist the governance bodies and the members of the pôles in the development of collective strategies as well as accompany the partners of collaborative projects in management of cooperative research.

4 Appendices

4.1 Pôles de compétitivité : quelques éléments historiques et statistiques

Le dispositif des PC lancé par l'Etat à la fin de l'année 2004, réunit sur un même territoire des entreprises, des centres de formation et des centres de recherche d'un même secteur d'activité « autour d'une stratégie commune de développement et de projets collaboratifs a fort contenu en valeur ajoutée et en innovation »[87] Le dispositif s'inscrit à la fois dans la logique de la politique d'innovation, de la politique industrielle et de l'aménagement du territoire[88]. Son objectif est de « renforcer le potentiel industriel de la France, créer les conditions favorables à l'émergence de nouvelles activités a forte visibilité internationale et ainsi améliorer l'attractivité des territoires et lutter contre les délocalisations. »[89]

La politique consiste à mettre en réseau les acteurs d'un territoire dans des structures juridiques qui prennent la forme d'associations 1901 ou de GIE (groupements d'intérêts économiques). Le lancement de la politique a été effectué à travers un appel à projets (« projets de pôle ») où ces acteurs devaient, en accord avec les collectivités locales de leur implantation géographique, faire une proposition qui explicite des objectifs communs, un mode de gouvernance et des règles de participation. Le processus a abouti à la labellisation de 71 pôles de compétitivité en juillet 2005 repartis sur l'ensemble du territoire français. L'Etat apporte son soutien aux structures de gouvernance et d'animation des pôles.

En termes de thématiques les PC couvrent un grand nombre de secteurs : agriculture et l'agroalimentaire, santé, textile et matériaux et chimie, transport et logistique, électronique et logiciels, énergies renouvelables, développement durable, nucléaire, équipements du foyer, aéronautique et espace, risques et sécurité, mécanique, optique et photonique, services de la finance et du commerce[90].

L'Etat différencie les PC selon leur ambition et leur potentiel de R&D. Le label « pôle mondial » est accordé aux pôles ayant des capacités d'innovation qui les placent parmi les leaders à l'échelle internationale et dont les thèmes de recherche sont suffisamment larges pour garantir leur visibilité à l'étranger. Le label « national » est accordé aux pôles qui ne rempliraient pas ces critères.

Une fois les pôles constitués, l'Etat a actionné le levier de labellisation de projets pour impulser la dynamique collaborative. Des projets de R&D montés en consortium, composé d'au moins deux entreprises et un organisme de recherche public « labellisés » par les représentants du pôle et concourent ensuite aux subventions accordées par l'Etat dans le cadre d'appels à projets biannuels. Cette labélisation par le pôle signifie que les représentants de la structure d'appartenance des partenaires reconnaissent la pertinence des objectifs du projet par rapport aux objectifs communs.

Sélectionnés par les pôles, ces projets font l'objet d'une expertise nationale par les ministères. Une fois retenus, ils sont partiellement financés par le fonds unique interministériel (FUI) dédié aux pôles de compétitivité. Ce financement peut être complété par des subventions de l'Agence Nationale de la Recherche[91], de l'OSEO[92] et des collectivités territoriales.

La deuxième phase de la politique, « pôles 2.0 » conçue pour la période 2009-2012 est caractérisée par un renforcement de la présence de l'Etat. Chaque pôle dispose de deux interlocuteurs référents : un

[87] Houel et Daunis (2009), p. 7
[88] Clayes et al. (2009), p. 13
[89] Houel et Daunis (2009), p. 7
[90] DIACT (2008) et http://competitivite.gouv.fr/
[91] L'ANR accorde des financements de projets de R&D fondamentale
[92] le groupe OSEO est une agence nationale qui a pour mission de soutenir l'innovation et le transfert de technologies en accordant des prêts à taux zéro ou des subventions pour les activités de recherche

correspondant du Groupe Interministériel de Travail au niveau[93] local et un correspondant local. Les correspondants nationaux assurent le lien avec les administrations centrales et les directions générales des ministères ainsi qu'avec les agences et organismes membres du GTI. Ils seront amenés à former de véritables binômes complémentaires avec les correspondants locaux. Ces derniers existaient déjà mais de manière plus ou moins informelle. Ils font le relais avec les services déconcentrés et les délégations locales d'organismes publics nationaux concernés (Barthet et Thoin (2009), p. 81).

Pluriannuels, les contrats de performance sont signés entre chaque pôle, l'Etat, les conseils régionaux et les autres collectivités territoriales concernés. Par ce contrat, le pôle s'engage à mener les actions nécessaires à son développement sur la base d'objectifs stratégiques assortis de calendriers de réalisation et d'indicateurs de suivi de résultats. De leur côté, l'Etat et les collectivités territoriales concernés s'engageront sur le suivi stratégique du pôle et sur son soutien financier. Outre la description du pôle, ce contrat fera état de la feuille de route stratégique du pôle (Barthet et Thoin (2009), p. 81).

L'Etat a affecté 1,5 milliard d'euros au lancement de la première phase (2005-2008). A la suite d'une évaluation positive, ce budget a été renouvelé pour une seconde phase (2009-2012). L'évaluation de la deuxième phase est en cours. En complément des subventions de l'Etat les collectivités territoriales ont accordé 750 millions d'euros pour la période entre 2005-2011. Entre 2005 et fin de 2011, plus de 1 000 projets collaboratifs de R&D ont été retenus. Ils ont représenté au total 4,9 milliards d'euros dépenses à la R&D et mobilisé 15 000 chercheurs. [94]

Deux mesures du programme d'investissements d'avenir qui mobilise 35 milliards d'euros sont spécifiquement dédiées aux pôles : le développement de projets de R&D structurants (300 M€) et des plates-formes mutualisées d'innovation (200 M€). D'autres mesures impliquent aussi les pôles : les instituts de recherche technologique (IRT) et les instituts d'excellence en matière d'énergies décarbonées (IEED)[95]. Six ITR ont été sélectionnés en 2011 et recevront au total 2 milliards d'euros[96].

On voit que la politique des PC politique est conçue selon la philosophie que la perspective de subvention (« rente publique ») incitera les acteurs du réseau institutionnalisé à coopérer effectivement (Younès (2011)). Il faut cependant souligner que sur 71 pôles, 54 s'inscrivent dans une dynamique de collaboration antérieure, informelle ou soutenue à travers le dispositif de SPL[97]. L'obtention du label « pôle de compétitivité » a été perçue comme une opportunité pour structurer et renforcer les relations préexistantes.

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[93] Le GTI réunit les ministères et organismes publics impliqués dans le soutien aux pôles : les ministères chargés de l'aménagement du territoire, de l'industrie, de la recherche, de l'agriculture, de la défense, de la santé, des transports, de l'intérieur, du budget et de l'emploi, OSEO innovation, l'Agence nationale de la recherche (ANR), la Caisse des dépôts et consignations (CDC), le Haut représentant pour la sécurité économique et le groupe des personnalités qualifiées. Le groupe est conjointement animé par la délégation interministérielle à l'Aménagement du Territoire et à l'Attractivité régionale (DATAR) et le ministère de l'Economie, des Finances et de l'Emploi (direction générale de la Compétitivité, de l'Industrie et des Services (DGCIS)).

[94] DGCIS et DATAR (2012)

[95] http://competitivite.gouv.fr/documents/commun/Documentation_poles/brochures_poles/francais/brochure-fr-internet.pdf

[96] http://www.gouvernement.fr/gouvernement/les-premiers-instituts-de-recherchetechnologique-voient-le-jourvisité le 5 mars 2012

[97] Systèmes productif locaux qui est une politique de mise en cluster industriel de type districts industriels décrits par A. Marshall, sans l'enjeu de l'innovation, cette politique a été mise place en décembre 1997. Un rapport d'évaluation de cette politique a été publié en 2008 : http://territoires.gouv.fr/sites/default/files/datar/2009-rapport-evaluation-spl.pdf

4.2 Contexte de la mise en place de la politique des pôles de competitivité et politiques existantes de soutien à la recherche collaborative public-privé

La politique nationale de l'innovation a longtemps misé sur les « champions nationaux » opérant dans quelques secteurs de pointe (aéronautique, aérospatiale, énergie nucléaire, matériel de transport) en mettant en arrière-plan d'autres secteurs jugés moins stratégiques où opèrent beaucoup de PMEs et enfin d'autres types d'entreprises (start up, PME innovantes). Ainsi, en 2004 quatre premières branches bénéficiaires (construction aéronautique et spatiale, instruments de mesure et de précision, équipements radio, machines et équipements) perçoivent plus de 85 % du montant total du financement public[98].

Comme résultat de ce choix stratégique, en 2004 quatre secteurs : automobile, pharmaceutique, aéronotique et équipements de communication totalisent près de 60% des dépenses privés en R&D[99]. Selon les données statistiques officielles, les dépenses de recherche restent concentrées dans un nombre réduit d'entreprises. Les entreprises de plus de 100 chercheurs représentant moins de 2 % des entreprises, réalisent plus de 65 % de la R&D privée. Les entreprises de moins de cinq chercheurs qui représentent près de 75% des entreprises effectuent moins de 10 % de la R&D[100].

Cependant il faut souligner ces données statistiques reposent sur la définition de l'innovation industrielle et technologique. Les activités de la R&D dans les PMEs sont diffuses et organisées autour de projets liés aux commandes des clients, les chercheurs ou les ingénieurs n'y sont pas affectés à ces taches à part entière. L'estimation officielle de la R&D tend à sous-estimer l'effort de R&D des PMEs[101]. En prenant l'acception la plus large de l'innovation telle que définie dans la 3ème édition du Manuel d'Oslo (OCDE, 2005) qui inclut les innovations d'organisation et de commercialisation, près de la moitié des entreprises se déclarent innovantes en France.

Les relations de sous-traitance ou de coopération en R&D entre les entreprises et les établissements de recherche publique sont relativement faibles : entre 2002 et 2004, seulement 10% d'entreprises font appel à des universités ou des organismes publics de recherche pour leurs activités d'innovation. Pour la période de 1992 à 2004, le montant des contrats de recherche publique financés par les entreprises tend à diminuer en valeur réelle de 514 millions d'euros à 509 millions d'euros[102]. Enfin, la part de la recherche académique financée par les contrats avec les entreprises est d'environ 2,7% en France, contre 5,0% aux États-Unis, 5,6% au Royaume-Uni, 8,7% au Canada, 12,6% en Allemagne et 12,7% en Belgique[103].

Sur cette même période, les contrats de recherche public-privé sont concentrés dans un nombre limité d'établissements. Plus de deux tiers des contrats de recherche avec les entreprises reviennent au CEA et aux écoles ; le CNRS et les universités engendrent 24% des contrats industriels. Cette concentration est extrême au niveau des laboratoires : les trois quarts de l'activité de recherche contractuelle sont portés par moins de 3% des laboratoires[104].

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[98] « Dépenses en R&D en France en 2004 » Note d'information du Ministère de l'enseignement supérieur et de la recherche 3 juillet 2006

[99] *Ibid*

[100] « Dépenses en R&D en France en 2006 » Note d'information du Ministère de l'enseignement supérieur et de la recherche 3 février 2009

[101] Les résultats officiels sont contestés par des études menées à des échelles moindres (secteur, forme d'innovation ou localisation) qui montrent que les PME innovent mais autrement (St Pierre et Mathieu, 2004).

102« Les coopérations public-privé pour innover en France » Note d'information du Ministère de l'enseignement supérieur et de la recherche 15 mars 2008

[103] Rapport sur la valorisation de la recherche 2006, par l'Inspection générale des finances et Inspection générale de l'administration de l'éducation nationale et de la recherche

[104] *Ibid*

D'une manière plus générale, cette structure est en partie le résultat de choix stratégiques reposant sur l'orientation des efforts de la R&D privée vers des objectifs prédéterminés mais aussi de la nature des interdépendances entre les sous-ensembles d'acteurs de l'innovation (organismes de recherche, universités, entreprises…) historiquement construits.

La faible diffusion des pratiques de partenariat public-privé en R&D reflète une faible distribution du soutien à l'innovation dans le tissu industriel. Pour être plus précis, les politiques d'appui à l'innovation **reposent sur les hypothèses de l'économie industrielle et de l'économie de la technologie qui rendent difficile l'innovation en technologie et en procédés pour entreprises de petite et moyenne taille** (Younès (2011)). Ainsi, les collaborations en R&D et le transfert de connaissances sont faiblement diffus sur l'ensemble du territoire.

La dernière décennie est marquée par une volonté de rupture dans les modes d'incitation à l'innovation. Le Gouvernement lance un vaste chantier de reformes qui visent à intensifier, diversifier et rendre plus flexibles les relations entre la science et l'industrie en privilégiant la construction d'un système répondant aux réalités du marché et plus ouvert à l'exploitation de nouvelles opportunités.

- **Nouvelle stratégie de l'innovation**

La fin des années 1990 est marquée par l'adoption de la loi Allègre qui facilite les passerelles pour les chercheurs entre l'activité de la recherche et la commercialisation de ses résultats[105]. Les mesures qui restructurent tous les éléments du SNI se multiplient à partir des années 2004-2005.

En matière de l'incitation à l'innovation par les opérateurs privés, la loi sur le crédit d'impôt recherche créée en 1983 est améliorée en 2004 et 2008 pour baisser le coût des opérations de R&D des entreprises. Les FCPI, Fonds communs de placement dans l'innovation, créés en 1997 et renforcés par la loi TEPA de 2007, ont l'obligation d'investir au moins 60 % de leur actif dans des PME innovantes et bénéficient en contrepartie d'exonérations d'impôt sur le revenu et de l'ISF[106]. Deux statuts fiscaux spéciaux, Jeune Entreprise Innovante (J.E.I.) ou Jeune Entreprise Universitaire (J.E.U.) sont créés en 2008 pour encourager la création d'entreprises par toute personne impliquée dans des travaux de recherche des établissements d'enseignement supérieur. En leur faisant bénéficier d'exonérations sociales et d'allègements fiscaux conséquents, ce statut aide les entreprises à passer le cap des premières années de leur développement[107].

Une réorganisation de la recherche publique et universitaire est entamée pour la rendre plus ouverte aux interactions avec les acteurs socio-économiques. Il s'agit notamment de la création des PRES[108], et des R.T.R.A. et R.T.R.S[109].par la loi de programme pour la recherche de 2006 et de l'autonomie des

[105]Il s'agit de la loi sur l'innovation et la recherche adoptée en 1999 qui a créé un cadre juridique incitant les chercheurs à créer des entreprises innovantes et à exploiter leurs brevets

[106]Rapport « Recherche et développement, Innovation et partenariats » par le Ministère de l'enseignement supérieur et de la recherche, 2009

[107]Information recueillie sur la page http://www.enseignementsup-recherche.gouv.fr/cid5738/le-statut-de-la-jeune-entreprise-innovante-jei.html visitée le 10 mars 2012

[108]Les PRES, pôles de recherche et d'enseignement supérieur créés en 2007 ont comme ambition de participer au rayonnement international des établissements d'enseignement supérieur et de recherche français, de rapprocher universités, grandes écoles et organismes de recherche et de faciliter la structuration du territoire de l'enseignement supérieur et de la recherche

[109] Des **R.T.R.A.** et des **R.T.R.S.** sont respectivement les réseaux thématiques de recherches avancées et les réseaux thématiques de recherche et de soins. Leur objectif est de rassembler, dans un domaine, une masse critique de chercheurs de très haut niveau, autour d'un noyau dur d'unités de recherche géographiquement proches, pour être visible et concurrencer les meilleurs centres de recherche à l'international. Actuellement 13 RTRA et 9 RTRS regroupent des établissements de recherche et d'enseignement supérieur publics ou privés et, éventuellement, des entreprises. Depuis 2006, 250 millions d'euros ont été investis dans les R.T.R.A. et 48 millions dans les R.T.R.S.

universités définie par la loi relative aux libertés et responsabilités des universités de 2007. L'opération CAMPUS qui finance la rénovation de l'immobilier universitaire et une reconfiguration des sites universitaires à la hauteur de 5 milliards d'euros, contribuerait à une plus grande visibilité des universités et de la recherche françaises.

Le financement sur projet s'est répandu avec la création en 2005-2006 d'organismes d'aide publique à la R&D : l'Agence Nationale de la Recherche(ANR) qui accorde des financements de projets de R&D fondamentale ; le groupe OSEO qui a pour mission de soutenir l'innovation et le transfert de technologies en accordant des prêts à taux zéro ou des subventions pour les activités de recherche. Enfin, le programme de l'investissement d'avenir doté de 35 milliards d'euros soutient l'innovation à travers de cinq domaines prioritaires : l'enseignement supérieur et la formation, la recherche, l'industrie et les PME, le numérique et le développement durable.

Des mesures visant directement à **décloisonner la recherche publique par l'incitation à la R&D collaborative** comprennent : [tableau annexe – généalogie modulaire de dispositifs de soutien à la R&D collaborative]

- Des **RRIT :** des réseaux de recherche et d'innovation technologique créés en 1998 rassemblent l'ensemble d'acteurs d'un domaine technologique : organismes de recherches, universités et écoles d'ingénieurs, grands groupes et PMEs, syndicats professionnels, groupements d'intérêt économique, centres techniques. Les réseaux fonctionnent par appels d'offres sur des thématiques prioritaires. Les RRIT ont reçu près 450 millions d'euros de 1998 à 2004[110] et près de435 millions d'euros entre 2005 et 2007[111].

- Des **S.C.R.** : des laboratoires ou structures communes de recherche public/privé créés dans les années 1970, ont connu un fort renouveau durant la première décennie du 21ème siècle. Les S.C.R. associent sur le moyen-long terme, les compétences de chercheurs publics et privés autour de problématique de l'entreprise partenaire et mutualisent les moyens de recherche pour une durée supérieure à un projet spécifique (en moyenne, 4 à 5 ans renouvelés une à deux fois). Actuellement, 214 structures sont recensées soit, au total, 200 laboratoires publics de recherche partenaires de plus d'une centaine d'entreprises ou de centres techniques. Ce dispositif est plutôt utilisé par des grands groupes qui ont leurs propres équipes de recherche et qui ont besoin de faire recours à des compétences plus pointus.[112]

- **Des Instituts « Carnot »** : inspiré des instituts Fraunhofer allemands ce label est décerné à des structures publiques de recherche qui placent au cœur de leur activité la recherche conduite en partenariat avec des acteurs socio-économiques. Entre 2006 et 2011 33 instituts ont reçu un financement à la hauteur de 1.5 milliards d'euros et ont généré 230 millions d'euros de recettes contractuelles avec les entreprises. En 2011, le programme IC2 a labellisé 34 instituts qui bénéficieront d'un budget de recherche de 1,9 milliard d'euros et près de 350 millions d'euros de recettes partenariales dont 60 millions d'euros avec des P.M.E[113].

(Source : http://www.enseignementsup-recherche.gouv.fr/cid56330/les-reseaux-thematiques-de-recherches-avancees-et-de-recherche-et-de-soins.html visité le 7 mars 2012)

[110]Présentation par Jacques Astoin de la Direction générale de la recherche et de l'innovation en 2007, téléchargée le 7 mars 2012 à l'adresse suivante : http://www.google.fr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=16&cts=1331118439114&ved=0CGEQFjAFOAo&url=http%3A%2F%2Fwww.medinnov.com%2Fdoc%2FTunis_Avril_2007_Astoin.ppt&ei=XkFXT9LrIlyX0QWj_e3tDQ&usg=AFQjCNHq_PU-Qdrfmx692DwZvNSU19wCHA

[111]Rapport annuel de l'ANR 2007, p. 145

[112]http://www.enseignementsup-recherche.gouv.fr/cid55939/les-laboratoires-communs-de-recherche-public-prive.html

[113]http://www.enseignementsup-recherche.gouv.fr/cid22127/les-instituts-carnot.html visité le 7 mars 2012

- **Des pôles de compétitivité** crées à la fin de 2004 rassemblent sur un territoire donné des entreprises, des laboratoires de recherche et des établissements de formation pour développer des synergies d'innovation entre les organismes recherche publique et les opérateurs économiques.

4.3 The Clusters Strategy of the Montreal Metropolitan Community (MMC)

Diane-Gabrielle Tremblay

The policies espoused by the Montreal Metropolitan Community (MMC) since the 1990s supports the idea of a network-based local development (Rifkin, 2004) or cluster strategy (Gertler and Wolfe, 2005). The current mayor, Gerald Tremblay, introduced the concept of clusters, a model which in his own words[114]:" is designed to stimulate the creation of conditions within which new ideas and processes can pass from embryonic to commercialized stages and provide returns for stakeholders" in 1991, as Quebec minister of Industry, Commerce, Science and Technology (MMC, 2008).

After almost twenty years since the first presentation of the concept, this strategy has brought the city of Montreal to define for itself four clusters to be supported actively by policy: the Aerospace industry, born in 2006 after a concerted effort spread over two years, Health Sciences which was recognized by the MMC policy in 2002, Information Technology and Communications sector launched in 2002 and, finally, the Film and Audiovisual production cluster. Together, these clusters represent a total of 238 000[115] jobs distributed between approximately 6 363[116] institutions, businesses and organisations belonging to these four sectors.

Who oversees the development of these clusters within the CMM cluster policy? The Montreal Metropolitan Community (or *Communauté métropolitaine de Montréal,* CMM) is responsible for the strategy and so serves as the coordinator of the three fundamental steps in the creation of a cluster: pre-startup , startup, and operation. One of the conditions for eligibility for the CMM and its governmental partners to lend financial support to the secretariat of the cluster is that all of the industries' stakeholders have to be part of one non-profit organization run by a board composed of the sector's professionals.

In the case of the Film and Audiovisual production cluster, the organization set up to oversee its activities is the Québec Film and Television Council (QFTC), an independent body which receives monies from the CMM after having signed agreements outlining the allocation of funds for specific projects. The QFTC receives two equal installments and a third, which represents 10% of the allocated funds, disbursed at the reception of the project report. The relationship between these two organizations remains independent, as it is the QFTC which has close ties to the field and which is solely responsible for the completion of the projects.

This development strategy is based upon the mobilization of the principal stakeholders around a leader or champion willing to rally the community around a common goal. The objective is to allow Montreal to project the image abroad of a city of knowledge, as well as a creative and prosperous city. The European Union's interest in these practices, which led to the development of CLUNET (Cluster Network) beginning on September 1st, 2006. The three-year international project, coordinated by the North West Development Agency, aimed to create a network of the most innovative regions with clusters. CLUNET is composed of 16 partners, including Montreal, the only non-European participant, and the main objective of the network is to launch pilot projects fostered by international cooperation "to achieve a

[114] Montreal Metropolitan Community, 2008, *Les grappes et l'innovation : Libérer le capital créatif.* (our translation)
[115] *Ibidem pp.14-15*
[116] *Ibidem pp.14-15*

common agenda for Europe that will lead to the creation of world-class clusters delivering global competitive advantage in lead markets"[117].

The internationalization of expansion into new markets demonstrates a willingness to explore all of the means necessary to prevent the cluster policy from becoming merely a regional development tool and, instead, bring renewed investment into the regions they represent through the strengthening of international ties and the exploitation of the theory's full potential. This stems from the recognition of the fact that clusters need to be based on international links as well as local relations. The first potential pilot program was launched at a conference held in Montreal in September of 2007 entitled "Europe Meets America". The conference focused on the cooperation between the aerospace industry clusters in Hamburg, Berlin and Montreal; a second alliance is based on a group of 8 pilot projects based in both Tuscany and Montreal, which focus on transnational commercial incubation of businesses. There does not seem to be other projects related to this international dimension.

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[117] *CLUNET Conference, Europe meets America, Montreal, 20th September 2007*

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4.4 Brief description of the pôles included in the study

Arve-Industries is specialized in activities of complex machining and precision engineering: http://www.arve-industries.fr/

Cosmetic Valley is specialized in perfume and cosmetics sector: http://www.cosmetic-valley.com

Mer PACA is specialized in maritime security and safety, ship and nautical industry, marine energy and biological resources, environmental and coastal management http://www.polemerpaca.com/

Minalogic - MIcro Nanotechnologies et LOgiciel Grenoble-Isère Compétitivité is specialized in micro- and nano-technologies and embedded system on chip : http://www.minalogic.org/

PASS - Parfums, Aromes, Saveurs et Senteurs - Perfumes, Aromas, Flavors and Fragrances operates in cosmetics sector is specialized in characterization, evaluation and production of natural extracts used in cosmetic and aromatic industries: http://www.pole-pass.fr/

Pégase Aéronautique et Spatiale – Pégase Aerospace Industry : http://www.pole-pegase.com/

PEIFL - Pôle Européen d'Innovation Fruits et Légumes- European Cluster for Innovation in the sector of Fruits and Vegetables : http://www.peifl.org

PNB - Pôle Nucléaire Bourgogne - Nuclear Cluster of Bourgogne is specialized in engineering and design, manufacturing, control and maintenance for nuclear energy production: http://www.polenucleairebourgogne.fr/

S2E2 - Science et Système de l'Energie Electrique- Science and Electrical Power System is specialized in electrical energy technologies and smart grids in the service of energy management: http://www.s2e2.fr/

SCS - Solutions Communicantes Sécurisées Secured Communication Solutions is specialized in micro-electronics, telecommunications, software and multimedia: http://www.pole-scs.org/

System@tic is specialized in software and complex information systems: http://www.systematic-paris-region.org/

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