Knowledge Governance for collective innovation: The case of collective exploration in the IAR French cluster for new bio-based activities

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Abstract

Collective exploration is a particular collective action for innovation. It is characterized by a lack of knowledge that has to be created and high uncertainty. The governance of these relationships is thus critical. After defining 'exploration', our research explores two elements: (i) the role of knowledge in the design of governance (ii) the main characteristics of governance design in the case of exploration involving different actors (research, industry) under government help in the context of French competitiveness clusters for new non-food applications called agro-resources industries.

(1) The exploration as a mode of innovation is under studied and especially in this new bio-based activities. (2) The concept of governance has long been discussed in the literature but never defined and conceptualized for relations and for the particular and delicate case of knowledge creation. (3) The link between three concepts always treated separately: Knowledge, innovation and governance. (4) The particular context of competitiveness clusters launched in France on 2005 is interesting to study. The aim of the cluster is to boost innovation and to have international visibility through a territorial base and combining the strengths of local Academic Research, Industry and Training under the eye of public power.

Research question:

How to govern collective exploration for knowledge creation in the context of cluster competitiveness for new bio-based activities?

Methodology:

Since 2005, the innovation projects to develop this new technology of non-food applications of agricultural products abound. The collective exploration between research and industry under the benevolent eye of the public power is advocated among other organizational forms because of the great uncertainty that accompanies such projects. Organizational complexity and diversity of forms of relationship is special to this new industry called agro-resources. We used a qualitative and explorative methodology by studying the case of exploration of the second generation of bio-fuels.

Findings:

Our research provides an extended analytical framework for the study of governance in the context of collective exploration. We suggest that the hybrid governance is the most suitable for collective exploration. The design of efficient governance structures between industry and research must take into account the knowledge to be created and shared. We found the existence of multi-level governance that we called: Meta, network and project governance, creating and sharing different type of knowledge and using diverse mechanisms of governance and must be complement for high effectiveness.

Contribution:

Understanding what will determine the success or failure of collective exploration in terms of governance. We propose a framework for analyzing the specific case of knowledge creation, in a new activity with great uncertainty and complexity. Our study helps to better understand the knowledge governance (Foss, 2007).

Practical implications:

Our research aims providing a renewed and extended perspective of the concept of governance. We give an insight on modern innovation processes, where the boarders between industry, research and public authority are blurred. For managers, this topic is critical: in this new biobased industry the competition is more time-oriented. Thus acquiring some competences in the ability to design proper governance structures for knowledge creation and share is probably one of the key elements of future success in fast moving market.

Keywords: Governance, collective exploration, knowledge creation, cluster, biobased activities

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Introduction

Innovate or die is the challenge facing firms but also nations in this new area of Knowledge Based Economy (KBE). Drucker (1985) stressed that the innovation is the mean allowing the value creation for the entrepreneur but the image of the isolated inventor in Schumpeterian tradition which inseminates the economy of an idea that is communicated by the sky is now fundamentally schematic and outdated. The process of innovation is not the same in Montpellier, Geneva or San Francisco, the appearance in France of the 'competitiveness clusters' attests that.

This model of a multiplicity of actors working together in the process of innovation highlights the relationship and interaction between users, providers and institutions and entities that are part of the innovation system. Inventors and innovators are in community, in a coalition based on shared trust and embedded in a dense network of interactions (Scott & Brown 1999, Brown & Duguid, 2000, from Laursen & Salter, 2006).

Drucker (1993) points out that innovation is none other than the creation and application of new knowledge to make them productive. Then we believe in the same vein of 'Innovation Based on Knowledge' (Nonaka and Takeuchi, 1997; Johannessen et al., 1999; Leonard-Barton, 1995; Amidon, 2001) that innovation and knowledge are two faces of the same coin.

The success of innovation depends on the governance mode (Teece, 1996) for the mainstream of the governance literature. The Williamson transactional framework does not consider knowledge: its nature, its dimensions and its process. The need to develop a new scale of governance choice based on knowledge (as a base for innovation) is crucial to go in this new era of knowledge.

This issue is even more critical when it is about exploring like those of valorisation of Agro-resources. Bio-fuel, agro-materials, bio-molecules, bio-energy are the four activities that researchers, industrials, agricultural cooperatives and institutions wishing to emerge and for which the '*pôle de compétitivité'* Agro-Industries and Resources (IAR) was created.

Our aim in this article is: (1) to link these three concepts: governance, innovation and knowledge, which have been widely studied, but there were little (or no) attempts made in the direction of connecting the three, by (2) exploring this question in the particular context of exploration as a regime of innovation for biobased activities in the case of the IAR French competitiveness cluster.

First, we will highlight the link between innovation and knowledge, then defining governance and the shortcomings of the literature. Secondly we will introduce the concept of "knowledge governance" (Foss, 2006) which means choosing governance structures (e.g. markets, hybrids, hierarchies) and coordination mechanisms (e.g., contracts, directives, reward schemes, incentives, trust, management styles, organizational culture, etc.), for the purpose of influencing processes of creating, transferring and sharing knowledge. Then we will try to define the exploration as a particular process of innovation and its challenges. Finally, the application to the case of emerging biobased activities is proposed.

As Simon has noted (1986): "*a current priority in research organizations is to understand how they develop new products, bring new production methods and marketing and new forms of organization. This is the unfinished task that Chester Barnard has left us* "(p.16).

EXPLORATION : A SEPCIAL CASE OF COLLECTIVE ACTION FOR INNOVATION

Exploration: researching a definition

In Etymology, to explore comes from Latin explorare: running, and would have made sense to go, and with ex, go away. Explorer navigate an unfamiliar area in studying carefully examine, study (Larousse, 2008). Exploration is, first of all, the discovery of new areas previously unvisited or even ignored. March was the first to define exploration in comparison with

exploitation. The March dilemma, which gave birth to the 'ambidexterity stream', was interested by how to align operations and the exploration?
Segrestin (2006) extended the March definition: "*Exploration concerns an ill-posed problem, a concept for which no implementation exists and where the available knowledge is very limited or not directly exploitable. She states that the exploration can be a planned process or an adaptive process*". But could we "discipline" this process in order to give birth to innovation?
Garel et Rosier (2008) defines exploration as an innovation regime where it is a great potential of expansion of technology and value[1]. It corresponds to situations where teams have to explore innovative new applications outside of their usual references. The concepts refer to a proliferation of applications and uses for unknown users in new areas and different without being able to determine a priori the technological choices or architectures. There are thus both great potential of applications and technical uncertainty.
But, what about 'knowledge' in this process? To complete the lack in their definition, we used the C-K theory (Hatchuel, 1996 ; Hatchuel et Weil, 2003 ; Le Masson *et al.*, 2006).
They developed a theory called "C-K" which presents the 'conception' as iteration between two spaces: the space of concepts 'C' and space of knowledge 'K'. They then characterize innovations along two dimensions: the gap between the concept behind an innovation and existing concepts in use and the gap of knowledge incorporated in innovation and the stock of existing knowledge. A small gap is noted "δ" (small delta) and a significant gap "Δ" (large delta). On using this matrix to innovation regimes defined by Garel & Rosier we will have this typology:

		Knowledge K	
		δ K	Δ K
Concepts C	δ C	*Do not mobilize little research and development*	Renewal
	Δ C	Consolidation	Exploration

We suggest that exploration is a process of innovation, after what exploitation is a natural extension, once innovation is stabilized and business is established. This process of exploration starts from a fuzzy concept with reduced or absent knowledge, in a process of testing in situ and evaluating "potentials" and implementing projects. The aim of the collective action (organization, partnership, etc..) by exploring is to introduce on market, from new concepts, an innovation that will have "useful effect" or to be positively valued by the market and therefore customers.
Based on the work of Möller, Rajala and Svahn (2007), March, Hatchuel, creativity approaches, and Nonaka's work on knowledge creation we can define the exploration process into three stages according to the criterion level determining the value and knowledge exchange in the exploration (see figure below).

[1] they define three innovation regimes respectively : consolidation, renewal and explorations regime.

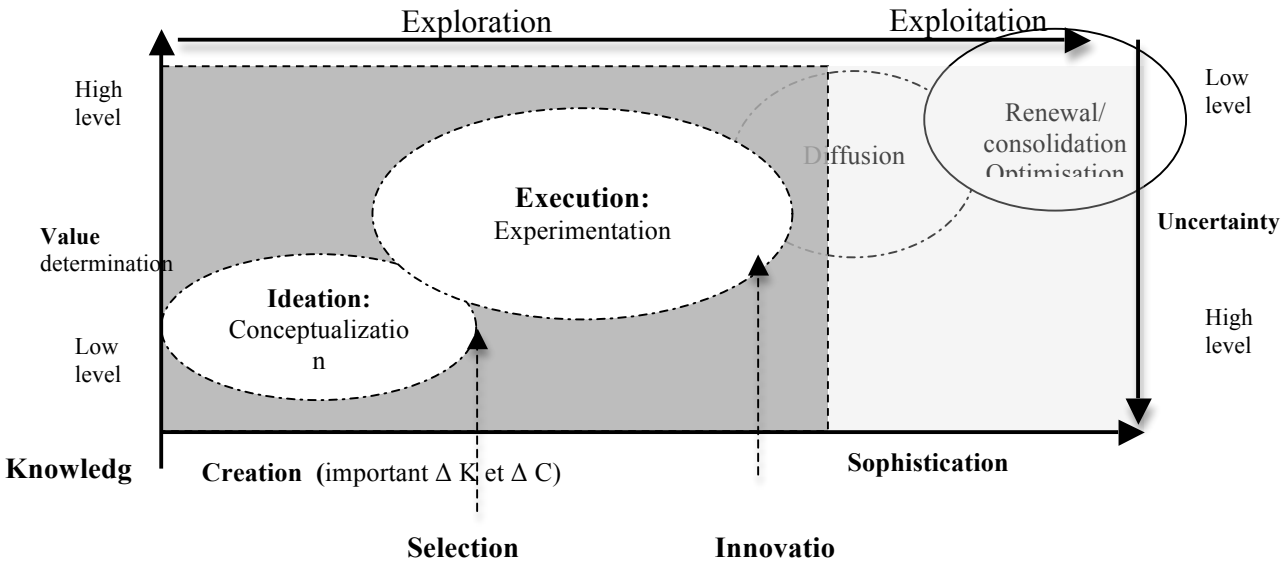


Figure 4 : Process of exploration

Exploring the potential of bioresources: Promising Ideas and diversity of actors

The living organisms in general, and cultivated plants in particular are the reservoirs of massive amounts of molecules with diverse activities and properties (molecular structures, with a reserve or biological activity). Used in full or after elementary transformations as food, textile, timber or heating, paper etc., this material is now entering a new era: the biorefinery or vegetal refinery

The Consortium 'Biorefinery EuroViews' defines biorefinery as: "*The integrated bio-industries, producing from biomass and a variety of technologies (enzymatic, thermochemical...), both chemicals, biofuels, energy, agro-materials (including plant fiber), and food and food ingredients* ». The biorefinery concept is linked with the political priorities of the Lisbon and Gothenburg on regard of competitiveness and sustainable development.

The concept addresses several contemporary challenges: Support for growth and diversification of the rural economy; the use of renewable resources ; support for European energy independence ; promotion of renewable energy (20% in 2020) ; developing integrated bio-economy ;

The idea of using biomass for energy and industrial purposes is not new. The concept of biorefinery was born in the 1980s, much progress was made but the concept and its development modes are yet to be explored and determined. The knowledge is not yet fully explored, it is likely that the deepening knowledge on bioresources will unveil new uses and applications not yet considered in the current phase. Also, the need to maintain and develop basic research is crucial: to have databases more complete, if not complete, which could refer scientists engaged in applied research. If we recall the Hatchuel classification, the gap concept is important in relation to what already exists (fossil refinery). Creating new knowledge is essential in order to discover new uses of bioresources.

In France, there is a very intense mobilization for research in these immense unexplored resources, and potential offered by the bioresources for sustainable development. The participation of scientists is paramount. Universities, public and private centers of research are mobilized.

Scientists, engineers, technicians, industries and consumers are all actors of scientific and

technical progress and must interact with each other. The dispersion of knowledge between different actors is the characteristic for exploring the bioresources potential. It suggests the establishment centers of expertise and excellence at the national level and also at the European level, to attain the critical mass that gives international credibility to the European research.

Exploration challenges in bio-based activities :

In the exploration that interests us, the collective action consists of a multitude of actors from different organizational environments: scientists, industries, farmers, state and local governments aiming to co-create knowledge.
Some challenges are facing the exploration concerning the collective action, the knowledge co-creation:
- In the vein of Hatchuel, and as it is a collective action, the first question that arises is how to design it. The actors of exploration are not known and their involvement is not necessarily granted. The perimeter of the group, relations between its members, the rules governing it and its identity as a group are therefore also part of the field to explore (Hatchuel & Weil, 2002; Segrestin, 2006)
- Each actor has his own vision of emerging opportunities due to the fragmentation of knowledge and specialization, so creating a common vision is difficult (Möller, Rajala and Svahn, 2007): How should we deal with diversity of approaches without blocking the exploration? Because of the heterogeneity of actors, the problem of perceived value to create (publication for scientists, patent for the industry) and the perception of time (longer for scientists and a real race against time for the industry) are to resolve:
- The challenge is also that cooperation is not natural among various actors with different and sometimes conflicting interests (Segrestin, 2006; Brousseau, 2000). Uncertainty plays a very important role. According to current economic, it is the cause of the existence of the firm (Coase, 1937, Richardson 1972) and may lead to uncooperative behavior that Williamson called ex-ante 'opportunism' or ex post 'moral hazard'.
- We said that the purpose of exploration is unknown, or when it is known it is not clear and contains a large complexity leading to uncertainty. This uncertainty requires the need of generation and production of new knowledge. This creation is complex and requires a thorough knowledge of the characteristics of incoming and outgoing knowledge, factors facilitating or constraining it, the various mechanisms and actors in place. More than Identifying the nature and dimensions of knowledge involved in the exploration, the strategic orientation of knowledge creation is challenging (Nickerson & Zenger, 2001; 2004).

THE KNWOLEDGE-BASED ECONOMY: KNOWLEDGE AND INNOVATION

Knowledge and innovation: definition and dimensions

The innovation is the creation and implementation of new knowledge to make them productive (Penrose, 1956; Drucker, 1993). So, to identify the innovation we need to understand knowledge. Winter (1987) was the first to propose a typology of knowledge (Foss, 2006, 2007) depending on whether this knowledge is tacit / explicit, non articulated/ articulated, observable / non-observable, complex / simple, element of a system / independent. Thus depending on its dimensions, knowledge is easily transferable or is difficult to transfer, its property rights are difficult to define or not and so on. In this cartographic perspective, Henderson and Clark (1990), Hall and Andriani (2003) offer interesting typologies of innovation. The former distinguish incremental innovation, modular, architectural and radical, depending whether knowledge is unchanged or changed and concepts are reinforced or

reversed. Hall and Andriani were more interested in the degree of incremental and radical innovations to distinguish minor and major degrees depending on the knowledge quantity and substitutability.
More global and dynamic, we find in the literature of innovation the difference between exploration and exploitation. Holland (1975) was the first to make this distinction, then used by March (1991). The exploitation concerns the extension and refinement of knowledge and technologies (March 1991) without changing the nature of activities with a limited uncertainty of the environment. Exploration is characterized by the break with what is being done to focus on the discovery of new technologies (March 1991). The exploration is not the efficiency of operations but is a process which concerns the uncertain search for new business opportunities based on new technologies. Knowledge creation is more important than diffusion for the exploration innovation.

Innovation as a process of transformation of knowledge

In the vein of the 'Knowledge Based Innovation' we support the idea that the innovation process is the process by which knowledge is transformed, combined and implemented. Nonaka (1991, 1994), Nonaka and Takeuchi (1997) are still the main contributions to the understanding of mechanisms of knowledge transformation. The model of the creation and capitalization of knowledge is based on the distinction between tacit and explicit knowledge. Tacit knowledge is rooted in the action, the routines in a specific context (which can increase personal productivity at the individual level and the competitive advantage at the enterprise level). The explicit knowledge is knowledge codified, transmitted in a formal and systematic language. In organization, the creation and accumulation of knowledge occurs at three levels: at the individual level, group level, organization level. It uses four modes of conversion: (1) Socialization, tacit knowledge to tacit knowledge (2) Exteriorisation of tacit knowledge to explicit knowledge (3) Combination of explicit knowledge (4) Internalization of explicit knowledge to tacit knowledge to a higher level.

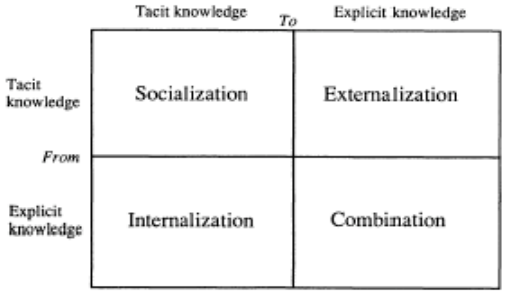


Figure 1: Knowledge mode of conversion, Nonaka (1994)

Nonaka proposes the spiral of knowledge creation that explains the transition from tacit knowledge to explicit one and vice versa and between different levels. Our purpose here is to explore this dynamic of creating knowledge for innovation in an interorganizational context from the governance perspective. Particularly, the objective is to understand the emergence of monitoring devices and governance mechanisms when question of knowledge creation and sharing are at stakes.

GOVERNANCE AND KNOWLEDE

Governance: the need for a new paradigm

The concept of governance has been extensively studied by theorists of organizations (Westphal and Zajac, 1995). Governance means the way of organizing transactions (Williamson, 1994) and by extension the relationships. Its purpose is to achieve the correct order by public or private use of coordination mechanisms. The governance structure is the design of an institutional matrix in which the integrity of the transaction or set of transactions is decided (Williamson 1996) or an institutional model that governs trade in controlling opportunism (Dyer, 1997).

Williamson proposed a complete matrix of choice of governance but not very suitable for this special transaction ‘knowledge’. With his two books' Markets and Hierarchies' and 'The Economic Institutions of Capitalism', Williamson built the theory of transaction costs where the analysis unit is the transaction. The choice of the appropriate structure is based on three criteria which are the characteristics of transactions, the uncertainty that accompanies these transactions, the frequency and specificity of assets involved. Williamson argues that when the specific asset is idiosyncratic, integration can reduce transaction costs. It must be said that it is opportunism that worries Williamson. We will build the definition of governance in a functional approach based on dichotomist function: disciplinary and cognitive (Charreaux), relational and contractual mechanisms (cf. figure 2).

As several authors (Conner and Prahalad 1996, Kogut and Zander, 1996) we support the idea that the contextualization of governance by situations where knowledge is created raises the need for an extended theory. The innovation and dimensions of knowledge may explain the choice modes of coordination.

More specifically, two directions need to be explored: the question of governance levels, and the complementarity of governance mechanisms at different levels.

Considering the first point, as Gomez highlights (2009), the actual theory of governance is inadequate to the study of new productive forms of action (for instance: clusters) in context of high uncertainty and complexity as those present in the phases of innovation for the emergence of new activities. This mismatch stems from the fact that:

- It is difficult to establish property rights on economic rent from the collaborative networks as the dominant theory on corporate governance in the capitalist system is based on a clear allocation of these rights.
- The stakeholders in a cluster have divergent interests on nature and time horizon and consensus can not be found on looking for a single collective benefit, as suggested by the theory of corporate governance.

Renewal or looking for a new paradigm is especially urgent as there is a multiplication of these forms throughout the world both in the developed countries and in developing countries.

On the second point, the work by Poppo and Zenger (2002) shows an interesting complementarity between formal contract and relational governance (i. e. the “social processes that promotes norms of flexibility, solidarity and information exchange” (Poppo and Zenger (2002:710). For them, the reason of this complementarity is to be found in the fact that customized contracts narrow the domain around which parties can be opportunistic. “Customized contracts specify contingencies, adaptive processes and controls likely to mitigate opportunistic behaviour and thereby support relational governance” (Poppo and Zenger, 2002:721). Nevertheless several questions remain unsolved; for instance the question of mutuality between parties, of problem of conflicts, problems of measurement of costs and of benefits of the exchange. These questions are particularly of interest in the situation of knowledge exchanges. As suggested by Antonelli (2005) the economics of knowledge has

shifted from public goods then towards proprietary goods and finally towards localized technological knowledge. For Antonelli "at each point of time the topology of agents in the space of knowledge, hence their relative distance and structure of their relations and interactions are key features of the system" (Antonelli, 2005:14).
In a general statement, the core question is, finally, whether or not this phenomenon of complementarity between governance mechanisms is to be observed in the context of knowledge creation and clusters.
On these points the so called knowledge governance approach (hereafter KGA) brings interesting insights. We will develop this approach and its interests in the following point.

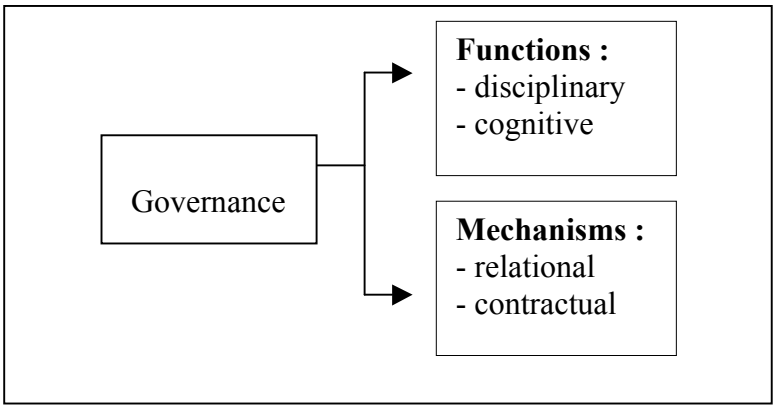


Figure 2: governance components

The Knowledge Governance Approach (KGA):

According to Foss (2006, 2007), Grandori is the pioneer to have used the concept of 'Knowledge Governance', which he defines as: "Knowledge governance therefore means deploying governance mechanisms so as to maximize the net benefits from processes of transferring, sharing and creating knowledge. This is similar to the transaction cost minimizing logic of transaction cost economics." He adds: "The approach may be briefly defined as a sustained attempt to uncover how knowledge transactions -which differ in their characteristics- and governance mechanisms -which differs with respect to how they handle transactional problems-, are matched, using economic efficiency as the explanatory principle."
The KGA starts from the hypothesis that knowledge processes (i.e., the creation, retention, and sharing of knowledge; Argote, 1999) can be influenced and directed through the deployment of governance mechanisms, in particular the formal aspects of organization that can be manipulated by management, such as organization structure, job design, reward systems, information systems, standard operating procedures, accounting systems, and other coordination mechanisms (cf. Grandori, 2001). The KGA asserts that such governance mechanisms should be seen as critical antecedents of knowledge processes.
More specifically, Foss identifies the causes of the research gaps, mainly the missing micro analytic foundations (at the level of individuals) and the neglected role of organizational antecedents, as well as of the formal organization. On the contrary, Foss suggests that the governance approach, i.e. the specific combination of governance structures (market, hybrid, hierarchy) inside organizational forms will influence the knowledge process (sharing, integration and creation). Similarly he suggests that this is necessary to identify knowledge-based hazards, and "how does the deployment of governance mechanisms remedy such hazards" (Foss, 2007:42).

An interesting development of the KGA literature is also the question of unit(s) of analysis. For Foss, the most applicable unit is the "knowledge transaction", that is to say "the transfer of an identifiable 'piece' of knowledge from one actor to another one" (Foss, 2007:44).
Nevertheless, the innovation does not appear in the KGA. Teece (1986) proposes an interesting framework combining knowledge (in-house, outside or to be created), innovation (autonomous or systemic) and mode of governance (S = flexible structure, V = Virtual M = Multiproduct integrated, A = alliance). Teece attests that the reality is better represented by the existence of mixed modes (Richardson, 1972) where firms adopt simultaneously or alternatively the two modes of governance. For Teece, innovation is not monolithic, and it is imperative to understand the kind of innovation that is used (autonomous, systemic) (see figure 3). In the continuation of this work, Gopalakrishnan et al. (1999) propose to combine innovation and knowledge, based of the three knowledge dimensions: tacit conditions, autonomy and complexity.

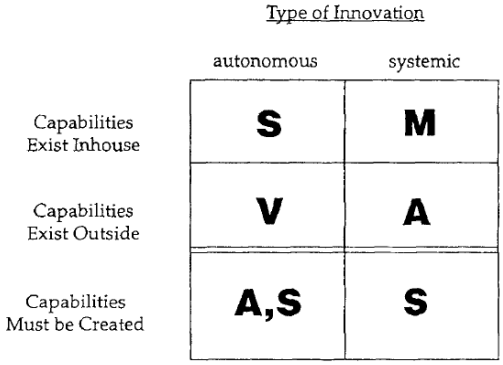


Figure 3: Innovation, knowledge and Governance, Teece 1996

« *LE PÔLE DE COMPÉTITIVITÉ »* IAR : A FRENCH CLUSTER FOR BIORESOURCES

Methodology

The literature had extensive discussions on the issue of governance, but left in the shadow of the descriptive and explanatory framework, concrete structures and governance mechanisms (Ehlinger et al. 2007). The aim of understanding and exploration suggests a qualitative exploratory approach involving a case study. Indeed the novelty of the research on governance in special context, where it is about exploration as a particular process of innovation aiming to develop new technologies and non-food applications for bio-resources that provide interesting analysis, that is a breakthrough innovation with great complexity and uncertainty.
The application of this method is favourable in terms of feasibility and the research design, which can be explained by the following quote from Yin (1994:6) "In general, the case studies are preferred when the issues of" how "or" why "questions are asked, and when we focus on a contemporary phenomenon in the context of life." According to Glaser and Strauss (1967), the objective of the research case study is to "discover" a theory.
The chosen field of investigation is the exploration in a '*pôle de compétitivité'*, this French version of cluster launched to enhance competitiveness and innovativeness of French industries. It was necessary to focus on the project dimension. We had the great opportunity to study the Industries and AgroResources (IAR) cluster for the developing new non food values of biomass and the mega project called "FUTUROL" for developing the 2sd generation of biofuels from the enzymatic process. The project had the same architecture as the cluster: researchers, industry and funders actors. The data was collected by interviews with different

actors: academics, industries, policy-makers, by attending actors meetings and also analysing secondary data (reports, some presentations performed by the actors, some emails exchanges). In the following section we will describe the cluster and identify the knowledge to integrate to create a new one, the governance structure and collective action attributes. Then, we will announce some propositions that emerge from the literature and the case-study.

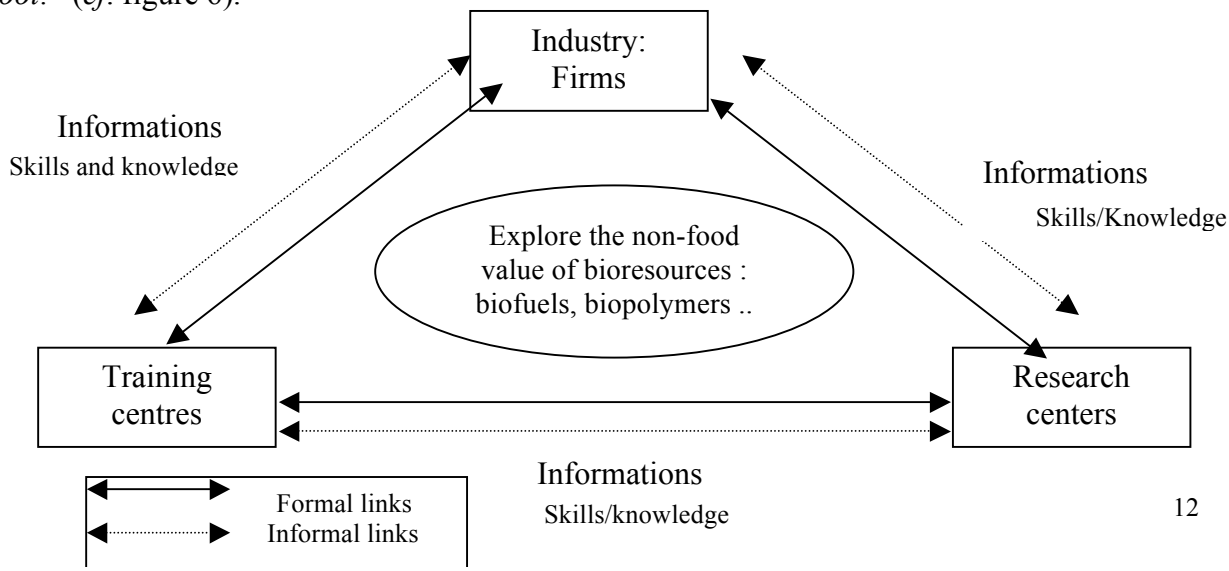
Industries AgroResources 'IAR' cluster: growing in green

« Giving to the most dynamic territories the means of European and global ambition: this is the vocation of the competitiveness clusters, which also embody a new vision of land management »
Jacques Chirac, President of French Republic, 2005

- Our empirical focus is on emerging biobased industry where innovation has many facets. On the one hand, the origin of products for which it will give birth, 100% derived from renewable agricultural, functionality to the extent that they will produce no nuisance to the natural environment (biodegradability...), the technology that will be used to produce these products, which is still unknown in large part. But more important is the framework which has been created in 2005 for governing innovation by launching the French model of clusters called '*Pôles de Compétitivité' (PDC)*. The development of this process follows a model of encouraging open innovation industry-research-training relationships. This network connecting different actors detaining resources and capabilities and designing new activities proposes to break with the existent technology and to bring a radical change that will lead to the creation of a new value system, with ideas still fuzzy, exogenous uncertainty related to the project concerning the process, and the output, as well as a high endogenous uncertainty associated to the difficulty of assessing performance. Also the net is characterized by a significant level of complexity relating to the subject of the relationship (Biobased activities), the diversity of partners which belong to different organizational environment (Plewa et al, 2004), a complexity that induces a specificity of human, physical (Heide, 1994) and relational (network, other relations) assets.

Jacquet & Darmon (2005) precise that: "each actor has a specific role, clearly defined and identified: the private sector is responsible for the cluster and the government represented by the public collectivities accompanying the device and participating in coordinating committees and funding". All these different actors are joined in local and regional environment and maintaining relationships to innovate.

The relationship in this context is tripartite between industry (big groups and SME's), research centers (public and private) and training centers exchanging different streams of information, knowledge and skills by formal links like 'committees' "*commission*" and informal channel like "*friendly discussion: "over a beer*" or "*over a game of human baby-foot!*" (*cf*. figure 6).



In the definition of the IAR cluster (Jacquet & Darmon, 2005), each actor has a specific role, clearly defined and identified: the private sector is responsible for the cluster and the government represented by the 'public collective bodies' accompanying the device and participating in coordinating committees and funding. It is important to know the role of each one in terms of governance functions and mechanisms.

- The governance structure in the IAR is an associative configuration based on the membership to a solidarity community between pairs (no subordination link) on developing a community hub. It allows maintaining equilibrium between research and Industry, and also '*representativity*' of the two regions (Picardie and Champagne-Ardenne). Its main challenge is to identify, accompany and help educate regional R&D projects in the field of agro resources (www.iar-pole.com). The local powers (regional council, DRIRE, CCI, CRA) and local collective body help forming and maintaining the economic actors without participating directly in the cluster governance (Figure 6) via the '*Institutional partners committee'*. The institutional frame plays a crucial role on governing the links between actors (Brousseau, 2000). The association is organized around a steering committee that selects the projects with a view to their labelling by the pole based on an independent audit by a scientific committee. The labelling allows projects to be oriented, to be submitted to the committee for funding, and to the possibility of different funding related to its content (figure 6). To execute the plan of actions defined by the association, several working groups, and committees have been established (Thematic Comittees and the '*COS* or *Comité d'Orientation Stratégique'* (Strategic Orientation Committee). They are spaces to meet, to think, to animate the network, to break boundaries and particularly project ideas incubation. We distinguish then three different network levels in terms of coordination: project level, cluster level and institutional environment. Each dimension refers to different governance levels (Brousseau, 2000).

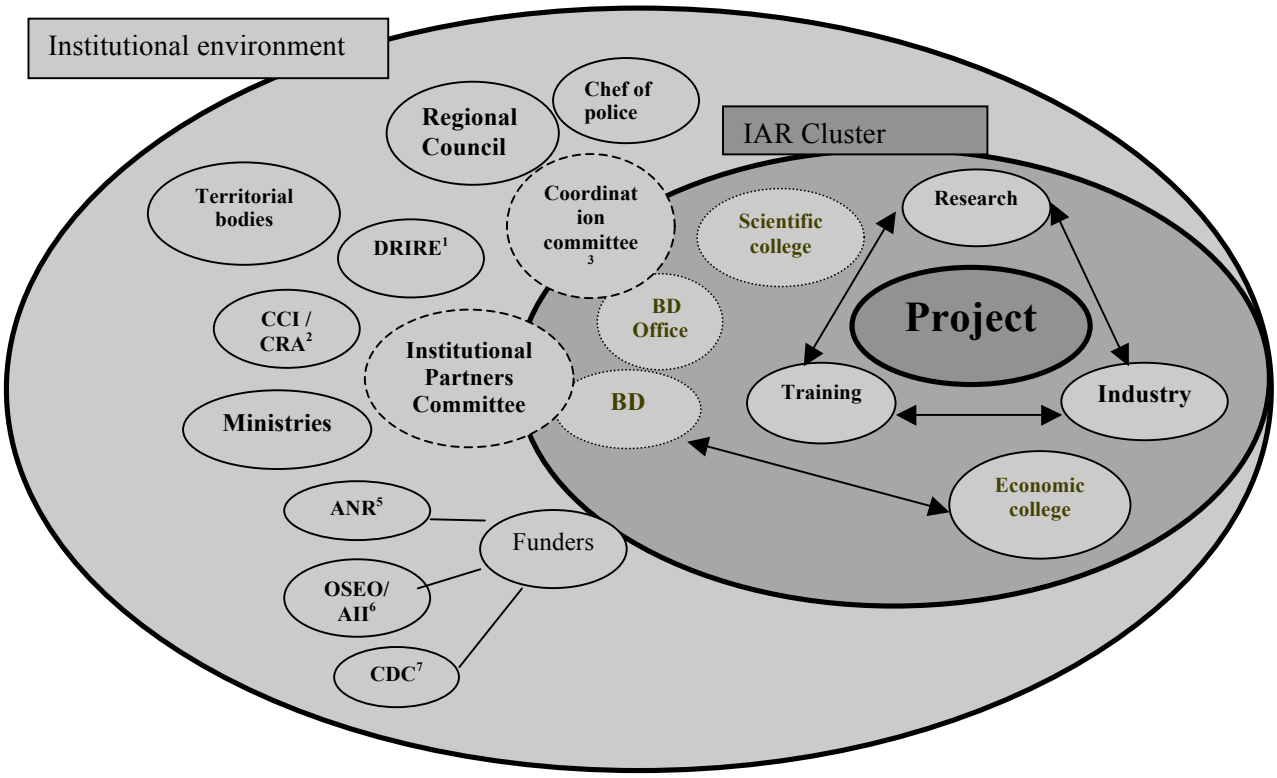


Figure 7: Governance levels in IAR Cluster

- "*FUTUROL*" is the project concerning the biofuels of 2sd generation and covers a period of eight years. This second generation has to be developed from an enzymatic way to benefit from the whole plant and to avoid the competition between energy and feeding. The project budget is about 74 millions Euros, financed partly by OSEO (governmental agency for innovation) and by the eleven actors involved in the project: scientists (INRA, IFP, ONF), industrials (TEREOS, TOTAL, Lesaffre), agriculture cooperative (Unigrains, confédérations des betteraviers, champagne Céréales) and funder (Crédit agricole Est). The project includes sixty sub-projects.
- In this exploration of biobased activities, the knowledge needed is a "*new*" knowledge (Peterson, 2010) combining scientific and industrial, generic and specific, tacit and explicit, complex and simple, collective and individual. There is "*project*" and "*sub-project*" scientific and industrial knowledge is completing each other, where explicit knowledge is combined, (report/reviews exchange, meetings, committees), implicit knowledge is exteriorized (project teams,), explicit knowledge is internalized (exemple), tacit one is socialized (project-teams, Phd students). We identify then Nonaka's creation process of knowledge. This creation aims to lead to innovation conducting to new market and new values. This innovation needed is systemic in the way that to go to go further in the 2sd generation of biofuels we need the results of 1st generation biofuels. We can summarize the characteristics of exploration in biobased activities as below:

	Innovation	**Uncertainty**	**Actors**	**Knowledge**			
				Scientific / industrial	*Tacit / Explicit*	*Complex/ simple*	*Collective/ individual*
Exploration of new non-food values of bioresources	**Systemic**	**High level**	**Heterogeneous**	**New**			

Research propositions about governance of knowledge creation for exploration in new biobased activities

As advanced, in exploration the need is for creation knowledge using different knowledge: tacit/explicit/complex/simple at different proportions. This knowledge production is done under uncertainty context but also to avoid uncertainty. The latter makes difficult the establishment of contracts, so market governance seems risky. The strategic knowledge is not yet spotted and difficult to internalized (organization). Also, the diversity of partners, which belong to different organizational environments, makes hierarchy not appropriate or not realistic to implement. The hybrid mode of governance seems to be the most appropriate and the most efficient for exploration in Biobased sectors. The more the partners are various, different and the more the environment is uncertain, the more we need a specific governance mode far from market and hierarchy.

Proposition 1: Exploration involves high uncertainty, requires new knowledge creation and involves heterogeneous actors; the hybrid mode of governance is then more appropriate;

Looking at the "homes of decisions" in the case studied, we noticed the existence of different centers. In the case of the "Futurol", the SAS (simplified joint stock company) created, is the first outbreak of decision with a board, a strategic committee and a scientific committee. Then, each sub-project consists of a team led by a director. The strategic decisions are decided

at the 'Strategy Committee' formed by the eleven partners. The 'Scientific Committee' deals with policy and scientific choices and is formed by scientific partners with the possibility of industrial actors to attend the discussion as advisory and without voting the decision. The power is held by the different partners. This architecture of decision is polyarchic insofar as no one knows exactly where to go and how to get there, it does not hold the key knowledge (that no one knows yet) and that knowledge is dispersed.

Proposition 2: Associative and polyarchic governance is more appropriate to govern the creation of knowledge and exploration;
The creation of new knowledge required integrating different knowledge held by different actors. They are tacit and explicit, complex and simple, collective and individual. In addition, this knowledge is dispersed among different actors, in our case among science and industry. The uncertainty that accompanies the exploration open the 'knowledge space' beyond existing partners, to other actors who may hold in due course a useful knowledge.

Proposition 3: the creation of new knowledge in the collaborative exploration requires flexible and open governance. This governance must balance contractual and relational mechanisms.

The lack of subordination link and the reciprocal interdependence of the various partners (Thompson, 1967) require the development of a specific function of governance in order to foster cooperation and to try to align the mental patterns of the various partners. In the case of innovation network in the emergent biobased activities, it is needed to create an interactive space where different actors could exchange and help the fuzzy ideas to become project-ideas and then projects. In studying the relations between industry and research in the biobased industry we found that there are different levels: (1) the 'macro-level' constituted by national public institutions but especially regional institutions (2) the 'meso-level' materialized by the '*pôle de compétitivité'*, which constitutes the network of various actors with weak ties association where the different partners meet to maximize the benefits of the cooperation between the different actors and (3) the 'project-level' governing the relation-project assumed by a pilot (decision centralized) (figure .
There is a complementarity between the 'cluster-governance' assumed by the 'pôle de compétitivité' and the project level. We suggest that the cluster governance has mainly a cognitive function while the project governance guarantees the double function. The effectiveness of the relation depends on the capacity to create the complementarity between the different governance levels.

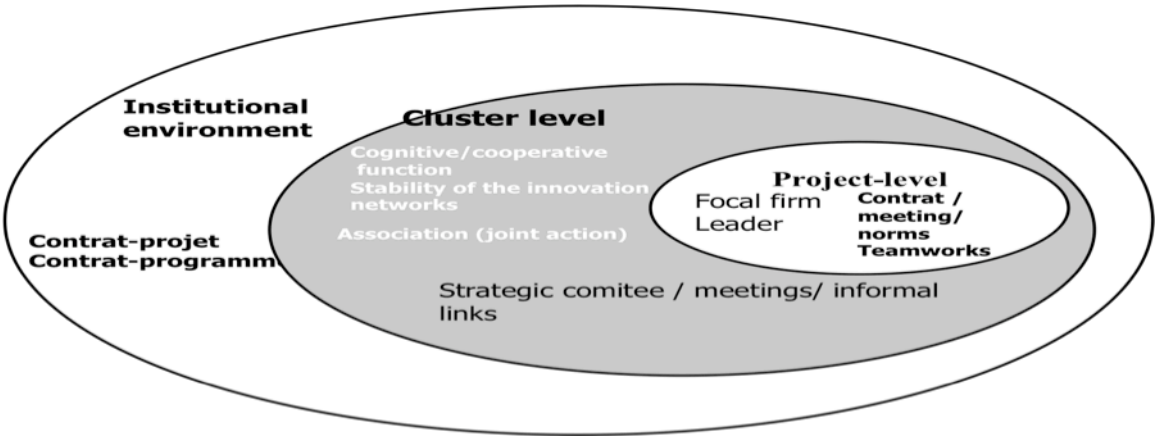


Figure : Three levels juxtaposed for developping new biobased activities

Proposition 4: In exploration of new biobased activities there are complement levels of governance. Each level has specific knowledge characteristics that necessitate appropriate mechanisms of governance;

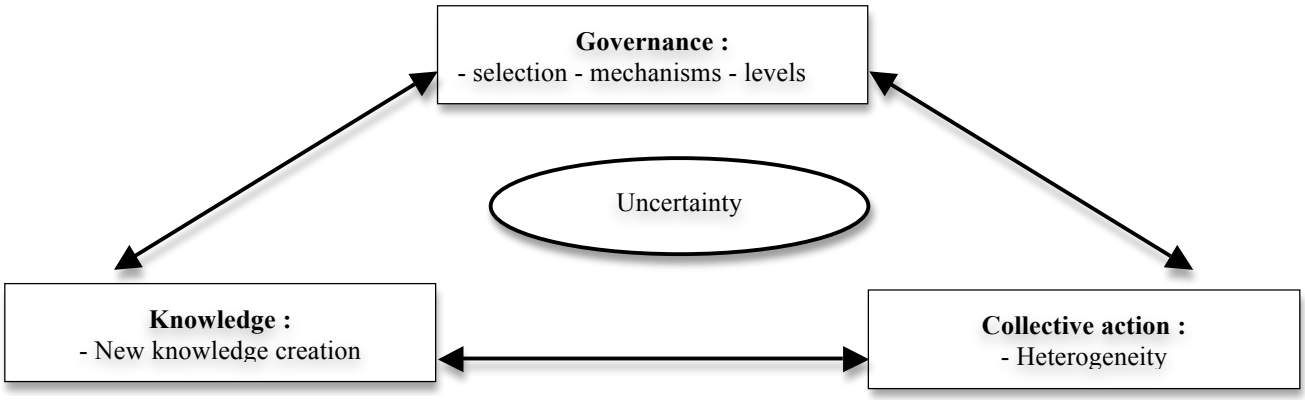
	Institutional- environment	*Cluster-level*	*Project-level*
Knowledge	*Information (as a low dimension of knowledge)*	*Explicit Simple*	*Tacit Complex*
Disciplinary function			*Contractual governance*
Cognitive function	*Contractual governance*	*Relational governance*	*Relational and contractual governance*

In the case

The collective exploration is a process where we go from limited existing knowledge to new one. This adventure needs a governance pattern that could be flexible and could evolve when the knowledge is more defined and stabilized. Then the contract could be more precise and the appropriation better defined. The key knowledge could be identified, so the actor who holds it could be the focal firm leading and governing the innovation process.

Proposition 5: the governance mechanisms adopted for collective exploration are likely to evolve over time gradually as the knowledge creation evolves.

From all the above, reviewing literature and exploring the cas study, we design the following framework linking : knowledge (leading to innovation), collective action and the governance :



Conclusion: Managerial and theoretical implications

We suggest that analysing and understanding innovation and especially exploration as a particular process for innovation, go through an investigation of what is knowledge: its nature, dimensions and its processes. We attempt to articulate the three components of strategy until now separately discussed in the literature: innovation, knowledge and governance. For that the traditional corpus of governance (principally a contractual approach) is no more sufficient to understand the innovation in the sense that knowledge (nature, dimensions) is excluded from the analysis. In using the KGA approach as well as Teece, Penrose, Drucker,

Schumpeter and others, we attempt to shed a new light on the point of junction between innovation, knowledge and governance.
We think that the management of exploration induces a need for a specific governance of knowledge, which means understanding the complex characteristics and transformation processes of knowledge implicated in a given innovation pattern. This new conception leads to some implications in understanding the governance modes of knowledge for innovation, and especially the idea of *governance functions and levels* that are complementary within '*global innovation system'*.
A better understanding of factors that influence the knowledge creation for innovation could be a great help for managers and policy makers. The future of innovation is linked to the control of the process of knowledge creation and exchange.

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[1] Regional direction for Industry, Research and environment
[2] Regional consular for industry, commerce and agriculture
[3] Institutional Partners Committee: the two president of the regional council and the chef of department
[4] Head of an administrative area
[5] National Agency for Research
[6] OSEO- AII: Regional agency for innovation
[7] Caisse Des Dépôts: Public fund for the economic development
[8] Regional Center for Innovation and Technology Transfer in Chemistry and Environment

Websites:

www.iar-pole.com; www.competitivite.gouv.fr