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Evolution of business models in French *Competitiveness clusters* and the role of intermediaries: the case of horticultural varietal creation

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Abstract: The French *Competitiveness clusters* policy notably entails the financing of collaborative projects. This gives rise to a particular approach to open innovation that mainly relies on the co-construction and sharing of a resource common to stakeholders. This may entail a questioning of current innovation practices, thus giving rise to new constraints and opportunities leading firms to reconsider their business model. However, internal and external constraints may impede their evolution. *Competitiveness clusters'* governance bodies act as innovation intermediaries playing a central role in releasing stakeholders from those impediments.

Keywords: open innovation, business model innovation, *Competitiveness cluster*, innovation intermediary

JEL : L10 ; O31 ; Q16

I. Introduction

In 2004, the French government launched the *Competitiveness clusters* policy, a cluster-based technological policy. Such policy is coherent with a larger trend towards the decentralization of public action that has translated into a new approach of public policy. Public policy has become of a more bottom-up nature since the issue at stake has been to support local initiatives (see Fromhold, Eisebith 2005). A central device of the *Competitiveness clusters* policy lies in the financing of cooperative R&D projects involving different agencies, depending on their aims and size: Governmental funding (*Fond Unique Interministériel* – FUI hereafter) and National Research Agency (*Agence Nationale de la Recherche* – ANR hereafter) at a national level or regional funding agencies (Oseo, integrated into BPI France, a French national financing agency, since July 2013).

Strong discrepancies among cooperation practices exist within and among *Competitiveness clusters* even though all cooperative projects rely on an open approach towards innovation (Amissé, Muller 2011; Hussler et al. 2012). Cooperation may rely on common projects or on the exploitation of formal / informal individual and inter-organizational networks. Furthermore, for many actors, the centrality of cooperative projects in the *Competitiveness cluster* policy gives rise to important evolutions in their cooperation practices (Bearing Point et al. 2012 ; Hussler et al. 2012). This translates into new modes of value creation and capture and new business models for involved firms, thus raising two questions. What are the conditions of business models evolution in the specific open innovation framework promoted through cooperative projects? What role do *Competitiveness clusters*' governing bodies play in this evolution? We show in this paper that clusters' governing bodies (responsible for orchestration and technological transfer at the cluster scale¹) play a key role in business model evolution. As intermediaries, they contribute to the emergence and the securing of value creation opportunities while supporting the flexibility of involved organizations facing evolutions in their productive and institutional environment.

We will show in the next section why the *Competitiveness clusters* policy is associated with a specific approach towards innovation. Furthermore, we will describe the way through which it can entail evolutions in the business models of firms involved in cooperative projects. More precisely, we will analyse the role *Competitiveness clusters* play in this evolution through the concept of intermediation. In a third section, we will present a case study showing that horticultural nurseries involved in the *Competitiveness cluster Vegepolys* were led to progressively change their business model and to adopt a business model based on vegetal varietal creation. However, such an evolution suffered from several barriers that Vegepolys has contributed to overcome thanks to its intermediation role.

¹ All *Competitiveness clusters* have created local offices aimed at their orchestration and coordination. Coordination offices are normally made up of a President in charge of shaping and communicating a global strategy for the cluster, a general assembly aimed at informing members and a board of directors discussing, validating and monitoring the implementation of the global strategy (Bearing Point et al. 2012). Furthermore, most *Competitiveness clusters* have created a technology transfer office (TTO) whose purpose is to bind the academic world with the business world by enhancing scientific coordination and technology transfer. Those offices also aim at supporting cooperative R&D projects. In the remainder of this paper, we will refer to those orchestration, coordination and technology transfer offices as *Competitiveness clusters*.

II. Open innovation as a mediated networked structure: putting firms' business models into question

II.1. Open innovation in the *Competitiveness cluster* policy: the necessity of business model evolution

A primary aim of the French *Competitiveness cluster* policy is to support the innovation capacity of firms, notably through a funding of R&D projects. Different types of funding are offered, depending on the aims and on the scale of the project. The FUI fund is the main device as it has accounted for almost half (48% of 2,7 billions Euros for the 2008-2011 period) of the public financing of cooperative R&D projects (Bearing Point et al. 2012). It basically aims at funding applied research or development projects since funded projects have to develop innovating products or services entering the market five years after the end of the project. FUI funded projects also have to involve several industrial partners and at least one public research lab from one or several *Competitiveness clusters*. In comparison, the ANR mainly funds projects in upstream levels of the R&D process and represent less than one third (28%) of the total financing. ANR's main targets are public and non governmental organizations (76,8% of financings through ANR). Finally, Oseo (now part of BPI France) accounts for the last funding source (Bearing Point et al. 2012).

Through the FUI, the *Competitiveness cluster* policy explicitly encourages private organizations to adopt open innovation practices. Open innovation refers to the way firms benefit from resources and ideas circulating between their frontiers and their environment (Chesbrough 2003). More specifically, open innovation, as promoted by the *Competitiveness cluster* policy through their cooperative projects, gives rise to coordinated collective action aimed at maximizing the exploitation of individual innovation capabilities. External cooperation is fundamental, not only for enhancing firms' innovation capabilities, but also for the shortening of time-to-market. Cooperative R&D projects therefore support sourcing strategies as firms mobilize external sources of innovation (Fey and Birkinshaw 2006). Project partners may be involved in different ways: by directly participating to R&D, providing resources, etc...

One can however observe different ways of mobilizing external knowledge and information (Laursen and Salter 2006). This may be a harbinger of different types of openness depending on regimes of resource appropriability and appropriation (see West 2003). For instance, openness in the case of a sourcing strategy does not only entail the development of absorptive capacity (Cohen and Levinthal 1990). It also requires capabilities designed for identifying and selecting relevant knowledge and partners (Laursen and Salter 2006) and to coordinate with partners (Sachwald 2008).

Open innovation (and, more particularly, sourcing) relies on networks, thus assuming numerous interactions among different actors (Cooper 2008; Ferrary 2011). Indeed, open innovation may be considered as an open system in which relevant knowledge is widely distributed among them (Chesbrough 2006). It involves different types of stakeholders (firms, public research labs, supporting organizations) characterized by different strategies and business models articulating diverse objectives and rationalities. For instance, Cooke (2005) refers to the concept of systemic innovation to explicate the importance of the external environment for local systems such as industrial clusters. Firms engaging into open innovation therefore have to cope with dramatic strategic and relational changes (Fleming 2001; Dahlander and Gann 2010): extension of markets or access to new markets, new ways of collaborating and of managing incoming and out-coming resource flows, the influence of

external actors on internal R&D and the choice of selective revealing, new ways of managing intellectual property and capturing value.

Open innovation, as promoted through the *Competitiveness cluster* policy, thus leads to reconsider the business model of firms or, even, to evolve it. Innovation per se may not be considered as a guarantee for success but must come together with a definition of go-to-market and a strategy of value capture (Teece 2010). At the core of business models are the construction of a competitive advantage and the ability to generate supernormal profits (Teece 2010). All different approaches to the concept of business model (see Zott et al. 2011) emphasise the way resources and core competences are mobilized and combined in processes designed for creating and capturing value. Business models therefore perform two fundamental functions: value creation and value capture (Chesbrough 2007). This is possible as soon as the firm defines its activities and outputs in order to generate a competitive advantage. Out of this, we consider business models as cognitive devices through which decisions on innovation are assessed, adopted and translate into economic returns (Chesbrough 2006).

The (re)definition of an open innovation strategy thus leads to question the modes of cognition and of action underlying the development of a competitive advantage and of new internal and external opportunities (Chiaroni et al. 2010). More specifically, it assumes the capacity to devise coordination processes for exchanging incoming and out-coming ideas, knowledge, competences, projects and implies a flexible use of business models for seizing opportunities (van der Meer 2007). Thus, any evolution in the open innovation strategy may imply changes in the business model of the firm as it builds on its resources and core competences (Johnson et al. 2008).

Furthermore, open innovation leads the firm to reconsider its frontiers and coordination with external partners, thus leading to new organizational forms and new collective rules. As it contributes to structure relationships with different actors, open innovation is also associated with collective rules. In turn, those rules contribute to frame the business model of organization engaged in open innovation. Collective rules are here understood as models of thought and behaviour agents adopt (Hodgson 1998, 2003, 2007) for framing coordination (Berro and Leroux 2010). Rules may be informal, as in the case of common representations, or formal, as in the case of norms or models. Strategies for seizing value thus rely on collective rules settled through processes of agreement, bargaining or ultimatum depending on power asymmetries among partners (see Dockès 1999).

Business model evolution (see Chesbrough 2010) in *Competitiveness clusters* partly depends on the capacity of partners to reach agreements going beyond possibly diverging interests (Berro and Leroux 2010). More generally, business model evolution depends, not only on the way firms collectively manage the open innovation process for building up competitive advantage (see West 2003), but also on their capacity to evolve rules underlying existing business models.

Firms willing to exploit the outcomes of open innovation have to experiment in their business models and to agree on new collective rules (Chesbrough 2007). This is all the more true when firms adopt sourcing because it contributes to intensify relationships with external partners and to institutionalize new practices (Chiaroni et al. 2010). The flexibility of collective rules therefore determines the flexibility and the resilience of business models. Business models are not set once for all but are dynamic (Baden-Fuller and Morgan 2010). Evolutions may be partly teleological and partly emerging because they integrate new opportunities and constraints of the environment as well as new rules governing open innovation (Demil and Lecocq 2010). In this way, dynamic consistency refers to the ability of

a firm to evolve its business model while maintaining a high level of performance (Demil and Lecocq 2010).

However, business model evolution might suffer from internal and external barriers (Chesbrough 2010). Internal barriers are of two types:

- **Organizational inertia.** The redeployment of assets is not always possible and may encounter an internal inertia (Chesbrough 2010; Zott and Amit 2010). In this case, business model evolution depends on the capacity to purposively articulate three meta-capabilities (Doz and Kosonen 2010): strategic sensitivity corresponding to the capacity of identifying opportunities, leadership unity, resource fluidity allowing to rapidly redeploy resources and to reconfigure capabilities. Business model evolution would require more effort as path-dependency is strong.
- **Uncertainty of gains out of business model evolution.** New business models frequently give rise to performances that are temporarily lower than existing ones (Chesbrough 2010). However, in the context of open innovation, the issues of the capacity to capture rents and resources are key since the decision of evolving the business model depends on the capacity of the firm to appropriate the gains of innovation and the new business model. Thus, uncertainty is pervasive and may take three forms (Bénézech 2012): 1) strategic uncertainty arising out of information asymmetries and associated with situations of adverse selection and moral hazard; 2) substantive uncertainty linked to a lack of information necessary for decision taking; 3) coordination uncertainty referring to the fact that coordination involve different actors, resources and competences that may evolve over time and for which relationships must take into account power asymmetries and complex agreement and bargaining processes,

The fact that firms are embedded in relationships involving different actors corresponds to a second type of barriers to business model evolution. As firms are embedded in value networks involving a multiplicity of actors (customers, suppliers, partners and complementors, competitors), their business model has to comply with a dominant logic (Sabatier et al. 2012). It follows that business model evolution not only occurs at an individual level but also has to take into account rules and constraints governing the value network. More particularly, the capacity to evolve in the business model depends, not only on the evolutions of the value proposal, but also on the compatibility of this value proposal with the other value of network members' business models (West 2006).

Business model evolution also depends on other actors' strategies and on power asymmetries. For instance, Fautrero and Gueguen (2012) highlight the role played by ecosystem leaders. Leaders may behave in a way favouring the collective dynamics of the ecosystem. Such a *keystone* strategy actively participates to value creation and sharing within the ecosystem (Iansiti and Levien 2004). Leaders may also develop domination strategies as they control entries and role evolutions within the ecosystem. In this case, the issue at stake for the leader is to appropriate the value and rents actors have generated through open innovation.

All in all, collective rules and power asymmetries determine the lasting capacity of actors to capture the collective rents. Potential conflicts therefore have to be anticipated, mediated and proactively solved, unless the collective strategy framed by actors involved in open innovation and their capacity to evolve their business model would be put into danger.

II.2. The smoothing role of intermediaries for business model evolution

In the previous section, we insisted on the internal and external barriers for business model evolution in the context of open innovation. They are of different kinds: organizational inertia; strategic, substantive and coordination uncertainties; dominant logic in the value network, power asymmetries and coordination rules. The origin of most of those barriers lies in the interaction between the firm and its environment.

Numerous contributions, especially dealing with business ecosystems, have underlined the mediating role of platforms. It corresponds to institutional arrangements whose aim is to support interactions through a reduction of information asymmetries (De Vogeleer and Lescop 2011). Platforms are considered as mediating objects and take the form of loci (virtual or not), standards or shared artefacts. In the specific case of collaborative R&D projects, platforms include the outcome of the project and other common resources. Since they are arrangements smoothing collective action, platforms are associated with a set of coordination rules among stakeholders and are often associated with a modular architecture (Brusoni and Prencipe 2001). Thus, platforms can be considered as mediating arrangements decreasing development costs and time to market and are likely to support the exploration and the exploitation of complementary competences (Argyres 1999).

However, the real capacity of platforms for supporting business model evolution remains uncertain as they are in general produced and controlled by the leading firm in the ecosystem (De Vogeleer and Lescop 2011). The capacity of other stakeholders to evolve coordination rules associated with the platform mostly depends on the strategy of the leader (Iansiti and Levien 2004; Fautrero and Gueguen 2012). Finally, coordination rules may only evolve incrementally because any significant change would lead to question the overall architecture of the platform (see Aggeri and Segrestin 2002). In this case, business model evolution would be limited to adaptations without any significant updates.

Intermediaries may also take the form of “acting bodies”: individual or organizations, as discussed in the literature dealing with innovation intermediaries (Lichtenthaler and Ernst 2009). In a broad way, Howells (2006) defined an innovation intermediary as: “[a]n organization or body that acts an agent or broker in any aspect of the innovation process between two or more parties” (p.720). This perspective will be adopted in the remainder of the paper since innovation intermediaries may support open innovation and business model evolution in two ways. First, they influence relationships among actors. Second, they support the circulation and accessibility of resources and knowledge.

A first function of an innovation intermediary is of a relational nature. It increases the density of the local network and fills structural holes (Kirkels and Duysters 2010; Obstfeld 2005). In the first case, it acts as a third party promoting trust among partners because it contributes to secure opportunities generated through the cooperation (Möllering 2006; Bénézech 2012). The third party contributes to avoid hold-up problems when investments in specific resources are required (Nooteboom 1999). As a third party supporting cooperation, the action of the intermediary also gives rise to indirect benefits. The density of the network associated with a multiplication of communication channels guarantees the quality of information and knowledge circulating in it (Coleman 1988). However, this assumes that actors are characterized by strong ties with the intermediary (Granovetter 1973; Burt and Knez 1995) or, at least, compatible objectives (Nooteboom 1999).

The task of intermediaries for filling structural holes consists in selecting and introducing partners coming from ecosystems whose knowledge and resources are locally lacking (Padgett and Ansell 1993; Klerkx and Leeuwis 2009). They therefore contribute to

increase the internal variety of the ecosystem and to reduce risks of lock-in. For instance, increases in the internal variety facilitate the connection of the ecosystem with organizations holding path-breaking commercial or technological ideas. This allows to generate or to induce new opportunities (Sapsed et al. 2007). However, sufficient intergroup link density must complement the entry of new members in the network (Burt 2004). Newly introduced actors otherwise run the risk of being marginalized. This shows that local connectedness and global cohesiveness are complements for business model evolution. Indeed, the likelihood of collective rule evolution increases if both conditions are met.

A second function of innovation intermediaries consists in smoothing knowledge and resource circulation inside and outside the group. In this case, intermediaries contribute to identifying and selecting holders of external knowledge and their translation and sharing (Giuliani 2011). They also propose an independent assessment of new ideas (Winch and Courtney 2007). Thus, they contribute to increases in firms' absorption capacity as they act on its relational component (Spithoven et al. 2010). However, innovation intermediaries must in turn develop significant absorptive capacity and social capital (Morrison 2008). This is why leaders often assume this function as they benefit from a personal network allowing them to access varied sources of knowledge (see Giuliani 2011).

Intermediaries also contribute to orchestrating the local network of firms (Rychen and Zimmermann 2008). In so doing, they may adopt strategies ranging between two extremes (Arikan 2009). At one extreme, they favour competition-oriented strategies. In this case, relations among actors only comply with strategic aims and the opportunities for knowledge sharing are low (Amissse and Muller 2011). At another extreme, intermediaries favour cooperation-oriented strategies. They support open innovation, as they are supportive of knowledge and resource sharing. However, for sharing opportunities to be realized, intermediaries must implement corresponding incentives (Dyer and Nobeoka 2000).

More precisely, intermediaries adopting cooperation-oriented strategies often have to orchestrate networks, corresponding to undertaking deliberate actions for creating value for the benefit of stakeholders (Dhanaraj and Parkhe 2006). In so doing, intermediaries must contribute to knowledge diffusion and innovation appropriability and the dynamic stability of networks as well (Dhanaraj and Parkhe 2006). This last task consists in ensuring the active participation of members and the replacement of any leaving member. In orchestrating networks, intermediaries have to supply members with incentives for taking part to network dynamics, notably by ensuring sufficient levels of internal variety in knowledge and resources. At the same time, orchestration involves promoting the systemic coherence of the network by integrating and valuing participants' inputs (Weil et al. 2010). Network orchestration assumes adopting a keystone strategy as well as maintaining a sufficient level of flexibility in collective rules.

All in all, intermediaries when understood as "active bodies" contribute to decrease some causes of organizational inertia as they enhance access to knowledge and external resources. They also contribute to reduce uncertainty as they act as third parties and supply external resources. They finally fill structural holes and orchestrate relational networks, thus contributing to avoid relational lock-in and to maintain flexibility in collective rules.

Intermediation may also be associated with tensions and issues. One of them is obviously associated with its very nature, as intermediaries have to fill numerous gaps: cognitive and informational, in norms and values (Klerkx and Leeuwis 2009). Furthermore, some constraints may be related to the type of organization working as intermediary (firm, teaching and research organization, etc.). These constraints are key as they determine its legitimacy and raise the question of the nature of actors' and intermediaries' objectives (Ollila

and Elmquist 2011). The main issue for the intermediary is to be identified as achieving objectives compatible and complementary to those of other stakeholders as they may come from distinct groups having possibly conflicting goals. The intermediary can solve this dilemma by achieving ambiguous or multiple objectives (Padgett and Ansell 1993). However, this may only be a short-term solution because the intermediary's behaviour contributes to uncover its real goals (see Nooteboom 1999). A lasting solution would be for the intermediary to show that it assumes this function for its own sake with no other goals. For instance, as the *raison d'être* of a private intermediary is to generate profits, it may exploit its position in the network for capturing associated rent (Kogut 2000) or quasi-rent (Bénézech 2012). However, as keystones, intermediaries normally should contribute to generating rent without capturing it (Winch and Courtney 2007) as would public actors do.

In the specific case of *Competitiveness clusters*, coordination and technological transfer offices may assume an intermediation role, as their development does not imply to achieve profits. Their legitimacy relies on two grounds. First, their public nature allows considering them as independent and impartial, thus reinforcing their trustworthiness (Klerkx and Leeuwis 2008). Second, as they were associated with the creation of *Competitiveness clusters*, they have had time to build up lasting relations with firms and research organizations, thus reinforcing their visibility (see Nooteboom 2005).

The next section will be devoted to highlight the intermediation role of a *Competitiveness cluster's* coordination and transfer office in the specific case of a FUI-funded R&D project. It emphasises the way the *Competitiveness cluster* policy may induce business model evolution through an evolution in open innovation rules. It underlines the key role of coordination and transfer offices in those evolutions.

III. Open innovation, intermediaries and business model evolution: plant varietal creation in the Vegepolys *Competitiveness cluster*

Vegetal varietal creation follows an open innovation logic and is considered as a priority axis by the Vegepolys *Competitiveness cluster*. Vegepolys is located in the French *Pays de la Loire* region and gathers activities of creation, production and marketing of “specialized plants”, i.e. high value added plants. Vegepolys gathers organizations operating in height sectors and associated upstream and downstream businesses: ornamental horticulture, fruit and vegetable growing, seeds, wine, medicinal and aromatic plants, mushrooms, cider and tobacco. The cluster is involved in different tasks such as the development of cooperative R&D projects, strategic foresight in “specialized plant” markets, innovation and technology transfer. Vegepolys gathers 4,000 companies accounting for 30,000 jobs, 450 researchers and several higher education organizations (engineering school, university) accounting for 2,500 students.

The local horticultural sector is considered as a leading activity at the French level as it is a national leader in potted plants, bedding plants, young nursery stocks, bulbs, dahlias and container shrubs. It accounts for more than 280 companies and 3,300 jobs with leading companies such as Bioplant, Briand, Ernest Turc Production, Jardiland, Plan Ornamental and Vilmorin².

We draw a distinction between two periods of time: before the implementation of Vegepolys in 2005 and since then. Until 2005, informal inter-firm networks structured the

² Source : <http://www.vegepolys.eu/vegepolys/les-membres/>, accessed 21/11/2013

local horticultural sector. Value capture strategies relied on downstream production activities rather than on breeding activities³, on a localization rent and on informal networks allowing to capture an organizational quasi-rent (Bénézech 2012). Intermediation was private as most intermediaries were charismatic leaders belonging to old families of plant producers. Since 2005, the implementation of Vegepolys has contributed to a renewal of companies' strategies in an uncertain environment and to changes in open innovation processes. Open innovation has become more formal and has relied on cooperative projects and on common resource building. Moreover, new business models have been tested and applied. However, such evolutions have not been straightforward. Barriers emerged and former private intermediaries were unable to solve them. Through a specific focus on BRIO (Breeding, Research and Innovation in Ornamentals), a cooperative R&D project involving horticulturalists, plant nurseries and a public research lab (a full description of the project is given in the methodological box), we will show how Vegepolys, as a public organization, has played a crucial role in smoothing the coordination of open innovation processes and business model evolution.

In this section, we show the importance of public intermediaries (Vegepolys here) for open innovation processes and business models evolution. First, we show that private intermediaries contributed to locally structure breeding strategies through vegetal creation. Second, we show that plant companies evolved towards breeding strategies through varietal creation⁴ by relying on Vegepolys, now playing the role of an intermediary. Companies have evolved their businesses from plant producers towards breeders. This has allowed them to become more competitive at an international level.

Material for this case study was collected in 2008 and updated in 2012 and in 2013 through interviews. We triangulated the data by processing archival data and participating to seminars. 80 semi-direct interviews were made, each lasting between two and three hours. Interviewees included:

- Plant producers. These were firms located in the Pays-de-la-Loire regions under the NAF 2007 (i.e. French classification of economic activities) header "01.1D (horticulture, nurseries). We interviewed the 20 largest firms (in terms of turnover) about the organization of the local industry before 2005. All of them are located in the Maine-et-Loire department. Respondents were company directors and a few horticultural engineers. For the period after 2005, we interviewed company member of the BRIO project (for confidentiality reason, we are forbidden to disclose the name of companies). BRIO involves 21 firms that are organized in common structures (economic interest groups, research consortia). 67% of them are dedicated to breeding through varietal creation, employ 10 to 150 workers with a turnover between 0,5 and 10 millions euros. 33% of involved firms are SME and 80% are located in the Maine et Loire department. We interviewed all firms located in the *Maine et Loire* Department. We interviewed some firms twice and we had access to their archival data.
- The Vegepolys cluster. The cluster contributed to write the proposal. The BRIO project was

³ Breeding corresponds to activities and processes linked with the creation of new plant varieties that are potentially protected by plant breeders' rights (PBR). Plant breeders develop strategies for seizing the innovator's rent by protecting new varieties through PBR and the payment of royalties. Until 2005, only a very few local plant producers followed such a strategy, most of them being members of SAPHO, a professional union.

⁴ Breeding through vegetal creation covers all processes aimed at changing the traits of a plant through interbreeding or hybridization without recourse to direct genetic modifications. Breeding through vegetal creation may be considered as a process innovation as the new hybrid is considered as a mother plant that is then multiplied. Breeding through varietal creation covers all activities aimed at creating new varieties through direct genetic modifications. It may be considered as a product innovation.

selected for financing in March 2010 in the frame of the 9th FUI call for proposal. BRIO was endowed with a 1,6 million euros grant. We interviewed members of Vegepolys' board of directors and employees of Valinov, its technological transfer office (TTO).

- Researchers involved in project from the INRA (the National Institute for Research in Agricultural Sciences) of Angers, the University of Angers and from AgroCampus Ouest in Angers, an engineering school specialized in horticulture.
- Representatives of a horticultural trade association
- A representative of a horticultural professional union
- Representatives of supporting organizations: local chamber of trade and industry, Angers Technopole.

III.1. Open innovation in breeding through vegetal creation with historically private intermediaries

Although Vegepolys was officially settled in 2005, the *Pays de la Loire* Region has developed a long-standing experience in horticulture. One can date the origins of ornamental horticulture back to the 15th Century and it was institutionalized during the 19th Century with the establishment of scientific societies, the accumulation of a collective wisdom, and the diffusion of tacit knowledge among horticulturalists (Amissé et al. 2013).

The development of this competence in horticulture historically relies on process innovation: development of techniques for conforming plants, for controlling production cycles or enhancing cultivation techniques (e.g. cutting beds). Plant enhancement is internal to the firm. It consists in enhancing the characteristics of a plant and then crossing it with other varieties in order to obtain new colours or hybrids. The aim of plant enhancement is to enhance the aesthetic characteristics of plants and the creation of varieties. To this end, each firm develops and maintains a collection of parent plants constituting its main specific asset.

Horticulturalists spontaneously develop informal sourcing processes to become more efficient. This sourcing mainly relies on the strong ties between entrepreneurs and allows them to initiate flexible cooperation. Reciprocal business visits give opportunities to observe and to copy local competitors' best practices, thus contributing to develop a collective wisdom. Some entrepreneurs also undertake study trips abroad and share acquired knowledge. Innovations partly rise out of a crosschecking between firms' accumulated internal experience, the observation of best practices from competitors and the co-construction of a collective experience through observation and discussions among them. Thus firms benefit from a collective knowledge base whose exploitation remains internal. Free-riding behaviours are seldom because firms disclose and use information in a balanced way so that each one benefits from information exchanges to become more efficient in terms of innovation. This flexible appropriability regime is collectively accepted because it contributes to enhance information flows and to better seize business opportunities.

This atmosphere conducive to cooperation is also the outcome of a structuring in dense and closed social networks. Horticulturalists belong to a community characterized by strong and dense multiplex ties (Amissé et al. 2012, 2013). Horticulturalists are strongly embedded in dense and intertwined professional, friendship and family networks that also constitute barriers to the entry of outsiders. The construction of a collective experience and embeddedness contributes to build-up a strong common culture. This common culture comes together with collective emulation fostered by horticultural competitions and with an

intellectual tradition based on botanical societies gathering horticulturalists, connoisseurs, botanists and scientists.

In such a context, innovation may be qualified as open since sourcing and the co-construction of a common knowledge base enable plant companies to innovate in-house through vegetal creation and enhancement. Moreover, they contribute to tame different types of uncertainty: strategic (thanks to dense networks), substantive (through better access to information) and coordination (thanks to multiplex networks and the common knowledge base).

From the 1970's until the end of the 1990's, value creation associated with the business model of plant companies relies on three main components: plant production, localization rent and an organizational quasi-rent of a Marshallian character (see Gaffard 1990):

- Plant production was always organized around three main markets: business, private (e.g. garden centres) and landscape architecture for local governments. During that period, those markets are very dynamic and competitive intensity is quite weak. Moreover, firms specialize and adopt different niche market strategies (nurseries, bulbs, cut flowers, potted plants, bed plants) and competition behaviours. Those strategies are also in line with the particular organization of the value chain that is organized in three main steps (breeding, production, trade), each step being associated with different competences and specialization logics. Plant companies develop different strategies along the value chain.
- The localization rent relies on several factors. A first factor corresponds to weather and soil conditions that are particularly suited to plant production: sandy and clayey soil, alluvial valleys and a moderate coastal climate characterized by a microclimate particularly suited for growing exotic plants. A second factor is linked to the collocation of actors within a 100 km area around Angers. Collocation favours the development of social networks among horticulturalists and constitutes a barrier to the entry of newcomers, as most productive plots have been already cultivated. This localization rent is also associated with an organizational quasi-rent linked to the geographic concentration of actors and the development of multiplex relationships: informal discussions, transportation costs pooling or joint production of knowledge.

Some key private actors, who also played an intermediation role, have jointly produced the rules underlying the local organization of actors. They are charismatic leaders belonging to old families of horticulturalists. They set the rules for selecting newcomers, for sharing knowledge and experiences, and for accessing the common resources that constitute strong barriers to entry. In this way, leaders contribute to implement strong rules and codes regulating local competition. They also shape the social network articulating professional, friendship and family relationships. Their contribution for shaping the social network builds on the exploitation of structural holes (see Padgett and Ansell 1993).

Their intermediary role may be qualified as keystone because they are at the root of the whole collective organization. They also contribute to mutual trust, as they are key in defining the rules of behaviour and coordination, including rules punishing inappropriate behaviours. However, the other side of the coin lies in the relative inability of local actors to appropriate resources because this is entirely regulated by the network. This does not provide plant companies with incentives for trying to protect their innovations. Process innovation mostly relies on the enhancement of plant characteristics, thus making hard to capture extra value out of it. Most horticulturalists do not try to protect their innovations as the incentives to innovate are weak. For instance, nurseries' customers are not willing to pay any extra cost for the innovation. Furthermore, relations with local public research are quite fragmented and

horticulturalists maintain links with public research only for addressing specific R&D needs. Local horticulturalists then become dependant upon international breeders for issuing new varieties and importation, what prevent them from capturing the innovator's rent.

From the end of the 1990's on, horticultural markets start stagnating and new market issues appear. The three main markets (business, private and public landscape architecture) develop into niche markets. French horticulturalists realise that their usual production and distribution channels are not adapted to those developed by larger retailers and more particularly, by garden centres: production levels are too low to supply national markets, their logistic is not adapted to reference constraints, they are unable to answer tenders in public landscape architecture. In some cases, problems of company succession appear (Amisse et al. 2012, 2013). The emergence of industrial companies specialized in trading licences based on breeders protection rights increases competition at an international level. At the European level, the Netherlands have acquired a dramatic competitive edge based on rigorous intellectual property and breeder protection rights and licencing policies and their capacity to enter new markets (Widehem et al. 2009).

The localization rent generates less value. International competitors are able to compensate the absence of favourable weather and soil conditions by technology (greenhouses, hydroponic...). Local rules become obsolete because they do not manage to cope with changes in the competitive context and they do not provide incentives to monitor market. Charismatic leaders progressively disappear and ties among local companies evolve or vanish while no new intermediary emerges. No new collective rule for capturing value or for regulating local competition appears and uncertainty becomes pervasive. Local firms (mostly SME) do not reach a critical size sufficient to set strategies of value captures on international markets dominated by big groups (Syngenta, Sakata...). They can only maintain or enter some niche markets. However, in so doing, they have to entirely reconsider their strategies for creating and protecting new varieties.

The challenge for local firms is now to issue more systematically new varieties on their own in order to become more competitive at the international scale and to generate value. To reach this goal, they have to reconsider the management of intellectual property rights over the whole value chain. Only few horticulturalists are able to achieve this goal individually due to the high level of associated uncertainty and their small size. The implementation of the Vegepolys cluster offers them the opportunity to reach this goal collectively.

III.2. Vegepolys as an intermediary: evolving the open innovation model and business models

Since 2005, Vegepolys has played a key role to change collective rules of open innovation and to evolve horticultural companies' business models. The issue for firms is now to enter new market niches by issuing new varieties and to speed up their creation and production processes. Furthermore, developing a business of breeder as well as licensing activities for capturing more value have become key, unless companies would have to import at ever rising cost plant material (Widehem et al. 2009). But developing such a business requires them to have a better knowledge of their own plant material and to overcome some technological constraints by becoming able to create, for instance, short-growing cycle flower varieties or early-blooming plants. To this end, firms can exploit the internationally acknowledged expertise local research labs have developed in the field.

III.2.A. Business model evolution as a consequences of BRIO

In the same time, innovation in horticulture has undergone a dramatic evolution. It is now based on plants' intrinsic characteristics and on their capacity to withstand adverse weather and soil conditions rather than on their aesthetics or varieties. For instance, plants designed for public markets have to stand up wind and drought, need to receive the least possible care and to comply with regulations promoting sustainable development. Public landscape architecture markets therefore value plants' intrinsic characteristics and their compliance to current regulatory orientations (low use of plant protection products, poorly invasive plants, etc.) rather than their aesthetic characteristics.

This new business requires to work on the genetics of whole species rather than through grafting of individual plants of a few varieties⁵ belonging to the firm's collection. This implies that firms have undertake R&D at a higher scale as the plant material necessary to create new varieties goes beyond what is possessed in their own collections. The new aims of R&D therefore calls for the cooperation among local horticulturalists in pooling the most possible genetic makeup. In turn, successful cooperation call for rigorous and effective rules to protect innovation at the individual and collective levels.

Vegepolys plays a key intermediary role to help horticulturalists to structure in a network with public research laboratory. This is done through BRIO, a cooperative R&D project. BRIO has also contributed to change the local open innovation model. The former model used to be based on information and knowledge disclosure and the construction of a collective experience. The open innovation model through BRIO has turned to be based on cooperation associated with the construction and the sharing of a science-based collective resource (the plant genetics). It consists in implementing predictive methods of varietal creation for enhancing firms' reactivity by allowing them to better target crossbreeding or to speed up individual programs of varietal creation. Intended outcomes are increases in plants' range of colours, a shortening in their growing cycles, the identification of impediments to the introduction of new genetic resources, enhancing the overall shape of plants, to increase their resistance to disease and drought.

To reach those objectives, firms rely on the experience of a few local firms that already include breeding in their business. Those firms play a leading role in BRIO as they have already engaged into a cooperation strategy to enter international markets by grouping through partnerships or consortia. For instance, INRA, in cooperation with a consortium of local firms, have worked since the early 1970's on varietal creation programs on ligneous ornamentals. Since then, locally developed programs have received support from the industry to release new varieties (in cooperation with SAPHO, a local professional union, since 1972) or through research financing in cooperation with various trade associations. Furthermore, in 2005, French and German nurseries have settled a trade association that became part of the BRIO project. Besides, the BRIO project has provided the opportunity for other participating firms to settle similar associations.

In the frame of BRIO, access to specie's genetic makeup becomes key for designing predictive methods. Sourcing is then targeted towards plants' genetics and their crossbreeding potential. It relies on the capacity of processing previous results left accessible by each

⁵ Specie contains varieties. For instance the specie "hydrangea" counts for more than 80 varieties, each having different characteristics (colour, shape, etc.). Working on an individual plant implies to do process innovation, as its aim is to reach some characteristics of a parent plant (e.g. through grafting). By way of contrast, working on a whole specie implies to do genetic-based innovation through varietal creation. Doing genetic-based innovation requires possessing the plant material of the whole specie since working on the genetics of the varieties hold in the company's collection is insufficient to obtain any new valuable variety.

member of the project and grouped into taxons⁶. Members of the project therefore feed a shared platform for varietal creation by making possessed genetic material available. This genetic material is in turn used to build up the predictive method of varietal creation. However, only public research labs from INRA and AgroCampus Ouest are allowed to process those data. Vegepolys plays an intermediary role through Valinov, its TTO, which organizes the contribution between horticulturalists and public research labs. Thus, Valinov plays the role of a “liaison” intermediary (see Gould and Fernandez 1989) between the business and scientific communities. On the one hand, it has knowledge of each firm’s genetic material and is able to identify possible technological and organizational compatibilities. On the other hand, it knows the way public research labs process and recombine those data. Its intermediation and trust-building role is key because it fills the structural hole between firms and public research labs. Valinov therefore contributes to the overall cohesiveness and connectivity of the open innovation network, thus allowing common resources to freely flow and to be redeployed.

The open innovation model of varietal creation relies on the coexistence of a two-level intellectual property rights protection systems:

- At an individual level, a firm can create new varieties only by relying on its own genetic material. The firm enjoys full protection rights over the outcome because it has provided all needed genetic material even though the varietal creation method results from the synthesis and the processing of the genetic material supplied by all members. The firm can protect the output either by applying for plant breeders’ rights (PBR) or through a trademark or both. A trademark enables the firm to market plants of the new variety and to capture an associated rent over a long period of time while the PBS allows seizing value over the new variety through the paying of royalties⁷ from other nurseries over a shorter time period.
- At a collective level, the genetic material from several firms can be used to create a new variety. In this case, it is subject to a common PBS and to a common BRIO trademark. The varietal creation method is owned by the public research labs from INRA and AgroCampus Ouest and is not released to firms.

This new value creation model redefines the business model of firms: from producers depending on foreign breeders, their new business model is now a breeder-producer one. They base their value capture strategy on an innovation rent generated through trademarks and the licencing of PBR. Furthermore, they develop niche markets within their three main target markets (business, private, public landscape architecture). For instance, for public landscape architecture, the creation of varieties complying to sustainable development regulations and cost constraints (less water demanding and hardier plants) has become key and new market opportunities have arisen. The BRIO project therefore allows firms to seize new market opportunities. Their competitive edge now relies not only on varietal creation but also on a broader product range made possible by creating new varieties and by breaking down previous boundaries among some productions (e.g. the production of potted plants and outdoor plants for a single variety). Boundaries within the value chain break down, what

⁶ A taxon corresponds to an unit used in the science of biological classification, or taxonomy. Taxa are arranged in a hierarchy from kingdom to subspecies. A taxon ordinarily includes several taxa of lower rank. Source: Encyclopedia Britannica online, <http://www.britannica.com/EBchecked/topic/584691/taxon> accessed April 23rd 2014.

⁷ The valuation of a new variety corresponds to an increase from 20% (up to 50%) in a plant’s market price. The relative share of royalties also depends on varieties and may account for 7% up to 20% of a plant’s market price (Plottu et al. 2011).

contributes to densifying the local inter-firm network. All in all, those major shifts enable firms to better master distribution channels and to penetrate niche markets at the international level.

The objective of the project is to allow firms to control the whole value chain of those niche markets (by mastering value creation in the R&D phase) while integrating the whole supply chain: nurseries as well as potted plant, bed plant, bulbs and cut plant producers. Collectively leading those markets and binding partnerships with other actors of those supply chains allow gaining market power. At the same time, it decreases competitive pressure among members of the project because the current open innovation model is mainly located on upstream phases of the value chain and is associated with lower competition. The capacity to make profits relies on the dynamism of the innovation process allowed by the open innovation model and on decreases in production costs allowed by those innovations: decrease in the use of inputs, water and energy.... Furthermore, current orientations of sustainable development regulations lead local governments to use local varieties, what contributes to develop local cultures and their market valuation through trademarks and PBR.

III.2.B. Barriers to business model evolution: the role of Vegepolys for overcoming them

However evolution of firms' business model gives rise to barriers and the intermediation role of Vegepolys is key, thanks to its capacity to act as a third party and its scientific expertise. The evolution of the open innovation model and businesses towards models of breeder-producer is likely to generate strong strategic, substantive and coordination uncertainties for those SME. Those different types of uncertainty are associated with barriers linked to market constraints, regulations or firm's behaviour:

- Launching common R&D projects and redeploying internal assets to start a breeder's business is very risky for most firms, as they do not possess sufficient scientific competences. Furthermore, their economic environment is uncertain.
- New regulations linked to sustainable development question the range of genetic material necessary, plants' most valued species and intrinsic characters (e.g. the obligation of using local varieties) to innovate successfully.
- Breeding projects have to be compatible in order to profit from open innovation even though firms developed diversified production strategies in the past
- Firms feared a questioning of their local status (political or economic power) due to the entry of public research labs into the project and the possible emergence of conflicts in rules and in strategic objectives.
- It was necessary to trust new intermediaries and to accept new leaders and modes of leadership to allow resources to freely flow. Firms had to get rid of their usual competitive behaviour and to adopt more cooperative behaviours.
- Organizational inertia (e.g. inertia of former rules based on informal coordination) is a strong barrier to evolution in cooperative projects characterized by very precise rules in intellectual property rights management.

Business model evolution was possible thanks to the mediating role played by Vegepolys. Its mediating role may be qualified as *keystone* since its action has influenced two levels: technological and institutional on the one hand and political on the other hand. Vegepolys has managed to implement incentives and to orchestrate cooperation by ensuring the mobility of resources and knowledge; a fair enforcement of property rights over the output

of open R&D processes, by facilitating access to funding and by maintaining the dynamic stability of the innovation network. Furthermore, Vegepolys has filled the structural hole existing in the innovation network between firms and public research labs. Through Valinov, it has contributed to the conception, management, implementation and institutional support of the innovation network's architecture. Vegepolys's trustworthiness comes from the fact that it is acknowledged as having no interest in capturing the technology and the value it contributes to generate. Vegepolys's role is one of a facilitator because it contributes to the coproduction of collective rules of sharing and trading. Thus it contributes to the cohesion of the whole project pool. In turn, accumulated trust enables Vegepolys to perform more easily its technological intermediary task of articulating scientific and technological knowledge. In short, Vegepolys is acknowledged as a legitimate intermediary for all members of the project (firms, research labs, etc.) because it is not likely to capture the innovation rent and the profits potentially generated through the project.

As a legitimate intermediary, Vegepolys facilitates the co-production of collective rules. More particularly, the selection rule for the entry of new members to the innovation network is key: even though it has to remain open, the network has to restrict to a small number of firms complying with the overall aims of the network (i.e. conceiving and applying predictive methods for varietal creation) and relationships are based on the fact that their cooperation is bound to common R&D projects. Organization rules are grounded on the overall cohesion and the unifying character of the project because stakeholders cover the whole horticultural supply chain. Those rules describe the basic principles members have to comply with and they constrain and frame collective action.

Furthermore, the development of the project requires trade-offs to be made between stakeholders in the case that their proposals come into conflict. Vegepolys as a public intermediary contributes to fill cognitive gaps (e.g. by better integrating the value chain, and understanding the research methods from partners), to reduce potential conflicts among partners and to overcome (inter-)organizational inertia.

Main barriers to business model and open innovation model evolution have been overcome thanks to the intermediation role played by Vegepolys and the outcome of the BRIO project are of different kinds. First outcomes are methodological. The results obtained through the project have allowed to optimize and to increase the reliability of varietal creation methods. Then, the implementation of those methods has allowed multiplying the number of tested varieties, thus allowing to better assess their capacity to reach assigned characteristics and to fit to propagation processes (i.e. to be produced at an industrial scale). For instance, the new method allows testing between 500 and 800 different varieties instead of only 50 with classical methods. Therefore, the new method allows to reach higher scales, to save time and money in the breeding process and to use resulting plants as parent plants or source to licence PBR. Firms have also been encouraged to structure and strengthen their varietal creation capabilities. Finally, firms accessed new *in vitro* cultural techniques.

The BRIO project officially started only in 2010 and expected revenue increases due to the project range between 0.2 and 1.2 million euros, up to 2 millions euros for biggest firms⁸. Expected gains also cover decreases in the production costs because firms are expected to pay less royalties over licenced varieties. The main characteristics of the evolutions induced by the BRIO project are summarized in table 1.

⁸ Those figures have been estimated through fees collected for marketed varieties, each being multiplied by the number of varieties and the number of plant per variety.

It should also be noted that BRIO also impacts Valinov and, therefore, Vegepolys. At the outset, Valinov was involved in small-scale varietal creation through individual ad hoc projects. Nowadays, it plays a key role in varietal creation in the cluster. Through BRIO, it had to increase its internal research competences in molecular biology and in cytogenetics, thus reinforcing its legitimacy as a technological intermediary.

		Open innovation model before BRIO	Open innovation model since BRIO
Open innovation model		Informal cooperation relationships; common experience building through social networks	Formal networks based on a common resource (genetic platform) and genetic material pooling
Main characteristics of business models	Main valuation criteria	Æsthetic characteristics and variety	Intrinsic characteristics, conditions of use (low cost of use, ability to withstand adverse weather and soil conditions, etc.)
	Origins of value creation	Plant production, vegetal creation rooted on process innovation; exploitation of specific weather and soil conditions; colocation; organization in networks; shared horticultural culture	Varietal creation; entry into upstream breeding stage; development of a niche strategy; broader offer of plants
	Value capture	Growing markets (business, garden centres, public landscape architecture); barriers to the entry of outsiders (dense social network, colocation, screening of newcomers) to capture the location rent and the organizational quasi-rent	Licencing of PBR; (individual or shared) trademark strategy; joint exploitation of the common resource limited to the members of the project; control of the whole value chain on niche markets; lower production costs through varietal creation
Intermediaries	Intermediaries	Private actors: charismatic CEO	Public actor: Vegepolys' coordination office and TTO (Valinov)
	Barriers	Barriers to cooperation in the business model: Competition among firms	Barriers to business model evolution: Uncertainty linked to the evolution towards a business of breeder and the technical and scientific adaptation in face of new regulations; achieving compatible objectives and strategies among stakeholders; lack of a common background (knowledge, issues) between private actors and public research; uncertainty and strategic interdependences due to resource sharing; inertia of former collective rules and power distribution
	Benefits of intermediation	Shared rules regulating competition; screening rules for newcomers; internal regulation rules contributing to barriers to entry and to the network overall cohesion	Facilitated cooperation between firms and public research labs; trust-building and increased cohesion among firms; trade off rules + rules to create and share the common resource + screening rules for newcomers to the BRIO project; contribution to the global cohesion of the interfirm network to achieve leadership and control over national and international niche markets

Table 1: Evolution in the open innovation and business models and intermediaries associated with BRIO

It is noteworthy that those new local strategy and industrial trajectory have now become irreversible. The model inspired by BRIO has become long-lasting since follow-up projects are now developed. Even though they do not necessarily exactly reproduce modalities in firms' partnerships, their underlying idea is to keep on exploiting the innovation platform. In fact, some firms consider they have exploited through BRIO all possibilities offered by their own genetic makeup and have no immediate needs. By way of contrast, other firms wish to continue the R&D process initiated through BRIO. External criteria as well as internal contingencies (development of new product and access to new markets through innovation, employee turnover, etc.) may also influence firms. All things considered, following projects retain the open innovation model developed through BRIO even though they are likely to vary in their modalities of participation and cooperations.

IV. Conclusion

This article strived to show that the emphasis put on cooperative projects in the French *Competitiveness cluster* policy may lead, not only to an evolution in the open innovation model, but also to an evolution in firms' business models. Such evolutions are made possible by clusters' governance structures and TTO thanks to their key intermediary role. Their legitimacy as intermediaries is rooted on the fact that those actors do not appropriate the technological or monetary value rose through the cooperation. The case of a French horticultural cluster shows that intermediaries may assume different roles as facilitators, regulators or arbitrators of local cooperation. Furthermore, intermediaries contribute to overcome barriers to business model evolution because it fills the structural hole between firms and public research labs and it reduces uncertainties, thus paving the path towards the development of new competences and capabilities. In the case of Vegepolys, it enabled firms to develop breeding activities.

From a theoretical viewpoint, this article shed light on the link between the adoption of new open innovation models and business model evolution. Evolution in the open innovation model contributes to create or to give access to new business opportunities and new potential for value creation. However, evolution speeds may be different for stakeholders and the flexibility (between emergent and teleological changes) of the whole system is key (Demil and Lecocq 2010). Such flexibility rests on cooperations of varying intensities (entry of new members, evolution in their level of commitment, etc.) and content (adoption of particular roles, active commitment, etc.), and on the flexibility of jointly produced collective rules (value capture and distribution, etc.). Furthermore, we show the importance of intermediaries in the management of open innovation and in business model evolution. Intermediaries are here understood as "acting subjects" assuming different functions (relational, orchestration, trust-building, relational and technological unlocking, etc.) rather than "objects" such as common platforms.

In conclusion, this article contributes to the larger issue of collaborative entrepreneurship in *Competitiveness clusters*. It shows that the capacity of open innovation for reconfiguring activities and capabilities is possible through public intermediation. The capacity of public intermediaries to operate dynamic trade-offs between market valuation, technological and scientific development and the legal framework is key for the overall coherence of the system. However, governance and technology transfer processes may change or articulate in different ways from one cluster to another. Further work should then widen the analysis to better grasp their determinants, actual performances and evolution capacity.

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