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Technical knowledge and production contracts between a company and its suppliers: lessons from a French case-study

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Abstract:

Changing farming practices to improve crop diversification requires knowledge acquisition and transfer between the actors involved. Drawing on the theory of transaction costs and the knowledge economy, this article analyses the ways in which production contracts between an agri-feed company (the buyer) and storage organisations (suppliers) promote the transfer of technical knowledge needed for growing a minor crop in France. Semi-structured interviews with the company and its suppliers showed that there was a considerable need of technical knowledge for drawing up the contract, and that collectively organising the contract fostered knowledge transfer among actors.

Key Words: supply chain, faba bean, field crops, governance structure, network, transaction costs

1. Introduction

In Western countries, the dominant agricultural production model is based on the intensive use of synthetic inputs and the crop specialization on a few major species, such as wheat and maize (Tilman and Clark, 2015). Today, the negative externalities of these systems have resulted in calls for greater agricultural biodiversity and agro-ecological practices (Altieri, 1999). However, diversification crops (also called minor crops) suffer from a lack of competitiveness vis-à-vis major crops. In particular, the lack of technical knowledge, less genetic progress and few market outlets are advanced to explain their weak competitiveness, helping create a lock-in situation (Magrini et al, 2016. Meynard et al., 2013). This raises questions about whether actors in production (farmers, storage organisations) and processing (companies) would able to organise themselves in such a way as to disseminate the economic incentives and knowledge that promote alternative agricultural practices (Fares et al., 2012). Indeed, these new practices depend on updating the technical knowledge available, as well as updating the ways in which actors organise themselves to create and share knowledge (Nguyen et al., 2013; Compagnone et al., 2015).

Coordination in the agro-industrial sector has been studied in new institutional economics (NIE), in which the contractual arrangements governing exchange is central (Ménard and Klein, 2004; Cook et al., 2008). Strengthening vertical coordination of agro-food chains, evidenced by an increased use of contract farming, has received increasing attention (Ménard, 2005; Fischer et al., 2010; Da Silva and Shepherd, 2013; Bouamra-Mechemache et al., 2015). Among the variety of contractual relationships, most studies have focused on contracts directly linking producers' organisations to the agricultural supplies (Sykuta and Parcell, 2003) or processing industries (Bogetoft and Olesen, 2004). Few studies have focused on 'storage organisations' (cooperative or private owned organisations) contracts with buyers, and yet these actors play a key role in selling and managing agricultural products, especially field crops (Chomel et al., 2013).

In a case study on supply chains for minor crops, Meynard et al. (2013) found farming contracts, which link farmers, storage organisations, and processing companies, to be a privileged means for reintroducing diversification crops. Because these contracts specify certain production conditions, they disseminate technical information that can help build a body of knowledge about these crops; whereas sales contracts are only interested in the conditions for selling the harvest and price (Ricome et al., 2008). Moreover, for a company that wants to differentiate by requiring buyer-specific raw material, contract farming will be a more effective way to obtain supplies than the spot market, because the contract enables

knowledge transfer about farming practices with suppliers (Jang and Olson, 2010). Thus, these production contracts are particularly interesting organisational forms for examining the coordination of agricultural chains, since storage agencies are key players in the dissemination of technical knowledge among farmers (Labarthe, 2010). Yet to our knowledge, there is no research that seeks to clarify the mechanisms by which such contracts may convey knowledge.

Farming contracts have primarily been studied as performance incentive tools (through their pay systems) or via the transfer of decision rights (Bouamra-Mechemache et al., 2015). These studies are based on standard hypotheses that view the contract as a complete and optimal coordination tool. This theoretical and normative vision of contracts is, however, counterbalanced by a more pragmatic approach in which contracts remain incomplete organisation tools due to the limited rationality of agents (Brousseau and Glachant, 2000). This recognition of contractual incompleteness means that we must examine all the relational arrangements used by actors to regulate their transaction. As Cook et al. (2008) point out, the vertical, contractual coordination of agricultural chains increasingly relies on "network" or "collective organisation" forms that may include a company and its suppliers (Knoeber, 1989; Sauvée, 2000; Raynaud et al., 2009) or group together several competing storage organisations under a single quality label (Ménard, 1996). The literature on quality certification schemes also shows that the effectiveness of the coordination of the actors depends on combining formal contracts and informal arrangements through relationships, which allows actors to adapt over time (Raynaud and Sauvée, 2000; Boger, 2001; Mazé, 2002; Mazé and Ménard, 2010; Ménard and Vascleschini, 2005). These studies emphasize that a contractual relationship between two parties may also be based on multi-party arrangements. The study of contracts, therefore, cannot be reduced to the contract itself, but must encompasses the governance structure of transactions, that is to say, following Williamson (1979, p. 239), the "institutional matrix within which transactions are negotiated and executed."

Therefore, the purpose of this study is to examine the governance structure of transactions between a company and its suppliers to understand how coordination, based on contracts, enables the acquisition and transfer of technical knowledge required for introducing a new kind of crop. In 2016, we conducted a case study on a supply chain under construction in France, on a diversification crop, faba beans. Specifically, we studied the practices used by a feed manufacturing company to source faba beans from storage organisations (hereafter, SOs). The coordination mechanisms studied here combined two forms of organisational arrangements: bilateral production contracts between the company and its suppliers, and an association bringing together all the stakeholders. This article highlights the ways in which the actors involved viewed the acquisition and dissemination of technical information when making contractual arrangements.¹

One of the original contributions of this article, therefore, relates to the timing: the contractual relations studied here are in the process of being built. The results show that the acquisition and transfer of technical knowledge is a major concern in contract governance. Moreover, the results showed that the contractual and relationship arrangements between a

¹ The present study focuses on production contracts between a company and storage organisations. These contracts were established two years prior to the study, but are constantly being adapted. These contracts also directly affect the contracts between storage organisations and their farmers, although these contracts at the farm level are beyond the scope of this study.

company and its network of suppliers help develop the intangible assets needed for increasing crop diversity.

The following section summarises the literature that informs this study. Transaction cost theory (TCT) serves as the basis of the analysis, supplemented by concepts from research on the knowledge economy. Section 3 presents the case study, the construction of this faba bean supply chain using production contracts, and the methodology. Section 4 and 5 presents and discusses the results, while section 6 concludes.

2. Analytical framework

An agricultural supply chain consists of several organisations carrying out operations that are discreet (production, collection, storage, processing, and bringing to market), but which are dependent on each other via the transfer of goods between the links in the chain (Rastoin and Ghersi, 2010). This transfer of use rights (or property rights) between technologically discrete units constitutes a "transaction" in the words of Williamson (1985). Establishing an organisational arrangement to ensure the smooth unfolding of these transactions between actors in the chain is a prerequisite for benefitting from this division of labour. Studying these transaction coordination practices is at the core of neo-institutional approaches and in particular, the theory of transaction costs. Research focuses on managing the risk of opportunism (2.1). However, this body of work neglects the question of how knowledge is constructed and coordinated. Other approaches (2.2) are thus needed to identify the role contracts may play in knowledge acquisition and transfer between parties (2.3).

2.1. Opportunism: a central issue in analysing contracts

The theory of transaction costs is based on the assumption that economic agents have limited rationality and are potentially opportunistic. From this follows two major problems: first, successfully coordinating in a context of uncertainty, and second, benefitting from the exchange relationship while avoiding cheating or appropriating quasi-rents. These problems can either occur before the implementation of the contract relationship (ex-ante hazards) or after (ex-post contingencies). The level of these coordination problems and the transaction costs they generate (Coase, 1937) differ depending on the characteristics of the transaction, in particular its degree of uncertainty and the level of specific assets it requires. The greater the uncertainty, the more difficult it will be to agree on mutual commitments ex-ante and the greater the risk of mal-adaptations. Furthermore, the more a transaction involves specific investments between the parties (ex-post or ex-ante), the greater the risk of under-investment and grabbing the quasi-rents. An investment is considered specific if it lasts over time and cannot be re-used in another transaction without generating costs for other uses or other clients. Using specific assets has advantages such as saving on production costs and differentiating products. However, using specific assets also generates greater dependence between the parties. Among the different kinds of specificity, human assets are particularly important when examining the learning that occurs during the contractual relationship (Anderson and Schmittlein, 1984) or when the transaction's production process is knowledgeintensive (Foray, 2000).

To address these coordination problems, economic agents can choose between several transaction governance structures for planning, adapting, and controlling an exchange. Deciding between these different forms of governance is based on minimizing transaction costs (Williamson, 1989). Between the two opposite governance structures of market and hierarchy, there is a range of hybrid forms (Williamson, 1991). Hybrid forms use formal contracts that define the conditions of the exchange, enable the pooling of resources, and

combine mechanisms of competition and cooperation (Ménard, 2004). Due to the incompleteness of formal contracts, hybrid governance structures are complemented by other arrangements. The literature increasingly emphasizes this complementarity between formalized contracts and informal relationship arrangements (Ménard and Shirley, 2008).

While opportunism is a fundamental problem in competition, neo-institutional economics posits that win-win strategies are possible between stakeholders in an exchange, provided that the transaction governance structures are appropriate. In this sense, the formal contracts that are established to regulate inter-organisational exchange may help promote cooperation between actors by their renouncing opportunistic behaviour (Brousseau, 1995). Cooperation can also be defined as a way "to facilitate production planning" and to create value collectively (Richardson, 1972, p. 884). Indeed, the introduction of hybrid forms - enable a pooling of resources and/or decisions in order to create new resources, new products, and to enter new markets (Ménard, 2012). In this case, inter-organisational coordination often depends on resolving technical problems inherent to innovation (Brousseau, 1994). Thus a fundamental issue for organisations and markets is to coordinate technical knowledge about the production process over time (Langlois and Foss, 1999). Yet this aspect has hardly been addressed in transaction-cost economics, which leads us to consider the contribution of the knowledge-based economy (or learning economy) (Arena et al., 2012).

2.2. Knowledge: a challenge to the contractual approach

Since the seminal work of Penrose (1959), value creation has been closely related to the acquisition of knowledge over time (Arena et al., 2012). Traditionally, agriculture and agrifood industries are not considered knowledge-intensive sectors compared to, say, biotechnology or telecommunications (Pavitt, 1984). However, given the issues of agriecological transition, changing agricultural production systems is now seen as an intensive process in terms of technical and scientific knowledge (Caron et al., 2014). Creating new agrifood chains also calls for renewing the knowledge base about production practices (Meynard et al., 2016, forthcoming).

The knowledge-based economy regards knowledge as an asset, which can be an *input* similar to a skill or an output, such as an innovation (Winter, 1987). Once knowledge is considered an asset, the question of knowledge transfer arises and what kinds of organisational arrangements facilitate it. Beyond the absorptive capacity of firms (Cohen and Levinthal, 1990), this transferability is likely to vary according to the type of knowledge. Lundvall and Johnson (1994) distinguish four categories of knowledge: know-what, knowwhy, know-how, and know-who. This article focuses on the know-how, which refers to skills and actors' ability, and the know-what, i.e. knowing facts (e.g., What is the market price?, How many faba bean suppliers are there in the region?, What is quality of product is expected? etc.). Know-how is a more challenging type of knowledge to exchange because it is difficult to separate it from the organisation or the individual who possesses it. Know-what kind of knowledge, however, is more easily transferable and can, for example, be stored in a database. However, the appropriation of this knowledge by organisations or individuals still depends on their ability to research, select, and absorb relevant information. These considerations are also valid for tacit and codified knowledge. Knowledge is tacit if it has not been documented and made explicit. This tacit aspect may result from an inability to explain the knowledge (tacit by nature) or from a lack of incentive to codify it (Cowan et al., 2000). While know-what is usually easily codified, this is more difficult to achieve with know-how.

The literature on inter-organisational arrangements (or networks) such as joint ventures, franchise networks, and supplier-buyer partnerships suggests that some forms of

organisation are more conducive to knowledge acquisition and transfer (Powell, 1990; Mowery et al., 1996; Lam, 1997). Such knowledge transfers between organisations do generate costs, however. Langlois (1992) proposes the concept of "dynamic transaction costs" to refer to "the costs that arise in real time in the process of acquiring and coordinating productive knowledge" (Langlois and Foss, 1999, p. 208).

In the same way that hybrid forms based on contracts are considered alternatives to the market and minimize transaction costs, it is important to examine how contracts enable technical knowledge to be acquired and transferred more effectively than markets or hierarchy by minimizing dynamic transaction costs.

2.3. Contracts as a mechanism for acquiring and transferring knowledge

The idea that a contract can facilitate knowledge acquisition has been particularly developed in management studies. In this field, a contract is considered as a means of communication, which defines a repository of knowledge through the written specifications it contains (Barthélémy and Quélin, 2006; Reuer and Arino, 2007; Li et al., 2010). Moreover, the contract is considered complementary to relational arrangements, which improve stakeholders' absorption capacity (Li et al., 2010). However to our knowledge, there have been no empirical studies in economics that analyse the role contractual arrangements may play in knowledge acquisition and transfer. Considering the theoretical approaches explained above, we formulated several hypotheses that summarize how we planned to study the relationship between contracts and knowledge through production contracts for a minor crop:

P1. Growing a minor crop requires gaining the technical knowledge on how to grow it (knowhow) and the characteristics expected of the harvested product (know-what). The acquisition of this knowledge will be fostered by establishing a farming contract between a company and its suppliers.

P2. By limiting the risks of opportunism by the buyer and the suppliers, production contracts foster specific intangible investments to acquire the technical knowledge needed.

P3. Production contracts enable a transfer of codified knowledge about production by detailing specifications about the methods to be used and by monitoring procedures.

P4. Informal arrangements necessary for contract governance allow both the acquisition and transfer of knowledge (between the buyer and the suppliers but also between suppliers).

3. The Creation of a Minor Crop Supply Chain: Faba Beans in Western France

Several reasons justify the use of case study methodology here. As Yin (2014), stated, "the need to use a case study arises whenever an empirical inquiry must examine a contemporary phenomenon in its real-life context, especially when the boundaries between phenomenon and context are not clearly evident." Moreover, as highlighted in the literature on contracts, there is very little empirical data on contracts in the agricultural sector (Sykuta and James, 2004) and in France, there is no database of contracts for field crops. Furthermore, the purpose of this study is not to statistically verify the correlations between existing contracts and knowledge; rather, it is to understand the processes of interaction (or co-evolution) between contracts and knowledge, with particular attention to *why* and *how* contracts may be linked to knowledge acquisition and transfer. This line of questioning lends itself particularly well to the case study method (Yin, 2014). We present below the study context (3.1) and the method of collecting and analysing the data (3.2).

3.1. Context

The areas for studying crop diversification in France are few and relatively recent (Meynard et al., 2013). We chose to focus on a supply chain under construction started by an animal feed company - Valorex - which wanted to obtain a regular supply of faba beans (*Vicia faba*) for making livestock feed. Faba beans belong to the family of pulses, which means they have agri-environmental benefits for the diversification of cropping systems. In particular, faba beans do not need nitrogen fertilizer and thus help reduce greenhouse gas emissions. Grain-legume crops, which represent only 2% of the cultivated area in France, are particularly affected by a lack of knowledge and reference information (Meynard et al., 2013, Magrini et al., 2016). Despite their high protein content, the domestic faba bean market for animal feed is almost non-existent because this crop is mostly consumed by the livestock on the farms that grow the beans (about 140,000t). Faba bean farming in France amounts to about 300,000tannually (average 2004-2009). In contrast, export opportunities exist for animal feed (about 35,000t in 2015) and occasionally for food (75,000t, 2015) (Terres Univia, 2016). This study focuses on the faba bean supply chain under construction organized into the *Graines Tradition Ouest* Association (with about 2,000t of faba beans contracted to Valorex).

Valorex is a feed company based in eastern Brittany in France. Founded in 1992, the company produces about 200,000t/year of feed. Valorex positions itself as a niche player, whose growth strategy is based on product differentiation through technological innovation (Magrini and Duru, 2015). This company uses whole oil and protein-rich grain legumes in animal feed, thanks to a patented thermo-extrusion process. Since the 1990s, their expertise has focused on linseed, whose richness in omega-3 improves the nutritional quality of feed, and in turn, the quality of animal products in human food. In order to secure production, Valorex sources all its French linseed supply with production contracts, and thus has considerable experience with these contracts. In 2014, the company decided to incorporate faba beans in its products, whose richness in protein substitutes for the imported soya meal widely used in animal feed. For them, using faba beans in animal feed is a new source of product differentiation, because they can guarantee the feed is non-GMO and it has positive environmental externalities (reduction of GHG throughout the product life cycle, etc.). The company regularly promotes this qualitative differentiation during trade shows or in the media.² In the Valorex portfolio, faba bean is a promising new strategic asset, a source of added-value, and justifies establishing a secure supply chain. To do so, Valorex took the initiative to (i) establish production contracts with faba bean suppliers and (ii) to create an association, Graines Tradition Ouest (hereafter GTO), that includes faba beans suppliers in western France (representing nearly half of the utilised agricultural area (UAA) in France), a seed company, and a person in charge of association administration. This strong supply organisation differs from the commodities purchasing strategies (spot market) usually practiced in the animal feed sector (Charrier et al., 2013).

Suppliers in the association include five competing collection and storage organisations, as well as two individual farmers. Four of the collection and storage organisations are cooperatives and one is a private business. Their collection (of all crops) varies from 120,000t to 1,700,000t. For these organisations, the 2014-2015 faba bean collection campaign accounted for 0.01 to 0.3% of their total collection, while wheat accounted for 49% to 72% (based on data collected during detailed interviews, see below). These organisations position themselves differently on the market, but they are all looking for

² See their website: <u>www.valorex.com</u> as well as that of the Bleu-Blanc-Cœur association, <u>www.bleu-blanc-coeur.org</u>

(i) crop diversification strategies to move towards more sustainable systems and (ii) strategies for creating new added-value to improve farmers' incomes. For them, a new contracted outlet for faba bean is an interesting growth opportunity.

3.2. Methodology

We conducted 14 semi-structured interviews for 2 to 3 hours with one representative from each member of the GTO association with whom Valorex had established production contracts in the last two years (Figure 1). Valorex employees were also interviewed. We then triangulated the information collected (Yin, 2014) (see Appendix 1).

Figure 1: Subjects interviewed in the GTO Association

Association Manager			
(1)			
Feed Company	Storage Organisations		
(4)	(5)		
Seed Company	Farmers		
(2)	(2)		

The interview grid was designed in light of the theoretical framework explained in section 2 (Table 1).

Table 1. Main Items in the Interviews

The GTO association (goals, organisation, operations, etc.) The production contract (duration, commitments, end product specifications, process specifications)
The production contract (duration, commitments, end product specifications, process specifications)
specifications)
Decess for execting the contract receptions modifying the contract monitoring
rocess for creating the contract, negotiations, modifying the contract, monitoring
he contract
The specialised knowledge called upon in these various stages
Growing faba bean within the GTO
Historical yields and issues for increasing production
Fechnical aspects:
Factors that prevent increasing production
investments made and the kinds of knowledge used for production
Short-term investment needs and knowledge
Characteristics of faba bean sales within the GTO
Kinds of uncertainty involved in the transaction and the specificity of assets required
o ensure the transaction

All interviews were then transcribed to identify the excerpts of direct speech that would enable us to verify or qualify the hypotheses in section 2. The excerpts were

anonymized by assigning a number identifier for each respondent. When there were contradictory statements on a given issue, we considered that the hypothesis was not validated. We also completed the data corpus by analysing professional documents (articles of the association, the GTO production contract, sales brochures) and through participant observation by one of the researchers for one month at Valorex.

4. Results / Discussion

4.1. Transactions characterized by high uncertainty of production and knowledge needs

4.1. a. Uncertainty about the transaction conditions

Unlike transactions for major crops such as wheat or maize, equivalent to commodities, faba bean transactions are marked by considerable uncertainty. First, there is uncertainty about the quantity of faba beans provided by suppliers. The buyer needs to know whether there will be enough farmers to ensure the volumes required and whether they will be consistent from year to year. This uncertainty indirectly comes from the uncertainty about farmers' behaviour with minor crops. Farmers are also unsure about the variability of yields, which is considered greater with minor crops. All the storage agencies surveyed qualified this uncertainty on faba bean yields as "higher to much higher" than major crops. Stabilising yields was also highlighted as a priority by the seed company in the GTO in its genetic selection criterion, knowing the magnitude of interannual variation may now reach 4t according to some respondents. While this uncertainty about yields is linked to nature (soil and climatic conditions, genetic material available), they also stated that uncertainty results from farmers' growing practices and their lack of technical mastery (4.1.b).

Moreover, demand is also uncertain for faba bean farmers due to a lack of visibility about market outlets. Their uncertainty relates to the quantities that can be absorbed by the animal feed market:

It is clear that in some years, we said, "Gosh, are we going to be able to sell everything this year?!" And yet we didn't have tons and tons [of beans]...

Today when growing faba beans, we aren't able to sell them, or we have to run after the buyers to try to sell them...we've got a lot of other things to do than to deal with small quantities like this...

This uncertainty also relates to Valorex's changing demands in the medium-term, due to the innovative nature of the product and uncertainty about sales prospects. The storage organisations say they are ready to increase faba beans production, but would like more visibility about the growth of market opportunities in the medium-term:

I don't know the scale of the company's plans, I have a hard time calculating it, but if the company is actually going to increase [use of faba beans], it is a crop that could develop a lot.

Today, there is an expectation that the project will become big. For us, it's clear, we're ready to start!

After, we have to wait for the results of Valorex's experiments to know whether to extend or not the surface area.

Finally, uncertainty also relates to the purchase/sale price of faba beans. While some indicators of market price can be provided by brokers, there are no quotes for faba beans on the futures market. This lack of market reference makes setting prices difficult and costly for stakeholders. In addition, the purchase price of faba beans for animal feed is strongly influenced by the export market for human consumption to Egypt. However those outlets are opportunity markets, which are not stable from one year to the next.

Ultimately, a faba bean transaction is characterized by significant external uncertainty about market conditions, mentioned by all the storage organisations interviewed. Uncertainty regarding opportunistic behaviour among GTO members was not, however, highlighted by the actors interviewed.

4.1. b. Technical considerations and lack of knowledge

While the transaction may be affected by several external factors, as we have seen, the condition *sine qua non* for the transaction to happen is that there is a crop to sell. While this remark may seem trivial, this issue is at the heart of the coordinating minor crop supply chains, for which transaction governance goes hand in hand with increased production.

Here, in the Brittany area, we didn't do faba beans! If we had, Valorex would not have bothered to develop a chain, it would have gone to look for what there was [already] on the market.

Uncertainty about production is important in this particular context, and results from a lack of technical knowledge mentioned by all those interviewed. Indeed, the introduction of faba beans in a new area involved uncertainty about how to grow them (know-how):

One limiting factor is to try to grow a new crop and not mess it up...there is the unknown, it's jumping feet first into a crop that we don't know at all.

In areas where it's not done [grow faba beans], they're afraid to do it! Because historically, they have done tests and the results weren't satisfactory. If we had to grow faba beans throughout all of Brittany on a large scale, well, that'd be a lot of work!

It's not the same as doing wheat for export! Wheat export everyone knows how to do that!

In other words, storage agencies have to deal with farmers' lack of mastery for growing this crop:

There is not a lot of knowledge on the technical aspects, except for some individuals who master it locally.

This lack of know-how also directly concerns the storage organisations, especially the farming advisors who work for them to support the farmers:

None of us is a specialist in this crop.

What is needed is a technical reference person....This could be a member but today no one is an expert... I think that today we don't have the experience and the skills [to grow this crop].

This uncertainty about farming practices primarily concerns the management of crop pests and diseases (weeding and weevils) and controlling crop height.

In addition, creating a market outlet based on product differentiation also involves defining the nature/quality of the good sold and how to grow it. Indeed, the nature of the good does not exist before the exchange; producing actors must also acquire knowledge about the feasibility or acceptability of the buyer's requirements. In this case, uncertainty relates to the processing company's expectations about the quality of the beans, particularly protein levels and anti-nutritional factors (know-what), and on how to produce these qualities (know-how):

After, it's the knowledge of the various qualities and for that, you have to have a bit of experience to set it up. Here, we're just starting and so we don't know what Valorex's needs in terms of quality. Does the technology used enable us to avoid vicines and convicines? We actually don't know!

And we still don't know what they want exactly in protein...I'm not at all sure that what we deliver is the quality that they will want in five years, today we're growing as best we can...

For me, Valorex must decide, because it's Valorex which is the end point. So those people, they have specific expectations. We must try to meet as best as possible their expectations. After that, to know *how* to meet their expectations, etc., well that's another debate!

If Valorex tells me they want faba beans with this or that characteristic, which can be easily identified, and that depends on such and such growing methods, and that the farmer can have an impact all that... then you can set up quality specifications, but otherwise we cannot implement a quality grid when we cannot act in such a way as to achieve it!

For Valorex, the goal is that the protein content is the highest possible; after that, there may be an incentive grid, but behind that, can the farmer's practices actually improve things? I don't know!

Creating a faba bean chain implies that the actors can coordinate themselves in a context of uncertainty related to markets, the weather, the characteristics of the product sold and technical expertise. In turn, that seems to depend on making intangible investments to improve the technical know-how and production capacities of upstream actors. In what follows, we analyse the organisational responses of Valorex for organising its faba bean supplies by adapting to these uncertainties.

4. 2. Organisational responses by supply-chain actors

To manage the faba bean transaction, which respondents described as having high uncertainty and knowledge needs, the buyer and the suppliers developed several complementary forms of organisational arrangements. Bilateral production contracts were associated with relational arrangements between competing suppliers and buyers by creating an association, which enabled them to adapt to the context of uncertainty (4.2.a). This form of transaction governance seems to have been effective for supporting the development of faba beans by acquiring and transferring knowledge (4.2.b)

4.2. a. The governance structure of faba bean transactions

To build a faba bean supply chain, Valorex chose to contract the production and sale with its suppliers. To implement these production contracts, the buyer relied on its network of historical suppliers grouped into a non-profit association.³ This association, created in 2002, initially sought to develop another diversification crop: linseed. Recently in 2014, it updated its statutes to integrate grain-legumes, including faba beans. This association's goal is "the organisation of production, supply, and sales to processing companies of oilseeds and pulses between the economic partners involved." It aims to regulate production at the scale of the company's supply region (through a collective agreement on production quantities and prices) and also leads workshops giving technical advice and promoting crop diversification.

The GTO association and its operation

Membership in the association and thereby access to production contracts is subject to a selection process. Selection is based on the geographical/territorial complementarity of the collection region of suppliers.

So that is how it works, we have to create more production potential and additional land.

Reputation also plays an informal role in the selection process:

[Membership of certain storage agencies was denied] because originally they had not been interested and they only came [later] because they saw an opportunity, and there is nothing worse in a supply chain than people who come because it's a [business] opportunity, [because] at some point the whole thing falls apart.

The peculiarity of this form of organisation is to bring together competing organisations around a common goal: developing a local supply chain for minor crops. Members thus pool resources (annual membership, development strategy, working time) in order to structure this chain, while remaining competitors:

There's a good atmosphere in the association, even though in reality we are competitors. I mean, people work smart, you know. For now everything's going well.

I think we're all learning. We learn to live together as competitors, I mean, working together. Because in fact, we are competitors but we work together! There's some friction every day ... that happens, but at some point we [see] that we also have things in common which enables us to work together in one region...Competing companies can also work together!

It's not common to have several operators like that on a project. Well, it's also because it's a small project, you know. I think it'd be more complicated if we managed wheat ... Then again, it's always the same, if we do it, it's really in specific niches. We couldn't do this with more standard products...

³The association also includes a seed company that is specialized in grain-legumes.

Although the production contracts for faba beans are bilateral (between the company and the supplier), this association serves as governance framework that complements the contracts and seeks to collectively manage all the exchanges between the buyer and its suppliers across a farming region.

Governing incomplete contracts

The production contract is defined and signed before sowing the crop. Its duration is limited to one growing season and is renewed for each crop campaign. The contract includes a commitment to purchase/sell faba beans and defines the volume, delivery terms and a minimum guaranteed price for that volume. The quality of beans required is standard for the moment (wholesome, unadulterated and merchantable quality) and is not tied to payment. As for production, the contract requires choosing a certified plant variety from a predetermined list. No other constraints are imposed other than filling out a crop tracking sheet during the growing season. Ultimately, the production contract is short-term and rather incomplete. Nevertheless, it is part of the collective, relational arrangements that ensure contract governance. For example, during the growing season, the members meet 3-4 times during meetings of the board to negotiate, enter into, monitor and adjust the framework production contract.

This form of organisation enables members to cope with the uncertainty in the faba bean market by guaranteeing the buyer a supply and ensuring an outlet for the SOs. For example, while the contract specifies a quantity before sowing the crop, in practice there is a tolerance between the commitments on quantities before planting and the quantities actually produced. Repeated interactions between suppliers and the company at meetings during the growing season enable the company to monitor its suppliers' production and to adjust to events that could affect production (seed availability problems, climate conditions, etc.). Bringing together several competing storage agencies also introduces a form of informal peer monitoring. Furthermore, setting a minimum guaranteed price helps encourage farmers to produce a minor crop. The final price is fixed at the end of the growing season but before the harvest. The fact that contracts are annual and prices are updated each year protects the buyer from paying a price very different from the market price. However, the price results from a negotiation process, which means a lack of visibility from one year to the next. For this, the association's members want to formalize a remuneration system that would be indexed on the price of other substitutable commodities and guarantee a gross margin for producers that is at least equal to that of a reference crop such as corn or wheat.

The table below summarizes the characteristics of the transaction governance in this case study.

Obligations	Written contract	Governance procedures
Price	Set a minimum guaranteed price	The minimum guaranteed price is set in June of year n, and the final price is determined in June of year $n + 1$. For the moment, there is no formula for setting the price; it results from negotiations during the meetings (the buyer offers a price based on his/her knowledge of the market to which a bonus is added). This price is then negotiated.
Quantity	Commitment on	The total quantity to be divided among the GTO

1 able 2: Governance mechanisms for faba bean transactions in the G I	Table 2: (Governance	mechanisms	for faba	bean tr	ansactions i	a the	GT
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	volume	suppliers is determined by the buyer's needs. Then the breakdown of volumes by storage organisation is decided through negotiations, depending on their historical production levels. There is a margin of tolerance for weather events.
Production requirements	Required list of plant varieties	The list of varieties is suggested to the buyer and the seed company and discussed during the group's meetings. It is set and revisited at each growing campaign in the spring and autumn. There is a procedure for monitoring farming techniques by filling out a form.
Product specifications	Wholesome, unadulterated and merchantable quality, Amount of impurities	Specifications for the final product are rather vague, but will change depending on the results of the buyer's R&D.

The combination of formal contracts and more informal collective governance in the association ensures flexibility and that the cooperation among actors will last over time. The contracts specify the mutual commitments between each member and the feed company, but also between members. Although contracts are very incomplete and annual, the process to produce them forms a symbolic commitment to cooperate over the long-term. This form of organisation combining contracts, the pooling of resources, and competition and cooperation is characteristic of a hybrid form. It seems particularly effective in dealing with the level of uncertainty surrounding the transaction. In the next section, we analyse how this organisational form helps reduce uncertainty about how to produce by enabling knowledge acquisition and transfer.

4.2. b. Knowledge acquisition and transfer through organisational arrangements

The production contract for exchanging codified knowledge

Writing up a contract, whose terms are discussed in the meetings, allows for the exchange of codified knowledge about plant varieties and crop management. For example, the list of varieties encourages the SOs to use ones with a solid base of reference information (assembled by the seed supplier or by the SOs that also produce seeds) and which fit well with the buyer's needs. This can be likened to a knowledge transfer between the seed company, which is also member of the GTO, and the other members (the storage organisations and the feed company).

Moreover, while the production contract imposes no requirements about the farming techniques to be used, one of the contract obligations is to provide a form on the crop's management for Valorex. This sheet lists all the operations done during the growing campaign based on the grower's statements, and after the harvest the form is sent to Valorex. This bottom-up information transfer, when aggregated together, constitutes a base of information about the practices of the farmers who supply the storage organisations. The goal is then to assess the impact of these practices on the crop (in quantity and quality) to overcome the lack of knowledge about farming practices in order to eventually guide supplier

practices. This assessment is made by the buyer, Valorex. Here, the objective is not so much to control production but to gain information via the contract to improve knowledge throughout the association:

Every year, there is often someone doing a work placement at Valorex who analyses the crop management forms to work on progress. We did this with linseeds, and we're starting to do it with faba beans. And for each plot of land, qualitative analyses are done.

The storage organisations fill out a post-collection form for each parcel so that the farmers identify everything that was done technically, and yield performance, and eventually analyse in terms of practices what worked and what didn't. We're working towards a qualitative analysis, we have one for linseed. One for faba bean doesn't exist yet, but it will be done!

The production contract, interactions between members, and the exchange of tacit knowledge

Implementing production contracts is also a source of interactions in which tacit knowledge exchange occurs. There were two main types of interactions: those at the meetings 3 or 4 times a year and interactions during the field meetings held once a year. Negotiating contracts and contract monitoring fostered the exchange of tacit knowledge between competing storage agencies and the feed company about the technical difficulties encountered in production and collection:

After, there is the sharing of experiences, too. It's true that it's always interesting because we don't all work the same way. This helps to see how the other organisations work; it's always interesting to talk with others in the same business.

This brings together companies that are also competitors, and at least on this issue we can share with other partners who work in the same industry and we also share the same goal of development [i.e. faba bean growth].

The association organizes an annual field visit which includes all the members and the farmers who supply the GTO or those farmers interested in signing contracts for the next crop campaign. This day is an opportunity to exchange tacit knowledge and technical know-how among growers:

After, when there is an event, we're all there. Last year, it was a concurrent cooperative who organized it ... we were all present, that is to say, that we brought our farmers, our farming advisors, and everyone got involved. But you know, it doesn't draw massive crowds either, eh...When there are 50 growers there, we're happy.

Beyond the economic aspect, we exchange, we progress together, we coexist more easily, that create exchanges between the storage organisations and between farmers and I think it's good...And as I told you, at the GTO field meeting, we'll go to a farmer's land who's a member of one of the competitor storage organisations, and we don't feel uncomfortable...It's these things that create a kind of clever

emulation of each other, while remaining competitors, that makes the whole system progress...

The production contract and investing in and securing intangible assets

Finally, the successful completion of the transaction between SOs and the company depends on improving the producer-actor's technical mastery and acquisition of knowledge about the relationship between farming practices and bean quality. By giving members more visibility through market outlets (see 4.2.b), production contracts encourage members to invest in intangible assets.

To improve technical know-how, all the SOs who are GTO members had already committed independently (and simultaneously with the implementation of the contracts) to setting up training programmes or support for their farming advisors.

We started to train advisors, so they're ready to go to train farmers!

It's a course for two or three days, where we present the latest developments ... and then they are given a book that allows them to monitor the crop and have an answer for anything that they may find problematic.

The farming advisors s are multi-talented... however, when they have a question about grain-legumes they'll call the engineer responsible for them.

At our place... I trained them (laughs!) It's a crop I know, so I trained them and go around with them to see things [in the field] and so when they have a problem, they call me.

These actions are based on the resources and expertise available internally, which are limited as we have seen for the majority of GTO's members. One challenge, therefore, is to encourage investment in acquiring knowledge through exchanges with other organisations or by increasing R & D. While these kinds of actions are already done by the largest organisations in the group, it is difficult to envisage that the smaller ones would be able to do the same. Thus, creating supply chain raises problems of investment in intangible assets to acquire knowledge for improving production.

After all, with us, perhaps we also have to improve or perfect our skills on monitoring this crop, but here again, it's always a question of scale, because currently we're very limited and we're not going to deploy the heavy artillery [put great effort] on something that's small for now. But if this ends up growing, then yes, I think there's a need [to invest to improve].

5. Discussion

The results of this study suggest that the economic benefits of hybrid forms of transaction governance cannot be reduced simply to minimizing transaction costs; the economic advantages are also linked to knowledge that can be created and shared, which strengthens the competitiveness of the contracting parties. Furthermore, this study highlights the importance of broadening the theory of transaction costs to the cover the entire collective governance system for bilateral exchanges and knowledge acquisition.

Through formally framing faba bean transactions, production contracts encourage and protect suppliers' intangible investments so that they can fulfil the buyer's expected production requirements. By defining mutual commitments on specifications, they also enable the transmission of knowledge specific to the buyer-supplier relationship, which would not be done through spot market relationships. While TCT takes a bilateral approach to transactions, our results show that the collective management of contracts (here by the GTO association) involves multi-stakeholder dialogue. From the buyer's perspective, bringing together several suppliers may at first seem surprising because it reduces the buyer's bargaining power. On the other hand, this group helps reduce transaction costs related to contract governance by pooling the stages of negotiating and contract monitoring. Moreover, in this process, the results show that collective coordination enables the construction of a common knowledge base, which is needed for all the parties involved. This result calls us to reconsider the place of dynamic transaction costs in understanding inter-organisational arrangements (Langlois, 1992). A more detailed analysis of this dynamic requires additional research on historical case studies with contracts that have been established for several years.

This hybrid form of organisation combines the mechanisms of competition and cooperation and seems to affect knowledge acquisition. Bringing several competing suppliers together during negotiations can be seen as a way to reveal knowledge and set contract parameters more efficiently (for the buyer), such as those related to the price formula, which is currently being elaborated by the parties. The association also seeks to develop cooperative behaviour that facilitates knowledge exchange between members. Today, however, the arrangements between members are based on relationships and thus provide little protection against one member appropriating the quasi-rent (outsider strategy). Here, the rent refers to technical knowledge on know-how and know-what that improves crop competitiveness, and thus would give a comparative advantage to one of the storage organisations if it hoarded this knowledge for itself. In addition, this rent may also be grabbed by the feed company in order to disseminate this knowledge to other production areas. However, these issues were not mentioned during the interviews. It is difficult to identify this kind of opportunistic behaviour in the contract development phase; however, a historical study would be able to identify whether such behaviour was present.

These findings invite us to deepen our understanding of the mechanisms for cooperation within such an organisation, and relates to the literature on trust. Thus, it would be interesting to study the relationships of trust that pre-existed or not, the implementation of production contracts, and then to see how these relationships evolve over time through repetition of contracts (Zand, 1972). It would also be interesting to study the ways in which formal bilateral contracts can complement informal relational arrangements in the emergence of cooperative behaviour (Brousseau, 1995).

This study calls for further analysis of the type of knowledge exchanged during a buyer-supplier relationship. The local versus general nature of knowledge, for example, is likely to influence the risk of hoarding (or leakage) of this knowledge to external actors. Finally, the functioning of this form of organisation based on selecting members recalls the literature on clubs. These forms of organisation especially tend to frame exchanges between a small number of participants in economic conditions marked by high uncertainty (technological change, unpredictable demand, etc.). In the present case study, the technical knowledge involved is neither totally in the private domain nor fully public domain; it is similar to a common good, resulting from a voluntary process within a limited community (Olson, 1965). It may, in this sense, be regarded as a "club good" characterized by exclusion and partial non-rivalry (Buchanan, 1965).

6. Conclusion

The issue of crop diversification has been studied using micro-economic approaches through risk management at the farm level (Carpentier and Gohin, 2015) or through the probabilities of farmers' adopting innovations based on individual preferences and attitudes (Ridier et al., 2016). This article examines crop diversification from an organisational angle, at the scale of a segment of the value chain linking SOs and a feed company. We found that the technical knowledge that farmers and processing actors must acquire to develop a new crop is crucial. Specifically, whether trying to improve upstream farming practices or to define the quality of products, actors had to deal with a lack of knowledge about minor crops, which must be overcome by coordinating the stakeholders.

This case study on the creation of a faba bean supply chain illustrates the uncertainty associated with transactions for minor crops and the need for production knowledge and the types of organisational responses that actors contribute. First, this case study shows how the use of production contracts between the processing industry and the storage agencies secures the supply quantity by anticipating needs and adjusting the size of surface areas needed for production. These contracts, based on mechanisms setting the purchase/sale price different from the spot market, guarantee minimum prices for crops and reduce price uncertainty. In addition to this incentive function, these contracts also support the exchange of knowledge and then formalize the knowledge common to the supplier and the buyer by defining technical specifications. While a bilateral contract can convey codified knowledge, it turns out to be incomplete for managing the uncertainty faced by the actors in practice when building a new supply chain.

This study also highlights the governance structure of these contracts, which brought together a set of vendors and the buyer in one association. This multi-party institutional arrangement complemented the bilateral production contract in several ways: it allowed farming contracts to be negotiated and adapted during the growing campaign; it provided an additional safeguard against opportunism; and provided a space for exchanging the knowledge needed for encouraging production via meetings and field visits.

The combination of these two mechanisms enabled the transactions between suppliers and the buyer to be governed vertically, while the transactions also benefitted from horizontal exchanges between actors. For the buyer, bringing together several providers limited transaction costs, but at the same time decreased its bargaining power. Second, the guarantee provided by these bilateral contracts fostered intangible investments in these organisations, which were competitors but were able to exchange knowledge cooperatively through the association structure.

Ultimately, this study provides insights that complement other studies on supply chain organisation. Previous research has primarily analysed the suitability of a mode of transaction governance and the quality of end products by focusing on the guarantee of a quality label. Based on the findings here, we argue that future research on supply chain organisation should include upstream production and integrate technical and cognitive aspects.

From a theoretical point of view, this study also confirms the importance of specific immaterial assets and calls for further research into their nature. Finally, reintegrating intangible assets into transaction cost theory invites us to go beyond transactional approaches and knowledge-based theories. This case study provides a first illustration of this approach, and further studies are needed to confirm its results. The nature of knowledge (public or private) involved in creating supply chains would also benefit from more fine-grained

research, and opens up avenues for additional research on hybrid forms of organisation through the literature on good clubs. Finally, this study raises questions for public agencies and renews the debate on the economic efficiency of hybrid forms with regard to competition law. These hybrid organisational forms are conducive to the collective construction of situated, local knowledge and, with the need to develop knowledge about minor crops to support the agro-ecological transition, they should be supported by public policies. These forms of organisation build knowledge that complements other public research and development policies.

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Organisation	Positions of respondents	Duration of the interview
Buyer of grain-legur	nes	
Valorex (Feed	- Raw materials buyer	Several
company)		informal
	- Head of R&D	discussions +
	- R&D engineer, in charge of a project to introduce	observation in
	grain-legumes in feed formulations	the company
		for 1 month
	- Head of marketing technical support	
Cumuliana of anaim la		
Suppliers of grain-le	gumes	0 1 10
Cereos	- Director	2 nours 12
		111111.
Triskalia	- Head of the cereals department	2 hours 17
		min.
Garun Paysanne	- Head of plant production advising department	2 hours 40
		min.
Agrial	- Head of field crops sale department	2 hours 35
CAM53	Head of plant production development	$\frac{11111}{2 \text{ hours 5 min}}$
CANISS	- Head of plant production development	2 110018 5 11111.
Independent farm	- Head of the farm	2 hours 8 min.
-		
Independent farm	- Head of the farm	2 hours 43
		min.
Seed company		7 0 1
Agri-Obtentions	- Sales director	58 min.
	- Grain-legumes seed breeder	1 hour 40 min.
Association Admini	strator	
Chambre of	- Local feed and food sector development	3 hours 3 min.
agriculture of the		
lle-et-Vilaine		
department		