

# Buyer–supplier relationship’s influence on traceability implementation in the vegetable industry

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## Abstract

The increasing importance of food safety has made traceability a crucial issue in the agri-business industry. In this article, we have analysed the factors that shape buyer–supplier relationships, and how they influence the traceability of raw materials. In order to do so, first, we have reviewed the literature to develop an analytical framework. Next, we have carried out four case studies on vegetable firms with the purpose of uncovering the variables that characterise buyer–supplier relationships, and their influence on traceability in this sector. Finally, we have compared the observed links with the conceptual framework derived from the literature in order to build an improved model.

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## 1. Introduction

In the food industry, products to be consumed must be free of any kind of hazards for consumers’ health. Traceability is the registering and tracking of parts, processes, and materials used in production (Cox *et al.*, 2002). In this sense, traceability becomes an indispensable process to prevent consumer’s hazards and a crucial mechanism to assure quality in food firms. As of January 2005, European Union authorities require that food firms ensure quality by tracing all products in all stages, from the supplier all the way to the end consumer.

Traceability is a mechanism that requires and reinforces a maximum level of co-ordination between firms and suppliers, and between firms and retailers. Therefore, for researchers interested in the supply chain literature, traceability in food industries may become a relevant aspect to study.

The main objective of this article is to determine how the variables that shape the buyer–supplier relationship influence the implementation of traceability of raw

materials in the specific case of vegetable firms. The paper is organised in four sections. In section two, we have carried out an extensive literature review on buyer–supplier relationships in different industries in order to derive an analytical framework. In the third section, the methodology employed in this project is described. We have conducted in-depth case studies in four vegetable firms. Cases are described in the fourth section. Then, in section five, we have analysed the data contained in the cases, and have isolated those variables that determine buyer–supplier relationships in the vegetable industry and its influence on traceability implementation. Finally, we sum up our conclusions, presenting an improved model, and ideas for further research.

## 2. Literature review

With the review of the literature, our intention has been twofold. On the one hand, to find out those variables, previously studied, that influence the relationships between buyers and suppliers in order to establish a general framework; and on the other hand, to examine what has been studied regarding traceability as a management tool.

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## 2.1. Buyer–supplier relationships

There are several examples of research on the variables that influence the characteristics of the relationship between supplier–buyer in the supply chain literature, as shown in the literature reviews carried out by Croom et al. (2000), and Alfaro et al. (2002). For our purpose, we have selected several references, whose objectives and methodological profiles are summarised in Table 1. These articles have allowed us to identify 13 variables, which have been clustered into three factors, as described in Fig. 1. The factors are supplier-specific, firm-specific, and competitive environment.

From the *supplier* side, González Benito et al. (2003) hypothesised that the larger the company, measured in number of employees, the greater its implementation of supplier quality assurance practices in the Spanish automobile industry. In terms of internationalisation, González Benito et al. (2003) found that the degree of internationalisation was a significant variable: those companies with a global presence were particularly concerned about quality assurance. Ragatz et al. (1997) found that top management commitment was a variable that positively influenced the success of supplier integration, and defined it as a relationship structuring driver in a number of different industries. Zigger and Trienekens (1999) also emphasised the involvement of all management levels as a key factor to determine successful partnerships in the food industry. With respect to strategy, González-Benito et al. (2003) found that quality-oriented strategies eased the development and success of buyer–supplier relationships. Finally, the characteristics of supplies was found to be an important variable by Ziggers and Trienekens (1999), who affirmed that the variability of supplies in the food sector, for instance seasonality or biological variations, influenced buyer–supplier relationships. González-Benito et al. (2003) claimed that the technological complexity of supplies also influenced supply relationships.

We have found that some of the variables that are important from the suppliers' perspective are also relevant for buyers. On strategy, Carter et al. (1998) found that firms with quality oriented strategies implemented supply relationships with a higher degree of success. Ziggers and Trienekens (1999) showed that perishability and seasonality of final products are important elements. Kekre et al. (1995) added the breadth of line as a variable that influences the complexity and the uncertainty in supplier–buyer relationships. De Toni and Nassembani (1995) found that the nature of product/process also impact this relationship.

*Competitive environment* variables are encompassed in the external context in which firms compete. Several of them affect the supplier–buyer relationship. Kekre et al. (1995) cited degree of concentration, competition and availability of suppliers as the most relevant variables. The last one also appeared in González-Benito et al. (2003). Ziggers and Trienekens (1999) stressed the relevance of infrastructures and legal environment.

The above three factors determine the relationships between buyers and suppliers. This relationship is characterised through a number of different variables. Ragatz et al. (1997) for example, included trust, confidence, shared education, and training. Benton and Maloni (2004) added balance of power, commitment, co-operation, duration, attitude, degree of communication, information, and the agreement on planning and goals. From these variables, balance of power is also cited in Zigger and Trienekens (1999), González-Benito et al. (2003), Carter (2000) and De Toni and Nassimbeni (1995). All these variables are encompassed in what we call in Fig. 1 *degree of co-ordination*. In this paper, we want to analyse those variables that affect the level of co-ordination, which is the dimension, that in our view, best summarises the buyer–supplier relationships, and the one in which we are interested in this project.

Table 1  
Description of articles that discuss variables influences buyer–supplier relationships

Reference	Objective	Methodological profile
Benton and Maloni (2004)	Test the influence of power driven /seller relationships on supply chain satisfaction	Empirical research in the automobile industry
Carter (2000)	Identify the ethical issues involved in international buyer–supplier relationships	Empirical research in suppliers of diverse industries
Carter et al. (1998)	Investigate the role of the buyer–supplier relationship in integrating TQM through the supply chain	Empirical research in suppliers of diverse industries
De Toni and Nassimbeni (1995)	Carry out a comparative analysis of factors that affect the supply relationships stability	Empirical research in glass and textile sectors
González-Benito et al. (2003)	Analyse the relationship between different purchasing system variables and supplier quality practices	Empirical research in the automobile industry
Kekre et al. (1995)	Determine how different factors affect supplier availability	Empirical research in diverse industries
Ragatz et al. (1997)	Explore the management practices and competitive environment factors that influence integration of suppliers into the NPD process	Empirical research in diverse industries
Ziggers and Trienekens (1999)	Discuss competitiveness of food supply chains with special reference to quality assurance and vertical partnerships	Descriptive study in food industry

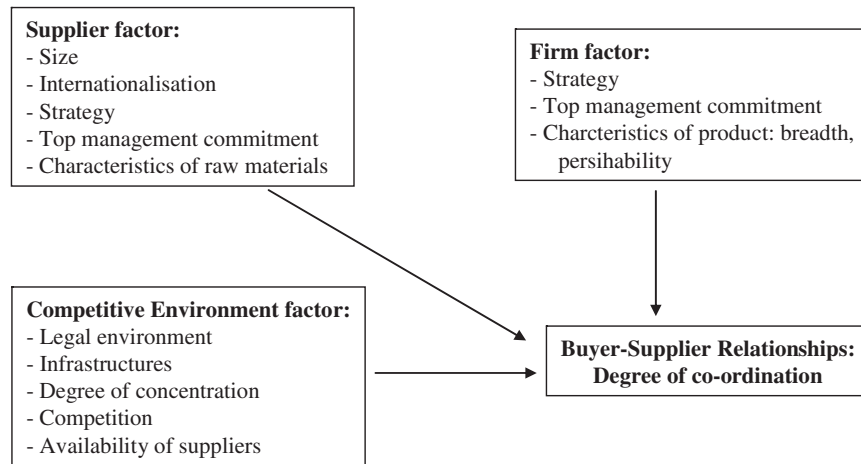


Fig. 1. Analytical framework from the literature review.

Even though there are similarities in the papers we have reviewed, we have not found any two articles containing the same set of variables. This is something that may be explained on the basis of the different aspects of supply relationships studied, different sectors, and even different countries. We have used the framework shown in Fig. 1 as a reference to analyse the case studies.

## 2.2. Traceability

The interest on traceability in the academic literature took off in the early nineties, even though there are some examples of articles written in the mid-seventies. Fisk and Chandran (1975), an early reference, gave several reasons why traceability should be considered a source of competitive advantages for firms.

Most of the research done in traceability in the last decades has been focused on the importance of tracing systems as a quality tool as well as a mechanism to handle information. Florence and Queree (1993) emphasised the fact that traceability opened opportunities for firms in order to improve quality. Cheng and Simmons (1994) analysed traceability in manufacturing firms and concluded that at least two forms of traceability should be considered: status traceability to provide knowledge of the current situation; and performance traceability to compare achievements with plans. Jansen-Vullers et al. (2003a) defined traceability in a passive and in an active sense. The former refers to firms that only use traceability to provide visibility on item's disposition and location at all times. Traceability used in an active way implies the usage of tracking information to optimise and control processes, something that must be seen as a tool to manage quality information through the entire chain. Dimara and Skuras (2003) developed an empirical study to determine if traceability, together with certification and geographic association, influenced the perception of quality by consumers. They stressed that these variables directly

reduce the risks associated with the adoption of new products. Sohal (1997) carried out a case study in which he described a number of factors, all of them critical to the development and implementation of a traceability system in an automotive parts manufacturer. The factors were basically related to top management understanding of CIM (Computer Integrated Manufacturing), a multidisciplinary team approach, relationship between software vendor and user, and training of employees.

Regarding the relationship between traceability and information, Lindkvist et al. (2002) reported on traceability codes for making digital fingerprints of products. Wilson and Clarke (1998) described a possible mechanism for the design and development of a software system for the comparison, location and dissemination of traceability data. Dióspatony et al. (2000) emphasised that one of the problems associated with traceability of raw materials was the vast amount of information that must be handled. In this sense, the authors proposed the use of several applications running on different database systems. Jansen-Vullers et al. (2003b) developed an approach to design information systems for traceability based on graph models. Kärkkäinen (2003) discussed the potential of utilising RFID technology to fulfil traceability requirements in the supply chain of grocery goods. Hobbs (2004) explored the role of traceability systems in the asymmetry of information. The author developed a taxonomy of traceability systems to illustrate the multidimensional nature of information problems related to food safety and food quality.

To sum up, we have found that the majority of authors tend to consider traceability as a mechanism that enhances competitiveness. We contend that there is still a need to do more research in order to have a better understanding about the variables that affect either positively or negatively the implementation of traceability. The above statement allows us to say that our line of investigation may contribute to filling a relevant gap.

### 3. Methodology

For this project, we have used Case Study methodology. As described by Yin (1984), Miles and Huberman (1984), and Voss et al. (2002), Case Study is a research strategy that tries to understand the dynamics present within single settings and is appropriate to study phenomena that take place in rich contexts where there are always many variables to consider in comparison to the number of observations made. This methodology typically combines data collection methods such as archives, interviews, questionnaires and observations, and can be used to accomplish descriptions, theory development and hypotheses testing. For this case study research, we have followed a multi-stage process.

In order to select the case studies, we first performed a round of interviews with representatives of three industry associations, the chairman of the government committee that supervises all industry regulations concerned with food safety, the Director of Agricultural Department of National Technical Centre of Canned Vegetables, representatives of co-operatives, and managers of an organisation in charge of certifying quality systems in the vegetable industry. A questionnaire listing 92 vegetable firms was provided and the experts were asked to identify those firms that had successfully implemented traceability. We considered as best practices those companies that were selected by at least four of the seven experts. With this criterion, 12 firms were pre-selected. The authors approached all of them and finally four were chosen because of two reasons: first, the willingness of the top 12 ranked firms to participate; and secondly, due to the fact that the four firms differ in size, type of products, ownership, raw materials employed and mechanisms to implement traceability. Therefore, we consider that the information provided by these firms positively reflects most of the characteristics of the vegetable industry in Spain, something that was confirmed by the experts that we consulted.

Data collection took almost one year and a half, from March 2002 to September 2003. Personal interviews were always performed by two members of the team in order to compare notes. Team members had complementary yet differing insights, something that added richness to the data. Different perspectives increased the likelihood of capitalising on any novel insights found in the data. Also, the convergence of information from multiple investigators enhanced the confidence in the findings. We used a semi-structured questionnaire. Interviews lasted an average of 1.5 h.

Data analysis of case research represents assessing whether or not evidence within each case is internally valid and supportive of the pre-specified propositions across cases. Therefore, data analysis is concerned with the issues of internal validity and generalisability. For each question, evidence from multiple sources was collected in order to allow for triangulation and consequently to enhance internal validity. In the analysis of the cross-case patterns, we followed Eisenhardt (1989) in order to prevent

premature and even false conclusions. For doing so, we selected categories and dimensions, and then looked for within-group similarities coupled with inter-group differences. Finally, we divided the data by data source. With all this, as stated in Eisenhardt's article, we tried to go beyond initial impressions to derive preliminary conclusions. The issue of generalisability is more complex. In this project, our intention is basically to find out if those factors in the literature that having been found influential in buyer–supplier relationships, also apply to the specific case of the vegetable industry. Thus, the generalisability issue was confronted through a multiple case study, and an independent evaluation criterion has been employed to further examine results and interpretations.

Like any other methodology, case studies are subject to potential researcher biases. In our case, we subjected findings to key individuals in the organisations that participated in the project. We did this in order to prevent misunderstandings that may have occurred and that would have affected the results. Doing this, results gained a higher degree of validity. In our case, key informants in the organisations (Miles and Huberman, 1984), confirmed the results and, thereby, provided support for the analytical technique.

### 4. Case analysis

The vegetable industry in Spain is mostly concentrated in two regions: Ebro Valley and Murcia (see Fig. 2). Around 60% of the Spanish vegetable firms are located in these two geographical areas. Our empirical research was carried in the first region, the Ebro Valley.

There are three kinds of suppliers of raw materials: farmers, trading companies and co-operatives of first degree. Trading companies act as intermediaries between the farmers and transforming firms, even though it is common to find farmers that sell their products to co-operatives they have created.

Transforming firms may be public corporations, and the so called co-operatives of second degree (co-operatives of first degree associated to transform the vegetables they grow). Transforming firms in this industry produce and sell five kinds of final products:

- First gamma products: fresh vegetables sold directly to wholesalers or retailers.
- Second gamma products: canned products made with vegetables.
- Third gamma products: frozen vegetables.
- Fourth gamma products: fresh vegetables that are cleaned, cut, mixed, and put into plastic bags.
- Fifth gamma products: cooked and pre-cooked food whose main ingredients are vegetables.

Finally, distribution is done through wholesalers and retailers. Supply relationships in the Spanish vegetable industry are described in Fig. 3.

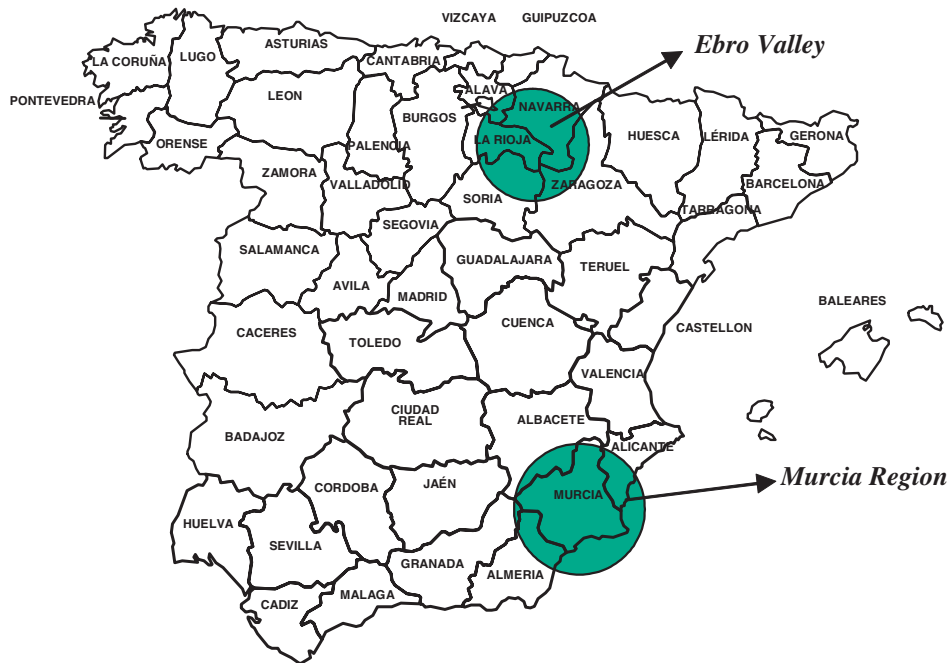


Fig. 2. Vegetable Industry in Spain.

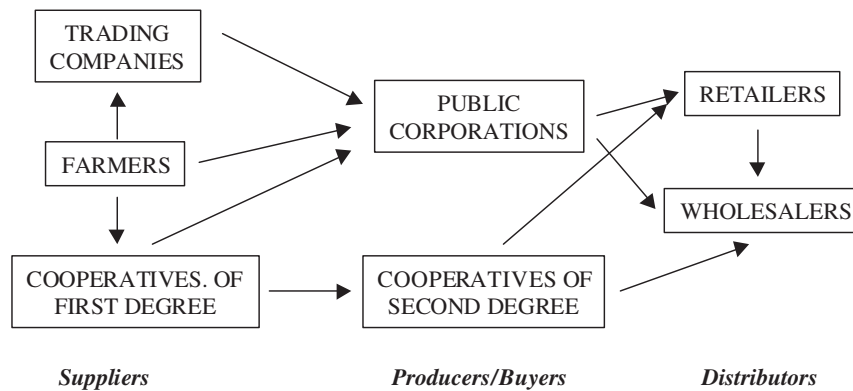


Fig. 3. Supply relationships in the Ebro Valley vegetable industry

The vegetable industry in this area has evolved over the last 20 years. Until the late eighties, the industry was mainly composed of small, family run, companies. Managing these firms was not complex and decisions were taken on the basis of the owner’s experience. The buyer–supplier relationship was based on contracts in which only the price and quantity of raw materials were specified. Chemical analysis was performed by the firms on a statistical basis to test the quality of supplies.

Due to the entrance of Spain in the European Union, new food habits and the competition derived from low-cost producers coming from Asia and South America, have changed the competitive conditions of the vegetable industry. Some multinationals bought firms, a number of small companies merged, and others disappeared. Traditional products, such as canned asparagus and peppers (second gamma), were replaced by new ones, much of them

of the fourth and fifth gamma. Large multinational retailers appeared on the scene with their enormous bargaining power. Finally, the mad cow disease crisis had drastically increased consumers’ concern for food safety.

The above circumstances, together with new laws enacted by the European Union about traceability have forced firms to face the necessity of controlling all the activities that have an influence in the assurance of food safety. In order to assure the quality of raw materials, firms must trace all activities, from sowing to delivering vegetables into the transforming firm’s warehouses. Our analysis is focused on the way in which traceability is implemented in the supply side of vegetable industry. Fig. 4 shows the different processes that are encompassed in the supply stage of any vegetable firm; it gives an idea of the complexity of tracing raw materials and the amount of information that must be managed.

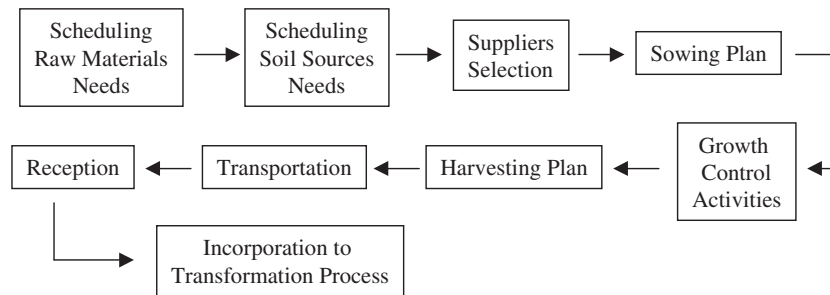


Fig. 4. Processes encompassed in the supply stage of vegetable firms

Traceability implies three kinds of flows between vegetable firms and its suppliers: first, requirements about the characteristics of raw material; second, a physical flow of raw materials from suppliers to the firm; and finally, information in which suppliers send the data that allows permits vegetable firms to trace raw materials.

As stated in the methodology, we finally selected four firms that had successfully implemented traceability programs. The first one produces frozen food (third gamma), and it is integrated into a European multinational group; the second firm manufactures fourth gamma products; the third one is a co-operative of second degree that is specialised in canned vegetables (second gamma); and, finally, the fourth case is a family owned firm that produces frozen vegetables (third gamma).

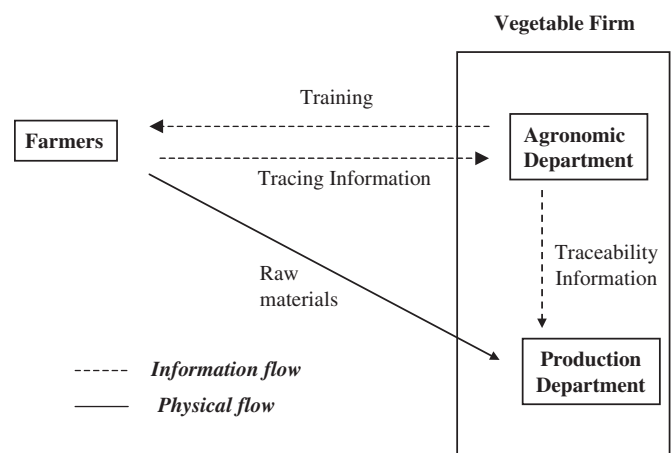


Fig. 5. Traceability Mechanism for Case Study 1.

#### 4.1. First case study

##### 4.1.1. Description of the firm

In this case study, we analysed a frozen food firm (third gamma) that uses different vegetables. The most relevant ones are cabbage, artichoke, peas, carrots and beans. Sales in 2003 were of 58 million Euro, and it has 254 employees. Total production of frozen vegetables reached 43 710 Tm.

##### 4.1.2. Buyer–supplier relationships and traceability implementation

This firm organised an Agronomic Department to monitor the relationships between the firm and its suppliers. The main objective of this bureau consists of monitoring all the activities involved in tracing vegetables purchased from suppliers. Its members spend most of their time outside the firm in different geographical areas, working with the farmers. In this way, the firm, through this office, follows up all farmers' activities that may have an impact in the assurance of quality. The firm has adapted the model that other plants of the multinational group previously implemented. Therefore, there is a strategic support inside the group that has eased the creation and development of this unit. We found in this firm a strong top management commitment toward tracing activities, something that reflects the culture of this multinational. The fact that size in this firm is larger than the average

firms of this region, has provided them with the required human and financial resources needed to set up such a costly system to assure the traceability of raw materials.

Size makes the firm purchase large quantities of raw materials, which gives them enough bargaining power to impose conditions to suppliers about price, scheduling, and traceability control. The buyer–supplier relationship is characterised by long-term contracts with individual farmers because it considers that purchasing from intermediaries, such as co-operatives and trading firms, makes traceability more difficult. The firm has a set of indicators to measure the performance of each supplier in terms of multiple criteria such as productivity, type of soil, age, economic background, etc. All this information is given back to farmers to help them to improve their own activities, something that has created an atmosphere of trust and commitment.

Fig. 5 describes the traceability mechanism of this firm. As it is observed, the Agronomic Department is in charge of organising training activities for farmers, and collecting all information related to raw materials. Once vegetables are delivered to the firm, Agronomic gives all the tracing information to the production office. From this point on, the transformation process begins, and the responsibility of traceability is transferred to production.

## 4.2. Second case study

### 4.2.1. Description of the firm

The main activity of the second firm consists on producing fourth gamma products. The most important raw materials that the firm transforms are lettuce, two varieties of endives, spinach, and chard. Sales in 2003 were 52.30 million euros, and it has 659 employees. Total production of frozen vegetables reached 16995 Tm. The firm belongs to a French co-operative.

### 4.2.2. Buyer–supplier relationships and traceability implementation

Because fourth-gamma products are highly perishable, the firm keeps a production flow all year around. This means that they must obtain a regular supply of all the vegetables they process. From harvesting to processing, the cycle cannot last more than five days. As a consequence, the firm has widened the geographical area in which they buy raw materials to include other Spanish regions and several other countries. The company has traditionally worked with individual farmers, but it has had to extend its network of suppliers to include co-operatives and foreign providers. The firm admits that this change of policy makes tracing raw materials more difficult.

In this gamma, the vegetables are not sterilised, as it occurs in the manufacturing process of second gamma products. This implies that there is a high percentage of probability that any kind of food safety hazard originated during the supply process may affect consumers, making traceability even more critical. To prevent health problems, the firm considers that a close relationship with suppliers is crucial, and this is the main reason why the firm decided to constitute an independent business unit. The pressure exerted by customers worried about the quality of final products reinforced this decision. This subsidiary began its activities as a way to ensure a regular flow of raw materials, and eventually this objective was enlarged to include the implementation of traceability. Fig. 6 describes the traceability activities for this firm. In this case, the trading company is in charge of collecting all traceability information, and also of training and controlling farmers' activities.

They preferred to outsource tracing activities because of their medium size, and also because they considered that its core business was not tracing. Because of this, in the medium term, the trading company is planning to sell raw materials to other transforming firms.

## 4.3. Third case study

### 4.3.1. Description of the firm

The third case is a second degree co-operative focused on second gamma products. Sales in 2004 were 7.65 million Euro, with 90 employees. As stated before, the main characteristic of this kind of co-operatives is that its owners are co-operatives of first degree, which, in this case, represent 3294 farmers. The co-operative transforms a total of 14360 Tm of vegetables, mainly asparagus, tomatoes and peppers.

### 4.3.2. Buyer–supplier relationships and traceability implementation

The implementation of traceability is carried out by the firm in itself, something that is understandable in a vertically integrated firm such as this one. Even though there is no an specific office dedicated to assuring quality of raw materials, there are three technicians who give recommendations about types of seeds, sowing techniques, use of fertilisers, etc., and who then follow up farmers' activities. The large number of suppliers involved and the high volume of tomato delivered requires a complex system to trace farmers' individual activities. This is why the co-operative uses the services provided by public organisations in charge of training farmers in agricultural techniques as a complement to their own control activities. Fig. 7 describes the traceability mechanism for this co-operative.

Implementation of traceability in this firm is affected by three circumstances. Firstly, this co-operative produces canned asparagus with a *Certificate of origin of the product*. This means that this vegetable must be cultivated in a small area of the Ebro Valley, something that eases the implementation of traceability because farmers must fill out reports that reflect all of the activities associated to the sowing, growth and harvesting of this vegetable. Secondly, tomato production is regulated by the European Union,

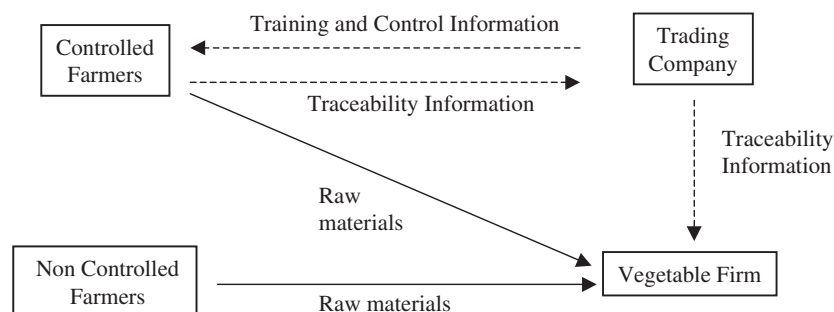


Fig. 6. Traceability Mechanism for Case Study 2.

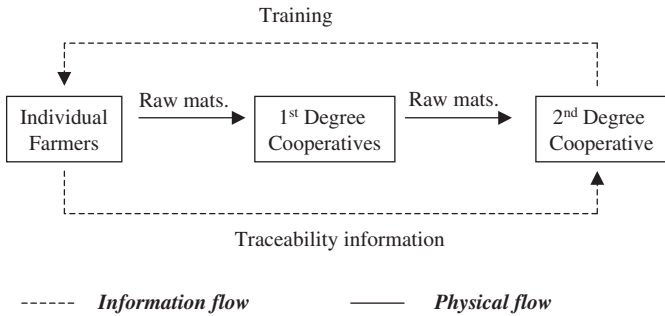


Fig. 7. Traceability Mechanism for Case Study 3.

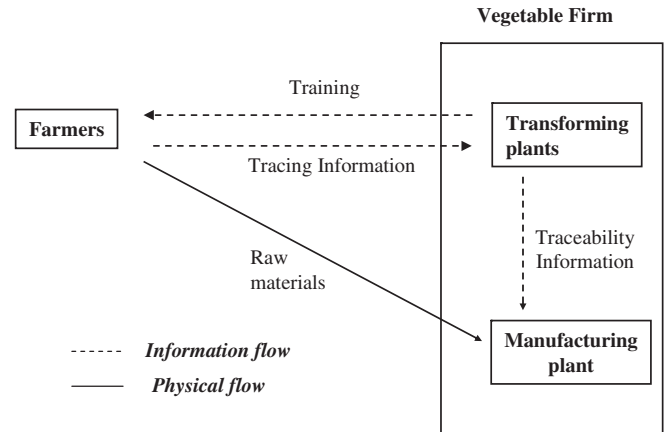


Fig. 8. Traceability Mechanism for Case Study 4.

which requires farmers to be associated in organisations called OPFHs (Organisations of Producers of Fruits and Vegetables). This implies that the manufacturing firm cannot work directly with individual farmers. Finally, it is difficult to impose technical criteria to farmers, specifically in traceability issues, due to the fact that they own the firms.

4.4. Fourth case study

4.4.1. Description of the firm

The fourth case is a firm whose main product is frozen vegetables (third gamma). It is a family owned firm, whose sales in 2004 were 126.03 million Euro, with 283 employees. The firm transforms a total of 133 000 Tm of a wide range of vegetables. The most important raw materials for this firm are French (green) beans, peas, peppers, broccoli, potatoes and carrots. The activities of the firm are distributed in eight plants located through all Spain. There are seven centres of production, which are in charge of receiving the vegetables harvested in the fields, selecting, cut and freezing. The location of these factories is close to crops. There is another plant located in the Ebro Valley, which is in charge of packaging and distribution, besides the headquarters for quality control and marketing of the finished products.

4.4.2. Buyer–supplier relationships and traceability implementation

This firm has implemented a traceability system that permits tracing in real time. A computerised system has been set up in which the finished product can be traced backwards; that is, from its arrival at the plant, to its delivery to the final customer. Apart from the fact that traceability is indispensable for food safety, the firm uses it as a management tool that permits the detection of shifts with abnormal production and its causes. The firm exports a high percentage of their production, and the requirements of international markets reinforced the decision to implement such an efficient tracing system.

The company works together with farmers to plan where to cultivate and what kind of vegetables to be grown. The firm pays great importance to the choice of seeds looking

for varieties that mature earlier, taking into account weather conditions when planning dates for sowing and harvesting. The correct choice of seed and density of plants per unit of soil allows a continuous flow of raw material during the harvesting season.

For the last eight years, the firm has insisted on a strict record of the pesticides used and the dates of use. Nowadays, each farmer must fill in a treatment card, so that the company can gauge the safety period, and the best moment for delivery of the product to the factory. The company provides the machinery for this crop, although the farmer does the harvesting. The farmers are responsible for the transport of crops. The vegetables are brought in containers and upon arrival at the plant are separated into lots. Because the firm usually purchases from large suppliers, it is unusual to have raw materials from more than three farmers within one lot. Upon arrival the consignment is evaluated to check for problems, and if any are found, it is clear which farmer they belong to. The type of suppliers varies widely within geographical areas: 50% of the raw material suppliers are located in the same area as the transforming plant. The firm deals with both individual and co-operative farmers, and always tries to use the same suppliers. Although individual framers are preferred, contracts are also signed with co-operatives in order to diversify risks. The firm has a unit with 13 agricultural technicians that co-ordinates traceability activity of raw materials. Fig. 8 summarises the activities involved in the tracing of raw materials.

5. Findings and propositions

The four cases describe the kind of relationship each firm maintains with their suppliers. Following, we develop a set of propositions specifying the influence that a number of variables uncovered in the analysis has on the degree of co-ordination between buyers and suppliers, the connection between some of the variables and the resources employed in traceability, and the relationship between co-ordination and traceability. We have grouped the variables into three



factors, which resemble the analytical framework derived from the literature review. Next, we describe them.

### 5.1. Supplier-specific factor

#### 5.1.1. Characteristics of raw materials

The fact that each vegetable requires different types of soils and a variety of seeds, determines the methods and timing of harvesting. In this sense, the vegetable the firm wants to trace determines the complexity of information that is necessary to obtain and, therefore, the degree of co-ordination with the suppliers. On the other hand, perishability of vegetables tightens the relationship, which is something that was observed in the four cases, and that we may generalise for all the vegetable industry. Therefore, we consider that the characteristics of the vegetables employed in the production process determine buyer–supplier relationships in the vegetable industry.

*P1a: The characteristics of raw materials determine the degree of co-ordination between buyers and suppliers.*

*Type of suppliers:* Individual farmers are easier to convince about implementing traceability activities because they are not constrained by legal factors and bureaucratic aspects such as cooperatives. The firms that we have analysed are always worried about productivity, the use of pesticides, the introduction of new seeds, etc., concerns that are easier to control when working with individual farmers. Besides, individual farmers can easily change the way they work, which is something that makes the relationship smoother and easier.

*P1b: Type of suppliers determines the degree of co-ordination between buyers and suppliers.*

*Geographical location of supplier:* Tracing requires direct supervision of farmers, and the fact that many suppliers are located far from the plant makes the co-ordination and the control of farmers' activities more difficult. In fact, all the informants agreed that the main reason to work with suppliers located close to the manufacturing plant is that it is much more efficient to create strong collaborative links.

*P1c: The geographical location of suppliers determines the degree of co-ordination between buyers and suppliers.*

### 5.2. Firm-specific factor

*Strategy:* Firms that have a strategy oriented to quality tend to establish strong links with their suppliers. Because of this, we observe in these cases that it is easier to implement traceability systems because top management is involved and supports all activities related to quality improvement. Informants told us that the culture orientation of the firm was in itself the reason behind the commencement of raw material tracing activities.

*P2a. Strategy determines the degree of co-ordination between buyers and suppliers.*

*Internationalisation:* We consider that the degree of internationalisation is determined by the percentage of sales that come from exports. This variable has played a

fundamental role in considering traceability as a strategic tool to improve the competitiveness of the company. Distribution chains in Germany, Belgium and Great Britain have been concerned with traceability long before Spanish customers, so their demands were of great help to the company when perfecting its system of traceability.

*P2b: Internationalisation determines the resources employed in traceability activities.*

*Size:* Firms with superior financial resources can afford to have a budget exclusively dedicated to tracing raw materials. We have observed that the power to negotiate is correlated to the size of the firm. In Case 1, we detected that the firm, which has a high turnover and a strong financial position, has the power to make some suppliers work with this firm exclusively. This is something that has empowered the relationships, making consequently the implementation of traceability easier. In this sense, the bargaining power is also linked to the incentive schemes to furnish reliable and truthful information in the supply chain.

*P2c: Size determines the resources employed in traceability activities.*

*Vertical integration:* We have perceived that this variable influences the type of relationship maintained in the supply chain. In Case 2, we have observed that vertical integration does not facilitate the implementation of tracing activities. This is so because suppliers are also the owners of the firm, and this situation affects the balance of power in the buyer–supplier relationships. Suppliers cannot be obliged to carry out food safety control activities in the same way as when this power is exerted with other types of suppliers. In this sense, there is no coercive power to force them to track their own raw materials, and to provide accurate information.

*P2d: Vertical integration determines the degree of co-ordination between buyers and suppliers.*

*Characteristics of final product:* The degree of transformation suffered by vegetables in the production process determines the importance of food safety control systems. The probability that any kind of food safety hazard originated during the supply process is enhanced when there is no sterilisation. Because of this, firms of second and fifth gamma products (Case 3) tend to minimise the significance of traceability. On the other hand, firms that produce third and fourth gamma products (Cases 1, 2 and 4) give traceability much more importance.

*P2e: Characteristics of final product determines the resources employed in traceability activities.*

### 5.3. Competitive environment factor

*Certificates of origin:* In Spain, it is common that food products, such as wine, cheese, and meat, have what is called a Certificate of Origin. In the case of vegetables, this means that a local government institution certifies that a certain vegetable product uses raw materials coming from an exclusive geographic area, using specific rules about the

methods of sowing, growing, and harvesting the vegetables. Local governments use these certificates as a way to differentiate local products in the markets. In the case of vegetables grown in the Ebro Valley, asparagus and peppers have this certificate. We have observed that firms that manufacture products that are under Certificates of Origin, such as the one in Case 3, maintain relationships with their suppliers, characterised by a positive attitude and an ample degree of communication. In this way, the existence of this kind of regulation is something that facilitates the co-ordination between buyers and suppliers.

*P3a: Production under certificates of origin determines the degree of co-ordination between buyers and suppliers.*

*Consumer's pressure:* The mad cow disease crisis heavily affected this industry. The pressure exerted by consumers compelled retailers to assure food quality. This has provoked an increasing number of requirements that vegetable firms must fulfil. This pressure is one of the main reasons that has increased the level of interest on traceability mechanisms.

*P3b: Consumers' pressure determines the resources employed in traceability activities.*

*Legal environment:* As a response to increasing consumers' pressure, new laws have been enacted in the past five years, changing the competitive environment in the food industry. As of January 2005, all food firms in the European Union must trace materials along the transforming process, from suppliers to end consumers. This implies that all food firms must keep records containing information about all the different stages that involve supply, manufacturing, and distribution.

*P3c: Legal environment determines the resources employed in traceability activities.*

#### 5.4. Degree of co-ordination between buyers and suppliers

The above variables have an effect on the characteristics of the relationship firms maintain with suppliers. Companies, like the one of Case 4, try to make farmers feel that the double checking that technicians carry out is beneficial to both sides. The firm tries to earn the trust of the farmer so that information is not concealed and the relationship is as transparent as possible. As a matter of fact, 50% of the raw material suppliers have been with them since the firm began its activities 18 years ago. In the analysis, we observed that the amount of resources devoted to tracing raw materials is larger, and the degree of success in terms of implementing traceability seems to be higher when relationships are tight.

*P4: The degree of co-ordination determines the resources employed in traceability activities.*

In the case of all four firms, we have also observed that the amount of resources devoted to traceability influence also the relationship between buyers and suppliers. In this sense, there is a two way relationship between tracing and co-ordination. All informants emphasised that the degree of co-ordination determines tracing activities. But, at the

same time, the development of traceability helps to reinforce this co-ordination. This happens because farmers observe the advantages that tracing implies in terms of quality, and, therefore, the profits that a higher co-ordination implies for the supply chain.

*P5: Resources employed and the development of traceability activities reinforces the degree of co-ordination between buyers and suppliers.*

All these propositions are deployed in a model that depicts the variables described in the reviewed literature, and the ones found in the data analysis from the cases of the vegetable industry.

## 6. Conclusions

The variables we have found in the analysis have been clustered into three factors: those associated with the firm (buyer); those associated with suppliers; and finally, those linked to the competitive environment. These three factors coincide with the ones described in the conceptual framework derived from the literature review, even though we have found some slight differences. These are:

1. *Supplier-specific factor.* In the case of vegetable industry, we have found two additional variables that affect buyer–supplier relationship, which do not appear in the conceptual framework. They are the type of suppliers (individual farmers, co-operatives) and geographical origin of suppliers. Certainly both are industry specific. On the other hand, size, internationalisation, strategy and top management commitment, variables that are cited in the literature, do not appear in our analysis. With respect to internationalisation, this happens because suppliers are small and only work with local firms. We have found in the case studies that, as long as firms may exclusively depend on national suppliers, they will not import vegetables. Regarding strategy, farmers in Spain, in general, are characterised by a low degree of awareness about the importance of traceability. This is so because of a lack of a quality-oriented strategy in the Spanish agricultural sector. Finally, characteristics of raw materials appear in both the analytical framework and the empirical study, but there are aspects in the vegetable industry that are specific such as the influence of soil, types of seed, and perishability.

2. *Firm-specific factor.* Strategy and characteristics of final product are variables that appear in the literature review and that have been also identified in the case study analysis. Though, from the case analysis top management commitment was not isolated from strategy. We would like to emphasise the fact that internationalisation, size and vertical integration, variables that do not appear for firms in the conceptual framework, seem to play an important role in the vegetable industry. This may be explained in two ways. Firstly, previous research on buyer–supplier relationships has been mainly focused on supplier characteristics. Secondly, some of the variables found in our study are industry-specific, such as vertical integration.

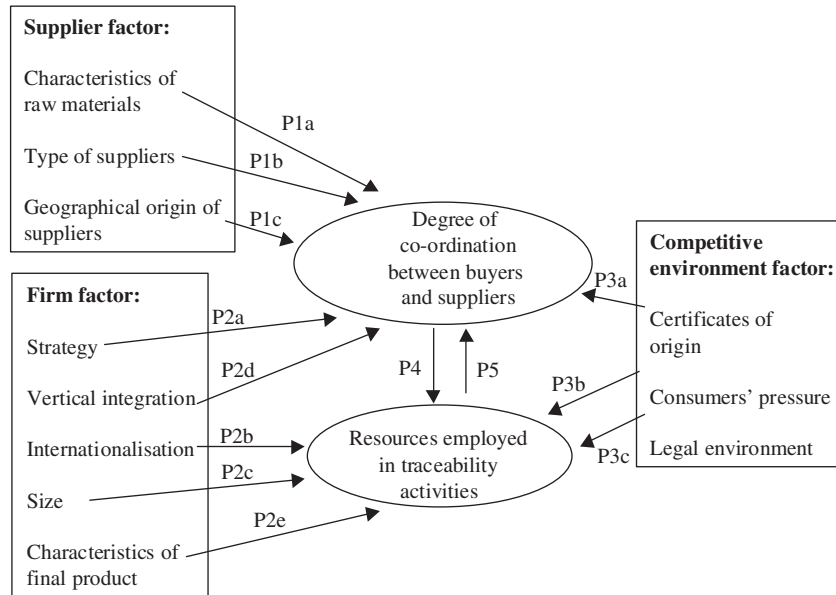


Fig. 9. Buyer–supplier relationships' model.

3. *Competitive environment factor*. The legal arrangement is the only variable that appears in both the conceptual framework and the model developed in this paper. There are two variables, certificates of origin and consumers' pressure, which are industry specific. On the other hand, infrastructures, degree of concentration, competition, and availability of suppliers are variables that are cited in the conceptual framework but do not appear as relevant in the vegetable industry.

After pointing out these differences, we have developed a model that is described in Fig. 9. From our analysis we conclude that buyer–supplier relationships in the vegetable industry are shaped by three factors, depicted in the model, which are formed by a number of variables, all explained through the paper. The degree of collaboration between buyers and suppliers is influenced by all supplier specific variables, by two firm specific variables (strategy and vertical integration), and by one competitive environment variable (certificates of origin). The resources employed in traceability activities are affected by firm specific variables (internationalisation, size and characteristics of final product) and competitive environment variables (consumers' pressure and legal environment). Finally, the model shows that the traceability mechanisms and the buyer–supplier coordination are mutually reinforcing. The model benefits from previous research done on buyer–supplier relationships and includes some considerations that are pertinent to the specific circumstances of the vegetable industry.

In order to generalise our results, further research must be carried out. A larger sample may allow the generalisation of findings through the use of quantitative analysis techniques to test each one of the propositions introduced in the Findings. Another useful line of research would be

studying the financial costs and benefits involved in traceability. A longitudinal analysis in order to determine the way in which the different propositions presented in this paper affect the mechanisms employed in traceability by different firms would be also interesting.

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