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TRACEABILITY USE IN BOVINE FOOD SUPPLY CHAINS

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Abstract
Worldwide, supply chains and markets for food fit for human consumption recently have faced several safety issues and scandals. This research project thus investigated traceability in meat supply chains. The project stems from current fear, trading practices and recent legislation. This article reports on investigations using phenomenological paradigm methods to compare literature and empirical observations in bovine meat supply chains. Representative companies of key supply chain stages of bovine product supply and distribution networks were interviewed. Bovine meat supply chains process issues relating to traceability were identified.

Introduction
Historically traceability is related to family lineage. The British royal family heirs to the throne are able to trace their lineage back more than 50 generations. By contrast, living members of families can loose track of each other as a result of distance and estrangement.
During the heat of battle, with destruction and loss of life and limb, confusion and lack of ability to follow each participant's actions result in "the unknown solder". The battlefield cemeteries from WWI all too frequently have head stones for dead solders engraved with 'A solder from Regiment'. With little more than human remains, where even the regimental badges on the uniforms are missing, many headstones are engraved with 'A solder known unto God'.
The British Government was defeated in the House of Commons in June 2009 over the introduction of compulsory identification cards for all adults resident in the UK. Such as system has been an integral part of the French republic for many years. Historically such systems have been abused for political gain and ethnographic manipulation or ethnic cleansing. During WWII the Nazi regime required all persons of Jewish heritage resident in Germany to register with the authorities. In and of itself, these registrations were not evil. The activities that ensued however were crimes against humanity.
Corporations have become the dominant economic medium of the 21st century. Many are more powerful financially than national governments. For profit organizations must provide goods and services to clients, while making profit. Once a profit is created, one of the business' goals is to minimize the risk-to-profit. Traceability is a principal tool to achieve this aim.

Commercial Case for Traceability
Many large corporations outsource core product and service activities to suppliers. In the even that supplier quality, delivery and service are deficient, defective or do not comply with specifications, the customer company becomes vulnerable. Their brand value may be reduced, their client contracts terminated and they may be liable as the purchasing company for financial damages and reparation. Customer companies therefore have responsibility to minimize the risk-to-profit for their own corporation and for their supply chain partners. They

therefore aim to ensure adequate control over materials, components, modules, core and non-core products, and ancillary parts such as packing materials.
Knowing the providence of a product, particularly in the catering industry is important to re-assure clients of the ingredient's heritage, lineage, and care taken to rear and slaughter livestock.
Regardless of corporate size, the risk of criminal prosecution, civil action and test cases brought against the business are a constant threat to corporate survival. Therefore companies demand traceability internally and throughout their supply chains to cover 'just in case' risks and eventualities: incidents that leave their reputation tarnished, and the business financially ruined from loss of sales or punitive judicial rulings. The latter may come from private law suits, class actions, public prosecutions, code infringements and violations. Companies can reduce these risks by complying with regulations, implementing safe and best practices, designing 'fail safe' systems with safeguards and back-up process redundancy.

Failure Mode and Effect Analysis
FMEA can be used to identify risks, the ability to identify or measure occurance, event frequency probabilities and severity. Rating these between 1 and 10 on a graduated scale, then multiplying these together creates results between 1 and 1000. The company must set in place controls, safeguards and measures in order to minimize the result, typically with 125 being a nominal guideline maximum. Companies have to prove they have taken reasonable precautions to prevent foreseen incidents and accidents. If they have not taken into consideration possible scenarios, have not put in place measuring systems or sensors, have not put in place controls to prevent incidents, or have not determined the severity of catastrophic failures, they shall liable to prosecution.
Text books on management regularly cite the Tylenol case. Tylenol is a Paracetamol based over-the-counter medication. Individual tablets in individual packs of the product had been deliberately contaminated by one person. The producer decided to recall all of their products from the market, national wide. They recalled all sold product, regardless of date and serial number. They then set about tamper proofing their products with dual and triple back-up mechanisms.
Automotive, toy and other product assemblers recall products with specific serial numbers, sell by dates or other identifying characteristics. They aim to remove from the market, recover and replace defective parts, and minimize risk to consumers and clients.
Ford's long-time partner Bridgestone had been requested to add an additional layer of fabric in the construction process to reinforce the structure. Individual tyres failed and lead to fatal road traffic accidents. Ford Motor Manufacturing had to replace 23 million tyres on their popular 4x4. In several trading regions, the relationship between Ford and Bridgestone was then severed.
Aero plane flying parts and automobile components have part numbers. All aircraft passengers must occupy their assigned seats upon take-off. For example, in the case of the Concorde crash just after take off in Paris, passenger cadavers may be identified by the seat number they are strapped into. Part numbers enable investigators to identify the last flight, the manifest, crew and passengers of aero planes crashed decades previously.
Today, domesticated animals may be chipped with a subcutaneous implant that identifies the animal, and provides the key data to trace the current and previous owners, dates when the animal crossed borders, the treating vet, full history of vaccinations, boaster hormones, and medical treatment received. The minimum traceability a dog has is a collar tag with a name and phone number of the owner.

Captive breading programmes in zoological parks subscribe to an animal identification and tracking system in order to sustain the diversity of the genetic. Lack of control of this system would lead to brother and sister producing offspring that would mate together. In-breading and animal age increase susceptibility risk of inherited genetic abnormalities and illnesses. Equally, sub-strain species can develop from this, such as the range and diversity of dog sub-species: Grey Hound, German Shepard, Shiatsu, Great Dane, etc.

Traceability for Livestock Destined for Human Consumption

Since Dolly the sheep, US beef producers have moved to cloning livestock. Genetic degradation can occur from successive generations: taking copies of copies of copies. Animal breading programs to avoid in-breading by transferring semen or an animal from one group to another in order to re-invigorate genetic diversity. Despite using similar, yet more stringent controls, hospital baby swaps periodically still are known to happen.

This research project focuses on cold food supply chains. Live-stock destined for human consumption are subject to more stringent traceability requirements. In the event of contamination, product degradation, contagion, customer illness or death, the core attributes and aim of traceability are to clarify responsibility, accountability, liability and authority. Since corporations are open to prosecution, they have protect themselves from risk as far as is possible. They have to prove they have assessed risks and they have taken all reasonable precautions. Despite these preventative safe guards, strategies must be developed to cope with incidents.

This research aims to answer the following questions:

- Why do companies implement traceability systems? For which reasons and benefits?
- Which are the solutions used to ensure their effectiveness and efficiency?
- Which are the potential issues and obstacles met with traceability implementation?

These questions are analyzed from the perspective of every actor within the food supply chain: producer, slaughterhouse, manufacturer, butcher, major outlet, logistics provider.

Research Methodology

This research used case studies to test the questions posed. Yin (1984), Miles and Huberman (1994), and Voss et al. (2002) case study research approaches facilitate understanding of dynamics, primarily within a given scenario. The approach appropriate to study phenomena in contexts where many variables contribute to outcomes and where comparison and contrast analysis may be derived from limited case examples.

This project primarily made use of the phenomenological paradigm method to compare literature and empirical observations in agribusiness supply chains. The aim was to analyze existing traceability systems within companies acting in supply chains, from production to retail.

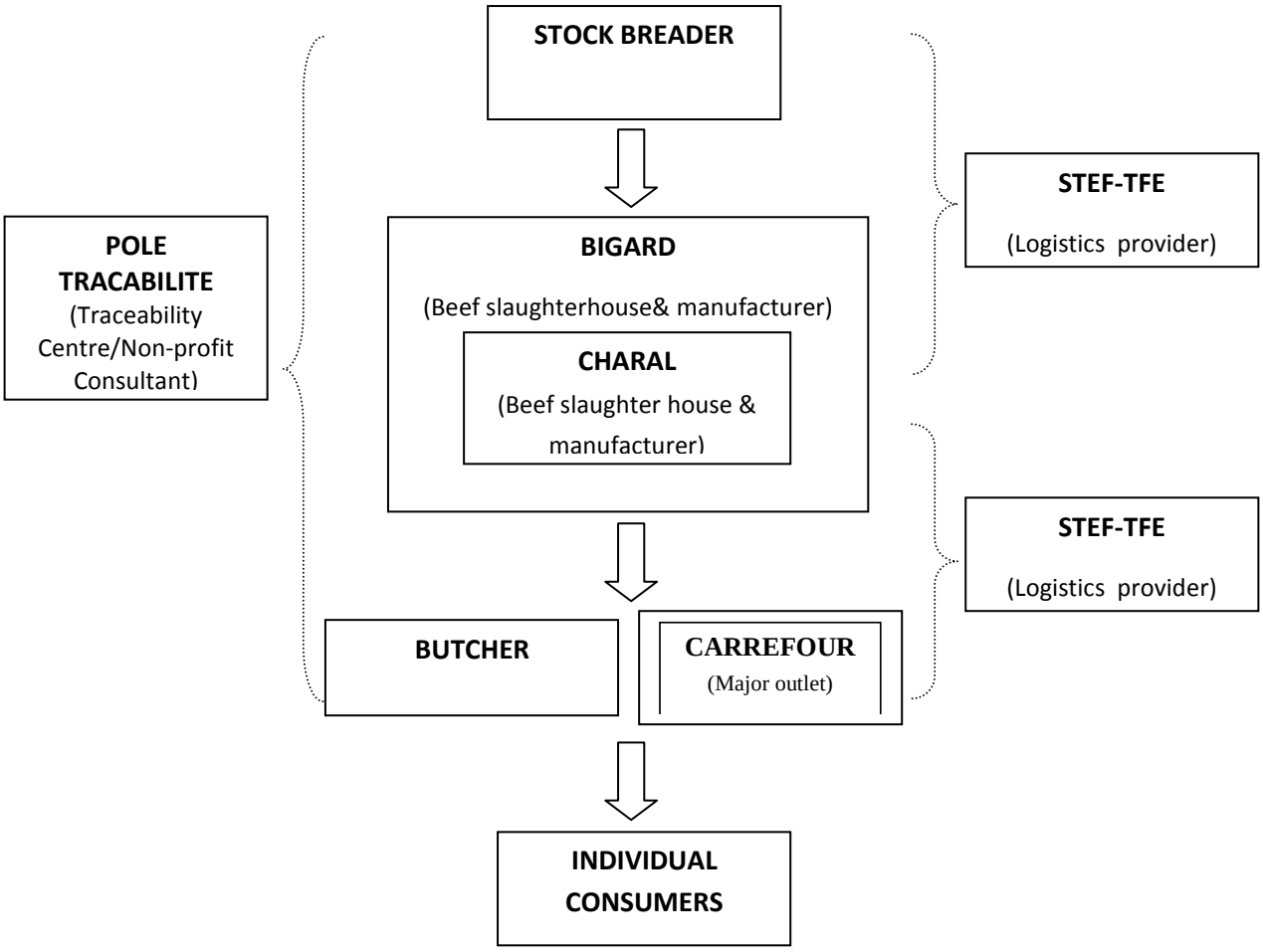
The scope of the case analysis is limited. The main driving criteria behind the choice of the companies are the following:

- To ensure consistency of data collected
- To generate a global overview of cold supply chains
- Ability to meet for a short time frame competent individuals in appropriate companies

This research into bovine meat supply chains stems from current fear, trading practices and recent legislation, representative companies of key supply chain stages of bovine products. Interviews and process mapping were undertaken at companies with the following roles in the

bovine meat supply chain: producer, slaughterhouse, manufacturer, butcher, major outlet, logistics provider, traceability consultant, see Figure 1.
Moreover, recent scandals related to food safety made bovine meat and derivative products a controversial sector. For instance, BSE an E.Coli 157 can have serious consequences on public health and on the global market. Avian flu H5M1 and swine flu H5N1 also have created the world human and live stock health, tourism, trade restrictions and suspensions. The issues and risks that affect meat supply chains are representative of those affecting most agribusinesses.

Figure 3.1.



The interviewee was not primed with explanatory articles or questionnaire prior to interviewing. Priority questions were generated prior to the meeting to provide a semi structured interview format. Interviews explored aspects of traceability. Interviews were conducted in French and audio recorded and systematically transcribed immediately the same day. Notes were taken during the interviews. Recommendations of whom to approach for further interviews were requested.

The producer and butcher interviewed are the owners of their businesses. Interviews with the quality director of Charal group, the director of local Bigard Distribution (Grenoble), the director of logistics operations of Stef, and the manager of meetings and fairs organized by Pôle Traçabilité. Limits of this research stem from: data analysis exclusively bovine meat supply chains. This article does not attempt to compare and contrast with other human food supply chains such as seafood, fresh fruits and vegetables, or dairy products.

Animal Flesh Cold Food Supply Chains

The UK television show "Kill it. Cook it. Eat it." invites the audience to follow the slaughter house activities behind a glass partitions, to watch the stun, puncture, bleeding, undressing, inspection and cut preparation processes. Vets certify each carcass is free from disease, there is no contamination from offal or fesses, and has been processed properly. The flesh then is prepared by chefs and the audience is invited to dine. They are then asked if, given their increased awareness of the abattoir process, they would eat more, less or the same amount of animal produce. Typically, emphasis falls on the quality of the rearing and animal husbandry, as well as the care taken not to stress the live stock.

Fresh Produce and Chilled Supply Chains

Businesses focused on or participating in fresh fruits and fresh/chilled meat supply chains must ensure they comply with industry specific legislation while producing, preparing, transporting and selling their products.

The agribusiness sector is a specific sector in many aspects:

- The structure of its supply chain is comprised of a multitude of small companies upstream that trade with highly centralized multinational groups downstream.
- Their products have a relatively short shelf life,
- The need to maintain and assure continuous temperature control, and
- The influence of unpredictable product attributes and weather on production.

These constraints and challenges affect every actor of the cold chain: producers, industrials, logistics operators, distributors and retailers.

General public awareness of the importance food condition, presentation, contamination and state stems from news stories including chicken salmonella (Edwina Curry), BSE and Escherichia Coli (E-Coli). Recent scandals prompted the European Parliament and Council to legislate with the aim of protecting public health. The 'Food Law', regulation 178/2002, became effective on the first of May, 2005.

Traceability today is a critical for all companies involved in food supply chains. Traceability can be used to provide structure and rigor to improve business' logistics process efficiency, satisfy corporate critical and key performance indicators and satisfy end users. Traceability is core to efforts to reduce companies' risk liability that result from defective, contaminated or deteriorated produce.

Traceability literature emerged in the mid-seventies. Fisk and Chandran (1975) notably argued that "traceability should be considered as a source of competitive advantage for firms". Contemporary authors concur (Rábade and Alfaro, 2006).

The Irish Pork Ban of 2009

Irish pork became an issue during 2009. Animal feed they were fed with was produced on contaminated soil that had been fertilized with compounds that contained illegal substances. Pigs from Ire had been transferred to Northern Ireland where they were slaughtered. Having been prepared for sale in Northern Ireland, the carcasses and sales packs were marked up as UK produce, and were then were made available to retail outlets and trade customer anywhere in Great Britain.

Literature Review: Agribusiness supply chains

AFII (2007) stated that 290 000 agribusiness companies depend on controlled temperature logistics. French companies employ 420 000 people in 10624 companies registered as focused on food related activities. These generate 140 billion Euros turnover.

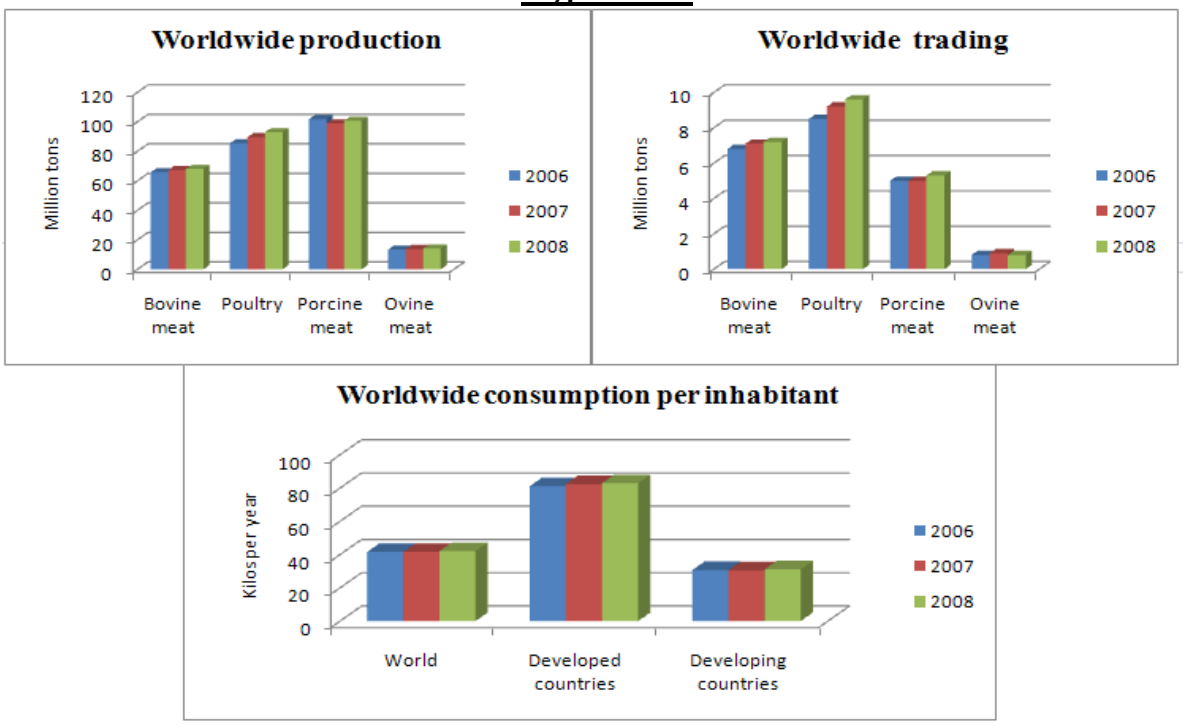
Europe has 492 million consumers. On average, the European consumer buys 530 kilos of food per year, of which 350 kilos are chilled or frozen produce. 172 million tons of food (chilled or frozen) are handled each year, and transported by about one million chilling or freezing vehicles.

About 60% of the food sector covers perishable products such as meat, dairy products, seafood, fruit and vegetables. France makes 20% of its sales abroad; 75% of this in Europe. For this reason, France is considered as a platform to provide millions of consumers through the continent. (AFII 2007) By contrast, the UK can feed approximately half of the 60 million plus inhabitants.

French major outlets have carved out a reputation for efficiency and competitiveness. They specify exacting standards that vendors must meet in terms of order, delivery and purchasing management. Significant European food retailers are French: Carrefour, Auchan, Casino and Inter Marché. (AFII 2007)

The WTO (2007) noted rising demand for products and diversification both increased global trade of farm produce worldwide. Between 2006 and 2008 meat production increased 3.5%. A notable exception is porcine. Poultry increased 12.9% while ovine meat (lamb and mouton) remained level. Average worldwide consumption of meat per person, per year, marginally increased up to 1.2%. The several crises in the meat sector, especially BSE, which strongly affected consumption and international exchanges of bovine meat world wide. Despite local and regional outbreaks that create news stories around the world, the production, trading and consumption of meat slowly is increasing.

Figure 4.1.



International goods exchanges mean increase distances between the origin of the product and its ultimate consumption. Risks for food companies are increasing with the complexity of the supply chain because of specific characteristics of short shelf life products. Nominal shelf life set by codes of practice and legislation tend to limit non-frozen meat products to 63 days from date of slaughter. Dependent on the deterioration rate, surface trimming may occur and repackaging in-store in order to improve the appearance of the meat. Depending on the complexity of the organization, and the investment in quality control procedures, samples may be taken to verify absence of microbes and excessive bacteria. The Food and Drug Administration in the US specifies permissible dirt levels on food.

The agribusiness sector is a very specific. Product quality deteriorates over time. Slowing the degradation process requires continuous controlled temperature environments for loose and packaged goods. Storing meat is required to overcome the influence of unpredictable weather, uncertain product tonnage and sporadic delivery, quality variations and high number of product variants (Kantor et al., 1997; Töyrylä, 1999; Bubny, 2000; Raman et al., 2001; Schiefer, 2003). Theses characteristics affect every actor of “the traditional food supply chain [that typically] is arranged as a complex array of producers, handlers, processors, manufacturers, distributors, and retailers” (Buhr, 2003). Shulman (2001) and Dilger (2000) considered that fresh products “present some of the biggest challenges for supply chain management”. Schiefer (2003) described the structure of this sector as a composition of “multiple small companies, at the beginning of the chain, who are facing highly concentrated globally-acting companies at the other end of the chain.”

Rábade and Alfaro (2006) assert food products “must be free of any kind of hazards for consumers' health. The increasing importance of food safety has made traceability a crucial issue in the agri-business industry”. Michael McCain, President and CEO of Maple Leaf Foods Inc., a major Canadian pork and poultry processor, referred to traceability as the “holy grail of the food supply chain”.

Defining Traceability

Traceability manifests in multiple roles and functions. It covers a wide range of applications. Traceability is subject to divergent interpretations in literature. ISO 9000 (2000) defines traceability as:

"ability to trace the history, application or location of that which is under consideration. When considering product(s), traceability can relate to

— the origin of materials and parts,
— the processing history, and
— the distribution and location of the product after delivery." (page 12).

A variety of other definitions are proposed in various sources that emphasize different aspects of traceability.

Cheng and Simmons (1994) developed the idea that two forms of traceability coexist: status traceability that "provides knowledge of the current situation" and performance traceability that "compares achievements with plans".

Then, several authors, such as Meuwisen et al. (2004) and Schwagele (2005) contrast the concepts of tracing and tracking. They cite Kim et al. (1995) "the ability to trace both products and activities as core entities in the food supply chain" and Moe's (1998) definition of tracking: "the ability to monitor a product though the total food chain." In this regard, Golan et al. (2004) stressed that "traceability systems are record-keeping systems designed to track the flow of product or product attributes through the production process or supply chain." The distinction between tracing and tracking fits closely with the ex-post and ex-ante traceability concepts introduced by Hobbs (2004).

Sparling et al (2006) suggest ex-post traceability is "a latent capability used in the event of a food-safety or serious product problem to trace food back to the source so that affected products may be identified and withdrawn." Ex-post traceability they suggest "helps both in locating the source of a problem and in assigning liability". Hobbs (2004) by contrast defines ex-ante traceability as a tool that "provides a mechanism for quality verification by providing continuous tracking and reporting on the quality attributes of products moving along the supply chain." The author believes that ex-ante traceability "reduces information costs for customers arising from quality verification". Hobbs and Sanderson (2007) assert "a commonly accepted definition of the term traceability has yet to emerge".

ASLOG identify two forms of traceability:

- Downward traceability (DT). This enables management and sometimes the client, at each step of life cycle product, to monitor a batch or a product. Such data is chronological, detailing activities, who authorized and undertook these tasks and the status through to a finished good. DT focuses on logistical activities. The objective is to reduce cost and time during crises. It involves techniques such as bar coding and RFID to make it possible to locate products at any step in the supply chain.
- Upward traceability (UT) provides a review of each step of product life cycle, maintaining tracking data of batch histories and origin. Upward tracking creates from the product to processes, settings, operator and raw material batches. UT focuses on product quality assurance issues. The objective is to identify causes of quality problems, either upstream or downstream the supply chain and be able to solve problems quicker and at a lower cost. Precautionary product recalls can be initiated for goods produced from the same batches of the material and out of control production variation. Other recalls using the same database can be due to insufficiencies of a given design release.

Jansen-Vullers (2003) distinguishes active and passive traceability. Active traceability in this context is defined as the implication of "the usage of tracking information to optimize and control processes, something that must be seen as a tool to manage quality information

through the entire chain". This idea refers to efficiency maximization within the supply chain through optimum use of available information. By contrast, by the same author proposes passive traceability that is used to "provide visibility on item's disposition and location at all times".

Mandatory Regulations

Worldwide food markets recently have faced several safety issues and scandals. Doyle and Brannick (2003) reviewed cases of Bovine Spongiform Encephalopathy (BSE) and the killer bacterium E.Coli that caused the death of 22 senior citizens in Scotland. Hobbs (2003), analyzed cases of salmonella in eggs and chickens, genetically modified foods, growth hormones, antibiotics and contamination with other such dangerous substances as dioxins and benzene. According to Pouliot and Sumner (2008), "governments may impose mandatory traceability in order to enhance protection from epidemics or invasive species to facilitate regulation." To date, despite assurances from EU authorities that the UK beef stock has been clear for several years, French authorities prohibit the landing of British beef for sale in France.

Consumers realized that food can represent a threat to their own health (Meuwissen, 2004), and as a consequence can loose confidence on producers and retailers. Increased consumers' awareness and changed attitudes inevitably would impact on markets. Souza-Monteiro and Caswell (2004) stressed that "traceability alone does not contribute to higher levels of safety or other quality attributes". Viaene and Verbeke (1998) agree with the above mentioned authors when they assured that "traceability itself is not a guarantee of anything in particular, but can provide the means through which specific attributes are supplied". Given their increased awareness, consumers at the moment seem to mistrust and be more reluctant to buy perishable animal food products. Gracia and Zeballos (2005) stressed that "the European beef market suffered an important crisis because of the BSE outbreak". As a consequence, public policy initiatives undertaken by countries authorities have emerged (Hobbs, 2003) to remedy the situation and modernize measures for food security.

Legislation and edicts from the European Parliament include VO (EC) Nr. 178/2002. This is commonly called the "Food law". The text stipulates:

> *"The traceability of food, feed, food-producing animals, and any other substance intended to be, or expected to be, incorporated into a food or feed shall be established at all stages of production, processing and distribution."*

Traceability therefore is mandated by the European Union. This law sits beside the REACH legislation, that mandates that corporations must undertake an extensive analysis of all compounds they use more than one metric tonne per year.

Every actor of any food supply chain shall be responsible for providing an effective traceability system and, in case of food safety, must be able to identify the relevant product and its components. Article 18 of the "Food Law" requires that traceability systems enable food companies to precisely recall targeted products. Product recall should be done expediently with the aid of an effective traceability identification and status database. The food law explicitly specifies conditions that trigger producers' obligations to inform consumers or official inspectors.

The Food Law proposes the adoption of a reactive strategy when detecting a potential. A company that does not signal a risk to competent authorities could be at fault, even if some doubts about the relevance of the risk or its consequences had been raised.
Each member state is subject to the Food Law. Each national government's objective is to protect their citizens. The law covers:

- Food products and any substance to be incorporated with them (additives, flavorings, etc…)
- Animals feed and any substance to be incorporated with them (bulking agents, binders, stabilizers, acidity regulators, additives, flavorings, etc…)
- Animals rears or destined for human consumption

Food categories exempt from obligations to enforce traceability are plants before harvest, seeds, residuals, phytosanitary products or materials designed to bind or package that are in contact with food products.
The act concerns actors at each stage of the food supply chain from primary production (animals yielding food products, harvest, stock breeding, milking cows,) and import or export collection and distribution via any form of transportation; and the production, manufacturing and transformation of animal feeds. Their obligations include:

- The capacity to identify providers and clients
- The availability of systems and procedures that yield, distribute and analyze information, and to provide authorities access to this data when requested
- Labeling food products and animal feed to facilitate traceability. Labeling is an integral part of traceability and an essential tool for traceability.

The "Food Law" does not require best endeavor but performance obligation. Every actor has the entire responsibility to decide which traceability system is implemented according to economical risks and constraints. The critical criterion is to provide information on traceability, regardless of how. Traceability techniques and solutions to use are not imposed by the law text. The objective of European initiatives is to "allow the flow of product information through-out the supply chain from farmer to consumer" (Gracia and Zeballos, 2003).
For the beef market as a specific case, "the European Union has developed a system for identification and registration of cattle and a compulsory traceability and labeling system that allows the flow of product information through-out the supply chain from farmer to consumer" (Gracia and Zeballos, 2005). This regulation is composed by three aspects:

- "Each Member State will have national cattle identification and registration system.
- Beef products will be labeled with a traceability number identifying origin, including where the animals from which the meat was derived were born, reared, slaughtered and processed.
- The regulation introduces rules for voluntary labeling with additional information (for example, production information, animal welfare information, etc." (Hobbs, 2003)

Supply chain and logistics management

Traceability is core to controlled logistics. GS1 and EAN-UCC standards require actors to use identification tools and a normalized codification system, that should be read and understood by every actor of the food supply chain. International standards EAN, diffused in France by Gencod – EAN, propose already mature, available and industry adopted solutions to identify logistic units and automatically capture data.
Responding to their clients and partners rising specifications and expectations, transporters and logistics providers constantly must search for solutions to improve effectiveness of

logistics (reduce delays and costs, improve service quality, …). Operating in a perpetual context of competitiveness, logistics providers must improve their how-know about physical flows management and be at the cutting edge of technologies. Real time data became a priority: access to stock levels, control of orders preparation, traceability of transit operations and expeditions, and proof of delivery.
In the transportation field, traceability systems are more and more used by professionals because they enable to work in just-in-time: no stock. IT programs for geographic localization contribute to optimize the preparation and the traceability of expeditions, while others have the function to control the quality. To know about the stock-level, many solutions are used: bar-codes, RFID, or even stocking software. Goals include:

- Merchandise loading control
- Bulking tracking
- Pre-invoicing of transport
- Reception of merchandises from providers
- Orders preparation
- Stock level management

Authentication technologies

To get an access to markets, counterfeited products must satisfy similar characteristics of originals (computers, mobile phones, etc). Counterfeiting is no longer synonymous with cheap and badly made copies of the original product. The high quality of some counterfeited products to day makes it very difficult to detect them. With increased globalization of commercial exchanges, extensive multi-location outsourcing and relocation of production centers, that current subcontractors may become future counterfeiters.
The proof of authenticity of a product sold under a brand or a label only can be brought by a tracer linked to the product and associated to the brand itself. Verification tests on products, such as currency water marks, special materials and secret process technologies can be used to increase confidence the product is genuine. RFID technology is another technology currently being trialed.

Empirical Data

Pilot Interview 1 – Organizer of the 2008 " Pôle Traçabilité " conference

A pilot interview was held during the 2008 " Pôle Traçabilité " conference that yielded a global vision of traceability through explanations of a neutral actor within the food supply chain.
The first motivation to implement traceability systems is the recent European regulations mandate traceability at every step of food supply chains "from farm to fork". However, the law does not specify which systems should be adopted, it only requires the capability to track and identify any product when required.
Many companies, especially the micro and small ones, comply with traceability regulations while using only paper-based information. Concerns were raised these is definitely are highly risky in terms of mistakes and slow response when to tracing back through processes and identifying other complications. The Food Law stipulates there need only be one person in charge of traceability concerns within the company. In such cases, the system may be rather subjectively structured and if that person is absent, traceability may not be consistently managed.

Bar Codes
Bar-codes technology is the most used system to for identify product. Even if scanning problems of are encountered, it remains an easy to use, economic and relatively reliable solution.

RFID
RFID can be used to access record information dynamically. In opposition of bar-codes, RFID technology identifies individual products. This can provide real time identification of products and enables can enhance stock management efficiency. Managers are able to exactly determine which products are available and where they are located in the warehouse or in display. Human intervention is minimized so potential errors as well. In this case, the control of the cool chain is not the priority; RFID enables a maximal efficiency in logistics.

Pilot Interview 2 A Family Butcher
A small local butcher was interview. The main motivation for efficient traceability from the butcher's point of view is the client's needs and well being.
Traceability was seen as 'true providence', knowing and relaying to customers the origin of the animal, its country of birth, breading, rearing and non-animal stressing slaughtering procedures. The goal of this seemed to be to restore client and general consumer confidence after the BSE crisis. This problem was perceived to be the fault of a few cost cutting supermarkets and rogue butchers that sold dairy cows as meat cows that had previously been fed with uncertified low price bone meal that increased operating margins. All actors in the bovine sector as a consequence have been the stigmatization. This is seen as the primary reason why consumption of bovine meat has decreased in recent years.
Butchers typically rely on the batch number and individual animal as traceability data. The butcher should be able to inform his clients, to guarantee the origin and an optimal quality. The butcher is the last step of the food supply chain so he is directly confronted to the clients and will be the first victim of bad traceability. However, traceability for a butcher is very simple, it is only paper-based, delivery notes and other documents are kept in binders and no information systems are used.

Detailed Case Analysis
Case 1: Stock breeder

Mr Max Gonon is a French stock breeder. He owns four bulls, three of which are "charolais" and a "limousin". These are available for favors on other farms. His herd consists of sixty cows. Allowing the animals to conceive naturally, most calve once per year, with approximately 50/50 gender split. Males become young beefers and are slaughtered at 18 months old. Females are kept until 30 they are months old; 15 of them are used for meat and other 15 for reproduction. Mr. Gonon B2B sells only livestock for meat; he does not operate a dairy. He works about 100 hectares, 10 of which are dedicated to cereals or maize, 30 to hay, and 60 are pastures. Supplementary cereals and maize that are not GMO products are bought locally from known sources.

Business and Traceability Objectives:

The primary role of a stock breeder is to produce product. Traceability is important for hygiene and health issues. Traceability enables a faster detection of eventual problems, and authorities can react on time in case of safety issues. Traceability enables to detect sick animals and contaminated ingredients, and to quickly find the responsible.
Traceability is for the interest of consumers to give them information about which quality they consume.

Solutions:

Mr Gonon considers that regulations for traceability are stricter in France than in most European countries.
Four days after the animal is born, an ear tag is affixed. These tags are supplied by the regional "Groupement de Défense Sanitaire". Each ear tag has a unique twelve digit number to identify the animal from birth to table.
A blood sample is taken from each animal once a year to verify the absence of foot and mouth disease, tuberculosis and brucellosis (Bang disease, undulant fever, Malta or Mediteranean disease).
Mr Gonon seems not unduly worried about cattle feed traceability. Some paper documents are archived in files, but this is not very organized nor followed up.
Mr Gonon relies on is a trust based relationship. His clients understand his working methods and are kept informed about his products. When selling, approached butchers seem interested to buy them. For Mr Gonon, everything stems from relationships. He prefers to work autonomously and to feel free to select and turn down clients.

Problems:

Quality labels: Animals are not "quality labeled" because the main client, Bigard Distribution, does not require them. To be associated to any quality label implies too many constraints while comporting relatively little benefit. The label requires documents (delivery notes for instance) about every single ingredient to be archived. A specialist auditor must visit the farm and control production. The stock breeder must comply with standards for buildings, water quality, feed ingredients and product specifications that are required by the quality label organization. This all add fixed and variable costs that squeeze margins.
Should this stock breeder one day have no choice but doing business with major outlets that require the quality label, he indicated he will then adapt his practices and plant. At present, according to him, investing would unbalance the status quo of existing business relationships. Working with autocratic central purchasing departments and material controllers would have the effect to move from collaboration to power struggles. In addition, animals would be transported further and for longer, causing loss of weight, thus lost revenue. Mr Gonon aims to avoid animal stress incurred by transportation conditions, since he believes this would result in lower meat quality. He prefers to sell limited quantities locally, at a premium, rather than industrial scale with less attention paid to animal and client.
A current problem is economic situation - it is difficult to sell. Gross demand for meat consumption reduced because the product is too expensive and cheaper alternatives are available from Brazil and Argentina. The owner stressed as well that people prefer to eat in a fast food instead of cooking a steak.

Mr Gonon only feeds his herd with vegetable derived feeds. He feels non-ethical stock breeders are a big issue. BSE, for instance, was at the origin of dishonest farmers who used feedstuff that included animal products.

Case 2: Bigard Distribution

Bigard Distribution is a subsidiary of Bigard Group, the largest French meat manufacturer. Founded in 1974, this group owns abattoirs, meat processing and prepared food manufacturing plants. Bigard Group produces beef, lamb, pork and veal and are distributed to major outlets and butchers. Annual tonnage for the group in 2008 was about 530k. The group turnover in 2008 was about €2.5 billion. Bigard Distribution principally is a distributor. Its main clients are butchers and major outlets. The workforce is more than 10 000 strong, of which 84% production, 7% sales and 9% are management. Since the beginng of 2007, Bigard Goup has owned 100% of Charal group, a popular prepared meat product producer.

Business and Traceability Objectives:

Traceability principally aims to protect consumers. Rapid identification of a problematic batch can prevent, or reduce risks of, contamination. Traceability is not a quality assurance in itself. The data recording, analysis and product status reports enable corporations to detect and solve problems more efficiently. This information can be public: consumers would like and should know the origin and the quality of what they buy.

Solutions:

Labeling is one solution to prove quality reassurance to consumers. According to Mr. Ruard of Bigard Distribution, even if slaughtering is considered as the most risky step along the bovine meat supply chain, consequences are rare. However, precautions are taken and all the process is followed and certified by veterinaries.

The process is the following:

- There is a **pre-mortem control** of all animals.
- **Labeling certificates and delivery notes are controlled**.
- The passport (**DAB) and the barcode number on the ear tag of the animal must match**.
- A **slaughter number is attributed** to the animal defining its position of entrance in the slaughter house (internal traceability).
- **DAB information is computerized**
- The animal is despatched
- **Offal is marked or bagged with the slaught number.**
- There is a **post-mortem control** to verify for glandular disorders and signs of disease
- The carcass is halved or quartered.

- **Carcass is stamped from the EU**
- **A EUROP stamp shows the killing number and certifies the carcuss is in conformity**.

A slaughterhouse card including DAB, EUROP and weight information is printed and affixed to the carcass. They then are transported to the client.
IT systems store and transfer high amount of information and makes the control of animal passports more efficient as well.

Problems:

The slaughterhouse is **IT equipped.** The biggest problem in slaughterhouses is that information is manually transferred to the computer database. Abattoir data is not as difficult to trace as processed food plants, because there are fewer goods going in and out. Hamburgers made from meat of different batches by contrast are much more complicated to trace than carcasses.

Case 3: Charal

Charal Group is the French brand leader of processed beef products, supplying annually in excess of 225k tonnes. They have a workforce about 3 000 employees, of which 500 are professional butchers. Charal's turnover exceeded one billion euros in 2008. Daily slaughter in 2008 averaged 7000 cattles, 12000 porcines and 1000 ovines (sheep). Daily capacity for boning averaged 30 000 quarters and production of elaborated products at 1 700 tons (800 chilled and 900 frozen). The quality director of the group Mr. Bernard Collin was interviewed.
The authors of this article wish to thank Madame Eloit, General Deputy Director of the French Ministry of Agriculture and Fishing for facilitating this contact.

Business and Traceability Objectives:

The primary concern of Charal is consumers' satisfaction. Implementing traceability systems was motivated by an objective to have full transparency with consumers. Charal informs consumers about meat origin through strict traceability procedures. The French group considers traceability as a direct component of quality assurance.
Traceability systems try to avoid hygiene and contamination risks. The ability to identify and recall non-compliant products is essential. Charal sells products through 3000 sales points every day. Rapid reaction is needed in the event of safety issues. In fifteen minutes, the system can trace any batch. Sick or unsatisfied clients can report the batch number. Charal is then able to track it back from the market. Traceability systems then can identify from every pack of steak which animal provided the meat, their slaughter day, which butcher produced cuts, where and when packed.
A significant guiding principle of Charal's traceability is precaution: "If there are reasons to think that… then there is the need to act". It is important to make the difference between a "removal" that happens between professionals, products are blocked in warehouses and a "recall" that happens at consumers level through media or public display. The Quality director of Charal mentioned brand protection as a key safeguard to secure employment of 3000 associates in their supply chain.

Traceability implementation is complex in the beef industry because it dismantles individual animals to produce many parts. The automotive industry assembles components to produce an automobile. Engines may be transferred from one vehicle to another. Authorities must be informed of these changes. Temperature-controlled products have specific constraints and must be available on display as soon as possible. Efficient traceability helps to improve supply chain logistics management, particularly if products are transferred across borders.

Solutions

The beef sector is already very regulated by European governments. Charal judged it important to place further control requirements on their supply chain:

- The riskiest step is slaughtering. Charal has not outsourced this activity. They decided to own every slaughterhouse their meat comes from.
- The supply chain must be controlled as far up stream as possible. The selection of providers thus is very important. Charal considers a relationship of trust and respect with all of them is essential. A program of continuous improvement and effective communication with providers are essential to achieve anticipated results. Charal shares benefits of improvements with its providers. To identify opportunities to improve, more than 1000 audits per year are made of supplier' farms; respecting traceability specifications are checked by the veterinaries and technicians. A bonus is awarded to stock breeders that achieve the expected traceability level.
- Charal considers human issues are crucial to ensuring effective traceability. Working conditions are difficult (physical effort, cold rooms, blood and fat). Hence the group invested in training and communication with staff.
- Voluntary collective initiatives (i.e.: quality label "French bovine meat") have been led, especially after BSE crisis. Traceability through documentation (i.e.: DAB, etc) is managed in France by the government that delegates implementation to regional administrations. A national database ensures no two animals have the same number and barcode. Moreover:

    - **Timestamps are affixed on the carcasses by veterinary services that certify meat health and hygiene.**
    - **The slaughter number is added with ink on the carcass exterior**
    - **Barcodes on paper tags are affixed**

Problems:

Meat consumption has decreased as a consequence of food crisis such as BSE, E. Coli 157 and Salmonella, of high prices and also of lobbies against meat.

There is a lack of standardized bar-coding technology. For instance, a DAB bar-code is readable but does not provide entire information because standards are different according the geographic area in France. As a solution, Charal decided to scan DAB of each animal automatically via software that takes a picture of the document (image recognition). Then, data is transferred to a computer database. Their challenge in the future is to harmonize traceability tools and technologies across owned and franchise operations.

The lack of standardization for EDI systems. A harmonized nomenclature has being built by GS1 because computer specialists invent their own language / system / codifications and this makes communication very difficult along the same supply chain.
There is also the problem of lack of equipment installations at providers. Many stock breeders and slaughterhouses have no computers.
Counterfeiting. The solution used is to register patents, brand marks and appearance of products. Authentication traceability technologies are not used. Charal has solved previous problems via out of court agreements.
When done manually data capture is risky. The solution is to maximize computer hardware and bar codes implementation. However, too many slaughterhouses continue to capture data manually. Investment in equipment is not a priority, and franchise operators are reluctant to invest in systems.

Case 4: Butchery

Mr. Thierry Brondel has been the owner of a butchers store located in Meylan for more than twenty years.

Business and Traceability Objectives:

The principal motivation to have efficient traceability system stems from client interest to have full providence of the product. The long term aim has been to use traceability to help restore consumer' confidence after the BSE crisis.
Avoiding brand damage and image building depend on traceability efficiency. The butcher may better inform his clients, to guarantee the origin and optimal quality. The butcher is the last step of the food supply chain so he is directly confronted to the clients and would be the first victim of complaints.

Solutions:

Batch number is the main reference in terms of traceability
Quality labels may increase the consumers' confidence in the product they consume. They stimulate trust relationships between the butcher and his clients. As a matter of fact, some controls are conducted and some traceability data are required
Traceability for a butcher is very simple, it is only paper-based, delivery notes and other documents are kept in some files and **no computing equipment** is involved.

Problems:

BSE was very detrimental to the sector. Blame was attributed to a few dishonest supermarkets and butchers who sold dairy cows as meat cows fed with bone meal, in order to make more profits. A consequence of this bad practice was the stigmatization of all the actors of the bovine sector. This is the reason why consumption of bovine meat has decreased in last years.
To join a label, the butcher has to pay an annual subscription to an independent organism. That calls into question their objectivity.

Case 5: Carrefour

Carrefour Group was founded in 1959 in France. Turnover in 2008 was just less than €110 billion. More than 56% of the turnover was made outside France. The group is the second largest worldwide mass distributor/retailer after Wal-Mart and the largest in Europe. They have 15000 retail outlets in 33 countries. Carrefour employs more than 495 000 people. Franck Merveillot, manager for meat products of Carrefour Meylan was interviewed.

Business and Traceability Objectives:

Consumer' satisfaction is the priority.
To manage efficient recalls in the event of a food safety scare or issue. These systems were tested during 2008 when Soviba products were removed and recalled.

Solutions:

The meat department of each store is supplied every morning by slaughterhouses. Products arrive boned and vacuum packed. When products are delivered, data is transferred manually from the delivery note to the software:

- batch number
- best before date
- origin
- weight
- meat category (heifer, veal, cow, young bovine)
- breed (dairy cow, cow meat, etc.)
- slaughter house name, processing date, vetenerian's certificate number

Once data is captured on the computer, labels are printed. Then, the butchers cut the product in smaller cuts and joints of meat and repack. An employee matches labels and beef packs and labels the sales packs for check-out. A 10% margin of error is tolerated, even if in theory, initial weight of the meat vacuum pack and the sum of weights of cut pieces should be the same

Problems:

Bar-coding technology is not yet available across all outlets in Carrefour's chains because there is a **lack of standardization** between Carrefour and their providers. Every product has barcodes on it, and barcodes readers actually exist in Carrefour. However the information systems are not enabled to connect both together. Bar-coding is used in Carrefour but only once a Carrefour tag has been created.
Manual data capture creates many mistakes. Warnings relating to this were raised by Hammer and Champy (1993), who proposed to automate and obliterate opportunities for errors to be introduced.
Lack of training and discipline of a high number of employees in disparate companies comprising a supply chain can result in mistakes. Products are sometimes packed with

incorrect information due to inefficient coordination between butchers and packers. Batch numbers are affixed on wrong products. That then creates a stock level misbalance and potentially lost revenue if products are sold as cheaper cuts. Equally, the chain may be open to mis-direction and miss information charges brought privately or by trading standards. The system is not 100% reliable. Mistakes can not be avoided with so much human intervention. The human factor is definitely an issue. The system can allow an operator could valid his date of birth as best before date should he wish to do so!

Case 6: Stef-Tfe

Stef-Tfe is the largest French logistics service provider operating in the controlled temperature food product sector. In 2007, the group turnover was about €2 billion. Founded in 1920, Stef offers warehousing services for frozen products. Founded in 1964, Tfe offers transportation services for chilled products. The group is complemented by Tradimar, founded in 1974 that specializes in transporting seafood and frozen products. The director of logistics operations of Stef, Mr. Malfettes, was interviewed in Lyon, France.

Business and Traceability Objectives:

Traceability has been a European regulatory requirement since 2002. Companies must ensure that at any stage along the supply chain, any product including its origin, components and destination must be identifiable.
Limits: the law does not define the decree the type or mode of traceability to adopt.
Objectives are to respond to client expectations in terms of traceability solutions, and to recall products with errors of labeling (Best before date)

Solutions:

The product and its associated information must be virtually available in an information system. Ideally, all the information related to a product is available but every actor in the supply chain only transfers useful data (and stores internally the rest of data).
Limits: in practice, all the information for each meat pack can not be transferred to the next step of supply chain because it would be much too expensive in terms of physical support (network cables, optical fibers, etc.)
Solution: every actor transfers only a part of information along the supply chain. This partial data must be sufficient to track upward or downward the supply chain to reconstruct all the information. Generally, information is transferred through batch numbers or Serial Shipping Container Codes (SSCC). A SSCC has 18 numbers and is readable through barcodes.

Information systems:

- eRecall, eStock, eReport,

- ✓ **Tags that use the same standard**, from production to product end-of-life. It would enable any actor of the supply chain to easily identify and read information
- ✓ **Bar-coding** standardized on GS1

RFID is still too expensive for the food industry. Stef-Tfe investigated implementing RFID and concluded that the investment was not economic. Productivity gains from the difference of time spent between scanning each box's barcode and passing a pallet through a RFID gate are not meaningful. Ideally, there is a single RFID tag per SSCC. If the SSCC is the transport-box, there would be too many RFID tags. And if the SSCC is on the pallet, it would be ok for a single homogenous batch. If products of the same pallets are separated and sent to different clients, then it does not work.
Limits: May be limited to returning packaging.

Problems:

There are traceability breakdowns between the logistics service provider and the distributor because there is a lack of EDI systems between logistics provider's platforms, industrial organizations and distributors. Relationships sometimes have confrontational. Logistics providers that work with distributors are very close to them, while other logistics providers work very close with industrial organizations.
Key issues are:

- ✓ **Lack of technology standardization**
- ✓ **Lack of collaboration between supply chain partners**
- ✓ **Lack of willingness to improve traceability systems (even from large companies)**

Conclusion

The main ideas stressed in the literature review also were identified during the interviews, in particular the driving forces behind traceability i.e. complying with legal requirements, B2B client requirements, consumer awareness, risk management and supply chain optimization.
However, the central contribution of the empirical study shows, despite limits of this research, that motivations and solutions in terms of traceability depend in particular on two factors:

- The role and the positioning of each stakeholder within the supply chain: for instance, logistics service providers and distributors traceability requirements, issues and challenges are different from breeders and stock rearing. The ISO 9000 2000 series has three classes 9001, 9002 and 9003 that enable companies to adopt the standard that fits the nature of their business.
- The size of the company. Under a certain critical size, companies can not afford significant investments. Typically in micro and small companies, traceability solutions are reduced to the minimum necessary to be compliant with the law (i.e.: manual traceability). The small companies analyzed consider traceability merely as a legally imposed constraint or specification demanded by their customers.

The companies that directly face the final consumer mainly are motivated by "customer communication" aspects of traceability. Both Carrefour and the independent butcher are vastly different in size. Regardless of size, both companies are face-to-face with consumers and both use traceability as a marketing proposition to restore consumer' confidence. However, it is interesting to note that neither company exceeded the expected level of quality. The butcher's traceability system is paper-based. The Carrefour hypermarket under

investigation made many mistakes due to lack of technology standardization and training. It is not possible to make any final conclusion based on only two cases. The following question begs to be asked: Is there any risk that traceability might become simply just another marketing gimmick rather a system that truly provides transparency down to the final customer?

Motivation to manage risk is common to large corporations. The Charal and Carrefour cases are relevant illustrations. Two observations lead to this conclusion:

- Since they sell more references, risk control and monitoring are more difficult in large corporations. They work with more partners and local suppliers, and manage more flows of products than small and medium enterprises.
- The brand image can be at risk. If traceability activities and data are flawed or erroneous, financial consequences could be significant. This happened to Buffalo Grill when, in December 2002, the group imported bovine meat from England that was still under embargo.

The interview data suggests in small and medium size companies (stock breeder, slaughterhouse and independent butcher), safety risk is perceived as low, or even very low, because they are confident in their competencies. In effect, accountable individuals in those companies are convinced they have the whole process under control. Interview data indicated mandatory regulations were not identified as a central motivation to start and maintain traceability.

Every actor of the supply chain is aware of the "Food Law" that provides the reference framework. For large companies, factors such as customer satisfaction or risk management are more important driving forces to use traceability than the law itself. Logistics service providers are in a different position: their primary motivation is commercial. Their objective is to provide, at a competitive price, traceable services that meet their customer requirements (producers, distributors, etc).

Only Charal and Stef-Tfe interviewees mentioned supply chain optimization as a potential benefit of traceability. Among all analysed companies, these two companies face the most complex supply chain environment.

Use of advanced technology seems to be a function of company size and resources. There is a significant technology gap between small and medium companies on one hand, and large companies on the other hand. Small and medium enterprises (stock breeder, slaughterhouse and butcher) have limited investment capabilities. Traceability solutions in use with out without technology include:

Small and Medium Sized Enterprises:

- Manual solutions are preferred (paper-based traceability)
- Limited use of barcodes
- No (or basic) computing equipment
- Absence of EDI
- Limited or absent web-based information transmission

Large companies such as Charal and Stef-Tfe invested significantly in traceability systems using:

- Extensively bar-coding technology,
- Extensively EDI systems
- Experiments with RFID technology. :
- Matrix code readers

The objective of the companies was to optimize their supply chain management. Results are mixed: Stef-Tfe considers the investment in RFID technologies not to be worth while. Charal found RFID advantageous in one of their warehouse. That supports literature that asserts RFID is not always appropriated even for large companies.
Information collected through the cases analyzed relating to implementing traceability solutions problems were consistent with literature findings. Cost is definitively the principal inhibitor for small and medium companies.
The main obstacles met by the companies interviewed were human factors including change management and training issues, costs and standardization issues.
For bigger companies, traceability is considered at strategic corporate levels (Charal, Stef-Tfe). The question to pose for future research 'Is there sufficient management willingness and involvement to make all appropriate investments in terms of training and/or technology at operational level (Bigard slaughterhouses, Carrefour local outlet)?
As already stressed, the food supply chain structured is composed of a significant number of small companies upstream and large companies downstream. Furthermore, traceability practices depend on the size of companies and as a consequence are heterogeneous along the supply chain. That weakens the whole supply chain traceability performance because it depends on the quality and efficiency of every link.
This project concludes the role of traceability in the competitiveness of food companies can be made that it more relevant at an industry level than at company level.
Collaboration and supplier development between stakeholders are driving forces for traceability to become more efficient within the food supply chain.

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