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Product traceability in food-supply chains

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The European consumer has become increasingly concerned about the quality and safety of food products and the negative effects of bioindustrial production. This concern has been strengthened by several sector-wide crises in the last decade (such as the BSE crisis, the dioxin crisis and the classical swine fever in Europe). Consumers can find product recall announcements almost weekly in any newspaper. Governments, both national and international, respond by imposing new legislation and regulations. These developments will have an impact on the analytical community since food processors will require faster, cheaper, more sensitive and accurate real-time validated testing methods for food safety/quality assurance.

Recently, the council of ministers of the EU has adapted the 'General Food Law' (EU 178/2002). It serves as a steppingstone for future legislation on food safety. It aims to offer a high protection level to the European consumer and supports free trade between EU countries. Furthermore, it should lead to harmonisation of legislation within the EU by defining basic conditions and constraints for food legislation. One of the main instruments for guaranteeing food safety and reducing the size of a product recall is the "traceability" of food products. Traceability is defined as "the ability to document and trace a product (lot) forward and backward and its history through the whole, or part, of a production chain from harvest through transport, storage, processing, distribution and sales." With regard to product traceability, the General Food Law states that, as of January 1, 2005, companies must be able to identify the suppliers of its raw materials and the customers of its end-products on a transaction basis. Traceability allows the detailed monitoring of properties of food products as they are made and as they move through supply chains, thus allowing early warning for quality problems and hazards for the purpose of avoiding these problems and efficient product recall when needed.

Product traceability is of importance on a chain level, as well as on company level. On the company level, a system should provide information on the location of the product and on the history of the product (this also includes the product as process information). On the chain level, besides information on the location of products, information on the origin of the components is also of importance. In this regard, it is important to identify the current unique characteristics of product (component) lots and the historical relationship between lots. This leads to more transparency, which makes it possible to offer specific information to buyers and consumers. This again can play a major part in (re)gaining the trust of the consumer. Moreover, by sharing information between partners, information flows can

be better managed, thus resulting in lower costs and more flexibility throughout the chain. We notice that retailers also react by imposing new traceability demands on their suppliers via certification schemes.

To comply with the new demands, companies are forced to introduce more or less sophisticated information systems that focus on identification and registration and tracking and tracing capabilities. One of the basic questions companies have to deal with now regards what sort of traceability performance level to strive for in the near future. In our research, we identified three chain traceability strategies: compliance (complying with governmental rules), process improvement (improving performance by benchmarking), and branding (creating added value in the market). This decision has significant implications for the design of the supply chain and the requirements put on analytical methods.

Our analysis is based on the results of an international benchmark study of best practices regarding the use of information and communication technologies (ICT) to support the traceability of food products and guarantee food safety in The Netherlands, United Kingdom, Germany, Australia, Sweden, United States of America, and Spain. In each country, supply chains of meat products, dairy products, fruit and vegetables, and grains/bread were investigated (from feed supplier—via primary producer—processing industry and retail, to consumer). Additionally, multiple audits on traceability systems were done in the Dutch food industry to extend our findings. Some of the main findings were as follows:

- There is a huge "spread in traceability performances" in the supply chain. In many cases, companies still focus on their own business instead of the complete supply chain from farm to fork.
- Most food processors focus on prevention via quality assurance systems such as GMP, HACCP, ISO, etc. instead of traceability (as a curative measure). Although these systems do provide traceability of raw materials to suppliers at the generic level, full lot (forward and backward) traceability from farm to fork often requires additional measures (for example, the implementation of chain monitoring programmes). Recently a number of traceability requirements have been incorporated in assurance systems to comply with the General Food Law requirements (see, for example, ISO 22000).
- The market demand for traceability systems increases when the risk for food safety incidents increases and consumer's trust is at stake (or competitive advantage can be created).
- There are a number of best practices that have almost full traceability in the supply chain. These best practices usually are completely integrated firms or highly coordinated supply chains that comprise feed suppliers, farmers, processing firms and retail activities that have agreed on the use of specific standards and systems.
- The differences between chains are bigger than that between countries. Most traceability initiatives are found in the meat supply chain, mainly because of the recent incidents in these chains.
- There are only a few ICT applications specifically designed for traceability. In most cases traceability is established via the linking of existing registration systems.
- When traceability systems are in place, companies cannot always profit fully. When incidents occur, retailers often remove all articles from the shelves and not just the articles from the specific lot it concerns. Furthermore, incidents often lead to general import restrictions without doing justice to existing traceability systems.

In this presentation, we will discuss the conclusions of this benchmark study and present an overview of the bottlenecks and success factors regarding traceability in food-supply chains. Furthermore, we will evaluate the current state of traceability systems in food-supply chains and present steps on how to perform a traceability analysis. We state that the traditional risk assessment should be expanded by focussing not only on the potential for an occurrence of an incident and the severity of the incident, but also on the volume of an infected lot (which is determined by the lot segregation), and the reaction time (how fast one can identify the problem, isolate the infected lots and recall them). This will identify new critical control points which—when managed properly—will reduce the chance of a large product-recall volume. Based on their traceability strategy, companies should identify these critical control points, the optimal lot sizes and sampling regime in each stage of the supply, production and distribution process.

The following figures show the PowerPoint presentation illustrating the points made in this article and the presentation is available as Electronic Supplementary Material on the Web page.

Fig. 1, Fig. 2, Fig. 3, Fig. 4, Fig. 5. Fig. 6, Fig. 7, Fig. 8, Fig. 9, Fig. 10, Fig. 11, Fig. 12, Fig. 13, Fig. 14, Fig. 15, Fig. 16, Fig. 17, Fig. 18, Fig. 19, Fig. 20, Fig. 21.

Product Traceability in Food Supply Chains

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Fig. 1

Menu

- What is product traceability?
- Results international benchmark study
- Bottlenecks for traceability
- Actual situation and developments
- Performing a traceability analysis
- Concluding remarks

Fig. 2

General Food Law (EU 178/2002/art. 18)

- *"Food and feed business operators shall have in place **systems and procedures** to identify the other businesses to which their products have been supplied. This information shall be made available to the competent authorities on demand."*
- Ambiguous demands:
  - What are systems and procedures?
  - What kind of information should be made available?
  - When should the information be made available?
- Each country has its own interpretation of demands

Fig. 3

Proposed demands of the Dutch Food Safety Authority

A system for traceability that comprises the following elements:
- The (time of) goods received and their internal handling
- The processing
- The dispatch
- Analysis of the determining of lot sizes

Provide the following information on request *within 4 hours* in case of calamities:
- Determination of the **batch size** of the product involved
- Customers of a possibly affected lot
- Possible suppliers of any ingredients of an affected lot
- Amount and sort of the ingredients
- Production circumstances including rework and influence on other lots
- Possible cross contamination during transport

Fig. 4

EU Guidance Document General Food Law (1)

- Traceability is a risk management tool
- Required is one step back and one step forward approach
- Food contact materials are captured in new regulation (EU 1935/2004)
- The chain covers the importer/grower up to the retailer outlet
- Recommended are:
  - Internal traceability (link incoming and outgoing products & batch splitting/combinations)
  - Tracking and tracing at international trading partners
- Determination of the recall batch size is the responsibility of the company (they should be able to show a traceability analysis to the relevant authorities)
- Direct informing of food safety authority in case of food incident

Fig. 5

EU guidance document General Food Law (2)

- Information to be provided immediately:
  - Name, address of supplier, nature of products that are supplied
  - Name, address of customer, nature of products that is delivered
  - date of transaction / delivery
- Highly recommended information (as soon as reasonably practicable):
  - volume or quantity
  - batch number
  - more detailed description of the product (pre-packed, raw, bulk…)
- Information detail depends on type of business (risk assessment)
- Type of systems and procedures needed: related to the time needed to deliver fast and accurate information.
- Record keeping = Minimum (5 years, Best-Before-Date + 6 months)

Fig. 6

Traceability is …

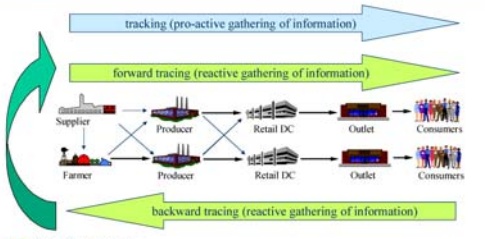

Fig. 7

Traceability is all about ...

- … deciding what performance level to strive for:
  - How fast can the tracing operation take place?
  - What is the tracing unit?
  - What is the maximum recall size that can be accepted?
- … knowing the wishes of your customers concerning food safety.
- … deciding on the lot segregation in your goods flow.
- … following lots through the process.

➢ Lot = a number of products (boxes, bags, pallets, ..) that have unique and homogeneous characteristics with a common history in process conditions.

Fig. 8

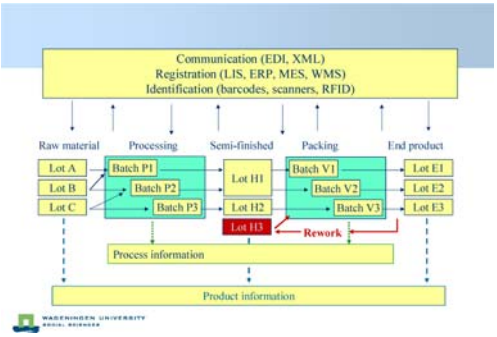

Fig. 9

Fig. 10

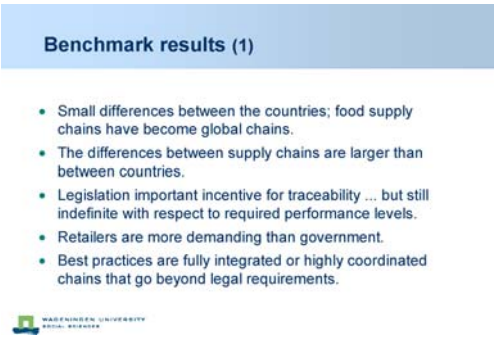

Fig. 11

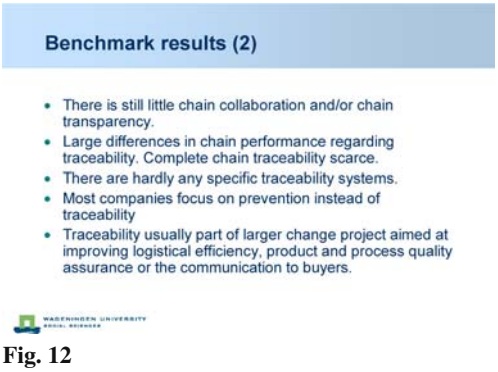

Fig. 12

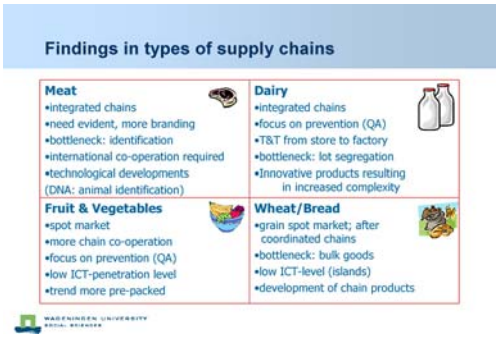

Fig. 13

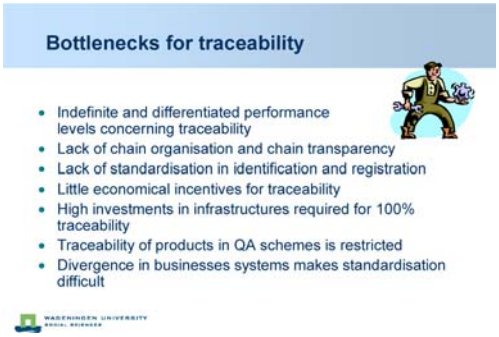

Fig. 14

Fig. 15

Fig. 16

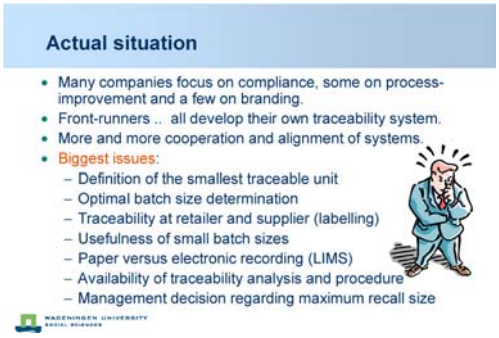

Fig. 17

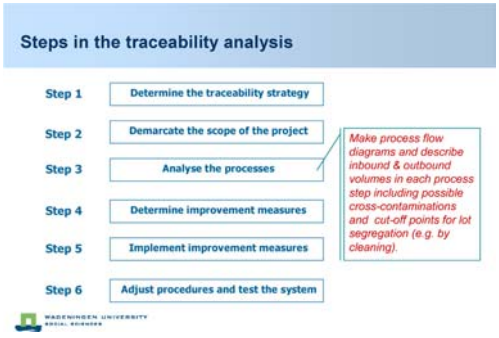

Fig. 18

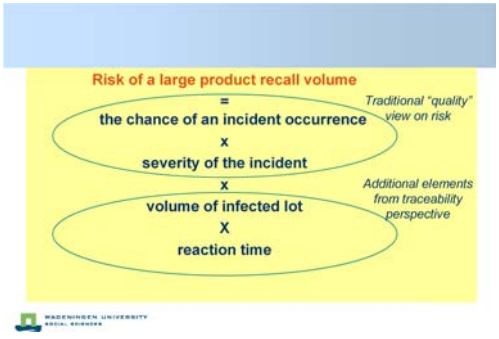

Fig. 19

Fig. 20

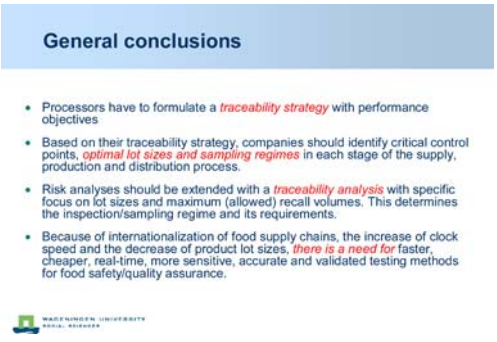

Fig. 21