

# State of the art of tracking and tracing in Dutch agribusiness

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## Abstract

*Tracking and tracing in Dutch agribusiness is evolving into an important instrument for producing food that can be trusted by consumers. Widespread concern about food safety has given a significant impulse to develop tracking and tracing systems in the meat sector. Early experiences by meat chains have leveled a path that other sectors can follow. Knowledge and infrastructure generated by the meat sector is now used by other sectors to facilitate the efficient and effective design and implementation of this complex type of information system.*

## 1 Introduction

At this very moment (summer 2002) a major activity of the ICT community in agribusiness concerns the issue of tracking and tracing (T&T) which requires a special category of information systems. The general feature of this type of information system is that they are dedicated to gather, process, and supply information on the history of product entities. Usually, products are produced and distributed by a 'chain' of activities carried out by a series of firms involved in transforming raw materials to products bought (and eaten) by consumers. Therefore, T&T-systems typically are inter-organizational information systems.

## 2 How it started - T&T and logistics

T&T is not a new concept. It has been used by many industries and emerged in the eighties and nineties as a tool in logistics. Supply chain managers, e.g. in automotives, were looking for ways to improve on efficiency by fine-tuning logistics. In order to reduce lead times and stocks, concepts like 'Just-in-Time' were evolved with the aim to get the right products to the right places at the right time. These approaches required more comprehensive information about the logistic flow of goods. T&T-systems are applied in this context to provide the required information about the location of physical entities at a certain time. Advanced logistic T&T is applied by companies that are striving for efficiency. Usually they are companies from many industries, including agribusiness, that exploit economies of scale and that handle large volumes of products.

## 3 T&T in Agribusiness – Extending functionality

In the late nineties Dutch agribusiness was confronted with several major food safety incidents (Dioxin in poultry, BSE) that resulted in a consumer attitude critical towards food. The government also became concerned about the safety of our food. Agribusiness companies reacted by implementing extensive food safety programs like e.g. HACCP. The food safety incidents also made clear to all involved, that the companies of a supply chain depend very closely on each other. All measures taken by one company can only be effective if its suppliers and clients also adopt similar measures. Also in response to the food safety incidents, product liability regulation was implemented and companies now need to know more about the history of the products they are dealing with. Agribusiness companies nowadays have to prove to consumers that their products are safe and faultless.

T&T-systems are designed to provide information about individual product units. In early versions of T&T, companies attempted to extend their logistic T&T-systems by food safety and quality control attributes. It soon became clear that this is impossible. The basic problem

is that in logistic T&T-systems, product units are used that are fundamentally different from product units required for T&T-systems that address food safety issues. The natural product entity in logistics is a transportable unit - a box, container, silo, truck, ship freight - no matter what is in the unit. All these logistics systems are designed for efficiency and therefore product batches and lots may become intermingled in the transport unit. Integrating food safety aspects in the existing logistic T&T-system therefore requires either a fundamental redesign of the information structure or a redesign of the logistics process, where some inefficiencies, e.g. from half-filled transport units, would have to be accepted.

T&T-systems designed to meet food safety objectives require significant investments and agribusiness companies try to employ them to also support their product differentiation efforts. At present, many initiatives are underway to differentiate food products by providing information about the product, or its production process, or both. New products like GMO-free, organic, environmentally friendly products, that are now entering the consumer market, are all differentiated by some information that is purposely attached to the product. Consumers normally have to pay some premium for these products and can expect that the information attached to the product is authentic and reliable. It is likely that most companies that are already investing in T&T-systems will integrate product differentiating information, thereby adding value to their T&T-systems.

#### **4 Tracking & Tracing basic architectures**

In developing T&T-systems two basic approaches can be recognized in practice. In the first approach, T&T is conceived as a *sequence of coupled information systems*. In this approach each company in the supply chain has to link its information system to the information systems of its suppliers and clients. Product shipments then trigger a transfer of information about the products from the shippers' information system to the information system of the receiver. Basically, this is implemented as an advanced (internet based) version of the EDI- or PDI-systems (Product Data Interchange). Product information is separated from the product itself but flows through the same supply chain as the physical product.

A *central database* is the basis of the other approach to developing a T&T-system. Each agent in the supply chain sends the information about its products to a central database from where the history of each product unit can be retrieved. However, this approach is still in an early phase of development and has not yet been implemented. Nevertheless, the central database concept seems to be the most promising at this moment.

From an organizational point of view the central database approach may be implemented in several ways. For example, in a vertically integrated supply chain the leading company may develop and operate the central database. Any company that does business with the integrator is then obliged to send all product information to the database. Alternatively, if agents in the supply chain are concerned about their information autonomy, the central database may be operated by an independent trusted third party (TTP). This trusted database operator would then charge the agents in the supply chain for each bit of information that is sent to or retrieved from the central database. Interestingly, one of the leading TTP in this area is the former Dutch Governmental Computer Center that has been privatized and is now trying to develop business in the area of massive data exchange.

#### **5 Current situation in the sectors**

Looking at the situation concerning T&T in Dutch agribusiness three different sectors have to be distinguished: meat, plant products, and processed food.

## **Meat**

The meat sector (beef, pork, and poultry) in the Netherlands has experienced severe food safety problems that have added to the urgency to implement T&T-systems. The dominant opinion in the meat sector now is that T&T with a high level of performance is an absolute prerequisite to stay in business. Furthermore, the Dutch government is expected to introduce stringent T&T-requirements so that in 2004 every piece of meat in the supermarket has to be traceable to the farm where the animal was kept. If government does not make this obligatory, the expectation is that retailers and food service industry will only do business with suppliers that can guarantee traceability of their products.

At present, i.e. in summer 2002, the large integrators of the Dutch meat industry are developing chain-wide T&T-systems that will probably be implemented at the end of 2002. Currently, the debate is focused on determining the best 'granularity' of T&T-systems, i.e. should meat products be traceable to the farm of origin, to a group of animals, or to the individual animal? The main concern in this discussion is to optimize the cost of product recalls. This requires that a balance is struck between (i) the additional costs of tracing smaller product units, (ii) the risk that a safety incident occurs, and (iii) the costs related to the size of the batch that has to be recalled in the case of a safety incident. However, sympathy is growing for the argument that cost optimization is a 'penny' concern in comparison with the 'pounds' of costs involved in losing one's good reputation and consumer image. From the latter point of view, optimal transparency and not optimal costs of recalls is the objective. Optimal transparency would require the identification of the smallest relevant product unit, e.g. the individual cow, or pig, or the clutch of chicken that share the same feedstuff, water, climate, and medical treatment. Because the costs and benefits of T&T are not equally distributed among the agents of the meat chain, agents have different views of the cost vs. transparency optimization issue. On-going research on the factors determining the optimal level of traceability and on methods for distribution of costs and benefits will soon shed more light on this issue.

Until now progress in implementing T&T in the meat chain has involved only Dutch companies and is limited to the domestic section of the meat chain in the Netherlands. Extending T&T to meat imports and exports is a challenge for the future.

## **Plant products**

Safety issues related to plant products – vegetables, potatoes, sugar, etc. - are not as serious as those related to meat products and T&T in the plant products sector is mainly stimulated by product differentiation objectives. Organic produce, GMO-free products, and environmentally sustainable products are emerging and the added value of these differentiated products is largely based on the information about their production processes. For such products T&T can be a useful instrument for guaranteeing authenticity of product information. The main obstacle to T&T here is to find a distribution of the significant T&T investment costs, risks, and benefits that is acceptable to all agents of the plant products chain. However, this sector has several alternatives available for T&T, such as labeling and certification of products, or directing the flow of plant product through dedicated marketing channels.

By and large, the main purpose of T&T-systems in the plant products chain was and still is to facilitate logistics, especially the logistics of fresh produce. So far no urgency to implement more advanced T&T systems could be observed. However, companies expect that food safety issues may also invade the vegetable products sector and they have begun to develop T&T-systems that address food safety and quality concerns. It is probably fair to say that the plant products sector is carefully observing what happens with T&T in the meat sector and that good practices from the meat chain will soon be adopted by the plant products chain.

### **Food processing industry**

Food safety is absolutely a top priority issue in the food processing industry. Implementing chain-wide T&T in this industry is, however, extremely complex. Products are composed of different raw materials from different supply chains, main products, additives, by-products, and surplus products, some of which may have been imported from all over the world. Complex, heterogeneous inputs make T&T from the consumer back to the farm very difficult. Nevertheless, T&T-systems are implemented in the food processor-retailer segment of the supply chain where implementation is facilitated by a clear definition of product units.

Although the Dutch food-processing industry has proven recall capabilities and a good performance record with regard to product recalls, for food safety purposes the industry relies on other instruments than T&T. Advanced quality control systems preventing hazardous raw materials or other obnoxious materials from being processed. The exact history of the product is of no concern as the system assures that all relevant product attributes fall within certain tolerances. Because differences in attributes between product units are ignored by this approach, the food processing industry is extremely reluctant to introduce products differentiated by their production processes, such as organic or GMO-free food.

## **6 Infrastructure for Tracking & Tracing**

Looking at the different initiatives for implementing T&T in Dutch agribusiness some observations on the requisite T&T infrastructure can be made. For successful application of T&T in a supply chain, the T&T-system must address several concerns and issues:

1. Organization: T&T-systems are by nature crossing the borders of organizations. This implies that a certain degree in organizational structure is necessary. Companies have to have a degree of willingness to cooperate with each other. Therefore, companies throughout the chain must share a common goal.
2. Technology: Physical connections and communication standards used to be the key problems 10 years ago. Thanks to 'Bill Gates' this has become a minor problem. Most of the T&T applications nowadays are Internet based. However, connecting all the way to the farm sometimes is a problem. In practice, we have observed projects where arrangements had to be made for getting a PC with an internet connection to the farm.
3. Reference models: For exchanging data a mutual understanding of the definitions of entities and attributes is absolutely necessary. Especially in cases where one agent is entering data that should be used at another place in the chain, incompatible data definitions are a source of error. When inter-organizational information systems integrate the systems of individual chain operators, adjustments of the individual systems are usually necessary. Of course, in the opinion of any one chain agent it is always the other agent that should do the adjusting. Neutral information models are available that help to solve such standardization problems and there is a public interest in making them available. In Dutch agribusiness the EAN standards are often used but the 'branch information model' developed in the late eighties is also employed.
4. Information system development methods: T&T is a special category of information systems. A central issue in the design of T&T-systems is which product unit or entity to select as a key entity. Along the supply chain this entity is repeatedly split up and combined with other entities. There is a general solution around concepts like 'bill of batches' that is relevant for every T&T-system and interesting research on this issues is in progress. Another aspect that can be dealt with methodically is the integrating into T&T-systems of the existing information systems of chain members. Interfaces

between local and central systems are generic by nature and in each specific solution a generic part can be identified and used in other situations.

In Dutch agribusiness several major programs funded by the Dutch government support the transfer among individual T&T-projects of experiences, knowledge, and tools. In a typical co-innovation project for supply chain development three companies from different stages in the chain, with at least one being a retailer, are developing a chain instrument, e.g. a T&T-system. The companies are supported by knowledge institutes, i.e. research institutes or universities, that facilitate the innovation by bringing in research and knowledge from other projects. In this way a significant body of knowledge about chain development has been accumulated in the Netherlands over the last eight years. This knowledge infrastructure has proven to be a strong enabler for developing T&T-systems in Dutch agribusiness.

## **7 Tracking and Tracing as a strategic competence**

After considering T&T as means to optimize logistic performance and to deal with the issue of food safety, the view currently held by many Dutch agribusiness companies is that T&T will be a strategic instrument in worldwide competition. Consumers will be more and more suspicious and demanding with respect to their food. Instead of dealing with every single food safety issue that pops up on the public agenda, companies are now working strategically on a food system that is transparent. Food is a complex product and everyone is or ought to be aware that something can go wrong along the long and winding chain from the farm to the fork. It is important that consumers and the public have the confidence that the agro-food industry knows what it is doing and is able to communicate effectively with consumers and the public at large. Being trusted by consumers will be the decisive competitive advantage for the coming decades and T&T thus will be the strategic instrument for building and maintaining trustworthiness.