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## **Tracking and Tracing in Food Networks: The Case of the Feed Industry**

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## Tracking and Tracing in Food Networks: The Case of the Feed Industry

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### Abstract

This paper discusses an organisational framework for Tracking & Tracing and quality management in the agriculture and food network and thus providing increased transparency therein. The legal and market environments that especially European companies of the compound feeds sector face today is being analyzed with respect to resulting recent and present requirements. A technological solution for companies and supply chains that helps dealing with these requirements is presented with an organisational glance inside the QM-G system.

**Keywords:** *Tracking & Tracing, Feed Industry, Inter-Organizational Information System QM-G*

### Introduction

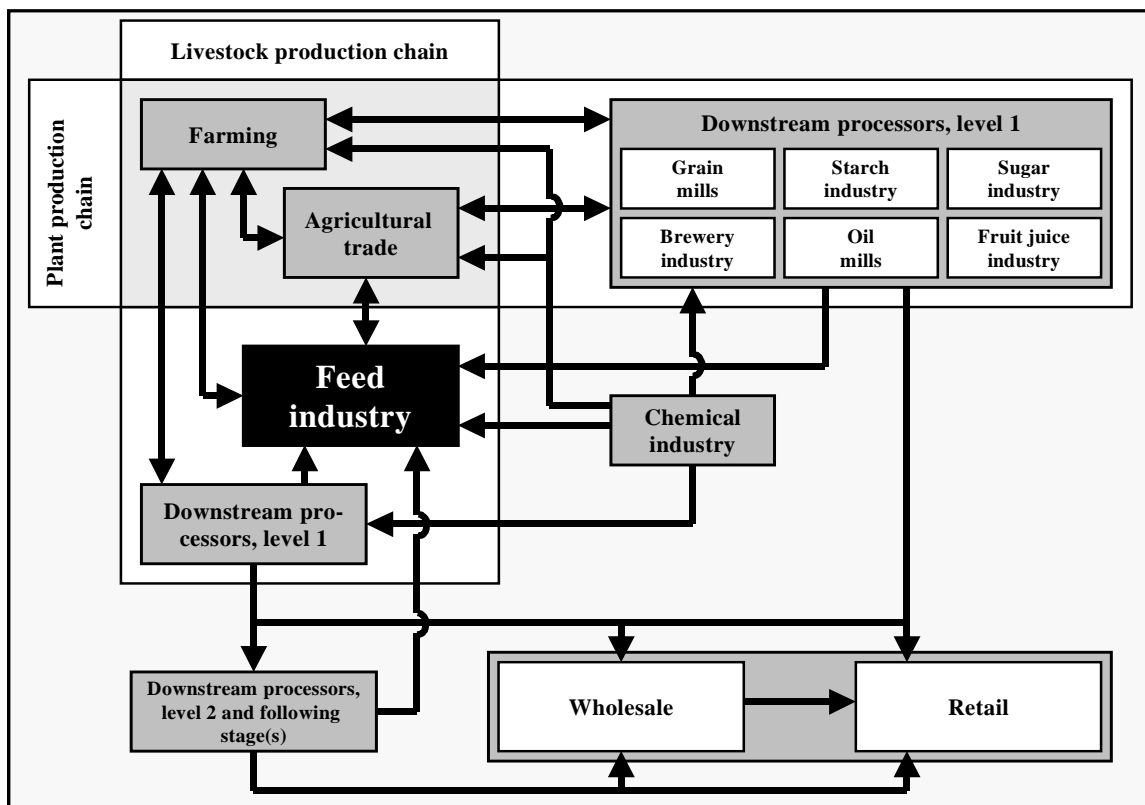
The companies in the feed industry are confronted with a wide variety of demands requiring them to ensure safety, hygiene and quality of their products. These demands originate from various sectors, such as

- **legislation:** traceability in accordance with the Regulation (REG) (EC) No. 178/2002, labelling and traceability of genetically modified organisms (GMO) and of foods and feeds made from GMO in accordance with the Regulations (EC) No. 1829/2003, 1830/2003 and 65/2004, the Regulation on maximum mycotoxin levels, as well as stricter reporting/notification obligations,
- **market environment:** demands resulting from general quality systems/standards such as HACCP, GMP+, GMP13, EUREPGAP, Q+S, KAT and others, and
- **specific requirements of individual customers** regarding documentation, supplier audits, retain sampling etc.

Despite the varying degrees of voluntariness, the requirements and quality initiatives outlined here have one common objective: to bring the compound feed industry and the food industry together in an integrated network to improve quality guarantees. The integration proceeds along two different avenues here. On one hand, feeds are understood to be the starting point for producing foods of animal provenance. In this light feed companies can be considered as a link in the food chain. On the other hand, food companies that circulate by-products for feed production, e.g. grain mills, will also be treated as feed businesses by the corresponding legal

obligations in future. Thus, different hygiene handling of main products and by-products in food enterprises is to be counteracted. The resulting position of food and feed production on the same level promotes comparable quality assurance throughout the network of production, processing and transport.

The feed industry assumes a central position within this network due to its large number of exchange relations with farm producers and trading companies, as well as with businesses in the food and additives industry (partially in the form of procurement/distribution loops; see Figure 1).



**Figure 1.** The Business-to-Business Food-Feed Network

The exchange relations are not only restricted to the pure flow of goods. The requirements stated above include the documentation and exchange of quality-related and logistic-oriented information as a fundamental principle. Neither documentation nor the exchange of information between compound feed producers and their suppliers or customers are new developments. While demands concerning in-house and cross-company information management increase, communication processes and traditionally used media for this purpose rapidly reach their limits. In particular the heterogeneous landscape of electronic data processing in the agribusiness represents a barrier to bringing relevant quality information together in accordance with changing requirements. Existing electronic data processing systems are generally isolated solutions. This leads to a large number of information gaps, multiple data recording within and between companies is common.

The system concept “QM-G”, which has been developed at the Chair of Business Management, Organization and Information Management (see [www.qm-g.de](http://www.qm-g.de)), addresses this problem complex in two steps. The first consists of building “information tracks” between companies of the different stages. In the second step a wide variety of information can be transferred between companies by using this “rail network”. The system thus adapts to the needs of the participating companies or to entire supplier-customer networks, and not vice versa.

### **Inter-organizational information system “QM-G”: implementation of current requirements**

The topmost goal of the project work was the development and implementation of the system based on practical experience. Development goes on to further enhance the QM-G System. That is why the research group sought intensive discussion with companies, trade associations and institutions in the food and feed industry from the very start. The focus of the first project phase was the grain sector, including its by-products (Poignée, Hannus, 2003). In close cooperation with companies and chains in the grain industry, QM-G was rendered fit for use in practice.

The integration of the stages of farming, agricultural trade and mills, and follow-on projects in other production tracks (e.g. malt for breweries) realised in the QM-G project also represent the basis for adapting the system to the requirements of the compound feed industry. Consequently, considering just the interfaces of the feed companies with the existing QM-G core, a good 50 per cent of raw material procurement and almost the entire sales of the feed companies are already prepared in the system.

The remaining procurement channels of the firms can be incorporated in QM-G thanks to the system flexibility regarding the integration of company specific requirements at different network stages. This networking capability and the optional mapping of internal processes of the companies lay the foundation for satisfying current requirements of the feed industry.

Despite the complexity of the requirement profiles, it was ultimately possible to identify six core building blocks for the implementation. These represent the basic framework of QM-G:

- A system for tracking and tracing (T&T) including the management of retain samples
- Internal documentation, storage, administration, monitoring and cross-stage exchange of information about quality measures as a basis for certification, as quality evidence to customers, as the basis of company risk and crisis management, and for continuous improvement of the firms own processes
- Internal and cross-company, electronic document management
- A system for managing supplier and customer stocks – insight into raw material stocks and qualities of upstream or downstream stages as a basis for optimising procurement, production, sales as well as logistics
- Contract system with quality sample and logistics management – dynamic consideration of trade sequences
- Information module with flexible company-specific, horizontal and vertical evaluations for consulting services.

## Tracking & Tracing as a foundation system for quality

Current demands regarding T&T and the handling of reset samples require compound feed companies to build up systems that allow swift identification and limited recall of contaminated raw materials and feedstuffs at any time. If the scope of legal minimum requirements such as Regulation (EC) No. 178/2002 is limited to the exchange of goods and information in between companies (see Overview 1), the question must be posed as to whether this is sufficient as risk management in practice.

**Overview 1.** Legal minimum requirements of traceability in accordance with Regulation (EC) No. 178/2002

- The cut-off date for practical implementation was 01.01.2005
- The obligation for T&T starts at harvest and ends at the entrance to the retailers (e. g. butchers, crafts bakeries, supermarkets etc.)
- No cross-stage traceability of companies required: only documentation of goods entrance and exit (when, received from who and delivered to whom)
- Internal lot traceability not required
- Article 18 does not provide any statements about the organisational and technological structure of T&T systems
- No details are given about the time frame in which products must be identified, blocked or recalled
- No details are specified for the lot sizes of “Traceable Resource Units”

Depending on the entrepreneurial willingness to take risks, discussions with companies revealed different wishes regarding their own integration and the integration of trading partners in T&T:

- Restriction of T&T to implementing legal minimum requirements: in-house documentation of incoming and outgoing goods, including the necessary statements on GMO,
- Extension from goods entrance and exit to include the entire internal storage and production processes for a “complete in-house” solution,
- Gradual involvement of suppliers and/or customers in T&T,
- Mapping of T&T in closed or semi-closed chain structures (e. g. regional quality programs; Poignée, Pilz, 2005),
- T&T in open network structures.
- 

However, different T&T requirements arose not only between companies, but also within the firms regarding the possibility of T&T individual raw materials.

For the development of a T&T system the variety between different intensities of traceability makes it indispensable to use a systematic basis that is as flexible as possible. Only in this way the decisions about how far their internal, cross-company or product-specific traceability should go are left in the companies hands. QM-G took this path in implementing the five T&T levels described, partly in cooperation with commercial software providers.

The Regulation (EC) No. 178/2002 forms a basis for building up a traceability system to satisfy the legal minimum requirements. The QM-G system satisfies the rules set out in this as

shown in Overview 1 by surveying data such as supplier/customer, goods, quantity, date and/or code of retained sample. By just satisfying these legal requirements the amount of necessary documentation is kept to a minimum. However, this way the companies have the character of a black box - There is no link between goods entrance and goods exit. This represents a gap in the companies own as well as chain or network wide risk and crisis management. In the event of contaminated goods occurring, it must be in the interest of the companies to limit the number of potential sources as few suppliers as possible. The internal batch traceability thus becomes the crucial efficiency criterion of crisis management (Vernède, Verdenius, Broeze, 2003). Regulation (EC) No. 1830/2003 does not explicitly require consideration of internal goods flows when building up a T&T system either (see Overview 2).

**Overview 2 .** Legal minimum requirements of traceability of GMO and traceability of foods and feeds made from GMO in accordance with Regulation (EC) No. 1830/2003

- Valid since 18.04.2004.
- Applies for each phase of trafficking products consisting of or containing GMO and for foods and feeds made from GMO.
- The basis of traceability is the transfer and storage of information that a product contains GMO or consists of GMO and the clear code of this GMO in each phase of trafficking.
- In the first phase of trafficking, the participants must guarantee that the customer is provided with the following written information: the statement that the product contains GMO or consists of GMO and the relevant specific identity marker(s) allocated to the GMO (see Regulation (EC) No. 65/2004).
- Corresponding information must also be transferred in writing to all other customers in all following phases of bringing into traffic.
- The participants must have systems and standardised procedures for storing the required data that enable them to determine within a period of five years after each transaction by which participant and for which participant the corresponding product was prepared.
- Traces of GMO that enter the product by chance or are technically unavoidable in otherwise genetically non-modified products are excluded from the traceability regulations (limit levels 0.9 per cent regarding characterisation and 0.5 per cent for the presence of non-allowed but scientifically positive assessed GMO).

The development of GMO labelling from the evidence to the application principle, the presence of a wide variety of possible blending processes within as well as between companies, and rules on the use of labelling “not genetically modified” call for greater involvement of internal processes in T&T handling, however.

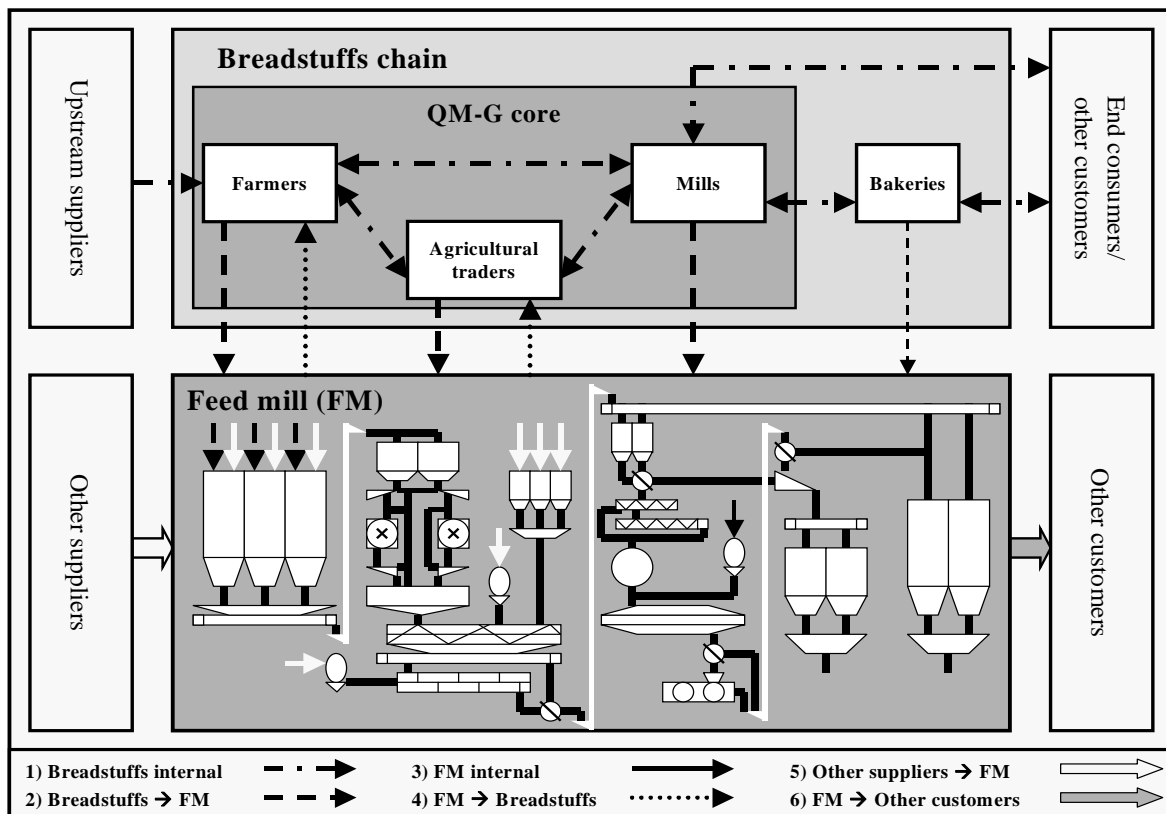
Figure 2 shows a T&T scenario with a display of the different traceability lines within the framework of exchange relations between a feed company and the breadstuffs chain.

Recapitulating, taking grain as an example, the following use scenarios of the QM-G T&T module (Poignée, Hannus, Jahn, Schiefer, 2004) unfold:

- In-house (legal minimum requirement or complete solution): feed company, mill, agricultural trade, producer cooperative, farmer etc.,
- Data exchange with suppliers and/or customers,

- Integrated system for the entire network: farmers + producer cooperative + agricultural trade + mill + feed company.

By taking the entire raw material management into consideration, QM-G also allows the feed company a product-specific selection between the T&T use options listed as well. For the most important raw material – grain – for instance, due to its high biological variability, it is thus conceivable to involve all upstream suppliers. For other raw materials it might be possible to manage by recording the goods intake. The decision is left to the companies themselves.



**Figure 2.** Example for a T&T scenario in the feed industry

The T&T module offers companies various added values through these adaptable networking possibilities. In addition to the improved crisis management already mentioned, information concerning all the GMOs in a feedstuff or raw material can be stored for an optional period, be tracked and passed on in the network. Thus it can be determined at any time who sold a specific product to whom, or how it was passed on and what processing it has been subjected to.

Traceability can create not only reactive but also proactive added value for all participating companies. QM-G implements this idea in the form of its batch systematic. The definable batches can be tagged via their batch codes with supplementary information (product, process, trade information) which can be exchanged between companies in this way. Using the image of the rail network again, if technology provides the necessary “information tracks”, the batch code is the “engine” to which a wide variety of information can be added as “wagons”. What information this covers is a matter to be decided by an agreement on a network, on a sector, or on the supplier-customer-relation level.



## **Technological integration platform**

In principle a strategy for developing an inter-organizational information system (IOS) could consist of designing the system completely isolated from existing electronic data processing infrastructures in the companies of the feed-food network. However, this would necessarily lead to multiple recording of the same data. The analysis of the landscape in electronic data processing at the individual stages of the agricultural and food industry showed that a large quantity of the data required is already recorded in the companies by internal electronic data processing (e.g. field files, Enterprise Resource Planning systems). In order to prevent multiple documentation, QM-G builds on existing data stocks and thus does not see itself as a parallel system, but instead as a quality and logistic-oriented integration system: QM-G surveys its own data in its individual modules, but also brings together relevant data from existing electronic data processing systems via automated interfaces. The in-house integration of QM-G thus also depends on the degree of technology in the participating companies.

In view of the large number of commercial electronic data processing systems, a standard interface is prepared in QM-G that can be activated on request. Thus, interfaces to process control systems (fill level, goods consumption, recipe management etc.), enterprise resource planning systems (e.g. contract management, goods entrance and exit) and weighing systems are relevant for feed companies.

The data managed is stored in a central database (alternative data transfer options such as peer-to-peer networks are in consideration as well). This can cover a company or an entire supplier-customer network. The data is forwarded via the Internet on the basis of the database. The Internet as an established tool offers the advantage that it makes the integration of smaller partners possible, reduces the bilateral need for reconciliation with suppliers and customers, and installation at partner companies requires little effort. Alongside a PC, only a standard web browser is necessary to use QM-G.

## **Summary**

The requirements regarding safety, hygiene and quality of individual feedstuffs and compound feed are wide and varied. They are no longer restricted solely to implementing and documenting quality assurance measures in the individual company, but increasingly also require the exchange of information with partners in the food and feed network. Therefore the objective must be to develop a system for supporting the individual company data management and cross-company exchange of information to satisfy such demands. However, traditional media quickly reach their limits here. New technologies such as the Internet provide the necessary efficiency potential.

The system concept QM-G developed in cooperation between the research group QM-G and companies, associations and institutions in the food and feed industry makes it possible to satisfy the requirements of tracking and tracing and quality assurance. On the basis of its technological and organisational flexibility as outlined in this article, QM-G allows the companies further operational added value in addition to the implementation of external

requirements which are obligatory in any case. By flexible linking of the core modules of tracking and tracing, quality assurance, stock management, contracts, document management and consulting information, QM-G is in a position to generate added value for all participating companies in food/feed safety and logistics. QM-G also has the necessary development potential to continue adapting flexibly to the dynamically changing requirement profiles of individual companies, in particular supplier-customer networks and the entire “rail network” of different production lines.

This paper focuses on the technological side of current tracking and tracing developments. However, the practical project work of our research group highlights the outstanding importance of organizational and institutional factors when implementing effective and efficient tracking and tracing systems as well as inter-organizational information systems. For further reading on these issues we refer to several authors (e.g. Bensaou, Venkatraman, 1996; Hannus, Jahn, Poignée, Schiefer, 2006; Premkumar, Ramamurthy, 1995; Theuvsen 2003a; Theuvsen 2003b).

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