A FRAMEWORK FOR IRISH BEEF TRACEABILITY FROM FARM TO SLAUGHTER USING GLOBAL STANDARDS

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Abstract
Beef traceability is required by EU law, this has necessitated the need for traceability of the inputs involved in beef production. This paper will recommend the use of radio frequency identification (RFID) for the identification of cattle as well as a Biotrack database which maintains biometric identifiers for individual animals. It is proposed that the EPCglobal Network be utilised for the exchange of traceability data between stakeholders, and a standard format for the content of the RFID tags compliant with the EPCglobal standard be introduced.

Introduction
The legal framework for beef traceability has been laid down by the European Parliament in EC/1760/2000, which has been supplemented by the Food Law EC/178/2002. Traceability can be defined as "the ability to trace and follow a food, feed, food producing animal or ingredients, through all stages of production and distribution" (European Commission, 2002). Article 3 of EC/1760/2000 states that "the system for identification and registration of bovine animals shall comprise of the following elements:

- ear tags to identify animals individually;
- computerised databases;
- animal passports; and
- individual registers kept on each holding"(European Commission, 2000)

A competent authority in each Member State of the European Union is responsible for the implementation of the computerised database. In Ireland the Department for Agriculture, Fisheries and Food (DAFF) is the appointed authority. The DAFF computerised database is made up of the following main elements, (a) Calf Birth Registration and (b) Cattle Movement Monitoring System (CMMS).

The Calf Birth Registration System registers all calf births on a central national database. The database holds the following information on the origin and identity of each animal:-

- ear tag number;
- sex;
- breed;
- date of birth;
- herd of origin; and
- ear tag number of dam.

The CMMS system was phased in with effect from September 1998 and captures all data on births, movements, deaths and disposals since 1 January 2000. In the development of the CMMS, use was made of electronic recording mechanisms, namely barcode technology. Computer equipment linked to the central database was installed at livestock markets, meat plants and live export points to record electronically all movements of cattle to and from these premises. In the case of private sales, the movements are recorded by the Department's Cattle Movement Notification Agency on the basis of notifications from farmers and subsequently loaded onto the CMMS database.

This responsibility of identifying and recording the sources of feed and any other substance intended to be incorporated into a food, is on the individual producer as stated by EC/178/2002, which in this case is the herd keeper. Herd keepers need to be able to identify where and from whom they received the feed for their animals. It implies, but does not state directly that, they should record which animals consumed certain feed, in order to avert, in the case of recall pertaining to feed or any other substance (medicines, for instance)

animals consumed from entering the human food chain. The DAFF databases do not record information regarding feed, they do, however, have information regarding feed producers and suppliers as required by EC/183/2005 (European Commission, 2005).

It is now necessary for the herd keeper to have the ability to identify the source of feed, and any other inputs that may be consumed, to provide traceability data upon request to the relevant authority in accordance with the food law. A gap exists in the current traceability infrastructure; it is this gap that this paper will address.

Materials and Methods

Currently barcodes are the data carriers in use on cattle ear tags in Ireland. However, with increases in information technology radio frequency identification (RFID) tags have also become valid electronic data carriers for use in animal identification. Sahin *et al* (2002) lists a number of advantages from the implementation of RFID over barcodes in the supply chain, including but not limited to:

- a reduction in labour costs;
- a more efficient control of the supply chain due to increased information accuracy;
- a reduction in delivery disputes;
- a better tracking and tracing of quality problems;
- a reduction in profit losses.

The use of RFID tags offers another advantage over barcodes through the ability of interconnectivity of RFID systems. GS1 (Global Standards Agency) has developed a system where RFIDs form part of an integrated global system through the use of EPC (electronic product codes). The EPC is a unique number that is used to identify a specific item in the supply chain. The EPCglobal Network is a set of technologies that enables immediate, automatic identification of items in the supply chain, anywhere in the world. Importantly, the Network allows trading partners to exchange such information about the goods they ship among themselves. In order for such as system to be implemented in relation to cattle and cattle products it is first necessary to define all the stakeholders involved either directly or indirectly with the production of cattle.

Verification	Cattle Movement	Input
CMMS	Mart	Pharmacy
Biotrack	Private sale	Veterinary
	Abattoir	Feed
	Knackery	
	Export point	

Table 1. *Stakeholders in cattle traceability*

The EPC network uses defined methods to identify trading partners and locations. A SGTIN (Serialised Global Trade Item Number) is used to identify individual logistical units (cow, feedstuff, medicine), a GLN (Global Location Number) is used to identify physical locations (farms, abattoirs, marts).

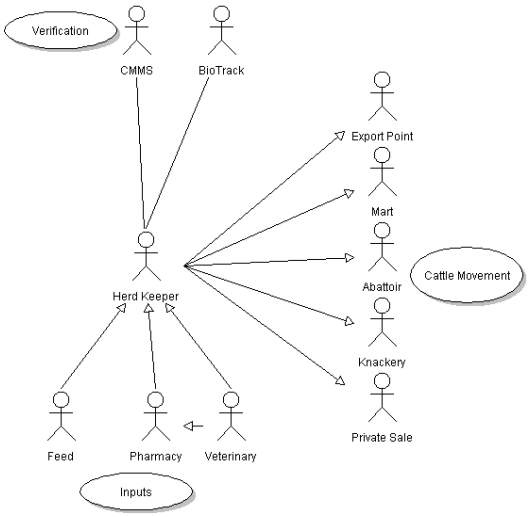

Fig 1. *Stakeholders and verification bodies*

Biotrack will act as an independent entity responsible for storage of individual cattle biometric identifiers, which will be used to verify cattle identity at various points along the supply chain. The CMMS database tracks all movements of cattle for sale and movement to different feedlots, when ownership does not change. The most extensive database will have to be

	Header	Filter value	Partition	Company prefix	Item Reference	Serial number
Bits	8	3	3	20	24	38
Digits		1	1	6	7	12
Values	0011 0000	010	6			
Meaning	Identifies SGTIN	Standard trade item grouping	Determines the length of next two fields	Assigned to Department of Agriculture	Region code + Herd code	Check digit + Individual animal identifier

Table 2. *Proposed EPC encoding for cattle identification*

maintained by the herd keeper, in order to record all the events over the animals lifetime, such as, feed consumed by the animal (batch number, expiry date, feed identification, feeding system), the veterinary interventions (tests carried out, treatment, medicines prescribed and over-the-counter medication administered).

When an animal is moved to another location the traceability data held by the herd keeper will have to be exchanged. This will be achieved by utilising the EPCIS (Electronic Product Code Information Service), which uses set message outlines to transfer traceability data between stakeholders in the supply chain.

Results

In order for beef traceability to be implemented there is a need to define the data content of the RFID tags to be used for the identification of cattle. EPCglobal Inc. has published a set of standard protocols for RFID tag contents (EPCglobal, 2007). The EPC tag content has six separate sections. It is proposed that the EPC tag for cattle identification contain the same identity number as the current ear tags (Table 3), and partitioned as shown in Table 2. The EPC tag structure shown in Table 2 is for 96 bit RFID tags, the above structure is equally valid for future 198 bit RFID tags.

	Region code	Herd code	Check digit	Animal identifier
Digits	2	5	1	4

Table 3. *Cattle identifiers used on ear tags in Ireland*

At this point in time there is no agreed message structure for the exchange of beef traceability data pre-slaughter through the EPCIS. It is, therefore, necessary to develop a set of standards that can accommodate the stakeholders need for efficient exchange of traceability data. GS1 has completed work in the development of message structures for the post slaughter scenario; work is underway to modify these message structures to enable the transfer of traceability data for pre-slaughter stage.

Discussion

In order for the above system to function there may be the need for new legislation as currently the on-farm herd registers do not have to be electronically based. In order for the efficient exchange of traceability data using the EPCglobal network it will be essential for all stakeholders to have databases that enables the exchange of traceability data through electronic means.

Conclusions

Ireland's traceability system at the moment is maintained by DAFF. It is mainly concerned with the identification of cattle, by use of ear tags containing barcodes and the authorisation of movement. The system does not have any means of verifying cattle identity. It is suggested that RFID replace barcodes as the data carriers to enable the use of the EPCglobal network for the purpose of full traceability between the stakeholders, as well as Biotrack database for verification of cattle identity.

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