Electronic identification and information flow in the red meat supply chain.

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1. Background

I am the second oldest of seven children. Bridget and I have 5 children aged between 7 and 18 and we live on a small farm in Co Antrim, Northern Ireland. My father still works the farm part time and I help as required. We run 80 commercial breeding ewes and 20 suckler cows, 15 of which are pedigree Limousin.

I studied for a Bachelor of Agriculture at the Queen's University, Belfast and followed that with a Master of Science degree in Computer Science and Applications.

I work as a Senior Technologist, specialising in Information and Communication Technology (ICT) at the College of Agriculture Food and Rural Enterprise (CAFRE) in Co Antrim, Northern Ireland.

At work my main responsibility is encouraging farmers to use information technology effectively to manage their business.
I have been involved in a number of pioneering applications, such as one of the first Agriculture College websites in the UK, the first online agriculture decision support applications and the first real time transactional web based government services in Northern Ireland, APHIS Online.

Looking at how technology is used by farmers, and by government to serve and support farmers, led me to look at what pioneering work is going on around the world.

Cormac McKervey, Campbell Tweed and Will Taylor introduced me to the Nuffield Scholarship process. I am indebted to all three for their encouragement and guidance.

Nuffield and the Thomas Henry Foundation have allowed me to travel and meet many inspirational people who provide leadership to the industry in their country. At farm level I witnessed technology being used to deliver real benefit to those who use it, and I have seen how cooperation and innovation in implementing database and information systems delivers at industry level.

The objectives of my study were to investigate the following areas:

- **The value of data**
    1. For disease control, traceability and marketing,
    2. For animal management/performance assessment?

- **The technology to facilitate automatic data collection, particularly Radio Frequency Identification (RFID or EID).**
    1. What is available and how is the technology being used?
    2. What research is going on and who is doing it?
    3. What knowledge and technology transfer is happening and how?

- **Data collection at the various points in the supply chain**
    1. What are the pressure points for animal data collection?
    2. What data is required at each point?

- **What Integration and co-operation exists**, and is required, between organisations involved in the red meat supply chain with regard to animal data and how does, or could, EID play a role?

- **What standards are in place** for EID and data transfer and how they are interpreted and applied?

- **What Opportunities/Threats** are there from pending or possible legislation?

- **How has government contributed to introduction of EID?**

While meeting many inspirational people and talking to leaders at all levels in the industry it is clear that farmers need to think about what influences them at different levels.

At global and national levels climate change, food safety, food security, supermarket power, government policies on transport, energy, employment, education, animal welfare, etc, can all have an impact on what farmers have the power and freedom to do and achieve.

Water in Australia, market access in New Zealand, production costs in Denmark, scale in Ireland, bureaucracy in the UK and power of large processing corporations in Canada are among some of the issues I encountered.

At industry level, production systems, processing capacity and efficiency, marketing power and marketing differentials, proximity to markets, access to markets and the scale and ability to supply large markets are all issues that have to be addressed by industry leaders.

At farm level scale, efficiency, technical competence, business acumen, location, natural resources all combine to determine how successful a farm business will be. Some of the best examples of people who made use of their resources were a sheep breeder in Western Australia, a wool producer in New South Wales, a dairy farmer in the South Island of New Zealand, and an Angus breeder in Canada.

A common theme at farm level in all countries is that successful farmers concentrate first and foremost on what they can actually control and manage at farm level.

In all cases control starts with having good information on which to base decisions. Good decisions need good information. The WA sheep breeder had the highest breeding value flock in Australia and was improving faster than any other, with figures to prove it. The NZ dairy farmer knew her profit per cow per day, the genetic merit of every cow and what the genetic merit of her cows was likely to be in 2 years. The NSW sheep farmer had evidence that he was improving wool production by 4% per annum using breeding values, against an industry average of 0.5%.

In all livestock enterprises, suckler cows, dairy cows, beef finishing, or sheep, the starting point for success is having the right breeding stock.

The question that stimulates most debate and argument amongst cattle and sheep producers is ‘what is the ideal cow (or ewe)’.

My answer to this question has developed to be “better than the ones you have now”.

In simple terms, there is no such thing as an ideal cow or ewe. Farmers must strive to improve breeding stock to suit the limitations and the potential of their own circumstances. The right cow or ewe for a dry, WA landscape is likely to be different than one for a temperate, high rainfall country like Ireland.
The main point is that criteria for selection must first be objective. Secondly they must be based on sound, relevant science.

Visiting farms successfully producing pedigree stock, crossbred stock, composite stock and all variations between, the common thread in all systems is selection based on performance criteria.

None of them ignore visual criteria (if it looks like a duck and walks like a duck it is unlikely to produce anything only ducks) but all refine selection based on criteria they have objectively decided are relevant to them and their customers.

The debate then moves to which criteria are most import and how do you record performance data to produce indices that allow objective decisions

A great example of putting this into practice is in Western Australia, where two of the most knowledgeable and enthusiastic single breed farmers have recognised the strengths in the other's breed and are collaborating to produce a hybrid or composite with the best characteristics of both for commercial customers. The result they hope will be long lived, prolific, parasite resistant, wool shedding, meat machine. They will succeed.

2. Animal Identification and Information Management.

2.1 The value of data and information – Supply chains.

I have given much thought to the concept of supply chains during the course of the last two years. It is another subject that many learned folks make a living observing, analysing, advising on and writing about.

Trying to think about new angles or new processes, and like many Nuffield scholars, looking for the Eureka or Halleluiah moment, I'm afraid that it didn't happen for me.

While considering supply chains and value distribution I asked many questions, including:

What is the purpose of a supply chain?
What does it mean to the customer or the producer?
Who else is part of a supply chain?
Is this different than a value chain?

I had to remind myself that I was looking at technology and about information flow and go back to basics.

What information is needed?
Who needs it?
When do they need it?
Who verifies the information?
What value is placed on the information?
How does the information contribute to product value?

As far as agricultural supply goes it is easiest to think about each group or stakeholder in the chain separately. The information needs of each individual player in a chain are largely disconnected. This is not necessarily the way it should be, but the way it is.
In many cases, schemes which try to integrate supply chain information are as much about marketing as any real desire to improve the lot of farmers.

Information management in relation to the red meat supply chain is a complex issue.

The overriding conclusion from all these thoughts and discussions is that farmers, at farm level, should manage what they can actually control.

Good information needs good data. It is impossible to talk about the benefits of data collection without first being convinced of the benefits of good information

Looking at red meat supply how can one define good information? In simple terms, my view is that information which serves a purpose in enabling better decision making, or adding value to a product is good.

In red meat production systems, information is used for a number of purposes. The three main information demanding purposes are

- Traceability and product quality assurance to consumer level.
- Animal disease control at farm, national and international level.
- Animal management at farm level to the farm gate, including aggregated animal production information for genetic improvement.

What information is required for each of these purposes?

2.2 Traceability and quality assurance.

Traceability and quality assurance are two terms used frequently, particularly in Europe with regard to red meat. We are constantly told that consumers demand traceability. What does this mean for red meat supply, how can it be delivered, and how can farmers be rewarded for delivering what the consumer demands?

Books have been written on information management in supply chains and the definition of traceability.

One possible definition, and one that is promoted for beef and sheep management at European level, is that a consumer should be able to see information about anything that happened from when an animal is born right through to the point when they have a piece of meat on a plate in front of them.
The information will include when and where an animal was born, who owned it, how was it raised (feeding, welfare, medicine administration, movements), where and how it was slaughtered and how the carcase was processed, packaged, stored, distributed and eventually sold.

2.3 Disease control is a W5 (or at least a W4) issue.
Who are the animals and their parents (dam at least for BSE) and who owns them?

Where are they now and where have they been?
When was the animal born, and when and where did it move (from, to, via)?
What diagnostic tests have been carried out and with what results?

Why is a question asked by many. Ask any of the industry leaders and government officials in any country that has survived a significant animal disease or product contamination event and it becomes abundantly clear. (UK, BSE 1995, FMD 2001 & 2007,. Canada, BSE 2003. Australia, Cotton Trash 1990's, Ireland North and South, Dioxin 2008)

In the event of a disease outbreak the key to containment is finding where an animal is, where it has been, who might have been in contact with it, where other contact animals might be and where animals that have been in contact with them might be.

Australia in particular have shown how EID enabled databases and electronic data have improved the ability to track and trace through exercises like operation Cowcatcher.

2.4 Farm management

I always assume that one of the main reasons a farmer farms is to make at least enough money to provide for their desired lifestyle. Profitability in red meat production is a complex and multi-factorial issue, but many of the factors relate to animal performance, and these include (not exclusively or exhaustively):

Fertility – sexual maturity, prolificacy
Maternal productivity – progeny size, vigour and survival, milking ability, longevity
Production efficiency – growth rate, feed conversion, foraging ability, temperament
Production value – meat/bone ratio, meat yield, fat cover, marbling, carcase conformation, wool quantity and quality,...

There are a number of recent Nuffield reports all discussing factors affecting the farm gate profitability of beef and sheep enterprises. (see bibliography)

The recurring theme through all of these is the ability of an individual farmer to select superior breeding stock based on

objective criteria. There is an absolute need for good information about the value of the breeding stock in relation to the production objectives on an individual farm, or within a breeding population in a geographical area (or country).
Having the information is the first step. Acting on it, or making and following through with good decisions is the key to deriving benefit from the information.

2.5 Information Value

Is there any thread through this information that might allow value to be derived?

In discussions with Brian Wickham and Andrew Cromie from the Irish Cattle Breeding Federation[1], they used a term that sums up the need to rationalise data collection, storage and sharing processes.

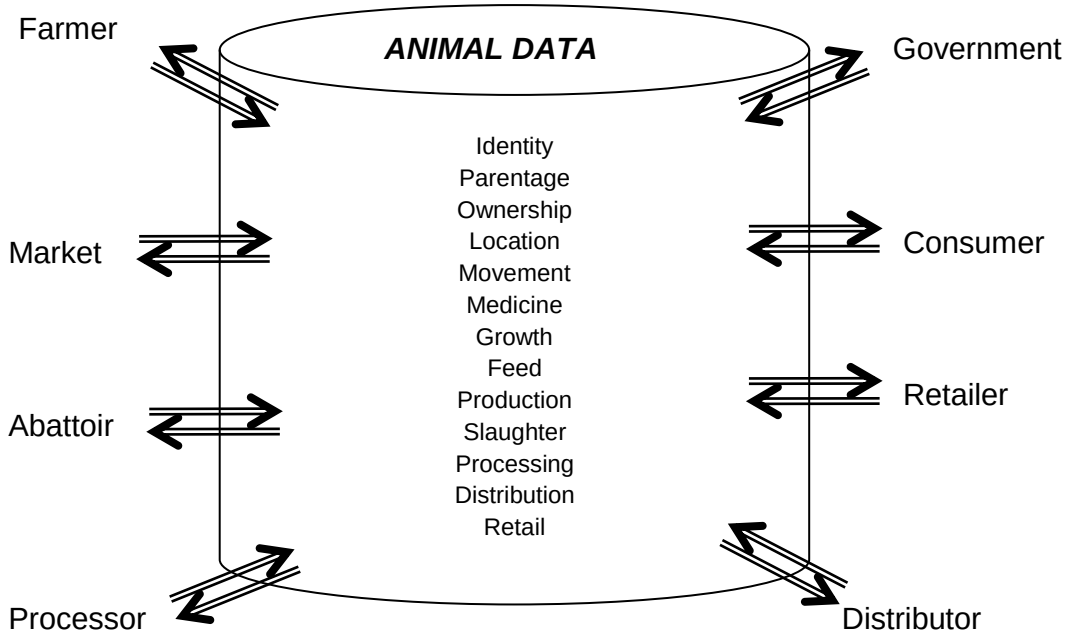
The "holy grail" for animal data management is

"ONE VERSION of the TRUTH"

Any piece of data should be collected ONCE (automatically), stored once in a SINGLE database and be accessible to ANYONE who has a legitimate purpose for using that data to produce information that will be of value.

There are areas where the data required to produce useful information overlap. These include data items such as the identity of individual, or batches of animals, animal movements, animal health treatments, post-mortem analysis for both disease status and carcase quality.

[1] www.icbf.com



Legitimate purpose and value are important concepts for discussion. Deciding who owns, who controls, who accesses and who pays for data is an area that all the countries I visited struggle to come to terms with.

For traceability and quality assurance the value of the information is derived from what the consumer is prepared to pay for the product. In some cases a premium may be justified on the basis of an enhanced level of traceability. In today's world the minimum "bar" is set high enough to mean premium is synonymous with niche. In any case, the information provides the processors and retailers with the tools to effectively market their produce and realise value.

In disease control, the value is derived in two main ways. The first is as above in providing assurance that products are of a minimum acceptable standard, allowing processors and retailers to sell the product.
The second is in the savings associated with not having to deal with the consequences a disease outbreak, or savings associated with the minimisation of costs associated with disease surveillance and control measures.

In farm management terms the value of information is derived from improvements in productivity and profitability through selection of more efficient breeding stock, as well as through improvements in management practices based on information gathered.

Generating information means collecting data. Collecting data means cost.

Selling products is about generating value (money). If information supports or enhances the value, then it seems logical that the value should, as a minimum, be shared among those who incur cost to collect the data.

The concept of sharing the value in the chain and sharing the cost of producing that value is one area that will continue to be debated in all countries.

In principle it seems entirely reasonable that both costs and value are shared equitably. The debate in all of the countries I visited is based on what equitable means and how both the costs and the value are shared.

If you can’t measure it you can’t manage it.

3. Technology

I started this study with a number of questions on RFID technology and how it might be used. The technology is important but some observations or conclusions are apparent from looking at how EID is used.

EID is an enabling technology. It allows animals to be identified automatically. This is only a small part in animal and information management systems.

The key to all of this is integration.

Animal handling systems (physical infrastructure to make sure animals move through the facilities with minimum stress and maximum safety for both animal and operator)[2], data collection processes, whether this is on a farm, in a market, in an abattoir, or wherever, data transfer processes and protocols, data storage infrastructure, data processing capability, data security procedures, reporting capability including processes to ensure the right people get the right reports at the right time, and that these people have the capacity to make decisions and follow through with appropriate action.

3.1 How it works.

Radio Frequency IDentification (RFID technology) has been developed significantly since use of similar technology in World War II by Allies to identify planes as friend or foe; and by Russians for espionage.

The technology is about using automatic identification technology to identify objects to enable data to be collected and facilitate information management, automated process control and ultimately improve productivity. This is achieved through reduced labour or more efficient product handling and improved decision making, through availability of better and timelier management information.

The identification device can be passive or active, but the principle is the same. The identification device is a silicon microchip with an electronic number. The microchip is incorporated, with an antenna attached, in a medium that allows the device or "tag" to be attached to an object.
In passive tags the device has no energy source incorporated and a reader will send a signal from which the tag absorbs enough energy to return a signal containing the coded number.

2 See www.templegrandin.com

For devices or tags with a power source (battery usually), a signal is usually broadcast continuously to be read by any reader in range.

The main discussion points for applications are

- the frequency used for transmission of read and respond signals, the strength of the signal and therefore the range at which tags may be read,
- the standards for coding of numbers to ensure that messages received are consistent and understandable, regardless of location and time, and
- whether the tags can be read many at a time or one at a time.

Other areas of interest are whether information other than the number can be coded or "written" onto the silicon chip, whether this information, including the number can be overwritten or changed, and how often can this be done. i.e. is the transponder Read Only, Read/Write, or Write Once Read Many (Worm).
Another issue is whether the number coded onto the chip is unique for each chip, and therefore for each item (or animal) identified, or unique for each product range.
The standards governing how all of this is administered are crucial to ensuring that systems can be implemented nationally and internationally and organisations can be assured quite simply that the systems will work.

3.2 Livestock EID

RFID or Electronic Identification (EID) as it relates to farm animal is simple.
A silicon microchip with a unique number programmed onto it is attached to an antenna and incorporated into a device that can be attached to an animal. This can be a tag, a rumen bolus, a necklace, a belt attached to a front or rear leg, a subcutaneous implant or a tail tag.

In all cases to date for national animal identification systems they are based on passive, low frequency (134.2 kHz), 64 bit, read only transponders, subscribing to ISO standards 11784 and 11785.
There are, however, many other examples existing of "tags" that are read/write, operate at high and ultra high frequencies and applications that provide on farm value supported by these ID devices.

For EID in cattle and sheep, the principle is that the tag will receive energy from a reader, absorb enough energy to return a signal that is picked up by the reader.

The unique number from the chip will be translated and be displayed and/or passed on to another system to allow an animal management task to be completed based on the identity of that animal. The task may be recording of a data item (weight, location, milk yield, drug treatment, blood sample), or a physical process such as milking or drafting.

3.3 Standards

The basis of all animal traceability systems, particularly cattle, is the unique, lifetime identity of the animal. It is essential that EID technology can deliver this requirement.

Since agriculture products are traded on a world wide basis, it is more than desirable that standards should be set at international level. The process for setting standards is important, as are the procedures for testing and approval of equipment against these standards, the publication of results of these tests and subsequent approvals, auditing to ensure standards are maintained, and sanctions to ensure compliance.

There are a number of standards in place to govern the implementation of EID systems and the manufacture of the devices and equipment that make up these systems

The main standards in place are the ISO standards 11784, 11785, 24631 and 14223.

- ISO 11784 represents the international standard for the structure of the data and the numeric architecture of the 64 bit code for Radio Frequency Identification of Animals.
- ISO 11785 represents the accepted protocol for transmission between the scanner (or reader or interrogator or transceiver) and the transponder (tag). This standard defines the timing sequence for both HDX (half duplex) and FDX (full duplex) air interfaces.
- ISO 24631 defines standards for testing devices and data transfer protocols
- ISO 14223 defines the standard for *Advanced transponders* for animals, where transponders may use advanced technologies to facilitate the storage and retrieval of additional information.

The international standards organisation is responsible for defining and refining the standards.

This organisation has devolved responsibility for testing and approval, and maintenance of the standards to the International Committee for Animal Recording (ICAR), acting as the registration agent for companies who wish to register equipment and devices for testing and approval.

ICARs primary mission is to standardize procedures and methods used in recording of livestock data and establish test procedures for the approval of equipment and methods for recording data. This remit is much wider than simply EID equipment testing and approval.

ICAR has in turn approved a number of laboratories to perform the tests on the equipment.
These laboratories in turn must be certified to ISO 17025 to allow users to be satisfied that test procedures are carried out in a uniform fashion, to an approved and verifiable standard.

ISO 24631 allows for laboratories certified to ISO 17025 to complete the testing and certification of EID devices.

3.4 Implementing the Standards

In my opinion, from the travels I have undertaken and in discussion with all of the people I met, I believe there are difficulties with both the standards, and in the way they are implemented.

The single biggest issue was that the initial standards (11784 and 11785) did not include any physical performance criteria for devices and equipment. A device may conform to the standard but not perform in an acceptable manner.

This should be addressed by introduction ISO 24631, which in parts 2 and 4 addresses testing procedures for performance criteria of transponders and receivers respectively. National authorities (or governments) have addressed this is independently, for example Meat and Livestock Australia standards for NLIS devices, whereby they define further testing and approval processes to ensure equipment is acceptable to the industry using it.

Policing of standards is an issue, in that organisations may sell equipment as complying with the standard, without having any testing or approval done by the standards organisations. Again this can be overcome by national governments, or designated competent authorities within countries legislating to ensure that the standards are met.

The debate moves then to deciding whether the legislation should dictate that equipment is tested through the recognised

international body, or can it simply be tested to that standard by a competent, licensed body?

The relationships between the groups influencing and with responsibility for this area are complex.

Organisations with an interest include:

- European Commission producing legislation and technical guidance,
- National governments through both agriculture departments and scientific representatives,
- ICAR as an international independent body and as a service provider,
- JRC as both an independent lab and a representative of the European Commission,
- Animal ID companies both individually and through representative organisations,
- ISO committees
- ISO Technical Working groups.
- Producer and processor representative organisations

Steering a path through this to provide reasonable advice to an organisation or individual who needs a sustainable solution is not easy.

3.5 Solution Advice

The term many users like to quote is that equipment must be ***"fit for purpose"***. This is true, but defining the purpose must be done by those who need the solution in partnership with those providing it.
Looking at how the technology can be and is used at both farm and factory or mart level, it is clear that defining the system requirements, developing the individual components and integration of equipment from either one manufacturer, or a variety of manufacturers, is a very important part of what manufacturers must do better for the industry.
When considering the large number of different reader types, weighers and other pieces of data collection equipment on the market, and the variety of ways that equipment available can be put together to provide a solution, highlights the need for better advice and for manufacturer collaboration.

To ensure that technology delivers there are a number of important steps that must be taken. These include, for RFID technology installations, the following:

1. An in-depth analysis of the problem to be solved by the technology.
2. A knowledge and understanding of both the hardware and software requirements, and the ability to define both effectively.
3. Site surveys for equipment installation carried out by technically competent experts
4. Development of an integrated hardware and software solution.
5. Installation, commissioning and training of users, again by properly qualified and competent technical people
6. Proper procedures for testing, using and reviewing progress to address issues quickly and effectively.

Some interesting quotes on technology include:

“Technology must solve a problem. Technology should not be seeking a problem to solve”. Private.

"Look, this technology is great, but somebody better figure out how to use it" Sara Lee Corp on how a radio frequency identification reader at a Wal-Mart store tracked the same case of breakfast meals going in and out of a storeroom 800 times because a clerk was reusing the empty box to carry stock.

"If you paid too much for a piece of technology, but it does what you want it to, then you lost a little money. If you buy a cheap piece of equipment and it does not do what you want it to, then you have lost everything”.

4. Traceability, disease control and herd improvement - National Systems

In all of the countries I visited and reviewed many areas are being addressed. This include

- what needs to be in place?
- how it should be implemented?
- who controls it?
- who contributes information and how?
- who owns information?
- who has access to that information?
- how is value attached to and derived from the information?

The process of answering these questions is at different stages in each country, and the systems are implemented in very different ways, although with some similarities.
Each country has different drivers in terms or climatic conditions, scale, farmer attitudes, markets serviced, government support, relative strength of agriculture and its economic value. All of these impact on how information systems are implemented

Although I did not do an economic analysis of costs and benefits, I will attempt to outline what I observed in each country and discuss briefly strengths and weaknesses, again as I perceive them, in terms of

- Traceability
- Disease control
- Herd improvement and farm management

Some statistics that may be of interest in preview are in the table below:

Livestock numbers '000						
Date (for Ag stats)	Country	Human Population ('000, 2009)	Cattle (Incl Dairy)	Beef Exports (% of production)	Sheep	Sheep meat Exports
Jun-09	Australia	21,875	27,000	70%	71,560	70%
Jun-07	New Zealand	4,351	9,654	96%	38,460	92%
Jul-09	Canada	33,505	14,840	40%	1,062	0%
Dec-08	Denmark	5,533	1,576	n/a	98	not relevant
Dec-08	Ireland	4,459	5,935	86%	3,423	72%
Dec-09	Great Britain	59,618	8,600	n/a	30,700	n/a
Dec-08	Northern Ireland	1,775	1,623	70%	1,973	70%

4.1 Ireland

Traceability and disease control in Ireland is the responsibility of the Department of Agriculture, Fisheries and Food

The Cattle Movement Monitoring System (CMMS) was replaced in 2008 by the Animal Identification and Movement (AIM) system. The AIM system is a generic traceability system that will cover various farm animal species, including sheep, goats and deer.
The AIM systems is an Oracle based database, using much of the latest in web and service oriented architecture to deliver an integrated solution for Irish cattle and sheep farmers. Work is ongoing to upgrade and integrate all the older database systems that deliver information required for effective animal traceability and disease control.

Herd improvement
Herd improvement is undertaken by the Irish Cattle Breeding Federation (ICBF). Having in 2008 taken on responsibility for the Sheep Ireland development project, a change of title may be on the cards.
Initial work started in March 1998 with the appointment of Dr Brian Wickham, the current Chief Executive, followed in October 1998 by the appointment of Dr Andrew Cromie.
ICBF was formed formally in 2000 and is a private company based in Bandon, Co. Cork.
Ownership of the company is in the hands of industry stakeholders including AI organisations, herd books (Breed Societies), Milk recording organizations (cooperative societies) and Farming Organisations.

The ICBF mission is very clear (and simple) – Genetic Gain, measured in Euros, for farmers in Republic of Ireland.
The rules of ICBF state that the main objects of the Society shall be:
To achieve the greatest possible genetic improvement in the national cattle herd (and now sheep as well) for the benefit of Irish farmers, and the dairy and beef industries and members by collecting, collating and distributing available information and data of practical and scientific interest, by promoting the exchange of all such information and data amongst breeders of cattle in Ireland.

An essential part of the formation and success of ICBF is the support from leading industry representatives.
The two main supporters in the early stages were John Malone, Secretary of the Department of Agriculture and Food (DAF) and Michael Berkery, Chief Executive of the Irish Farmers Association (IFA)

Progress was very slow in the early years 1998-2000 trying to get all sectors of the industry to approve the concept.

A turning point came with establishment of an interim board for ICBF under the chairmanship of John O'Sullivan who was chairman of the Irish Holstein Friesian Association (IHFA) and the Irish representative on the Hosltein UK and Ireland (HUKI) board. It was John who negotiated the deal to break away from HUK and get the necessary equity to invest in the ICBF database.

The key issue is that the right people at the right level in the participating organisations were fully in support of the project, including making funding available.

The organization provides herdbook services to all cattle breed societies, produces breeding indices for all cattle breeds and now sheep as well. It also provides services associated with data collection and management for all of the data required to produce reliable breeding values.

Strengths

1. Integration
2. up to date technology

Weaknesses

1. ICBF scale to be self sustaining without government support is not clear
2. managing

4.2 The United Kingdom

The structure of UK government has changed dramatically in the last 10 years with devolvement of some powers to the Scottish Parliament and the Northern Ireland and Welsh Assemblies. The structures and responsibilities for animal health and welfare are in turn difficult to explain.

In short summary, Northern Ireland, due to its geographical separation and historical governance issues, has always had a completely separate system for management of animal tracing and disease control measures and I will discuss that separately.

4.2.1 Great Britain

Traceability and Disease Control

In Great Britain (or England Scotland and Wales) animal birth and death registrations and allocation of tags is the responsibility of the Rural Payments agency through the British Cattle Movement Service. BCMS operates the Cattle Tracing System (CTS
BCMS maintains two Ear Tag Allocation Systems (ETAS). These two databases are accessed by tag suppliers to obtain unique tag numbers for cattle, sheep and goats.
BCMS are also responsible for approving official cattle, sheep and goat tags for sale in Great Britain.

Separate database are responsible for recording the allocation of identification devices for cattle and sheep, and for recording the births, deaths and movements.

BCMS database is a single species database.

Disease control and welfare is the responsibility of an executive agency of the Department of Environment Food and Rural Affairs, appropriately called Animal Health, but inappropriately created as a completely stand alone agency.

Carcase inspection is the responsibility of Local Authority Health inspectors, as is the welfare inspections at markets and abattoir lairages.

Although cooperation does exist between the organisations, each has its own separate database structures for collecting and collating information about the key elements of traceability.

Scotland and Wales do have devolved responsibilities for Agriculture, and the Identification registration and movement of Animals.

Strengths

1. None (in my opinion)

Weaknesses

1. No central database for coordination of actions required for tracing animals effectively
2. no single point of contact
3. Single species and single function solutions
4. No links with herd improvement organisations
5. no transparency on costs
6. no industry involvement or responsibility other than data input
7. no central database for sheep movements
8. difficulties with getting devolved administrations moving together in the same direction

Herd improvement

In the UK for beef and sheep there are 2 main systems for obtaining breeding values for pedigree stock.

The Australian Breedplan programme is used by a number of cattle breeds (Charollais, Hereford, Angus and Simmental)

The Beef and Sheep Company (BASCo) system, designed in a partnership between some breed societies (Limousin, Texel and Suffolk), Signet and SAC through Egenes is used to provide breeding values for Limousin cattle and a number of sheep breeds.

At present there is no facility for comparing data across breeds or for analysis of crossbred breeding stock.

The provision of diary genetic merit analysis is worthy of a Nuffield report in itself.

4.2.2 Northern Ireland

Traceability and disease control in Northern Ireland is the responsibility of the Department of Agriculture and Rural Development through its Veterinary Service.
All of the information requirements for these tasks are undertaken through the Animal and Public Health Information System (APHIS), managed by VS on behalf of DARD and the Industry.

The database hold details of the people who keep animals, identity of the animals, allocation of the identification devices (Tags), animal movements, disease testing

Strengths

1. Integrated system for all disease and traceability functions
2. data used for marketing

Weakness

1. Cost
2. industry involvement in management
3. links to herd improvement
4. policy dictated by UK

Herd Improvement.

There is no indigenous herd improvement system in Northern Ireland. Producers use systems available in the rest of the UK, i.e. BASCO/Signet and Breedplan.

Less than 10% of pedigree flocks and herds are performance recorded.

Even dairy cows, less than 25% milk recorded.

4.3 Australia

Traceability and disease control - the National Livestock Identification System (www.nlis.com.au).

NLIS in Australia was introduced in 1999.

The initial driver was primarily the fallout of export and trading issues following dieldrin/DDT detection in carcases sent to Japan in the 1995. Cattle imported into the state of Victoria had been fed cotton trash residue in NSW due to forage shortages as a result of drought. Although all traces were well below any recommended safety levels, trade was seriously affected.

The only solution was an effective cattle tracing system. Initial plans were developed in 1996, but it took to 1998 to convince an industry led committee to move forward.

Given the numbers of cattle in Australia and the numbers moving through saleyards and to abattoirs, it was clear that European style, passport and paper based systems for individual animals would be unworkable, both physically and financially.

A solution was tested in 1998/99 on a voluntary basis in the state of Victoria, heavily backed by state Government financial and political support, where it became compulsory in 2002.

During 2000-2005 the system was gradually accepted and adopted through Australia and management of the national database and technology standards was taken on by Meat and Livestock Australia.

It became compulsory on 01 July 2005 for all cattle to be identified with RFID tags and for all movements of cattle to be registered with NLIS.

NLIS is a very straight forward concept, which is one of its primary strengths

It is about identifying the cattle with a unique, whole of life, identifier in the form of a radio frequency transponder in either a tag or a bolus. Farmers are identified and properties are identified with a Property Identification Code.

Tags are allocated to a farmer at a property, and any animals born on that property are tagged as they leave.
The movement recording is the responsibility of the receiving property (another farmer, a market or an abattoir). Details of the PICs (selling and receiving) and all the animals in the consignment must be registered.

Strengths

1. Industry led and owned.
2. Managed by industry with government support
3. simple concept
4. fully electronic
5. roll-out funded and supported by government with a clear focus on promotion of benefits to farmers.

Weakness

1. links to disease control systems
2. links to quarantine service
3. links to animal production or herd improvement systems
4. starts when an animal leaves a property, not when it is born or first handled.
5. although a national system, there is duplication in services offered at state level.

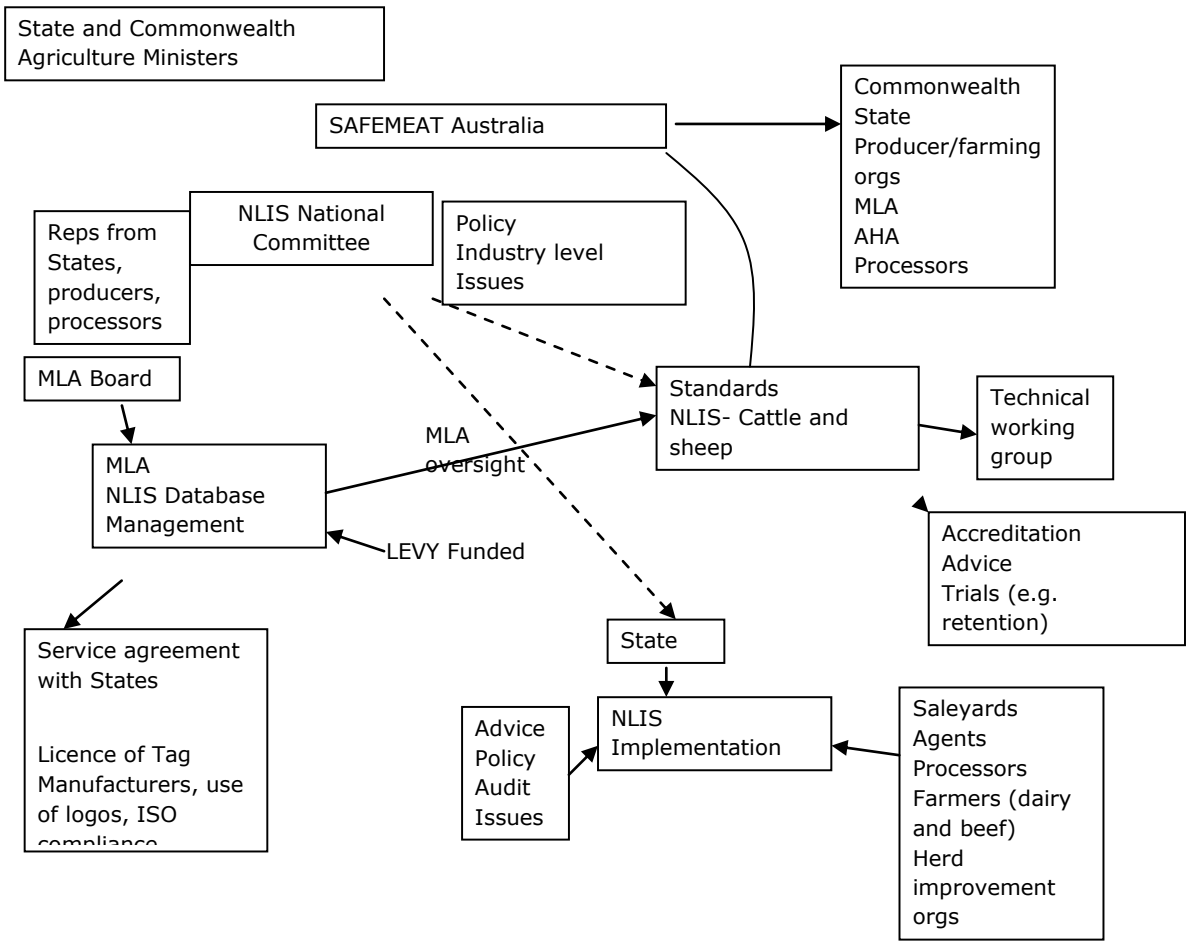
Through the process of developing the NLIS system there are many issues that have been addressed by the Australians.

The first is **technology**.
Meat and Livestock Australia (MLA) played a key role in taking the international standards from ISO and ICAR and adding performance criteria to these. They put in place clear testing and approval procedures to ensure that technology supplied to farmers, markets and abattoirs was acceptable. Technical support was and still is available to ensure all stakeholders know what to expect from the technology.
A methodical, logical approach, starting with abattoirs, then markets and then farmers, backed up by a central database and effective central services has delivered a system that simply works.

It may be something to do with Australian physce, but there was a very apparent acceptance of what the technology could or more importantly couldn't do, and a real drive to overcome problems and make it work.

The second major issue is **Governance**. While NLIS has a complicated management structure which I will attempt to convey, the single most important element of that structure is that primarily it is led by industry.

NLIS is an industry system providing services for the industry to ensure the industry can meet its obligations to consumers for the provision of traceability information.



SAFEMEAT Australia is the national body responsible for meat traceability and quality assurance, approved by the national and state governments to oversee this important activity.

A National NLIS committee, made up of representatives, at leadership level, of the members of Safemeat, oversee the policy and direction of NLIS. A number of subcommittees and working groups provide advice and direction on various issues.

Meat and Livestock Australia is contracted to provide the database services, and administer the standards and device approvals process. MLA also undertakes development and testing or proof of concept work.

Each state has an agreement with MLA to provide central database services and provide access to information relevant to transactions within that states control. Within each state local stakeholders manage how implementation and local adoption of the national standards and procedures is carried out.

Funding for NLIS comes from National Government, State governments and producer levies.

Farm Management and breed improvement

Australia have excellent genetic evaluation services in the shape of Breedplan and Lambplan, both associated with the University of New England based in Armidale, New South Wales.
The bovine evaluations are used by all beef breeds within Australia, and virtually all pedigree cattle breeders use their services.

The services are marketed extensively throughout the world, including in the UK.

Lambplan offers services to all pedigree sheep breeders in Australia, and in New Zealand. Again, the vast majority of breeders use performance recording as a selection tool, and as a marketing tool. Excellent research is ongoing to improve the breeding indices for both meat production and wool production, and for maternal qualities relating to both.

4.4 New Zealand

Traceability and disease control.

New Zealand has a proud record as an exporting country, and is keen to promote the health and welfare of dairy, beef and lamb production systems.

It does have excellent disease control procedures in place, and IT systems to back that up.

It also has some of the very best scientists and research wok with regard to genetic progress in dairy, beef and sheep production.

It does not as yet have a robust traceability system in place as Europeans would define one.

The National Animal Identification and Tracing (NAIT) system, when fully operational, should deliver that. It is based like other systems on identifying cattle, identify the places cattle are kept (and from that the people responsible for managing them) and then tracking the movements of those animals.

The NAIT project was initiated in 2005. It is supported and managed in partnership by government and industry, overseen by a board chaired by a farmer.

The industry has a strong voice in how the system is being developed and in deciding how the system should be funded and managed.

Government fully support the system and have provided funding for research and development and through negotiation will provide start up capital and a percentage of running costs for an initial period.

The business cases have been completed and in 2010 it will become mandatory to identify all cattle with an RFID tag as they leave the farm of birth.

New Zealand have accepted the large amount of effort expended in Australia to put in place testing procedures and adequate

conformance and performance standards and will therefore use NLIS approved tags and equipment for their implementation.

New Zealand are also clear that while the low frequency tags that are currently used may be the best available now, new technology may be developed and therefore the underlying principles of the ID and tracing system should be technology independent. This will ensure that new technology can be introduced, if and when it is proven, with minimal disruption and additional cost.

Technology trials are ongoing, looking at in particular, HF (13.7 GHz tags).

Strengths

- employing proven technology
- simple system
- industry controlled, government supported.

Weaknesses

- not yet in place (3 year phased implementation from 2010)
- integration with disease control systems
- need to ensure industry support does not fall away
- links to herd improvement not clear in specifications

New Zealand has not had an animal disease outbreak on the scale of national crisis as has happened in many, or most, other countries.
While a robust traceability system is seen as a prerequisite to international trade by most importing nations, having a system in place may be seen as an insurance policy. It is difficult to understand the need for insurance if you have never had a fire, and my experience from a farmers meeting is that there remains a cohort of farmers in New Zealand unconvinced of the need for improvements in how they track and trace cattle.

Herd Improvement and Farm Management

The New Zealand dairy industry is one of the most progressive in the world, being the largest exporter of milk powder.
Many Nuffield Scholars visit and write in detail about the industry and its structure.

My experience is that the support systems for farm management and herd improvement are second to none in the world. Almost all cows are milk record and the use of breeding values for selection of AI sires is almost universal.

On the farms I visited the use of management information for decision making was again universal, and the use of good information supported a range of decisions made by those I talked to, including expansion, consolidation, sell-out, conversion, irrigation.

Perhaps the most interesting use of data was a farm using information to support and justify the use of almost 2.5 tonnes per cow per year of concentrate feed to support the equivalent of about 8,500 litres per cow per year of milk production. This is almost heretical in the land of grass, but the figures back the policy.

The strategy employed did however highlight a message that I first became aware of in Melbourne on the Contemporary scholars course.

Successful businesses have simple systems, attention to detail is phenomenal, they work damned hard, and they reward people who share the workload.

For beef and sheep farmers, bulls and rams are bought based on how they can be expected to perform. There is still a need to ensure they are functionally sound, but stockmen want performance first, and if they look good that’s ok.

Sheep Improvement Limited, many private breeding companies producing composite breeding stock and Meat and Wool New Zealand all play a role in promotion of use of objective breeding stock selection based on economically important traits.

4.5 Canada

Traceability and Disease Control:

This in Canada is the responsibility of the federal agency, the Canadian Food Inspection Agency (CFIA)

The Canadian Cattle Identification Program (CCIP) was introduced in 2001 through an amendment to the Health of Animals Regulations and is applicable to all cattle and bison. The Canadian Sheep Identification Program (CSIP) followed in 2004.

Both programs are mandatory in all provinces. These programs are administered, apart from in the province of Quebec, by the Canadian Cattle Identification Agency (CCIA)

Traceability is delivered through premises identification, animal identification and movement recording.
CFIA is also responsible for enforcement of the legislation.

The Canadian Cattle Identification Agency

The system was based on visual tags, with animals tagged on the farm of birth when they left.

The dairy industry, mainly for production monitoring and genetic gain reasons had an identification system in place for many years.

Following the BSE crisis in Canada in 2003 when exports to the United States were stopped for few months there were 2 major outcomes.
The first was the value that could be placed on a traceability system was realised, in that the system in place with farm of birth tagging meant that the crisis was limited to a certain extent.
The second was the exposure of many of the flaws in the system.

The introduction of RFID tags began in 2005.

Like Australia, Canada is a federated country, with each province having autonomy over animal tracing and animal health issues. One of the strengths of the CCIA and the system is that it is national but despite the leadership of the CCIA, the province of Quebec moved forward with a mandatory RFID system before the rest of the

country was in agreement with how RFID introduction would take place.
From Quebec's point of view, this was a bold step in leadership in support of its industry. From other province's point of view, Quebec acted too quickly and allowed provincial government too much control over the system design and administration.

Strengths

- national system
- simple concept
- industry led

Weaknesses

1. provinces can still act autonomously on implementation
2. links with dairy industry are not immediately apparent, if present at all.
3. links with animal health are not clear
4. the relationship of producers with government at federal and provincial levels is not always smooth
5. industry buy in, particularly the abattoir and market sector, is still not apparent.

Herd Improvement and Farm Management

Due to the climate in Canada, type is a very important factor in breeding beef cattle. In the seedstock industry, ebv figures are important and there appears to be an acceptance of science based selection procedures such as genomics to a greater extent than in the UK, and even than Australia or New Zeeland.

In Canada the majority of diary cows are milk recorded.

4.6 Denmark

All information management is undertaken on behalf of government and farmers by the Danish Agriculture Advisory Services who provide secretariat and IT services to the Danish Cattle Federation which runs the Danish cattle database and administers the Central Livestock Register.

The Danish Cattle Federation is the trade association for all Danish milk and meat producers. Their vision is to make the Danish cattle industry the most competitive in Europe, both in terms of profitability, sustainability and quality. Farmer owned and controlled organisation.

The manager of these services within the federation is also the Chair of the ICAR sub committee on Animal Identification (see standards).

Advice, Technology transfer, education and data collection services are all offered through the centralised Advisory Services structure. This organisation has close links with the research organisations.

Denmark highly ordered and seems almost over-bureaucratic, for example a farmer is not allowed to administer medicine to a dairy cow. Medicines must be administered by a qualified vet.

Strengths

1. a single database to deliver all functions
2. Industry led
3. data used well from many sources

Weaknesses

1. costs may be an issue – it is difficult to quantify costs for individual functions and compare effectively with other countries.
2. It is still relatively bureaucratic, in that the amount of regulation, and the amount of data required under regulation appears to be more than in any of the other countries visited.

5. Conclusions

5.1 Technology.

The technology works. Manufacturers are innovating and improving applications constantly and there are applications available for all enterprises, and all sizes of enterprise.
There is research going on around the world on the technology for data collection and on the use of data to provide information for decision support. Unfortunately little of that work is happening in the UK.

Technology transfer work is one of the key elements of success in countries which have successfully implemented traceability systems based on RFID. The structures in the UK do not make it easy to transfer the technology and to educate and train, and lack of adequate, targeted funding makes it difficult to see how this will change.

5.2 Standards

The standards for EID and data transfer are available, but as yet the understanding of what the standards mean and how they can be used is lacking in the UK and Ireland in general.
Education, training and some technology transfer work, particularly with industry leaders, would facilitate a more structured debate on national contribution to the provision of standards, including the testing, approval and policing procedures, for the good of all.
There is a real danger that the standards setting process will be damaged by political infighting and lack of understanding across Europe about the impact of decisions taken.

5.3 Traceability and Disease Control.

The best systems are put in place through cooperation and collaboration between government and all sectors of the industry. This is most evident in Denmark and Australia, where there seems to be an attitude that everything is done for the good of the industry and work is done in a spirit of openness that is sometimes absent in the UK.
A countries attitude to disease control is influenced by the level and number of serious disease outbreaks, the value of export trade and the relative strength of the industry as a contributor to gross domestic product.

Information about cattle and sheep to deliver traceability and disease control must be integrated.

If the object of traceability is to deliver information about who keeps animals, where they are kept, where and when they move and the disease status of those animals through rigorous testing and inspection processes then Northern Ireland and Denmark are the only countries I have found that achieve this through a fully integrated database system.

Using integration and functionality as benchmarks, in my opinion the Animal and Public Health Information System (APHIS) in Northern Ireland is among the best traceability systems in the world. I did not do an in-depth economic analysis of the cost of administering the systems, but for what it does in an integrated manner, nothing available delivers more integrated functionality.

5.4 Herd/Flock Improvement

While the objective was not to do a comparative study of herd or flock improvement systems, but to look at what was possible, the conclusions are

- objective selection of breeding stock requires lots of data and a good system for processing that data to deliver usable, relevant and reliable breeding values.
- In my opinion, New Zealand and Canada have good systems. Denmark and Australia have better systems. Ireland has the best system, with uptake rising steadily.
- The UK has a system which could work very well, but lack of integration and lack of use are issues that must be addressed by beef and sheep sector leaders if real progress is to be made.

When using data, the following points are evident:

- the more data that can be integrated into genetic analyses, the better
- when data can be collected automatically at source that is better still
- When systems allow data to be integrated automatically from a variety of sources, wow.

The UK has considerable work to do in comparison with the rest of the countries I visited when it comes to the use of science to select breeding stock. Without doing an in-depth analysis it is clear that the proportion of breeding stock (dairy, beef or sheep) that are

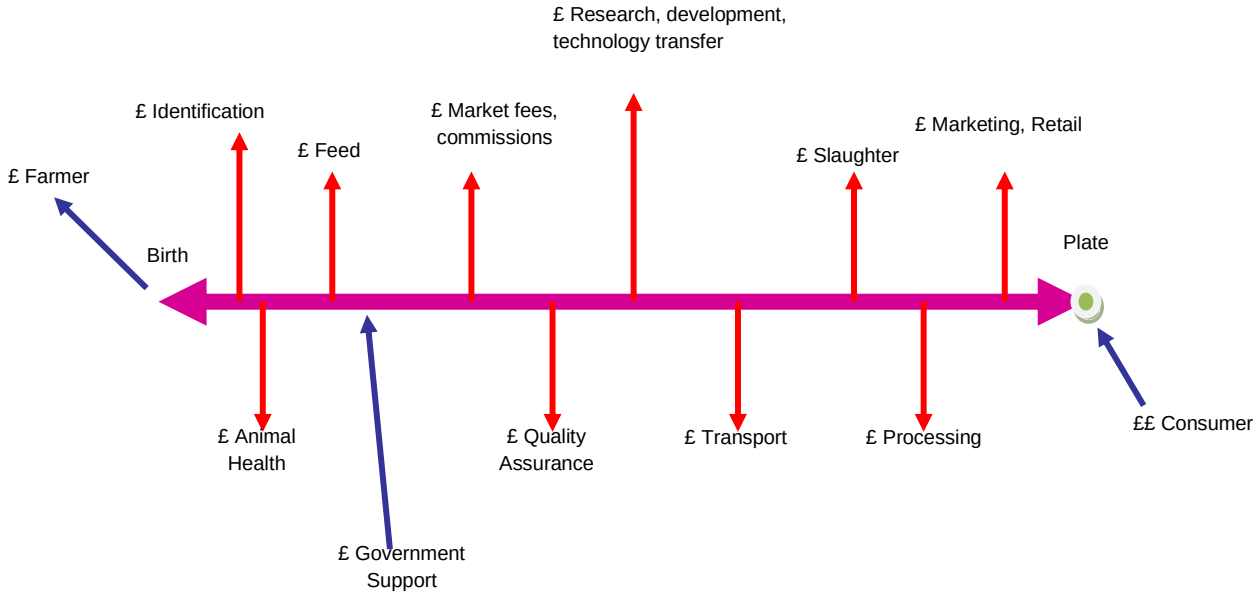
performance recorded is significantly lower than in any of the countries I visited.
While we have some of the best individual stockmen, some fantastic looking stock, the greatest range of genetic diversity in terms of breeds and traits, good universities, good agriculture colleges, intelligent and able farmers, we still lag behind in our ability to utilise these resources to their full extent.
The structure of the UK seedstock or pedigree industry for beef and sheep does not lend itself to making the sort of genetic selection decisions possible in larger scale operations in other countries. The relative strength of breed societies in relation to the herd and flock improvement organisations and the farmer representative organisations is an issue that must at least be considered.
Breed societies by their nature are self interest groups, and it is not always clear that their self interest is aligned with the goals of the commercial beef and lamb sector.

The best herd development services organisation is, I believe, in Ireland, with the Irish Cattle Breeding Federation (ICBF). It may be because it is the most recently formed and has had an opportunity to learn from all of the others, but I believe it is a combination of industry leadership, government support, excellent employees, good business plans, a little bit of luck, and proof that the system will actually deliver real benefits that have made it a success.
Starting with dairy cattle, proving the system worked, progressing to beef and then to sheep, is a strategy that appears to have succeeded.
Another reason for success is integration – they are closer to the "one version of the truth" model than any other nation.
The Danes could argue that their system has all of these elements, and I would be happy to listen to their case. I might even be convinced.

5.5 Value of data to farmers.

One thing that became clear while travelling and talking about red meat supply is the need to look at distribution of value with a supply process.

A diagram that sparked an idea was the NZ National Animal Identification and Tracing (NAIT) System information flow diagram, and I looked at this diagram from a financial stand point.



The seems to be only 2 ways for value (i.e. money) to enter the process, either through what the consumer pays for the final product, or through some form of government support.

Every other element of the process takes out value through cost of activities. It could be argued that value is added through an increase in the amount paid by the customer for the product and that could well be the case, but what is clear is that the farmer is the last one in the chain to realise any value.

In modern supply chains the farmer is far removed from the consumer and has little or no control over the final price, and little, if any, control over how much each of the other contributors removes or adds before he or she gets what is left.

While benchmarking and information management at farm level can make a significant contribution to improved performance on farm, farmers can legitimately ask if all other contributors' benchmark, share information, share value, encourage openness and collaboration, and ultimately foster partnership and trust.

My sense is that moving forward with food production at international level; distribution will become a key topic. This will be at 2 levels - distribution of food and distribution of value.

I firmly believe, given the technology available and the research being done, capacity for food production will not be problem. Distribution of the food will become increasingly important as the

effects of both population growth and changes in climate take effect.
Distribution of the value created in food production is and will be an important subject for people at all levels in the supply system, from farmers to international governments, to grapple with.

To try and distil my conclusions into a simple message I would urge people to consider the following:

1. Technology must be used in the proper context at international, national and farmer level. Get good advice and plan properly before implementing a solution.

2. Farmers must performance record breeding stock, with clear objectives for on farm improvements. There must be a clear steer from the commercial beef and sheep production sectors on what type of breeding stock is actually required. Leadership on this issue is vital for success.

3. At farmer level, don't worry about the big picture too much until you have your own house in order – keep it simple! The biggest change you can make is in how YOU deal with YOUR challenges.

4. One of the most important things a farmer can do is elect good leaders and educate them effectively to ensure negotiations with governments, supermarkets, consumers, abattoirs, and anyone else with a role in a supply chain, are balanced.

5. The UK commercial sector must properly challenge the pedigree sector to produce commercially effective breeding stock.

6. The pedigree sector must challenge the scientists and government to provide the data collection, analysis and reporting structures to allow objective selection to become a reality.

7. Collecting any piece of data more than once, and storing it in more than one place is a waste of your money, and mine!

Acknowledgement

I would like to thank the Nuffield Farming Scholarships Trust for allowing me the privilege of joining their number as a 2008 Nuffield Farming Scholar, and the Thomas Henry Foundation for their generous support in allowing me to complete an extensive travel itinerary.

I am grateful to the directors and management team at the College of Agriculture Food and Rural Enterprise (CAFRE) for their support and for allowing me the time to complete my Nuffield travels, particularly Director, John Fay, Assistant Director, Sam Kennedy and Branch Managers, Nigel Murphy and Ian McCluggage.
To all the colleagues who made sure my work was completed while I was away, my sincere thanks.

Anyone who undertakes a Nuffield experience will understand that the real hardship is with those left at home to make sure life and business continues.
My parents have always encouraged me to take on challenges, even when they know they have to work harder. My father in particular doesn't realise the inspiration he is by the way he supports me.

Missing family is difficult, but coming home to our children from all of the trips and enjoying the welcome hugs is special.

Before applying for a Nuffield Scholarship I received support, guidance and encouragement from Northern Ireland Scholars Cormac McKervey, Will Taylor and Campbell Tweed. Campbell, Michael McGirr and Oonagh Chesney put me through a mock interview that stood me in very good stead when I faced the real thing. I am indebted to all of them.

The appendices contain a list of all the people I met and had discussions with, but a few deserve mention for putting up with me for putting me up!

Mark and Claire Graham and their sons Edward and William, in Narrogin, WA. They were my first Nuffield family and they really set me off running through both hospitality and introducing me to some amazing people.

Murray, Emma, Ben, Emma and Georgia Sholz , Culcairn, NSW.

Sam, Sabrina and Amelie Archer, Gundagai, NSW

Karen, Michael, Conor, Aiden and Ruairi Wade, Maitland, NSW

Rob Kelly and Fiona Macarthur, now Mr and Mrs Kelly, Guyra, NSW

Lyndon and Davina Mulligan, daughters Michaela and Natasha and Davina's sister Georgia, Moree, NSW. (Sorry we missed the other girls).

Craige and Roz MacKenzie, Methven, NZ

James, Janine, Corin and Matthew Parsons, Broadwood, NZ

Steve, Vanessa and Ava Larocque, Three Hills, Alberta

Bryon Wolters, Remington Land and Cattle, Del Bonita, Alberta

There are many, many others who took time to talk to me, show me what they do, introduce me to colleagues, recommend visits, arrange visits, ferry me to and from visits, and generally make my travels the amazing experience it was. Thank-you all.

My cousin and good friend Eddie-Joe Hamill, who is now State Director for the Farm Services Agency in the state of Missouri, joined me for 2 weeks of travel in Australia and New Zealand. He attended many of the meetings and visits and his contribution to both the discussions and to my enjoyment of the trip was something I am very grateful for.

Finally and most importantly, to my wife Bridget whose love and support is unwavering and whose ability to love and care for our family is boundless, I can only say thank-you. Without your love and encouragement and your faith in my ability I wouldn't have thought about setting off on this amazing journey.

Appendix 1 - Bibliography

During the course of my study I read many of the reports by other Nuffield Scholars.

Those that influenced my thinking and help clarify my thoughts on my chosen topic include the following:

The Opportunity for Composite Flocks within the UK Sheep Industry, Samuel Boon

Maximising Suckler Cow Profitability Using British Native Breeds, Robert Parker

Easier managed sheep and beef cattle; simplified, profitable and productive sheep and beef farming, Charley Walker

Objective measurement in the Australian Prime Lamb Industry, Andrew Heinrich

How to Fully Utilise and Rapidly Improve the Australian Maternal Ewe Flock (including Merinos) to Ensure Continuity of Supply Into Our Valuable Meat and Wool Markets, Andrew Bouffler

Production verses Marketing: where should Australian wool producers focus? Robert Kelly

The New Industry Transformation. How to Redesign New Zealand's Red Meat and Wool Supply Chains, *James Parsons*

The web links in the table below will direct you to sources of information about many products and services offered by companies and organisations involved in the field of livestock traceability and red meat supply.

Meetings and web links

GREAT BRITAIN	Richard Webber	Shearwell Data	www.shearwelldata.co.uk
	John Bailey	UKEIDA	www.ukeida.org.uk
	Jim White	Earlsmere	www.earlsmere.co.uk
	Daniel Brierly	Dalton	www.dalton.co.uk
	Philippe Dubois	Gallagher Europe	www.gallagher.co.nz
	Nick Hayes	Newline ASP	www.auctionmarts.com
IRELAND Oct-08	Barry Lynch	Irish Farm Computers / Agrinet	www.agrinet.ie
	Brian Whickham	ICBF	www.icbf.com
	Andrew Cromie	ICBF	
	Sean Coughlan	ICBF	
	Martin Burke	ICBF	
	Seamus Hanrahan	Teagasc, Athenry	www.teagasc.ie
	Tim Keady	Teagasc	
AUSTRALIA Nov - Dec 08	Mark Graham	Farmer, Nuffield	
	Peter Trefort Snr	Hillside Meats / MLA	http://www.hillsideabattoirs.com.au/
	Dawson and Greta Bradford	Hillcroft Farms WAMMCO	http://www.hillcroftfarms.com/
	Dave Saunders	Midland Market / WAMIA	http://www.wamia.wa.gov.au/
	Renata Paliskis-Bessell		
	Bob Vassallo	DAF WA, Bunbury	http://www.agric.wa.gov.au/
	Farran Dickson		
	Jack Nixon		
	Peter Trefort Junior	Hillside Meats	
	Ashley Locke	Landmark, Narrogin, WA	http://www.landmark.com.au/
	Matt Thompson	Feedlot	http://www.narroginbeef.com/
	Adrian Veitch	Allstock	http://www.allstockwa.com.au/

Tony Britt Ken Evers Tom Glynn	DPI, Victoria	http://new.dpi.vic.gov.au/
John and Anne Wyld	Koolomurt Stud / NLIS / MLA	
Robert Wyld	Sapien Technology	http://www.sapien.com.au/
Harry Lawson	Lawson Angus	http://www.lawsonsangus.com.au/
Murray Sholz	Farmer, Culcairn, NSW	
Vaughan Smith	Wondonga Mart	http://www.nvlx.com.au/
Graham ? Will Cowley Paul Troja	Rockdale Beef Rockdale Beef / MLA	http://www.rockdalebeef.com.au/
Sam Archer	Farmer / Consultant, Gundagai, NSW	
Aaron Iori	MLA / NLIS	www.nlis.com.au
Robert Kelly Fiona MacArthur	Farmer / Researcher Mt William, Guyra NSW	
Steve Skinner Gill Stassen Cory Wilson Richard Apps	Breedplan ILRIC Saltbush Software Lambplan	http://breedplan.une.edu.au/ http://www.ilric.com/ http://saltbush.une.edu.au/ http://www.sheepgenetics.org.au/lambplan/
Lyndon Mulligan	Yamba Farm	
Pat Gunston Nathan Stewrat Brad	Allflex Australia	www.allflex.com.au
Paul Gibson	Australian Country Choice	http://www.accbeef.net.au/
Gus Moffet	Farmer, Aratula, QLD	

	Frank Finlayson	Aleis	www.aleis.com.au
	John Finlayson Jnr		
	Brian Clayton	Aleis	
	Ian Henderson	Dalby Market	
NEW ZEALAND Dec-08			
	Craige and Roz Mackenzie	Farmer, Nuffield, Methven	
	Stefan and Teressa Mavor	Farmer, Omaru	
	Peter Amer	Abacus Bio	http://www.abacusbio.co.nz/
	Jude Sise		
	Anna Campbell		
	Mark Oliver		
	Simon Glennie		
	Jack Cocks		
	Nevill Jopson		
	Peter O'Neill	Abacus Bio	
	Murray Rohloff	Farmer, Consultant Breeding Specialist, Gore	
	Danny Phillips	Alliance, Mataura	http://www.alliance.co.nz/
	Ray Welsh	Farmer	
	Paul and Suse Corboy	Farmers	
	Stephen and Blake	Dairy Farmers	
	Owen Boyes	Gallagher NZ	http://www.gallagher.co.nz/
	Geoff Pooch		
	Rob Ford	LIC, Hamilton	http://www.lic.co.nz/
	Garth Anderson		
	Ralph Cocklin		
	Bill Montgomerie	AEL	

	Craig Purcell	NAIT	http://www.nait.org.nz/
	Peter Maxwell Peter Davey	Innovation Waikato	http://www.innovationwaikato.co.nz/
	Ted Coates	Dairy Farmer / NAIT, Morris	
	James Parsons	Farmer / MWNZ Director, Broadwood	http://www.meatandwoolnz.com/
	Alec Jack	Farmer, Nuffield, Pakaraka	
	Brendan O'Connell Nick Howarth	Trutest, NZ, Auckland	http://www.tru-test.com/
	Mark Powell	EDiT ID	http://www.editid.co.nz/
CANADA May-09	Steve Larocque	Farmer / Nuffield	http://www.beyondagronomy.com/
	Rich Smith Reynold Bergen	Alberta Beef Producers	http://albertabeef.org/
	Doug Fee	Canadian Angus Association	http://www.cdnangus.ca/
	Stuart and Ed Thiessen	Namaka Farms	
	Dave Moss Pat Mergen	Livestock Identification Services	http://www.lis-alberta.com/
	Ron Axelson	Alberta Pork	http://www.albertapork.com/
	Elan and Scott Lees	Soderglen Farms	http://www.soderglen.com/
	Kerry St Cyr	CCIA	http://www.canadaid.com/
	Rob McNabb	Canadian Cattlemens Association	http://www.cattle.ca/
	Jason, Brian and Don Danard	Calgary Stockyards, Strathmore	http://www.calgarystockyards.com/ http://www.teamauctionsales.com/

	Mike and Scott	LIS Reps	
	Steve Primrose	CCIA	http://www.canadaid.com/
	Bryon Wolters Rob and Cody Gary Rairden	Remington Land and Cattle Cowboys Manager	http://www.remingtoncattle.com/
	Mitch Currie	Red Angus Breeder	
	Rod and Shelley Bradshaw	Farmer / Nuffield	
	Mabel Hamilton Gavin, Colton and Quinn	Belvin Angus / CCIA	http://www.belvinangus.com/
	Heather Bruce Steve Moore	University of Alberta	http://www.ales.ualberta.ca/
	Brent McEwan Rick Frederickson	Dept Agriculture Food and Rural Development, Alberta	http://www.agric.gov.ab.ca/
	Jennifer Aalhus John Basarab	Lacombe Research Centre	http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1180634888974&lang=
	Chris Parry Morris, Sandra and Henry Thalen	Morsan Dairy	http://www.morsan.com/
	Blair Vold Nanita Blomquist	Vold and Vold, Auctioneer CCIA	http://www.vjvauction.com/
	Leaders	Hutterite Colony	
	Sherri Marthaller Rob Pedersen Chris Thompson	Cargill Meats, High River	http://www.cargill.ca/
DENMARK Oct-09	Ole Klejs Hansen Jens Peter Hansen	Danish Agriculture Advisory Service / ICAR	http://www.landscentret.dk/English/English.htm

Carl Aggerbo	
Lene and Fleming Jensen	Dairy Farmer
Asder Latefod	Dairy Farmer
Andre Keters	Dairy Farmer