



Supply Chain Management -

Food Safety Traceability - Beef

**A Working Example of the use of
EAN Numbering and Barcoding in
the Meat Industry with validation
by DNA Finger Printing Systems**

Final Report

A project involving:

Australian Country Choice
Coles Supermarkets
Meat and Livestock Australia

20th October 1999

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1 Overview

This report combines an analysis of the “Supply Chain Management” existing methods and results of a trial project for Australian Country Choice.

Australian Country Choice is one of two companies on the eastern sea board that is a primary supplier to Coles Supermarkets for beef (and veal) cuts and value added products. The company is a family owned business that started supplying 70 beef cattle per week 20 years ago to its present position of processing 165,000 animals per year and producing over 28,000 tonnes annually of value added meat products.

The company owns as well as controls breeding properties, back grounding properties, feed lots and processing facilities. This gives the company a high degree of vertical integration as a meat production company. This level of vertical integration is very unusual in the meat industry. The result is a reduction in profit centers and an increase in cost centers. The traditional systems have up to 9 profit centers where as the Australian Country Choice system has one profit center and 9 cost centers. This type of cost control system allows for accurate costing and control of cost centers. This is shown as follows:

Traditional System (Profit Centers)

Breeding property (1)
 Transport (2)
 Back Grounding (3)
 Transport (4)
 Feedlot (5)
 Transport (6)
 Slaughter (7)
 Boning/ Processing (8)
 Distribution (9)

ACC System (Profit Centers) [Cost Centers]

Breeding property [1]
 Transport [2]
 Back Grounding [3]
 Transport [4]
 Feedlot [5]
 Transport [6]
 Slaughter [7]
 Boning/ Processing (1)[8]
 Distribution [9]

At a strategic level the company policies focus on addressing two main areas; customer service to their single customer Coles Supermarkets and cost per kilogram of processed product.

The areas of focus that this report addressed are the problems identified with the following:

- Common machine-readable identification of animals and product through the supply chain.
- Use of Standard Number systems for locations, products and status.
- Use of EDI for passing data between customers and suppliers.
- Validation systems for product identification for traceability.

1.1 Background

Throughout the meat industry there has been a growing need for the ability for producers and processors to provide evidence of food safety (product) traceability to consumers. Consumers world wide now have an expectation that retailers are able to identify the origin of the food they market. The growing pressure from consumers has forced the need for a review of the concepts and methods available to provide this evidence of traceability. This review of the industry has highlighted the concept of supply chain management and the importance of correct and cost efficient product identification through the supply chain. The cost benefits for correct control for product from source to consumer has become a major management topic in the grocery industry supply chain.

For food safety traceability in the meat industry to sustain consumer confidence it must embrace a “Paddock to Plate” philosophy, incorporating best practice strategies for supply chain management, food safety and food quality programs.

Many attempts have been made in the past to implement traceability in various stages of the chain, however no system is currently in place on a broad scale in Australia or overseas. Other programs that have been established at specific plants are intended to provide a simple system of single carcass boner/ slicer/ packer work stations. These systems provide a simple and low level of reliability of primal cuts linked to specific carcasses.

For a Food Safety Traceback system/ Supply Chain Management system to be successful it must cover a broad scope of activities and can be considered to be made up of a number of segments that comprise the following:

- Birth ID, Property of Origin and veterinary/ feeding history records.
- Transport/ backgrounding/ feedlot ID and tracking records.
- Slaughter Floor linking of Live Animal ID/ history collection and linking to Carcass Body ID.
- Carcass body linking to Primal Cut by individual or batch.
- Primal Cut linking to Carton / Pallet by individual or batch.
- Carton cross linkage to Carcass Body by individual or batch.
- Value Add/ By Product (offal, etc) linkage to Carcass Body by individual or batch.
- Retail Packs (and Case Ready – Modified Atmosphere Packaging) linked to Carton linked to Carcass Body by individual or batch.

Each of these project segments must be able to operate independently as well as linking to each of the corresponding segments either in sequence or by passing intermediate segments.

The key points that need to be considered for the implementation of a food safety traceability/ supply chain management program include:

- The cost per kilo of processed meat for implementation and maintenance of a traceability program.
- The use of numbering and machine read labeling standards that are common between trading partners (e.g. Grocery industry supply chain)
- Ease of implementation across different plants and operating methods.
- Compliance to the National ID Programs eg Current Meat and Livestock Australia project
- The reliability and accuracy of the program.
- The ability to audit the program.
- Verification of product identification and fraud detection.

2 Analysis (Current Position)

A review was conducted of the methods for product identification and control from live animal to carton product through distribution. The major activities and the related companies or organisations involved in these processes were identified as follows:

- Australian Country Choice Livestock Management (Breeding property, Back Grounding, Feedlot and transport).
- Q-Meat – Slaughter service provider (Ipswich – veal and Cannon Hill – Beef)
- Australian Country Choice Production Management (Beef Boning, veal boning, value add operations [Sausage, corning, stir fry, diced, etc] and distribution centre [Prepares orders for issue to Frigmobile])
- Frigmobile (Chilled and frozen distribution centre to 80 Coles Supermarket stores)
- Coles Supermarkets (final preparation for case ready retail packs)

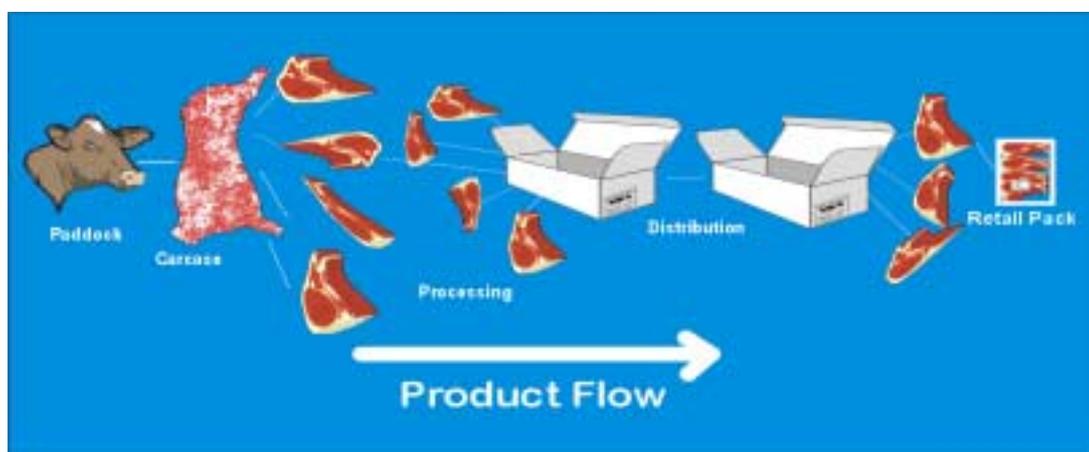


Figure 1 – Graphical Representation of Product Flow

The analysis involved reviewing the operational methods as well as the control system in place for each activity areas. The analysis focused on areas of problems and the validation methods used to ensure undetected problems did not occur. The analysis was conducted using interviews with the management of the various sections and lengthy direct observations of the different areas. The largest and greatest amount of time was spent on the areas of carcass processing and distribution to retail.

2.1 Livestock Management

Livestock management involves management of the company owned cattle as well as purchase of cattle to meet operational quotas.

Yearly cattle type quantity predictions are formulated to determine the breeding, back grounding and feedlot capability requirements. These are set at a strategic level and result in the acquisition of property, equipment, etc.

Weekly operational cattle type and quantity demands are formulated based on customer demand requirements (from Coles Supermarkets) and current inventory levels. The processing facility needs to process approximately 2500 cattle per week to maintain the production cost per kilogram of processed

meat. The resulting weekly considerations focus on what type and number of cattle are available, at what price, to meet both the 2500 quantity demand and the customer (Coles Supermarkets) product type demand (eg grass feed, grain feed, MSA grade, saving grade, etc).

The major areas of concern identified were the lack of individual animal identification being passed forward to slaughter and the quality traits determination from visible traits to objective grading traits. The traits issue is a problem that occurs as a result of trying to guess the likely grading result of a carcass by visual examination of the live animal. The current methods for animal source identification was through tail tags (identification of last property of control of the animal) and property management ear tags. Identification of origin of source of a specific carcass was very difficult and the ability to provide useful grading feedback on an animal by animal basis was impossible.

2.2 Slaughter Management

Once the live animals have been transported to the abattoir they are marshaled by lot, ready for slaughter. Property and like animal types are grouped into each lot. As they are slaughtered the carcass is given a carcass number which is linked to the lot number. This is used to provide the feedback to the property by lot. A carcass ticket is attached to each carcass (1/2 animal) and an electronic record of the weight and other data recorded.

The electronic record was sent on a daily basis to Australian Country Choice and the carcasses delivered directly into the chillers from the adjoining Q-Meat Cannon Hill facility or trucked for the veal product from Q-Meat Ipswich. Inventory management from Q-Meat was totally manual and hand written dockets issued for the physical product. Australian Country Choice scans the barcode on each carcass ticket to bring the carcass into inventory and to reconcile to the electronic record that had been sent. Neither the carcass ticket barcode or the EDI matched any standards, both were proprietary systems.

Q-Meat Cannon Hill (for beef) and Q-Meat Ipswich (for veal) conduct the slaughter. Q-Meat is a government owned service works that charge a rate per animal for slaughter.

The major area of concern identified was the high error rate of the electronic record and carcass ticket actually matching the individual animal. A system was implemented to electronically capture each carcass ticket number and to measure the cold weight after chilling. This data was reconciled to the electronic data provided by Q-Meat. There is a percentage allowance for shrinkage for each carcass taken into consideration. The result was that up to 5% of the carcasses had wrong carcass tickets. The typical errors included 2 or 3 left (or right) side carcass tickets for the same carcass body number. Carcasses weighting much more or much less than the carcass ticket displayed. This indicates that the carcass ticket was placed on the wrong carcass. A second problem was the data on the carcass ticket. The barcode had a high error rate of scanning. Carcasses could have a stated weight of 220kgs on the carcass ticket but when scanned the weight showed up as 1300kgs. An investigation showed that the type of barcode being used was an interleave 2 of 5 and that there was no error detection check digit. Numerous examples were found and when the issue was taken up with Q-Meat the answer was that they did not scan the carcass ticket for any reason.

These types of errors cast doubt on the ability of the system to provide suitable levels of both inventory management and product traceability.

2.3 Australian Country Choice Production Management

Once the carcass arrives at Australian Country Choice it is graded and data captured electronically through the use of the bar-coded carcass ticket. The data is then reconciled to the electronic record from Q-Meat. This builds up a set of data about each carcass. The grade is applied to the carcass and the carcasses marshaled by grade and weight range. The result is an electronically generated production schedule that is issued to the boning room. The Production Manager determines the boning room production sequence and the carcasses are feed into the boning room. The boned product is packed into suitable cartons based on customer demands, inventory levels and product type produced. This system of inventory management is based on lowest product to meet the customer product demands. As carcasses contain lots of different cuts and grades the inventory generated is often the result of the process more than the desire to produce specific product. I.e. The customer would like lots of MSA 5 star Tenderloins and no un-graded knuckles or Thick Flanks from a carcass. Carcasses do not work that way and along with the choice cuts (approximately 4 per carcass) there are a number of lesser cuts (up to 10 per carcass). The customer must sell the lesser cuts as well as the choice cuts. Inventory is managed as a volume of the different cuts and value added product (sausages, corned meat, diced beef, etc).

There is a chilled product distribution center on site that holds 40,000 cartons. Product is prepared into pallets of same product type and grade. These pallets once filled are stored until a number of pallets are prepared and then picked for storage and distribution through Frigmobile. Product that is to be frozen such as trim and other export product is directly transferred to Frigmobile for blast freezing. Each order to be filled for issue to Frigmobile is electronically prepared and each carton scanned to capture the serial number and validate product type and oldest use by dates. An EDI is sent to Frigmobile for each shipment as well as a physical delivery docket.

The areas of concern identified were the lack of adopted standards for the Barcodes used on the carton labels, lack of recording carcass body numbers as they entered the boning room and the lack of any means to relate carton serial numbers to carcass body number. Other issues identified included duplication of carton serial numbers, carton scan errors and lack of product source identification/batch controls.

2.4 Frigmobile

Frigmobile provides the means for distribution to the various Coles Supermarket retail stores (80 stores from northern NSW to north Queensland) and export product. As product arrives at Frigmobile the product is scanned into the distribution system and matched to the EDI that was sent from Australian Country Choice. A return EDI is sent as product is picked and sent to the various retail stores. There are various logistics control systems in place and strategic policies for Frigmobile. It is not the scope of this report to address issues at Frigmobile.

2.5 Coles Supermarkets

When product is received at Coles Supermarkets it is directly taken into the meat cold stores on site. There are very few records generated of the receipt of the product as it is controlled through the distribution system. Once the cartons are on the shelves at the retail store they are opened as needed and used as required. Inventory levels are manually reviewed on a day by day basis and re-stocking requests issued to Coles Supermarket distribution control center. Coles Supermarkets Head Office sets Inventory levels for quantity and product type and the stores just maintain the specific levels.

Retail display stock is the driving force behind back store processing. As display stock is purchased by customers, the back store replenishment preparation occurs by picking primal cuts from the relevant cartons and preparing the primal cuts as retail ready packs.

The areas of concern identified at retail are the lack of control of the carton product and product traceability. Once a carton is opened for retail pack preparation from primal cuts the carton lid, along with the carton label is destroyed. The carton may remain for up to 14 days on the shelf in the meat cold store. This means that a retail pack may come from any one of a number of un-identified cartons for up to a period of 14 days. This makes product source identification difficult and product recall very expensive. As up to 14 days of retail prepared product may need to be recalled. This can equate to up to 6000 kilograms of retail product through a single retail store over a 14 day period.

2.6 Conclusion of Analysis

The existing methods for product identification and specific unit tracking through the supply chain from property to retail are very ineffective in delivering product food safety traceability and supply chain management.

The major points identified are as follows:

- Lack of consistent machine readable identification systems for animals, carcasses and carton product.
- Lack of use of standards for numbering and data transfer.
- Lack of validation system for proving product source and identification.

Without the means for product identification, source determination and system validation inventory management can best be considered as a hit and miss system where product integrity can not be guaranteed.

3 Recommendations

A recommendation was put forward to design and implement a demonstration project by Australian Country Choice with assistance from Meat and Livestock Australian and support from Coles Supermarkets to determine a best practice solution to the supply chain management for beef. The project needed to address the requirements of food safety traceability, international trading standards and product identification. A system for validation of the product identification from paddock to plate needed to be included.

The project proposal consisted of an analysis of existing traceability projects, international trading standards and current meat traceability issues being raised in Europe. Specifically the project needed to include development of systems for identification, trial of the systems, and validation testing of the system. The project commenced formally in July 1999 and was completed in early October 1999.

A copy of the project Gantt Chart is included as an Appendix.

4 Project Outcomes

A demonstration project was undertaken by Australian Country Choice with assistance from Meat and Livestock Australia and support from Coles Supermarkets.

The project included defining and demonstrating a supply chain management program that provided a Food Safety Traceback System that addresses the above requirements in a framework that is commercially viable and provides an absolute level of independent integrity.

To this end the project has been completed and the outcomes recorded through video and supporting documents.

An Appendix showing the summary of the previous and current traceability projects that were researched has been included.

4.1 Supply Chain Management Model

The model for product identification, information flow and validation was defined as follows:

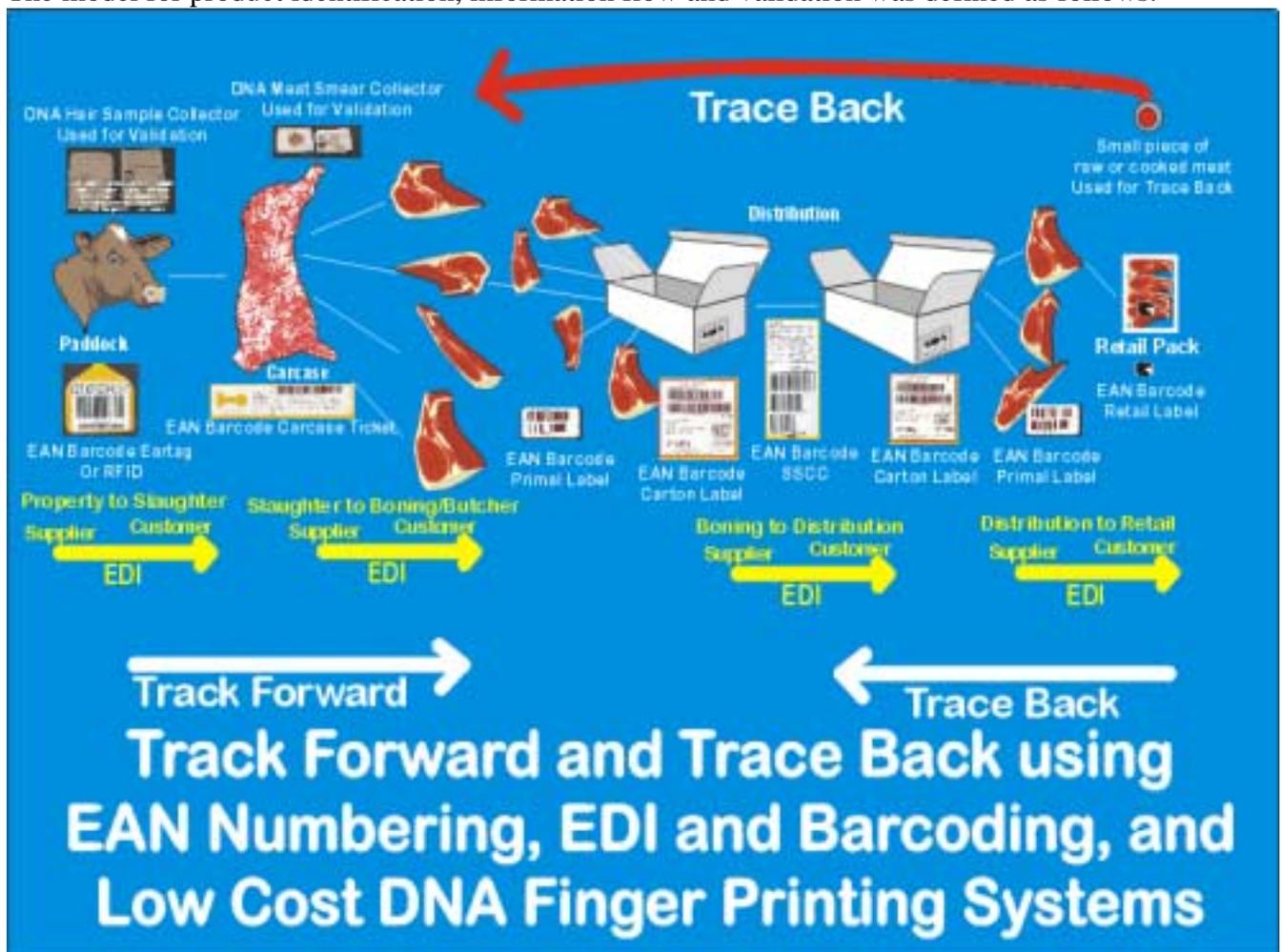


Figure 2 – Graphical Representation of Demonstration Project

The results of the project showed that a food safety traceability system based on DNA fingerprinting could be easily implemented into any processing organisation. The system is totally scaleable from basic or simplistic to complex. The use of EAN numbering and barcoding provided tools to facilitate easy linkage between live cattle and primal cuts and forms the basis of tracking through the supply chain.

The demonstration project included a number of aspects as follows:

- EAN numbering and barcoding for Ear Tags for Live Cattle ID at Slaughter
- DNA hair sample collection and archiving for validation of live cattle ID
- EAN numbering and barcodes for Carcase tickets (carcase ID)
- DNA meat smear sample collection and storage for carcase ID validation
- Barcode scanning and sequence recording of carcasses into the boning room
- EAN numbering and barcoding for primal cuts (unique serial numbers)
- EAN numbering and barcoding for carton product (unique serial numbers)
- EDI transmission of shipment details and generation of SSCC for shipments
- DNA finger printing validation of retail product to source carcase and live animal ID.

As a result of the project a number of the project parts have been adopted for on going operations, these include the following:

- EAN numbering and barcodes for Carcase tickets (carcase ID)
- DNA meat smear sample collection and storage for carcase ID validation
- EAN numbering and barcoding for carton product (unique serial numbers)
- EDI transmission of shipment details and generation of SSCC for shipments
- DNA finger printing validation of retail product to source carcase and live animal ID.

The project involved working with EAN Australia and representatives of the Meat Industry groups to develop a set of Meat Industry Guidelines for EAN Numbering and Barcoding. This guideline has been completed in draft and issued to industry for comment. A copy is available from the EAN Australia Web Site, and Meat and Livestock Australia.

4.2 Project Details

The two main components of the system are the EAN numbering and Barcodes, and the low cost DNA finger printing system.

The use of EAN numbering and barcoding provided a stable basis that met the requirements for machine readability for carcass, carton and primal labeling and tracking. The EDI EANCOM standards provided a means for electronically transferring carton identification data (unique serial numbers) through the supply chain. The use of EAN barcodes for live cattle identification was also tested as a means of quickly and cheaply capturing live ID at slaughter.

A number of trace backs using DNA finger printing were conducted during the project. Linkage between retail cuts and carcass numbers were determined using product type (carcass grade) and production date (carton production date, carton batch numbers, serial numbers and product type). The first test involved 10 primal cuts to be matched to specific carcasses from a batch of 50 carcasses. This was a total of 60 analysis. The results indicated which retail cuts came from which specific carcass body number. Therefore the source carcass were positively identified for the retail product. Additional DNA finger printing trials have been conducted on primal cuts, sausages and beef patties.

The demonstration project identified that the system was scalable from very simple to very complex depending on the requirements of the plant. A complex system provided the highest level of live identification pass forward to the primal cut. The basic or simplest system provided little pass forward of the live identification and relies on the DNA finger printing to identify a source carcass when a trace back was required. The two extremes are shown in the following table:

Processing Considerations

<u>Highest level of identification pass forward</u> Highest capital and operating costs – lowest cost for DNA validation. (Spend Now – Save Later)	<u>Lowest level of identification pass forward</u> Lowest capital and operating costs – highest cost for DNA validation. (Save Now – Spend Later)
Barcoded ear tag/ RFID on every live animal	Property lot identification at slaughter
DNA hair sample for live ID validation	Single day or lot batch size
Collection of live ID at slaughter	Lot based live identification
Collection of DNA meat smear at grading	Collection of DNA meat smear at grading
Scan carcass ticket into boning room	Production date batch size for carton product
Single body boning	No changes to traditional work practice
Primal cut serial number labels	Low capital and operating costs
Primal linking to carcass ID	Carton label batch identification
Carton serial numbers	Simple to implement
Major changes to work practice	Less opportunity for human error
Complex to operate	Simple to maintain
Subject to human error	High cost for DNA analysis – costly to validate
High capital and operating costs	
Large IT investment	
Low cost for DNA analysis – easy to validate	

Operationally every processing plant will be somewhere between these two extremes. A representative cost analysis is as follows:

Cost Comparisons

<u>Cost area</u>	<u>Complex System</u>	<u>Basic/ Simple System</u>
Ear tag (RFID or Barcode)	\$5.00 - \$1.00	n/a
DNA hair sample for live ID	\$0.35	n/a
Archive cost live (based on 500 per day)	\$0.20	n/a
Live ID collection at Slaughter	\$0.25	n/a
EAN Carcase Ticket (existing at most plants need to update to EAN)	existing	Existing
DNA Meat Smear Collector	\$0.14	\$0.14
Collection of meat smear	\$0.25	\$0.25
Archive cost carcass (based on 500 per day)	\$0.05	\$0.05
Scan into boning room	\$0.25	n/a
EAN carton Label (existing in most plants need to update to EAN)	existing	Existing
Primal Label (30 per body)	\$0.60	n/a
Application of label (30 per body)	\$3.00	n/a
Capital cost amortized over 5 years	\$1.50	n/a
Total cost	AU\$11.59 to AU\$7.59	AU\$0.44
Cost per kg of meat based on 170kg SMY	AU\$0.068 to AU\$0.045	AU\$0.003

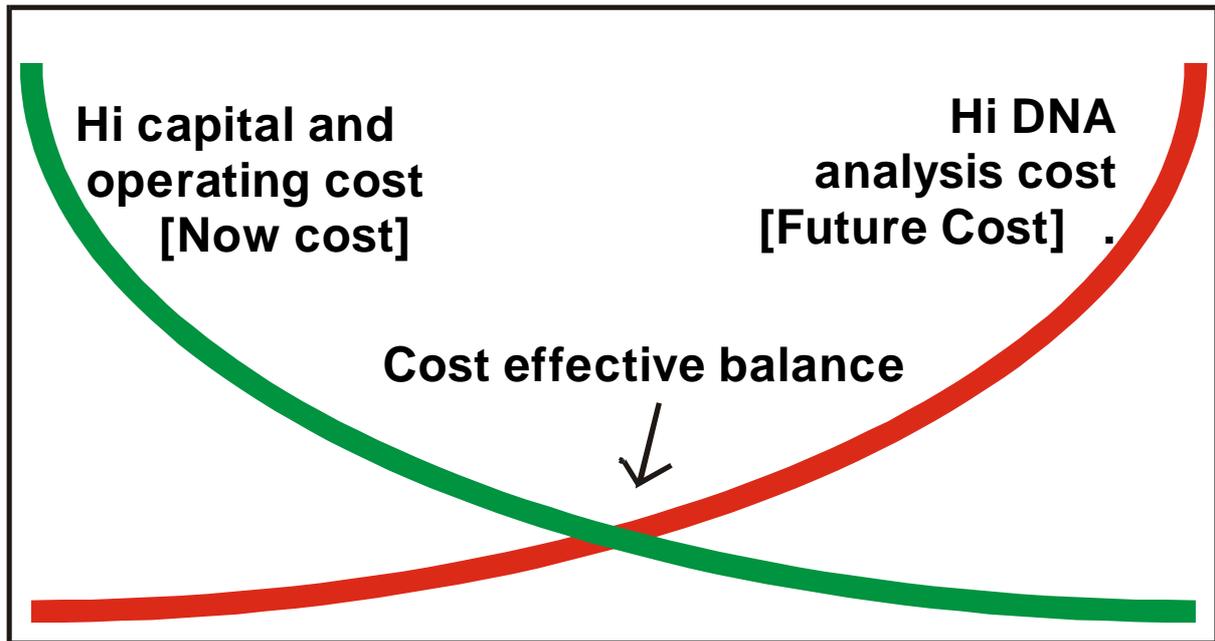
If the plant is processing 3000 head per week with a saleable meat yield (SMY) of 170 kilogram per head, the cost per kilogram of processed meat would be between AU\$0.068 and AU\$0.045 for the complex system and AU\$0.003 for the simple system.

The costs of the DNA consumables include one DNA analysis for every 1500 DNA meat smear collectors purchased. This equates for a plant processing 3000 head per week being able to conduct a DNA finger printing system validation audit on 20 carcasses to 1 meat sample every 10 ½ weeks.

The optimal system is somewhere between the complex and the simple system. Each plant must determine the most suitable level of system complexity that suits their respective operating methods and resource capability. If the market is not able to cover the operating costs of a complex system than a simple system must be used. Both the complex and simple systems provide absolute identification from a retail cut to a carcass, however the complex system incurs the costs up front with pass forward expense. The simple system only incurs cost when a trace back is conducted. The number of DNA meat smears that will need to be analysed is many times more for a simple system than the complex system. This results in the costs for the DNA analysis for the simple system being many times that of the complex system. The following graph shows the cost consideration issue.

Cost for Track Forward

Cost for Track Back



Complex System
 Single body boning
 RFID/Barcode Ear tag
 DNA hair samples
 DNA meat smear samples

Simple System
 Traditional Boning
 Lot based ID
 DNA meat smear samples

The above graph shows that the cost effective balance is somewhere between the very complex and very simple systems. The recommendation for use at a typical traditional processing plant is as follows:

Typical Plant Track Forward and Trace Back Identification Recommendations

<u>Recommended level of identification pass forward</u>	<u>Cost Estimates</u>
Medium capital and operating costs – medium cost for DNA validation. (Spend Some Now – Save Some Later)	
Barcoded ear tag (or RFID) on every live animal (EAN barcode)	(\$5.00) \$1.00
DNA hair sample for live ID validation	\$0.35
Archive cost live (based on 500 per day)	\$0.20
Collection of live ID at slaughter	\$0.25
Carcase ticket (update to EAN numbering and barcode)	Existing in most plants
DNA Meat Smear Collector	\$0.14
Collection of DNA meat smear at grading	\$0.25
Archive Cost (based on 500 per day)	\$0.05
Scan carcase ticket into boning room	\$0.25
Carton serial numbers (update to EAN numbering and barcode)	Existing in most plants
Estimated Cost per Body	(AU\$6.49) AU\$2.49
Estimated Cost per Kilogram of processed meat at 170kg SMY	(AU\$0.038) AU\$0.015

The process for linking of carcasses into the boning room used a time and sequence method. This process identified a number of carcasses that may relate to a number of cartons. This is shown below:

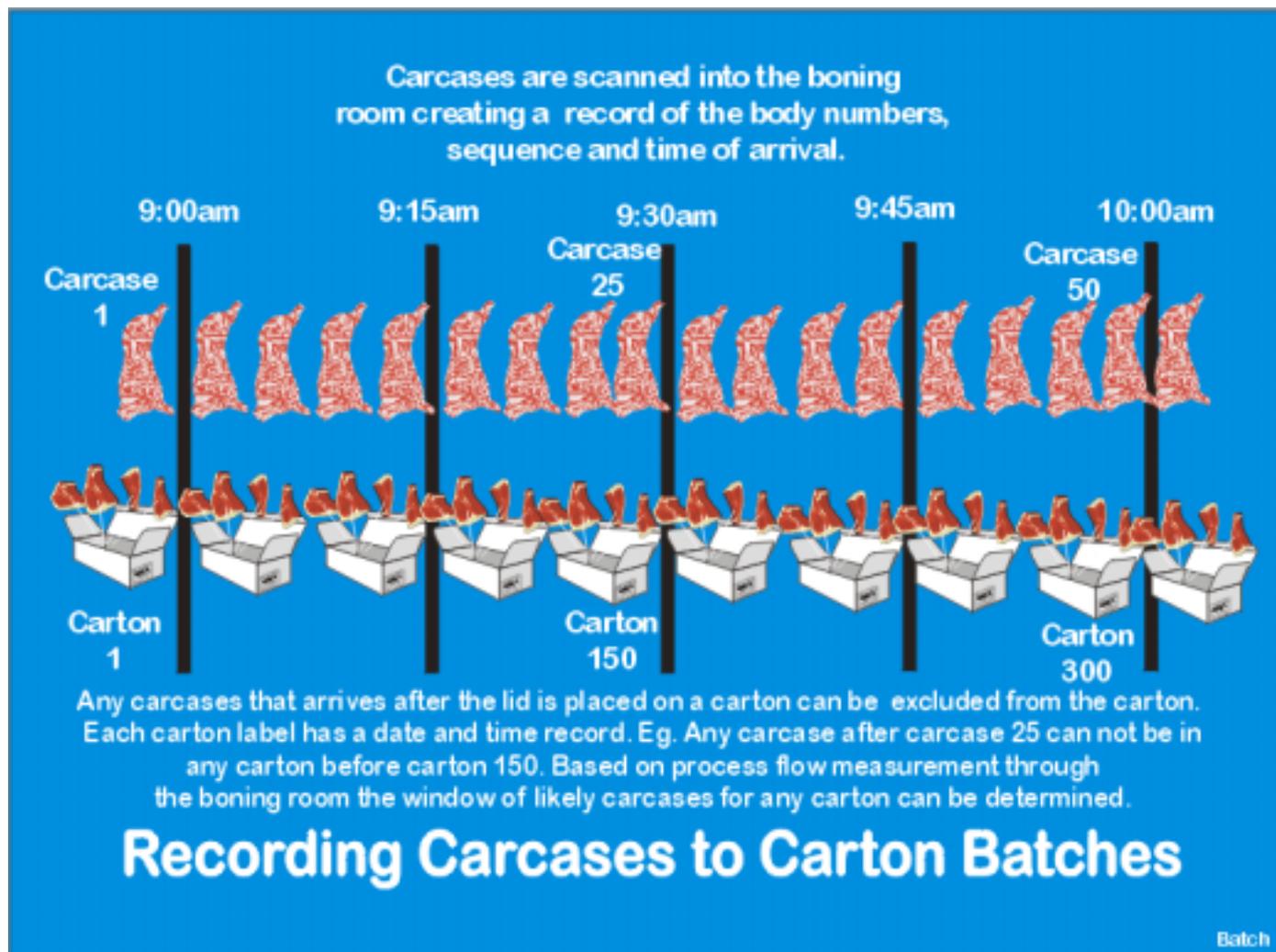


Figure 3 – Graphical Representation of Boning Room Entry

4.3 Impact on Third Parties

The demonstration project had major effects on Australian Country Choice and the third party organisations of Q-Meat and Frigmobile. Little impact occur with Coles Supermarkets other than the acceptance of the principle and consideration for adoption on a national basis.

The major impact on Q-Meat and Frigmobile was the upgrading of their computer-based system for EAN barcodes with correct Application Identifiers as outlined in the Meat Industry Guidelines for Barcoding and Numbering. Q-Meat changed their Carcass Ticketing System and Frigmobile changed their database and scanning equipment to read EAN barcode and application identifiers.

5 Conclusion

The analysis of the Australian Country Choice Supply Chain Management (Logistics Management) system identified a number of deficiencies that could pose a threat to consumer confidence in product traceability and product identity.

A number of recommendations were prepared which included a demonstration project to address the identified deficiencies. Funding was sort for the project and obtained. The project commenced and has been seen as highly successful. The demonstration project outcome has been prepared as a video for presentation to industry.

The major work yet to be completed that was outside of the approved scope of the project is the use of the EAN barcode and numbering system for live animal identification and traceability on a 6 month demonstration of several thousand cattle and the use of the EAN numbering and EDI for export shipments to Australian meat trading partners.

The use of the EAN number and barcoding, and the validation by use of the DNA fingerprinting system demonstrated that supply chain management from “Paddock to Plate” is achievable at a commercial level and can be cost effectively implemented within any size and type of processing facility.

The use of EAN numbering and barcoding as a means of product identification and the use of EDI (EANCOM Standard) for passing information from suppliers to customers will provide the meat industry with world wide accepted standards that can operate over the whole of the meat industry supply chain. The issue of the draft guidelines for the use of EAN Numbering and Barcodes for the Meat Industry is the first step in adoptions of the EAN standards at an industry level.

The result of all of these initiatives as they are adopted by industry is better control of the product through the supply chain to service the customer at each and every point along the supply chain.

6 Appendix A – Project Gantt Chart

7 Appendix B - Current Traceability Programs/ Projects

8 Appendix C – Samples of Labels and Tickets

9 Appendix D – Time In Motion Trial – Boning Room