How can we make better use of traceability?

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ABSTRACT

Traceability is rapidly becoming a way of doing business in the food industry. Companies have a choice of regarding it as a compliance requirement or to utilise the newly available technologies to capture data regarding full supply chain and product attributes. By having the relevant data available it can be analysed to unlock previously unavailable information regarding business processes and attributes while providing compliance traceability by default. Depending on this choice, traceability can either be a compliance cost or it can add value to an enterprise.

Keywords: value traceability; attribute traceability; compliance.

INTRODUCTION

Food safety concerns (BSE, foot-and-mouth disease, tuberculosis, etc.) in Europe, Japan, Canada and other countries and the associated trade complications that had, and are having, a profound impact on the way domestic food animals and their products are identified and the purposes they are used for. Consumers in Europe, Japan, the United States of America (USA) and elsewhere are concerned about what is happening to their food supply, where it comes from, how was it produced and most importantly of all, is it safe? The threat of food bio-terrorism expanded this concern and is of interest to the different stakeholders in the food supply chain; they need to know where raw materials came from, how they were produced and delivered; and likewise to pass the detail of their own value-adding process on to the next link in the supply chain.

This enhanced interest from consumers and other stakeholders, and the consequences and risks of associated litigation have had a major impact. Animal and product identification programmes have moved from live animal identification for animal disease tracking alone, to a position where it is expected to be an integral part of comprehensive full supply chain traceability systems.

There is obviously a cost associated with the implementation of traceability systems, so how can the cost be justified? There are at least two ways of approaching traceability, either as a compliance issue catering for ownership identification only or, alternatively, attribute traceability, where the traceability capability of the exercise becomes secondary or default and where the value of the captured data is unlocked to enhance company efficiencies (Thornton, 2002). This review will address a couple of examples.

Traceability - compliance cost or value added?

Potential benefits of an effective traceability system

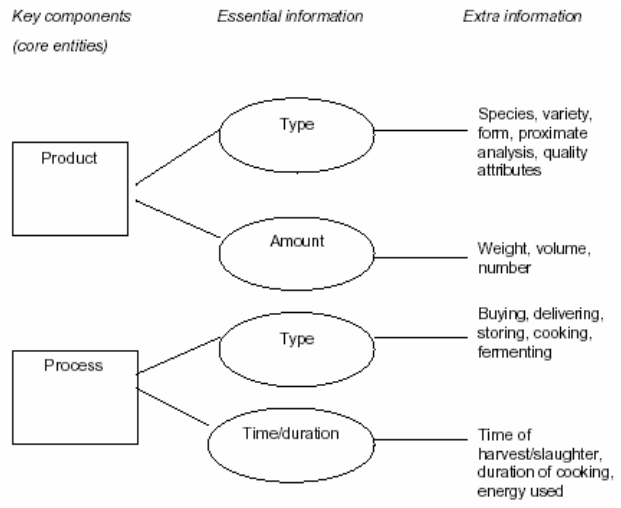
Some resistance to adopting traceability still exists among producers and processors because it is viewed as a cost burden. There is further resistance in the USA and other markets, because traceability adds potential liability, which they did not have previously if contaminating pathogens etc. in product can be traced back to individual links in the value chain (O'Rourke, 2003 & 2005). This perception of traceability as a cost burden comes from the superficial perspective of ownership traceability, which is the ability, to trace ownership both backward and forward to determine the potential source of a problem and either eliminate potentially contaminated food from entering the supply chain or to assist in an effective recall of a suspect product. Ownership of traceability is supported primarily by governments through the roll-out of national animal identification programmes to help contain disease or to limit the impact of a food security issue. In some instances, these programmes only capture the farm of origin. In others, they track all owners from farm to consumer (passport systems as used in Europe).

Traceability can be much more than just ownership traceability - it can also monitor (1) product attributes and (2) processes, e.g. when animals are turned into meat (Figure 1). A product attribute is some measured or observed characteristic of the unit of production at some point in the supply chain – e.g. the pH of meat is an attribute for a unit of production, as is an animal's breed. A process is something applied to the product at some point in the chain, e.g. vaccinating an animal or health inspections on a carcass. How does this all fit together to offer an advantage to the industry?

A red meat example

A very basic question in agricultural production is 'why farm animals, or any other agricultural commodity for that matter'? The simple answer is to utilise a readily available natural resource, to add value to it and to market it at a profit. So, we do not farm animals either to improve their genetic makeup, or their digestive efficiency or anything else, but simply to grow wool or meat and to get better at it so that we can do it at lower cost and get more for the product. Over time we have discovered that if we do it scientifically, there is a better chance of succeeding in the quest for better efficiencies and higher profits.

FIGURE 1: The basic components of a traceability system[1]



[1] Moe T., 1998.

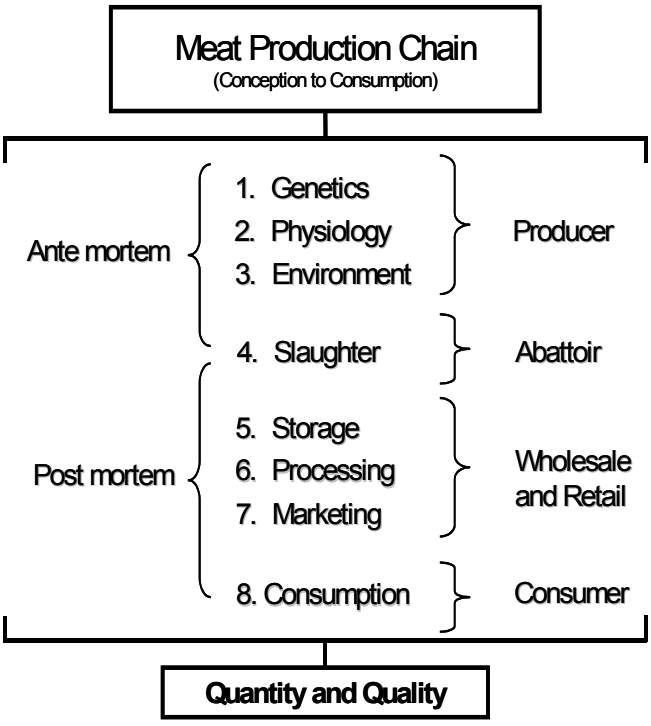
The primary producer (farmer) fulfils a single (very important) role in the sequence of events required to take a weaner or bobby calf, 'from the paddock to the plate'. This line or chain of events can be described as the meat supply chain and is summarised in Figures 2 and 3.

Different stakeholders have different responsibilities along the supply chain to transform natural pasture through the gut of an animal into nutritious protein for human consumption. This transition is a multi-factorial progression involving several disciplines and inputs where many changes occur in the process of turning muscle into meat. The two major parameters that determine failure or success are the quantity of production and the quality of production. Each parameter is influenced by a multitude of factors along the supply chain and by measuring and then manipulating or altering these factors we can influence the outcome. By measuring meat quality attributes the effect of a specific combination of input factors can be monitored (Naude, 1985).

To provide an idea of the available attributes that can be monitored along this journey of a blade of grass becoming a chop, we schematically depict quantity and quality attributes that influence productivity.

There is a generic global agricultural goal to produce more; with more land or animals, higher throughput, multiple processing plants or multiple shifts within those plants. Productivity, efficiency and optimisation of production practices are the answers to success. The still applies but in the new millennium emphasis has changed, with a much higher emphasis on environmental, considerations. This is evident, especially in Europe, with increased consumer awareness of the nitrification of soils, anti 'factory farming' sentiments, animal rights movements, a global urbanisation trend among traditional farming communities and health scares. The challenge is to achieve production capacities more efficiently. Farming and production practices impact on the quantity of the product being produced. For example genetics have a profound influence on the animal's feed conversion ratio, its average daily gain, its maturing rate and its ultimate dressing percentage. Similarly, harvesting practices such as drafting, transport, slaughtering, chilling and cutting, impact on carcass cutability and lean meat yield. An effective feedback (traceability) system can measure, manipulate and positively optimise these attributes for specific purposes.

FIGURE 2: The components of the meat production chain that influence quantity and quality of meat produced per animal



The value of any product is determined by a customer's willingness to pay, which in turn is determined by that customer's wants and needs. The value of beef is therefore ultimately determined by customers' desires. There are three basic beef carcass characteristics that affect carcass value (Wulf, 1991; Table 1).

FIGURE 3: Quantity and quality attributes of meat that influence production

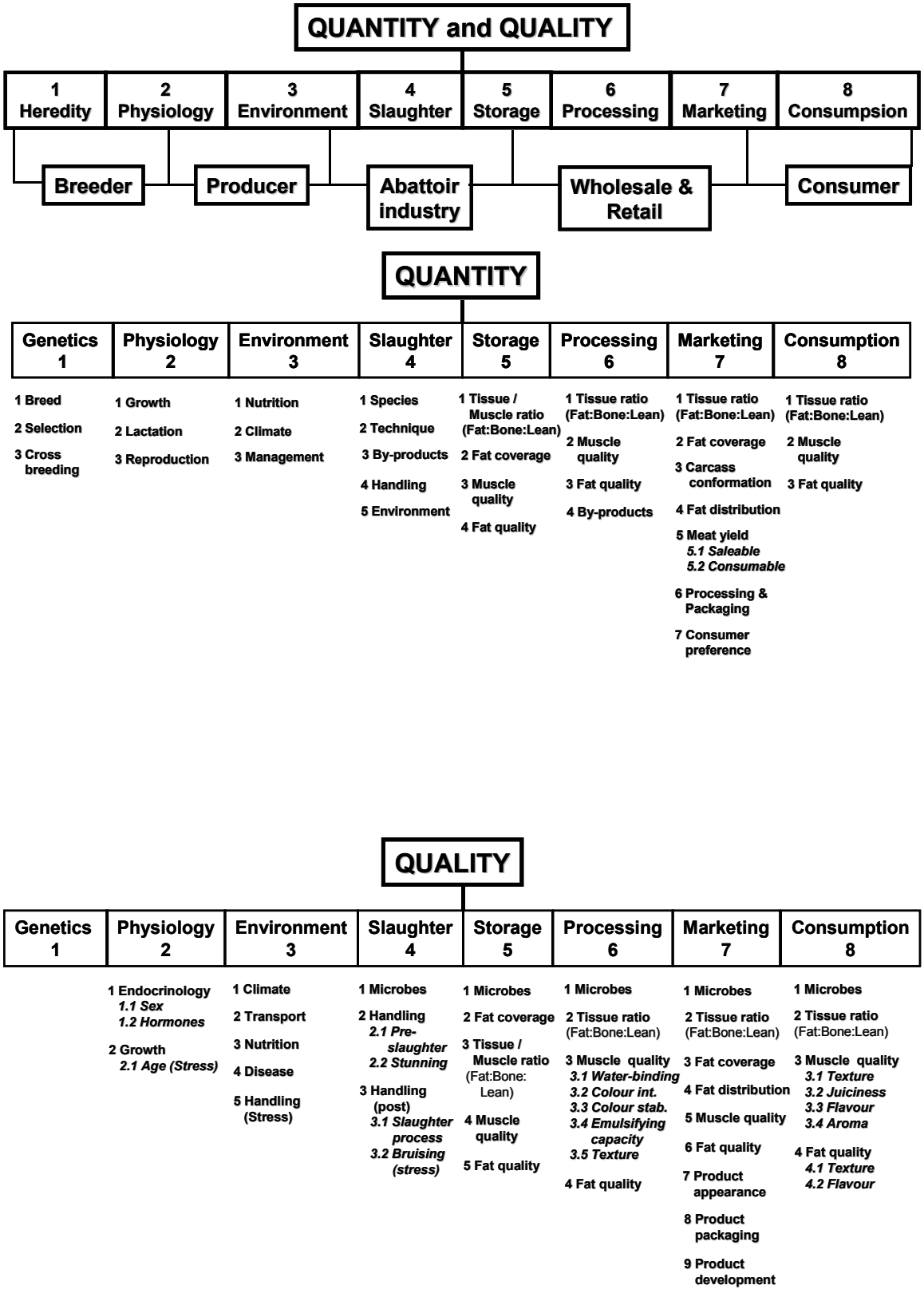


TABLE 1: Beef carcass characteristics affecting carcass value and the ease at which they are assessed

Beef carcass characteristic	Ease of assessment
Product size	Easy to assess
Product cutability	↓
Product quality (appearance and eating characteristics)	Difficult to assess

Dressing percentage in perspective

Dressing percentage is calculated by dividing the warm carcass weight by the shrunk live weight of the animal, and expressing it as a percentage. For example, say an animal has a live weight of 544.32 kg. After slaughter the hide, head, feet and gut are removed, leaving a 317.52 kg carcass. The dressing per cent of this animal is 58.3 percent. This figure represents the meat and skeletal portion of an animal relative to its live weight. Note that the animal is weighed after transportation to the packing plant so that live weight is in fact a shrunk weight and that the carcass is weighed warm as opposed to cold. Cold carcass dressing percentages can be 2.0 percent lower than warm carcass dressing percentages. Dressing percentage will vary significantly depending on breed, live weight, fat content, age, sex, diet, feeding regime (e.g. pastoral vs feedlot), distance trucked, the type of market where cattle are sold and season etc. Chill loss can vary between 1.5 and 3 percent depending on refrigeration efficiency, chiller wind speed and carcass fatness.

The industry is interested in dressing percentage because it establishes the weight upon which payment is calculated for animals sold on a live-weight basis. For example, a 0.5 percent difference in dressing percentage between steer A and steer B in Table 2, results in a $9.00 difference per animal; an extra $0.75 per cwt on a live-weight basis.

TABLE 2: The effect of dressing percentages on animal value

	Steer A	Steer B	Calculation method
Shrunk live weight, lb.	1200	1200	delivered to plant weight
Warm carcass weight, lb.	700	694	
Dressing percent	58.3%	57.8%	(warm carcass weight live weight) x 100
Carcass price, $/lb.	$1.50	$1.50	
Total value per head	$1050.00	$1041.00	carcass weight x carcass price
Live price per cwt	$87.50	$86.75	value per head live weight

Ref: Government of Alberta, 1999

A higher dressing percentage will not always yield higher dollar returns, so dressing percentages should be viewed in relation to other carcass quality factors as well, e.g. grading or classification.

Yield value

Carcass yield, as presented by the dressing percentage, is very important in relation to efficiency and can be used for calculating payment by the processing industry. Dressing percentage, can range from as low as 52% to around 60% for cattle and from near 40% up to 53% for lamb.

By recording dressing percentages through a traceability application, it would be possible to provide feedback to the abattoir, the feedlot/fattener, the primary producer and the breeder on an individual animal basis and contribute to integrated industry optimisation. The breeder could make selection decisions within and between breeds for optimum production. Furthermore, it is also important to know that the fastest growing animals do not necessarily have the best eating quality. Within breed, strains with a higher average daily gain, produce tougher meat. Integrated traceability would allow breeders to select genotypes with optimum growth with the least possible feeding, and ultimately the highest possible dressing percentage with a higher percentage meat in the more expensive cuts.

Currently, a number of software applications, from companies such as Uniworks and Sastek, can provide lot yield data through the slaughter line and the boning room, while other systems can capture individual animal attributes. By monitoring and tracking cutting and slaughter losses per individual animal through all the dis-assembly processes meat companies can optimise efficiencies. This requires weighing at strategic positions through the packing room, integrating all relevant information along the supply chain and communicating to the relevant stakeholders to be effective.

Small goods or further processing yield and traceability

It is imperative for producers of small goods to know the yield gains and losses through the different processing steps in the production of, e.g., bacon, salami or ham. In most companies this monitoring process is still done on paper retrospectively, not on the production floor. Due to the time-consuming nature of this type of recording, it is usually done only once or twice per week and in some cases only every fortnight. The bacon production process includes receiving, storage, tempering/thawing, trimming, pickle injection, curing, hanging/tumbling/massaging, cooking and and/or smoking, cooling, chilling and then forming, slicing and packing. Each step has an effect on yield, e.g. trimming, curing, cooking and slicing have a negative impact while injection has a positive impact.

To manage quality, processors need to control accurately all of these steps. For example, different cuts/products need different brines, pumped at different percentages. Traditionally cured bacon normally gets a 12% pump and processors do not want to lose more than 12% of total weight during the consecutive processing steps.

The larger the gain after processing, within the limits of perceived quality attributes and in some cases regulations, the more efficient or commercially viable is the operation. Different products, depending on type and market, can be pumped anything between 12 and 80%, therefore controlling the final product weight, i.e. yield, is imperative.

Business unit yield recording

For yield to be successfully analysed, it must be evaluated step by step. Each processing step needs to be seen as a separate business unit delivering a product to the next business unit. Each unit has inputs and outputs; the ingoing weights and either the waste created or the weight gain going on to the next business unit, need to be measured to arrive at a 'business unit value'.

Each business unit operates separately, and has a specific product. By recording the date it was produced a unique batch code is created, that can be facilitated using available data capture technology. Final product yield is a function of the gains or losses at each process business unit. If the entire process takes 3 days from receipt to packing, the business unit percentages can be collected daily and compiled on a weekly basis for the entire product, with the business unit values being available in real time. This information can then be used for monthly reporting to show how the yield process is under control and also for calculating 6 monthly moving averages.

Attribute or 'value traceability'

None of the above is new or innovative - meat scientists have for decades regarded this type of information as the basis for their field of expertise. What is novel is the new generation of information technology solutions that make it affordable and practical to collect the information and make it readily available for decision support and sharing with stakeholders up and down the value chain.

The value of tracing product attributes and processes comes from maintaining the identity of the specific product unit and the corresponding attributes and processes associated with that product unit from the farm through the conversion process, into meat, to the consumer via many owners and many form changes. Monitoring individual animal attributes enables producers and processors to distinguish which animal source and breed is the most productive and profitable. Production efficiency calculations therefore move from averages to individual production (animal) units. These data provide information for differential sourcing of animals, payment for quality rather than for quantity, optimising production practices and management decision support at the different links in the production chain.

AgInfoLink has documented over 50 case studies spanning multiple owners and a very large number of cattle (Pape *et al*., 2002). While ownership traceability is virtually free, it offers no financial benefit. On the other hand, when members of the chain invest approximately 0.5% of the cost of the raw product paid by the first stage processor for each unit of production, they reap better than 2.0% - 5.0% increased profit. In the beef industry, for example, investing about $5 per head of cattle has increased profitability by somewhere between $25 and $75 per head.

Paddock to plate traceability

Very little is in place as far as full traceability from paddock to plate is concerned. A major issue is the inability to aggregate databases and to run queries across currently disparate data sources. The only non-European Union (EU) country claiming this type of functionality in some of its systems is New Zealand (NZ), while Australia is envisaging this in the near future. The Australian system claimed it will have point-to-point traceability up as well as down the supply chain.

The NZ system is based on DNA fingerprinting combined with labelling and the e-Cert system. It is still batch-based rather than individual cut-based and batch sizes of about 50 samples need to be analysed to facilitate traceability from an individual retail cut, back to a single animal. Although the system has been proven accurate, it does not facilitate trace-back to an intermediate stakeholder through a single system, it is primarily a single objective (point) solution, not available in real time and, in comparison with alternatives, expensive.

One major NZ company spent multiple millions of dollars revamping its boning room to accommodate queuing or in-line boning to facilitate full traceability. The surprising fact is, that contrary to popular belief, this type of boning room configuration will not slow productivity and throughput does not slow down.

CONCLUSIONS

A senior Agriculture Canada official's comment of more than two years ago, that traceability in the food chain is fast moving from a niche market option to a standard commercial requirement and preference, is even more true today (Brinkley, 2002). While there is still a premium for some niche products, experience tells us that as a process becomes part of a base standard, as is rapidly happening with traceability, the premium tends to disappear and the process becomes a cost of doing business. As a result, the requirement for full traceability throughout the food chain will inevitably change the way we look at and manage the food system (Brinkley, February 2002).

I believe there is a lot to be learned from our major trading partners, the EU and the United States of America (USA). The EU nations are already compliant

and are demanding traceability from us as suppliers, when the USA comes on board, and it is just a matter of time, traceability will follow in the footsteps of HACCP food safety and will become a compliance requirement. NZ waited long enough to learn from others, we have a choice, we can simply be compliant or we can exploit traceability as a competitive advantage and a vehicle for adding value and profits.

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