INTERNATIONAL TRENDS IN BEEF CATTLE PERFORMANCE RECORDING AND EVALUATION

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1. Introduction

At the outset let me congratulate those who have organised the Aldman Stockman School and LRF Symposium for their vision in having your industry address such a wide range of topics that impinge on how to ensure the profitability of your beef industry. Thank you to the organisers for inviting me to participate in such an important event.

My talk will discuss:

- How performance recording has developed to cover a balance of production traits;
- How modern performance programs balance individual traits to obtain a selection index or indexes;
- How selection indexes form the basis for genetic tools that can be used to maximise genetic progress in economic terms;
- How gene marker information is being used to improve estimated breeding values;
- Software for minimising the effects of genetic defects;
- The progress that is being made with multi-breed evaluations;
- Progress with across-country evaluations;
- Trends in how genetic evaluation services are being delivered;
- The challenge – how better performance recording systems can make beef more competitive internationally.

2. Traits Recorded

Initially beef cattle performance recording systems focussed mainly on weight gain. The rationale was simple:

- Farmers can easily record weight.
- Weight gain is moderately heritable, and
- Many cattle are sold by weight so heavier cattle make more money.

However, long term selection based mainly on weight gain can be detrimental to some other production traits such as calving ease.

Modern performance recording programs cover a wide range of production traits. For example, Table 2.1 shows the traits that are evaluated in the BREEDPLAN® genetic evaluation system.

Table 2.1: Traits Evaluated in BREEDPLAN®

Growth	Fertility	Carcase	Other
Birth	Scrotal size	Carcase Weight	Docility
Weaning	Days to Calving	Eye Muscle Area	Feed Intake
Yearling	Gestation Length	Rib Fat Depth	Flight time
Final	Calving Ease	Rump Fat Depth	Shear force
Mature Cow		Intramuscular Fat %	Conformation
Maternal Growth		Meat Yield %	

Standard Traits

Specific Traits

All master breeders know that the commercial industry needs a balance of growth, fertility, carcase, docility and conformation and so they select across all these categories of traits together with beef tenderness and feed intake where appropriate recording systems are available.

3. How to maximise genetic gain across many traits

3.1 Selection Index

Adding more traits to the selection of animals may be fine for master breeders who spend virtually every waking hour wrestling with the challenge of how to breed the perfect animal. However, the more EBVs that are calculated the greater the potential for confusing the commercial bull buyer.

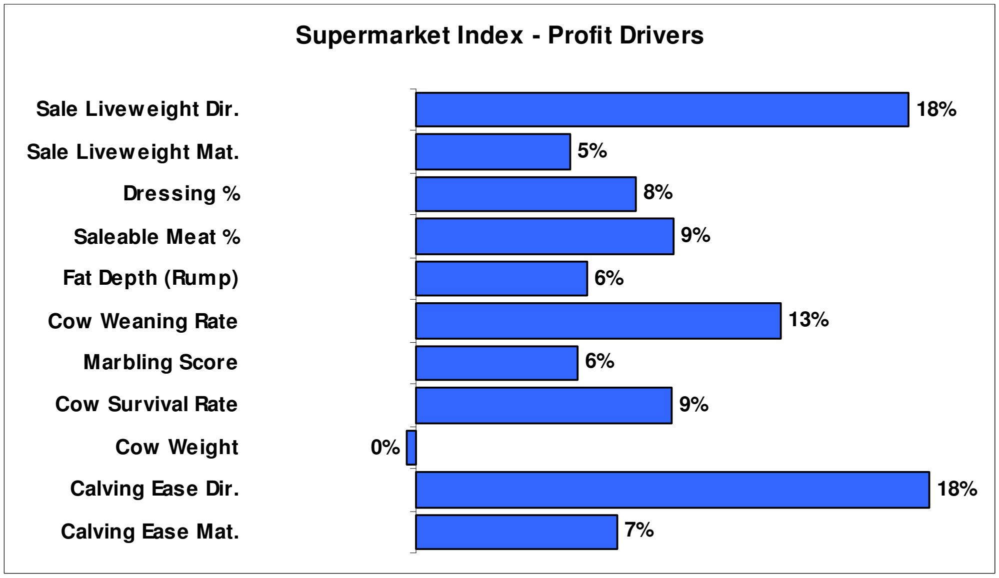
For this reason most livestock industries have moved towards the concept of weighting the traits for their importance to a particular production system and from this outputting an economic index (also called a selection index). This means that buyers who purchase high $index animals for their particular production systems can expect to improve their profitability. The system for doing this in BREEDPLAN is called BreedObject.

The concept that one index fits all breeds (which was until recently promoted in the UK) or that one index fits all breeders within a breed is nonsense. For example, the Hereford breed in Australia has developed and published four indexes:

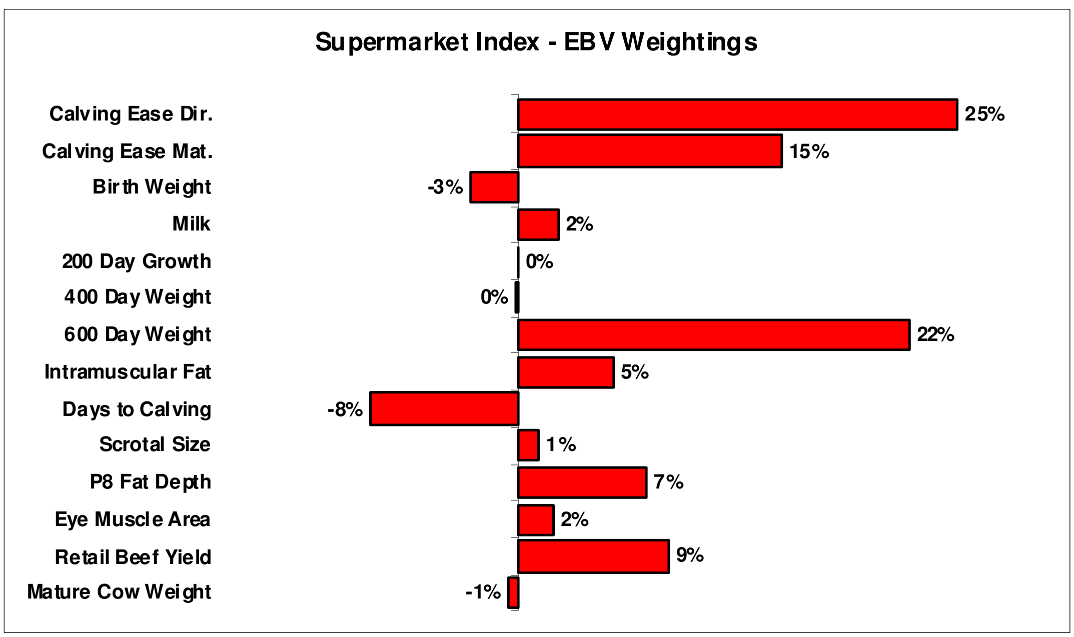
- Supermarket Index
- Grass Fed Steer Index
- Grain Fed Steer Index
- EU Index.

The Hereford Supermarket Index estimates the genetic differences between animals in net profitability per cow joined for an example commercial herd targeting the domestic supermarket trade. Steers are either finished on grass or grain (eg. 50 – 70 days). Steers are assumed marketed at 450 kg live weight (250 kg carcase weights and 12 mm P8 fat depth) at 17 months of age. Daughters are retained for breeding. A small premium has been placed on marbling.

The following bar graph shows the key economic traits that are important in this selection index. The different trait emphases reflect the underlying profit drivers in a commercial operation targeting the domestic supermarket trade.



Considering the genetic relationship between the key profit drivers and the EBVs that are available, the bar graph below illustrates the different emphasis that has been placed on each EBV within this selection index. The sign indicates the direction of the emphasis. For example, greater 600 Day Weight EBVs and shorter Days to Calving EBVs are favoured.



Unfortunately, many beef cattle breeds across many countries record performance on insufficient traits to allow the development of economic indexes to be meaningful.

This denies these breeds access to the very tools (TakeStock® and Mate Selection programs) that would allow them to accelerate genetic progress because those tools all require the availability of $ Indexes.

Providing good recording systems across a range of traits must be the first priority of any modern performance recording scheme.

3.2 Making Genetic Progress

Genetic Progress is achieved when the 'average genetic value of the offspring (eg. Your current calves) is higher than the average genetic value of the previous generation (from which the parents were selected)', Van der Werf et.al.

The formula is:

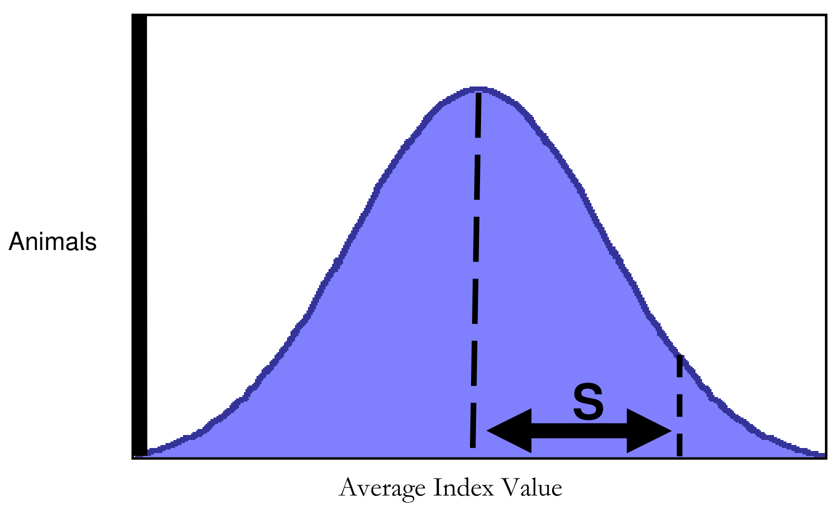
$$R = \frac{S \times h^2}{L}$$

Where:

R = Response to Selection
S = Selection Differential
h^2 = Heritability
L = Generation Length

<u>Selection Differential</u> is the difference between the animals selected for breeding and the average of the population from which they were selected. The greater the selection differential, the higher the response to selection (R). Recording the full range of traits appropriate to your breeding objectives will help increase the selection differential and the accuracy of selection.

Selection Differential - S



<u>Heritability</u> (h^2) is the proportion of the superiority or inferiority of a trait that is passed on to progeny. The higher the heritability the higher the Response to Selection (R).

<u>Generation Length</u> (L) is the average age of the parents (sires and dams) when their progeny are born.

The lower the Generation Length (L) the higher the Response to Selection. It is not easy to reduce L in less-intensive production systems.

3.3 Benchmarking Genetic Progress

TakeStock® is a genetic benchmarking tool developed recently by the Animal Genetics and Breeding Unit (AGBU).

TakeStock®:

1. Evaluates the genetic progress of a herd for each particular Selection Index.
2. Benchmarks the progress of the herd against the breed.
3. Identifies Key Performance Indicators (KPIs) that explain significant differences in the rate of genetic progress between herds.

The table below shows a summary of a TakeStock® report for a Hereford herd in Australia that is using the TakeStock® benchmarking service.

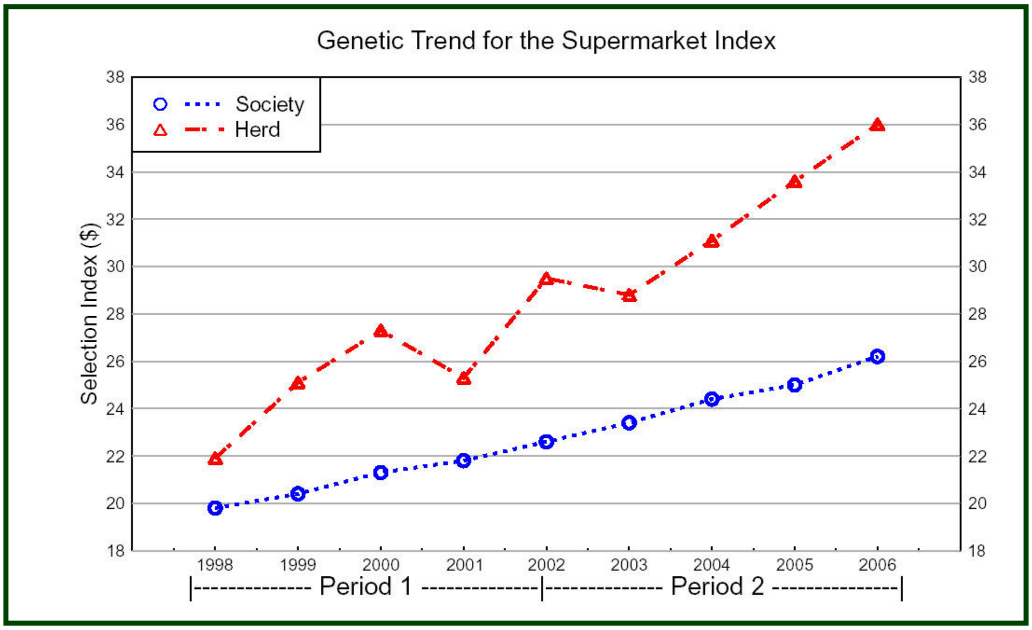
Supermarket Index

Summary Report

(Period 1 - 1998 to 2002 & Period 2 - 2002 to 2006)

		Herd	Breed Average
Average EBV in Period 2	Males (bulls & steers)	\$32.26	\$24.38
	Females	\$31.97	\$24.48
	Steers	\$30.05	\$19.92
Average EBV of parents in Period 2	Sires	\$36.83	\$28.22
	Dams	\$26.58	\$21.90
Average EBV in Period 2		\$32.12	\$24.42
Average EBV in Period 1		\$25.91	\$21.41
Genetic progress in Period 2		\$1.98	\$0.78
Genetic progress in Period 1		\$1.55	\$0.80
Average herd size in Period 2		179	89

This report shows that the Hereford breed has made steady progress with its Supermarket Index over time. The sample herd was achieving genetic progress at twice the breed average in the first period (6-10 years ago) increasing to 2.5 times the rate of progress in period 2 (2-6 years ago). A graphical representation of the trend in the Supermarket index is shown below.



Other sections of the TakeStock® report benchmark the two key components that drive genetic progress:

- Selection Differential (of Sires and Dams), and
- Generation Length

to help the breeder identify ways of improving his/her breeding program.

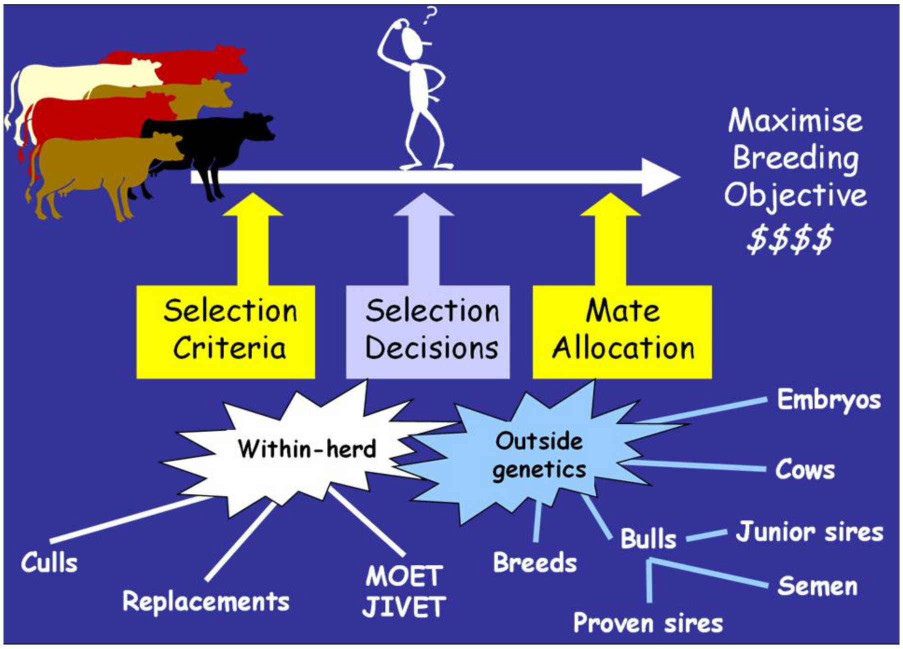
3.4 Mate Selection

Deciding which sire to mate with each dam, which parents to use in an embryo program and which AI sires to use are the decisions that determine the future rate of genetic progress.

What if there was a software package that determined the matings that optimised genetic progress subject to certain practical restraints imposed by the breeder?

Total Genetic Resource Management (TGRM) is an example of a package that does this. Developed by a team under Professor Brian Kinghorn at the University of New England this tool is used on a routine basis in the pig and dairy industries. Table 3.1 gives a schematic representation of how TGRM works on the beef industry.

Table 3.1 – Schematic of how TGRM works in the beef industry



Unfortunately, the main commercialisation licence for TGRM was let to a semen company which uses it to promote the influence of certain sires (rather than all sires) and so the product has made little impact in the beef industry despite its huge potential.

Professor Kinghorn has now written an improved mate selection program which is likely to be commercialised as part of the BREEDPLAN® system in the near future.

4. Incorporation of Gene Markers in EBVs

4.1 Background

When the Wright brothers started experimenting with heavier-than-air flying machines it has to be said that while their approach was innovative it was very crude in today's standards. But as we relax in the comfort of an A380 on an international flight we all owe a little to the Wright brothers for daring to dream about a new way to travel.

The development of genomics in the beef industry is not too dissimilar from the early attempts to fly. The early results have been underwhelming but the pace of discovery is accelerating and so we can look forward to being able to access much better products in the near future.

GeneSTAR® was introduced in 2000 as a single-marker test for marbling. By 2006 Catapult Genetics provided a 12-marker panel. This included:

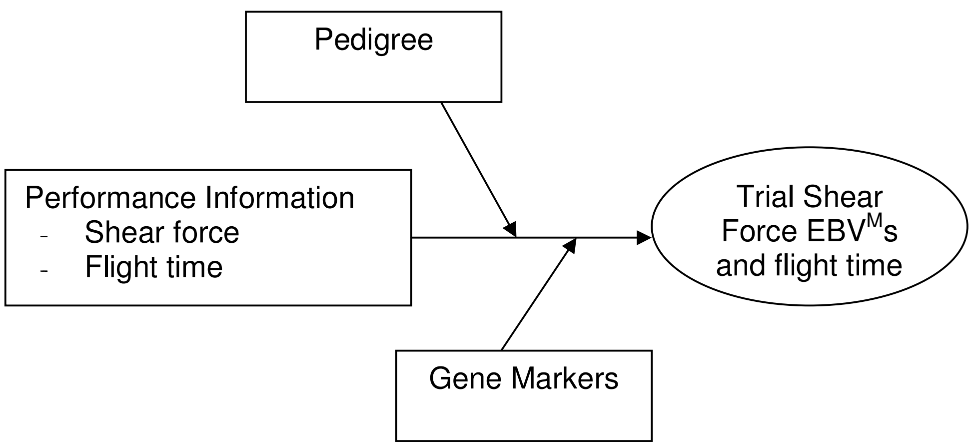
- 4 markers for marbling.
- 4 markers for feed efficiency, and
- 4 markers for tenderness.

At that point a range of interested parties agreed to work together in the 'SmartGene for Beef' project to determine the effect of the various markers on phenotype and how gene markers could be combined with phenotype to produce marker-assisted EBVs. The database available to the project was substantial – DNA samples for around 12,000 animals for which phenotypic records were available. They were tested for 12 markers.

The detailed results were released on August 6, 2008 for a cattle seedstock industry seminar. They may be viewed on the CRC Website – www.beefcrc.com.au.

The results for tenderness markers in *Bos Indicus* cattle showed the greatest promise. By October, 2008 AGBU had developed the methodology to combine pedigree, performance and DNA records to provide a marker-assisted EBV for tenderness which was labelled Trial Shear Force EBV^{M}s.

Figure 4.1 – Information used to calculate Trial Shear Force EBV^{M}s



These EBVs were available at Bull Week in 2008 in which over 1,000 Brahman Bulls are sold. Flight time EBVs were also released as these are also an indicator for temperament.

Tale 4.1 gives an example of four Brahman Sires with Shear Force EBV^{M}s.

Table 4.1 – Highest and lowest SHEAR FORCE EBV^{M}s (SF kg)

	Prog SF	**Stars (GeneSTAR)**	**EBV^{M} ***	**Acc**
Sire A	38	3	+1.22	84%
Sire B	18	2	+1.22	74%
Sire C	32	3	-0.74	81%
Sire D	8	4	-1.01	64%

* The higher the EBV^{M} for Shear Force the relatively tougher the meat.

This table provides two important messages:

i) The difference between Sire A (the toughest in the breed) and Sire D is material i.e. 2.23 shear force units meaning that there is considerable potential for improving tenderness by selection.
ii) The total number of stars is not particularly informative because the stars are not related to particular markers and some markers have a greater effect than others. Thus Sire A and Sire C both have 3 stars even though they are at different ends of the scale in terms of tenderness.

4.2 The Pfizer 56-marker panel

Towards the close of the SmartGene for Beef project in 2008, Pfizer Animal Genetics took over Catapult Genetics. Early in 2009, Pfizer released a 56-marker panel covering feed efficiency, marbling and tenderness. With 56 markers it clearly became impractical to continue with the stars concept and so Pfizer developed Molecular Value Predictions (MVPs) for the three traits based on marker results. Pfizer used a range of cattle populations in Australia and North America to develop the MVP technology.

The Beef Co-operative Research Centre (Beef CRC) in Armidale was engaged to evaluate the 56 marker panel using Australian cattle populations. The statistical analysis was performed by the Animal Genetics and Breeding Unit (AGBU) and is available on the CRC website – www.beefcrc.com.au. The proportions of genetic variation explained by the markers were:

Marbling	0 to 3.6%
Feed efficiency	0.2 to 6.2%
Tenderness	1.6 to 29.9%

That is, the 56 marker panel was better than the 12 marker panel but still of marginal utility in explaining variation in marbling and feed efficiency.

The initial publicity for the 56 panel marker made no attempt to alert users that the results may vary from breed to breed.

Pfizer is now working on introducing a much larger panel which can be expected to explain more of the variation than the 56-marker panel.

4.3 The Beef CRC

In 2005, scientists in Australia recognised the huge potential of genomics in the beef industry. They were successful in attracting about A$120M of funds into the Cooperative Research Centre for Beef Genetic Technologies, which is referred to in industry as the Beef CRC.

The Mission of the Beef CRC is:

"To capture the benefits of the human and bovine genome projects and the 'Livestock Revolution' by improving the profitability, productivity, animal welfare and responsible resource use of Australian and global beef businesses through world-class gene discovery and gene expression research and accelerated adoption of beef industry technologies".

At the time of the Beef CRC submission, the proposers promised that by the end of its 7-year term the Beef CRC would identify gene markers that would explain 50% of the phenotypic variation in a range of production traits.

However, as the research progressed the scientists found that each marker tends to explain only a very small percentage of variation. In the mid-term review, the Beef CRC shifted its goal to explaining "up to 15% of variation".

This does not diminish the strategic value of the research being undertaken by the Beef CRC which is now linked with similar research initiatives in North America. However, it does characterise the track record of beef genomics to date in overpromising and under delivering.

4.4 The Angus/Igenity Alliance

Igenity® is a registered trademark of Merial Ltd which is an international animal health company. It also is the product name for a range of DNA markers developed by Merial. In July, 2009 Angus Genetics Inc and Merial entered into an exclusive agreement to provide American Angus Association breeders with genomics-enhanced expected progeny differences (EPDs) across multiple traits using an Angus-specific profile of Igenity markers.

This is undoubtedly a significant milestone for the American beef cattle industry. It is also logical that a genomics company would develop and market a breed-specific DNA profile. The research of the SmartGene for Beef project confirmed that markers perform differently in different breeds.

The Angus/Igenity alliance is very clever because it essentially ties up around half of the American beef seedstock industry in one agreement and it recognises the need for breed-specific DNA panels.

4.5 The Pfizer Response

In September, 2009 Pfizer Animal Genetics (PAG) announced that it would release genomic predictions based on the high-density Bovine SNP50 Chip. The anticipated release date is mid November, 2009.

However, the first run of the genomics enhanced EPDs for American Angus using the Igenity panel is in mid December, 2009 so it is unlikely that the American Angus Association will show much interest in the Pfizer panel in the immediate future.

This raises the question, 'has Pfizer made its run too late?'.

4.6 The future

The use of DNA markers is already transforming the selection information available to dairy cattle breeders. This is assisted by the fact that 80-90% of the dairy industry is of one breed (Holstein) and the use of AI is high.

Progress in the beef industry will be slower than in dairy because:

i) There are many breeds and it is unlikely that funds will be found to develop breed-specific DNA profiles for other than the major breeds,
ii) The limited use of AI limits the rapid dissemination of genes from sires that are shown to be elite on DNA tests.

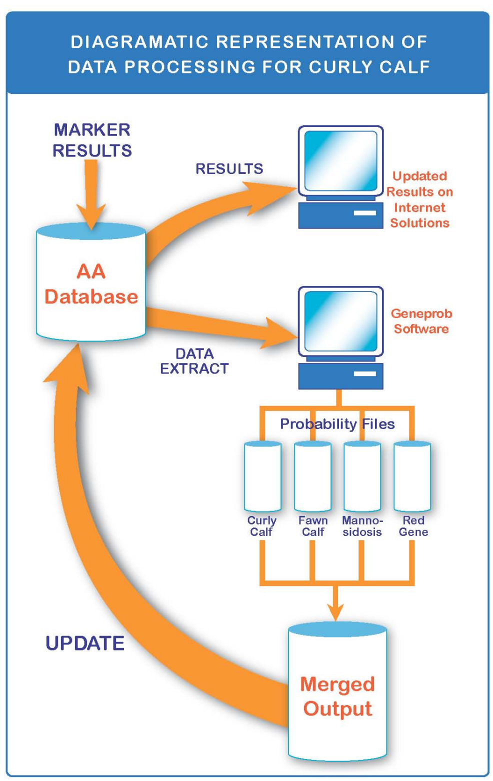
Despite this, genomics will transform the beef breeding industry worldwide and seedstock breeders who wish to see their stud prefix still prominent in 50 years time do need to engage with the potential that genomics brings sooner rather than later.

5. Minimising the impact of genetic defects

Operating at the leading edge of cattle breeding is challenging but not free of risks. When elite sires are identified on the basis of performance there is an understandable stampede to use the semen as widely as possible. But what if the sire is a carrier for a genetic defect previously unrecognised?

This happens with most breeds but it has come into sharp focus recently when a very popular Angus sire was found to be a carrier of a lethal genetic defect, Arthrogryposis Multiplex (AM) which goes by the common name of "curly calf".

Modern performance recording systems should provide a mechanism for calculating the risk of known genetic defects across the whole breeding population. ABRI has approached this issue by fully integrating an advanced software routine called Geneprob into the BREEDPLAN® pedigree/performance system as shown below.



The Geneprob software has also been developed by Professor Brian Kinghorn. It uses available gene marker tests and pedigrees to calculate probabilities of a gene (favourable or unfavourable) occurring in each animal across a whole breed association database – which may be across several million animals.

As soon as the gene marker test was found for AM, breeders started testing key animals and entering test results to the Angus Australia database. Geneprob is run at weekly intervals and the probabilities are updated to the Angus website. Very quickly the animals with a high probability of being carriers will be eliminated from the population. This will occur by either the high probability animals become unsaleable for breeding or by breeders testing them and only retaining non carriers.

The same software is able to give the probability of animals being carriers of a favourable allele such as for tenderness. Geneprob can also be used to identify candidate animals for DNA testing i.e. key animals which when tested would improve the accuracy with which gene probabilities can be calculated for rest of the breeding population.

6. Multi-breed evaluations

Another area of performance recording which has been over promised and under delivered has been multi-breed evaluations.

In 2005, a bold press release circulated around the American cattle industry entitled: **Genetic Evaluation Enters A New Era.**

The opening paragraph read:

'Five cattle breed organisations – Brangus, Gelbvieh, Limousin, Red Angus and Salers –have formed a new company that will combine and create one National Cattle Evaluation for the five breeds and provide one suite of EPDs for all members of the venture. Commercial customers no longer will have to learn the EPD bases for these breeds, as they'll be reported on a similar base and scale.'

The release also claimed:

'There will be two dominant national cattle evaluations in terms of database size – this new venture called Performance Registry Services and the American Angus Association'.

The five joint venture breeds released their databases to the National Beef Cattle Evaluation Consortium (a consortium of American Universities) to work towards a multi-breed production run.

In summary, the Consortium did not ever deliver a full production run and the Joint Venture fell apart. When you sit down and analyse the multi-breed evaluation concept, what else would you expect?

Most major pure breeds have been able to provide genetic evaluations to their members for between 12 and 20 production traits. The members value the wide range of traits reported and the selection indexes that can be built across those traits. But the trial multi-breed analyses to date provide EBVs/EPDs on a very limited range of traits concerned mainly with growth. This is because in order to build a commercially-relevant multi-breed evaluation model it is necessary to have head-to-head comparisons of the various breeds for all the traits – and these comparisons simply don't exist for important traits such as fertility. Further, it would be very expensive to run the field trials required to collect that data.

The second issue is a simple marketing issue. How many commercial breeders are committed to a breeding objective that says *'I just want the best bull available and the breed is irrelevant'*. I suggest to you, not many. A more typical question is, *'My breeding program requires the use of a bull of XYZ breed but I want the comfort of knowing that the bull I chose is among the best available of that breed for my production objectives'*.

The genetic evaluations that are commonly available today answer the question asked by the second group of producers i.e. the majority.

About a decade ago, following the clamouring of a vocal minority, BREEDPLAN did calculate a table of adjustments for five traits for a number of breeds including, Angus, Hereford, Simmental and Limousin. That is, a breeder could take the EBVs published for say 400 day weight for an Angus and a Simmental bull, apply the adjustments and come up with comparable EBVs. This was launched with a great fanfare and I am yet to meet a single breeder who used the service.

However, there are more practical ways in which multi-breed concepts can be used as shown in Figure 6.1.

Figure 6.1: A practical approach to multi-breed EBV calculation

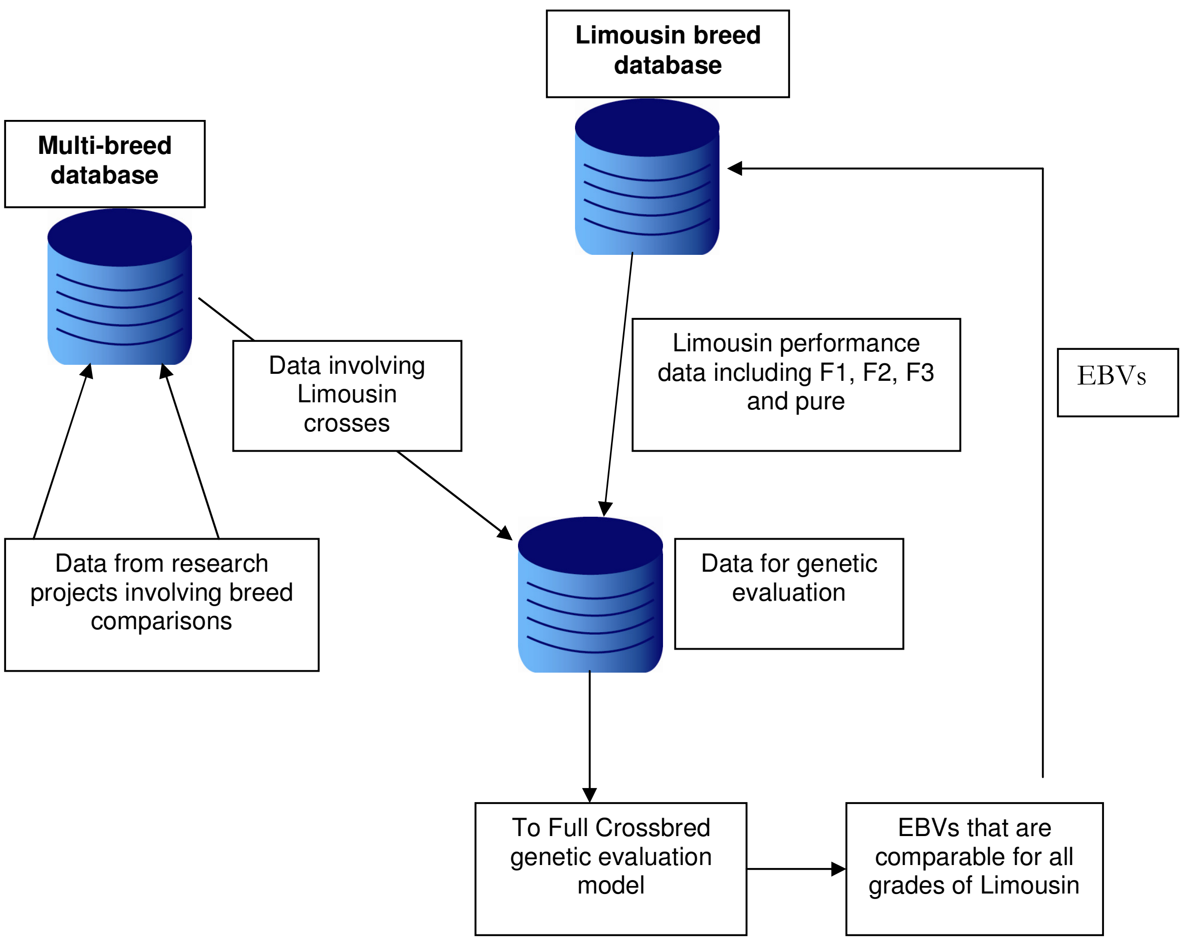


Figure 6.1 illustrates the approach used by BREEDPLAN and the Limousin Society of Australia (and any other breed with similar objectives). There are a number of field trials being conducted in Australia where a number of breeds or crossbreeds are run as contemporaries. For example, in one project Hereford females were bred to a range of sires of Hereford, Angus, Simmental and Limousin and the progeny were raised as contemporaries to assist in quantifying breed differences for a range of traits. All of this data and data from similar trials are entered into a national multi-breed database. Then when each breed undertakes its genetic evaluation (eg. Limousin) the relevant data from the multi-breed database is extracted and combined with that of the breed database in a full crossbred genetic evaluation model that is able to produce comparable EBVs for all grades of the breed evaluated (because phenotypic data is adjusted for heterosis). In this approach, whatever multi-breed data that is available assists the genetic evaluations for a number of breeds but it does not limit the EBVs that can be reported for any of the participating breeds.

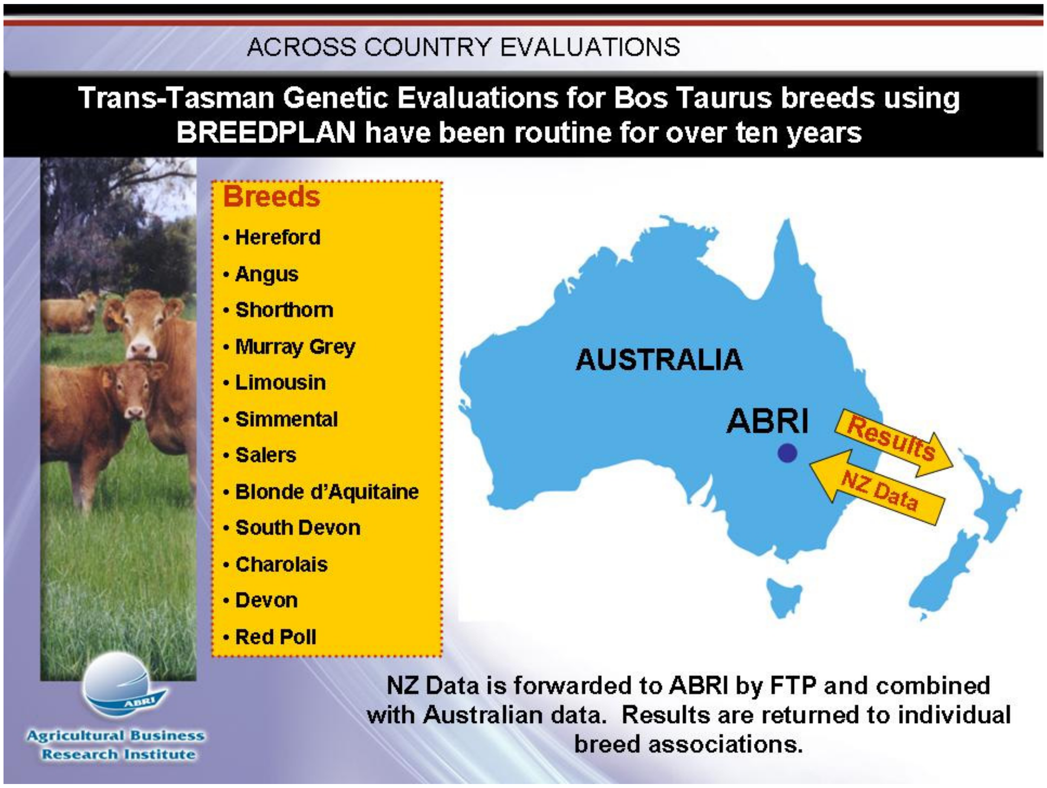
7. Across-country genetic evaluations

Across-country genetic evaluations have been in production with BREEDPLAN® and some other genetic evaluation agencies for two decades. This is still a rapidly developing field because the advantages to participants are both obvious and substantial.

- By increasing the number of cattle evaluated:
  - Accuracy in EBVs/EPDs calculated is increased.
  - There is a better chance of finding elite performers.
- Breeders can directly compare cattle across country borders.
- Breeders can have confidence in using genetics from another country.
- Breeders can benchmark their own herd genetics to other genetics around the world.
- Genetic progress of the breed can be accelerated where breeders use the best genetics from an international gene pool i.e. they can increase the Selection Differential.

Some examples of across-country genetic evaluations are given below.

Table 7.1: Trans-Tasman Evaluations for Bos Taurus breeds using BREEDPLAN have been routine for almost two decades.

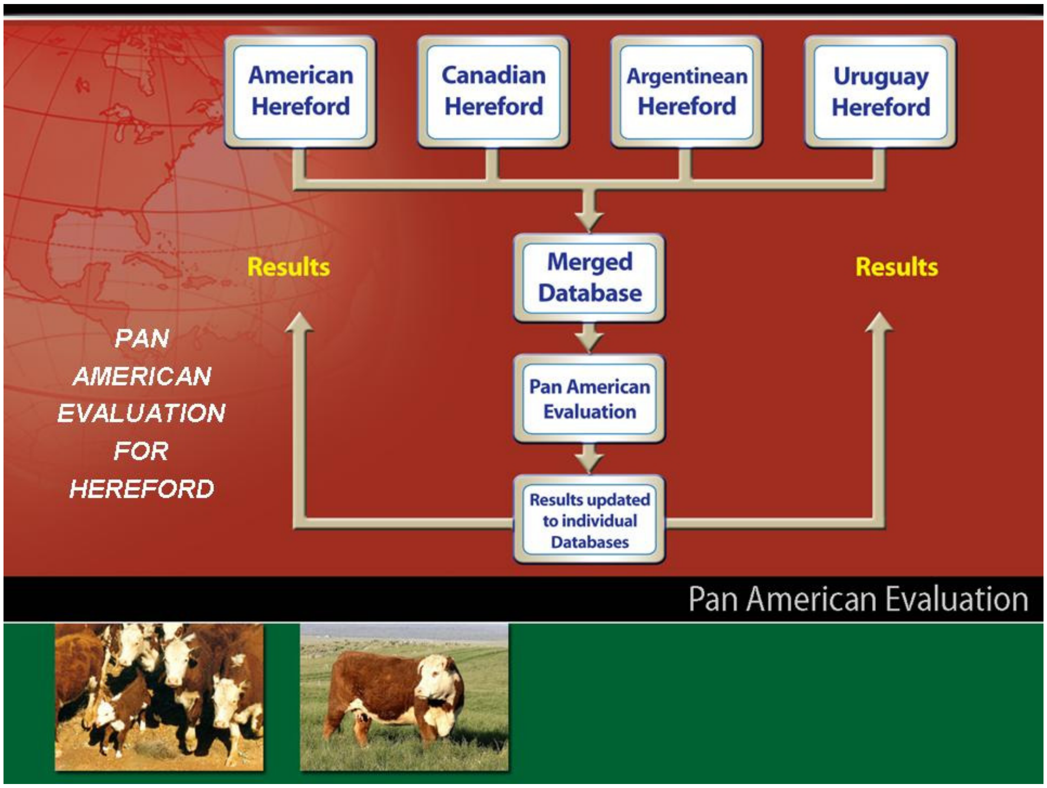


Other pairs of countries in which multiple service providers combine data for genetic evaluation include:

Canadian and United States of America
South Africa and Namibia
Argentina and Uruguay

A more ambitious project has been the Pan American genetic evaluation for the Hereford breed that went into production in July, 2009 following over 4 years of development work. Table 7.2 show how it works.

Table 7.2: How the Pan American Genetic Evaluation for Hereford works



The research and development phase involved:

- Complete re-estimation of adjustment factors and genetic parameters for all 4 countries.
- Matching of all common animals, a huge task as almost 6 million animals are included in the joint analysis.
- Revise analytical software to handle country specific trait definitions, adjustment factors and heritabilities.

The production run involved a huge dataset.

Table 7.3: Data set for Pan American Genetic Evaluation of Hereford

Trait	Total Records
Birth Weight*	3.0M
Weaning Weight*	3.8M
Yearling Weight*	1.7M
Final Weight	178,000
Scrotal Size	146,000
Scan REA-FAT-IMF	173,000 (x3)
Carcase (HCW, REA, FAT, MARB)	3,100 (x4)

*Direct and maternal.

- 5.7M animals (4.3M with a record/s)
- 240,000 sires.

- 1,870,000 dams

The benefits of this evaluation are huge. For example, sires which had small sets of progeny in particular countries now have a combined progeny set of several thousand animals providing very accurate EPDs.

The American Hereford Association (AHA) has already listed all the Uruguayan sires that meet its accuracy criterion on the AHA Website.

An even more ambitious research project conducted by AGBU has been a trial Global Evaluation for the Hereford breed. This involved the data for eleven countries in a test evaluation which was released in 2008. In this model, a full set of EBVs/EPDs are produced for each trait analysed for each country. This is a 'Rolls Royce' approach and AGBU has demonstrated that the advanced methodology works. Whether there is a commercial demand for this type of global service is still an open question.

The International Committee for Animal Recording (ICAR) is also undertaking research into across-country genetic evaluations.

8. Changes to the type of Service Provider

Historically the provision of livestock recording and genetic evaluation services was the responsibility of Government organisations and Universities. A continuation of this approach would only be justified if there is a demonstrated failure of the free-enterprise market to provide the services. This is NOT the case. As a consequence, this type of service provision has moved dramatically towards service companies with the exception of in some European countries.

Let me provide some examples of the trends.

Canada – the pedigree databases of most livestock breeds in Canada were maintained initially by the Canadian Livestock Records Corporation (CLRC). However, CLRC did not recognise the importance of implementing a modern performance recording system and integrating it with its pedigree recording service. As a result virtually all the major beef and dairy cattle breeds have withdrawn from CLRC and sought more commercially-focussed service providers.

United Kingdom – for some 50 years or so, beef cattle performance recording services were provided in the UK by the Meat & Livestock Commission (MLC). The MLC saw that it was the role of a Government agency to offer performance services but not pedigree services. As a result breed societies maintained their herdbooks with independent service providers. Inevitably the links between the pedigree databases and the MLC's performance databases were less than perfect and most breeders were exposed to recording twice.

When ABRI in 2004 offered a fully integrated pedigree/performance system in the UK, seven breeds representing 65% of the industry grabbed this option.

New Zealand – until the late 1980's, New Zealand had a national beef performance system underwritten by a Government Agency that operated on DOS and used a simple ratio system of performance evaluation. The whole of the NZ industry walked away from this to implement a BREEDPLAN system. Now, ten breeds operate under one roof and engage a service company called NZ Performance Beef Breeders (NZPBB) to undertake the data processing for all breeds. NZPBB has access to recording technology under licence from ABRI and this facilitates the routine conduct of across-country genetic evaluations.

South Africa – pedigree recording has traditionally been the province of the SA Stud Book and performance recording the Agricultural Research Council's (ARC) role. These two organisations collaborate in the provisions of an integrated pedigree/performance service using software developed initially in the Netherlands.

A number of breed organisations in South Africa have sought to have greater control over data ownership and processing and have changed to the BREEDPLAN system which is provided in South Africa and Namibia through a private company – AgriBSA.

Australia – prior to 1970 beef cattle performance recording services were provided by the individual Departments of Agriculture. Those departments collaborated in the establishment of a National Beef Recording Scheme (NBRS) in 1972 with the ABRI (an independent, non-Government organisation) appointed to run the service. That is, Government relinquished operational involvement in providing genetic evaluation services some 37 years ago. However, the Government(s) still support research and development into beef improvement.

USA – the USA has pioneered many of the innovations in beef improvement methodology – particularly the development of Best Linear Unbiased Prediction (BLUP) procedures. The USA has had little direct government involvement in its beef recording activities. Breed associations essentially approach individual IT companies to develop their pedigree/performance systems. The standards published by the industry-based Beef Improvement Federation formed the basis of collecting performance data. The individual associations send copies of their data to one of four Universities who offered genetic evaluation services. However, this has not proved to be a very satisfactory arrangement in that there is no adequate link between the breed association IT system and the genetic evaluation activity of the University. For example, data would be rejected from the University evaluation because it did not meet the University's edit checks but this was outside the control of the breed association who could not even access a diagnostic system to understand what was going on in the 'black box'.

In February, 2008 the US Beef Magazine published an insightful article titled 'Passing the EPD Torch'. The opening paragraphs say it all:

"Each day he goes to work, beef geneticists John Pollak crosses his fingers. Why? The Cornell University professor and head of the National Beef Cattle Evaluation Consortium (NBCEC) is waiting for the next step in genetic analyses.

That step is the Universities transitioning out of the service of calculating genetic analyses – where the industry gets its EPDs and sire summaries. Instead, they'll focus their efforts on the research and development needed to support EPDs".

The reality is that American Universities have not been good providers of EPD services even though they have heavy subsidised services in part from the funds they receive from government. By 2009, the Torch had already been passed to a small number of commercially-focussed service providers of which ABRI is a major player.

To his credit, my colleague Dr Hunsley initiated this transition two decades ago. It has taken the rest of the USA industry a little longer to come to grips with reality.

In summary, the role of government and government agencies in future should be simply to support worthy research, development and extension initiatives in beef improvement. Government should stay out of the service provision kitchen.

9. The Challenge – improving beef's market share

Much as we all love the beef cattle industry, the simple reality is that it continues to lose market share to pigs and poultry as shown in Table 9.1.

Table 9.1: World production of Beef, Chicken and Pork
'000 tons carcase equivalent.

Product	2000	2007	2008	Increase 2000 to 2008%
Beef	53,640	58,736	58,524	+9.1%
Chicken	53,057	67,753	70,748	+33.3%
Pork	85,904	95,658	97,130	+13.1%
Total	**192,601**	**222,147**	**226,402**	**+17.5%**
Beefshare	27.9	26.4	25.8	

Source: USDA

In the first 8 years of this decade, world beef production has increased by 9.1% versus increases of 33.3% in chicken and 17.5% in pork. Beef's share of production of these three meats has fallen from 27.9% to 25.8%.

In terms of exports the fall in market share has been greater as shown in Table 9.2.

Table 9.2: World Exports of Beef, Chicken and Pork
'000 tons carcase equivalent.

Product	2000	2007	2008	Increase 2000 to 2008%
Beef	5,986	7,610	7,606	+27%
Chicken	4,743	7,236	7,722	+62.8%
Pork	3,080	5,152	5,481	+78.0%
Total	**13,809**	**19,998**	**20,809**	**+50.7%**
Beefshare	43.3	38.1	36.6	

Source: USDA

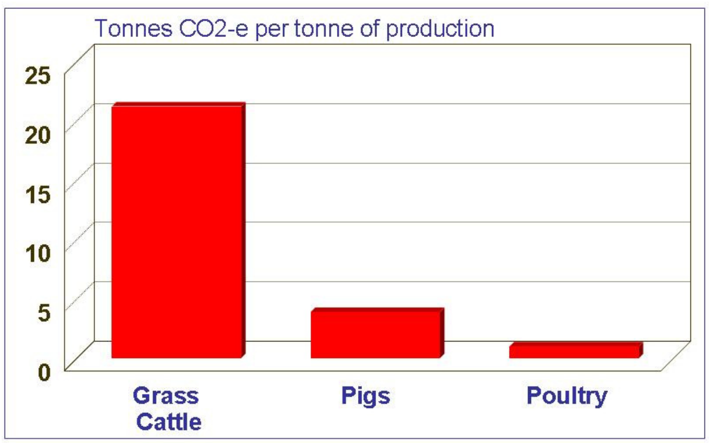
The fall of beef from 43.3% of exports of the three major meats to 36.6% in just 8 years is serious.

We need to give some serious consideration to why this is happening. Not surprisingly it is mainly to do with price.

The poultry and pig industries are largely run by corporates. The livestock (birds) have a short generation cycle and multiple births per breeding female. These intensive industries employ many of the world's best geneticists. Not surprisingly, they are achieving rapid annual productivity gains and with this they are able to reduce the cost of production and sell more product economically.

While we may not be able to match this with beef cattle, we can surely improve on what we are doing. An examination of beef cattle Sire Summaries across many countries shows that genetic progress for production traits is progressing at about +0.5% per year. The comparable figure in pig and poultry programs is up to 2.5% pa – five times the rate of gain observed with beef cattle. This genetic gain is cumulative so over 10 years it amounts to a 28% improvement in pigs and poultry. Little wonder beef is losing market share.

Another challenge for beef production is that its CO_2 emission per tonne of production is much higher than in production of pig and chicken meat.



This will become a serious economic handicap to beef production if a carbon emission tax is imposed indiscriminately.

However, if we look at changes in the BreedObject $Index for a range of beef breeds supplying the Australian domestic market things are a little more promising. The average increase is about +5% pa as our industry has found ways of improving traits that add value to the end product.

Having profit-focussed beef cattle performance recording schemes in place in ALL major beef producing countries is essential to underpin the economic future of the global beef industry.

Put another way, if you want your South African beef herd to be around in 50 years then it's YOUR responsibility to ensure that it maximises its use of today's beef improvement tools. Those are the very tools that will enable you to provide effective long-term competition in the world's future meat market.