Cattle genetics

Key actions

- Set the breeding objectives for your enterprise.
- Assess the merits of within-breed selection, changing breeds or crossbreeding
- Use BreedObject™ or a similar procedure to develop an index, or refer to breed societies' market-based indexes.
- Select bulls or semen based on an appropriate $Index.
- Bring genetically unrelated bulls into the herd to avoid inbreeding.
- Review your breeding program and tailor it to your requirements, considering traits that are individually important to your program.
- Ensure your breeding program matches your production system and the market being supplied.

Why is genetic improvement important?

Genetics sets the potential for upper or lower production limits that animals can achieve. This can impact on the goals for your beef enterprise, including your market options. Important beef enterprise profit drivers related to animal performance – including weaning rate, cow survival rate, cow weight, calving ease, sale weight, retail beef yield, P8 fat depth and marbling score – are influenced by the genetic make-up of the herd. Using the best cattle genetics allows you to improve the animals' contribution to enterprise profit.

Use best cattle genetics to boost profitability

Although animal genetics cannot improve non-animal production factors, such as pasture and grazing management, it can complement aspects of enterprise management, for example through greater capacity for more efficient feed utilisation and growth rate. Genetics can also determine whether you can achieve a particular production target, like a higher level of marbling or a particular muscle score.

In other situations, genetics can change the way you manage the herd (eg reduced need for supervision at calving) and reduce operational costs (eg easier management resulting from selection for better temperament).

Genetic improvement is about producing the best genotypes of cattle to suit a specific beef enterprises, and genetic gain is cumulative, permanent and relatively cheap.

What is genetic improvement?

Genetic improvement is the use of genetically superior animals as parents of the next generation. The definition of genetic superiority will be a function of many variables, including the production environment and the market being supplied. Most measures of genetic superiority will be based on potential profitability of the genotype for the given production environment and market being supplied. Not all genetic superiority needs to be based on profit but in commercial cattle enterprises, profitability is likely to be most important.

Genetic improvement should be continuous, and the most important variable that will limit continuous improvement is inbreeding. A sustainable genetic improvement program must manage inbreeding.

Other important considerations

A genetic improvement program must be designed in conjunction with culling decisions that influence the current herd and the existing herd management, and with consideration of markets being supplied.

How does this module assist you?

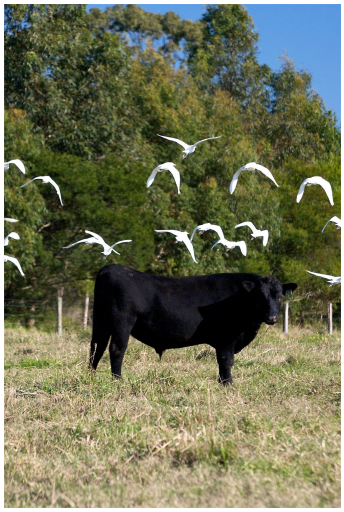
This module assumes that you have made the tactical decision to run a commercial breeding herd. Therefore, you need to select a bull to breed calves. Given that decision, this module will help you buy a bull that is value for money because it improves the genetics that are related to profit in your herd. If you are still undecided about running a commercial breeding herd, then you need to look at Module 1: Setting directions.

This module will assist the discerning commercial breeder whose main avenue for ongoing genetic improvement is through buying-in bulls or semen. It is not specifically designed for seedstock or stud breeders but the principles of setting a breeding objective are still the same. It takes you through the steps of establishing the breeding program to achieve animal production targets that contribute to enterprise profit. It also considers the implications of changing breeds or crossbreeding, and provides a guide to selecting the best bulls for your enterprise and setting up a mating program.

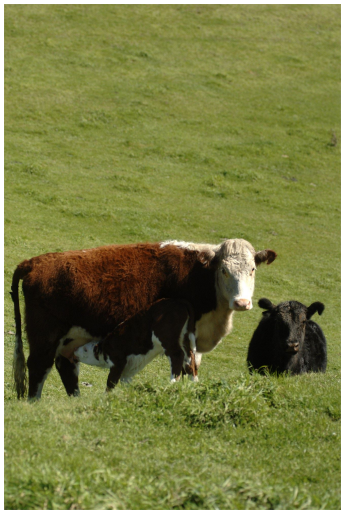
Linkages to other modules

The target markets and proposed herd structure for the beef enterprise are identified in Module 1: Setting directions, in relation to the pattern of pasture growth, long-term market prices, availability of finance and owner/manager goals and constraints. Module 1 also provides guidelines for

determining the current performance of the herd. There is a clear linkage to Module 7: Meeting market specifications and Module 5: Weaner throughput.



Principles of cattle genetics



- Some traits of cattle are under genetic control (heritable) and can be exploited to increase herd profitability. Traits that are economically important and are heritable should be included in the breeding objective of beef herds.
- Variation for economically important traits occurs within breeds and between breeds, and some variation can be created by crossbreeds. All sources of genetic variation should be considered when planning a breeding program.
- Bulls have a major influence on commercial breeding programs because of the number of calves they sire. Selection of sires is a critical control point in the operation of an effective breeding program.
- Genetic improvement should be considered in conjunction with non-genetic means of improving performance (eg current herd selection, improved nutrition or changes to market procedures), which may be more cost-effective.

Procedures for using best cattle genetics

- Procedure 1 – Use BreedObject
- Procedure 2 – Select breed
- Procedure 3 – Buy the right bulls
- Procedure 4 – Trait emphasis
- Procedure 5 – Culling policies

Procedure 1

Use BreedObject to develop an appropriate breeding objective for the herd and calculate a selection index

This procedure covers:

- guidelines for setting the breeding objective
- breeding objective
- BreedObject™

Guidelines for setting the breeding objective

Correctly setting the breeding objective for the production system and target market is critical. It defines the target for genetic improvement that maximises profit for the beef enterprise. If the breeding objective is inappropriate, the wrong emphasis may be placed on important traits (eg carcase weight or mature weight versus weaning rate).

The breeding objective lists the animal traits that affect enterprise profitability, and gives an estimate of the relative economic importance of each trait. The economic value of changing each important animal trait is calculated from financial and production data, preferably when setting the enterprises direction (see Module 1: Setting directions), but other approaches can be taken, such as using BreedObject.

The breeding objective is based on the 'ideal' animal for a particular enterprise

To initiate calculation of a breeding objective, the dollar value of one unit of change in each trait in the objective (eg 1kg of sale weight) is calculated while holding all other trait values constant. This calculation is the economic value for the trait. BreedObject software performs this calculation using costs, returns and current performance levels (eg sale weight 400kg or weaning 85%) for the enterprise recorded using a questionnaire.

The outcome of developing a breeding objective should be a list of traits with their relative importance to your herd profit. BreedObject is the most precise way to calculate the economic values of desirable traits, but other methods can be used. You can still use the procedures in this module if you have determined the breeding objective without using BreedObject.

The economic values may be informative when choosing between breeds as an indicator of what traits to look for in a potential new breed, but knowledge of the genetic merit of breeds is essential to make informed decisions. Changing breeds will make quantum changes in some traits and the relativity between traits will be quite different. If deciding to change breeds or switch to a crossbreeding program, you may need to recalculate the breeding objective because the average performance levels of the cattle will change.

BreedObject calculates a dollar index ($Index) for animals specific to the breeding objective

Once the economic value is calculated, BreedObject uses known relationships between objective traits and estimated breeding values (EBVs) to calculate an appropriate weighting for each EBV that will optimise progress towards the defined objective. Multiplying EBVs for individual animals by the weightings, then summing these values gives the $Index value. The $Index value is a measure of the genetic merit of the individual animal for the breeding objective; it describes how well an individual animal suits its intended purpose.

A number of breed societies have generic, market-based breeding objectives and selection indexes available on their websites, allowing commercial breeders to search for bulls that fit within their target index specifications (see Tool 4.1). These indexes are a very good guide as the objectives for many enterprises will be similar, and will rank animals similarly.

The breed-based indexes have been calculated from very good industry feedback on the costs, returns and trait performance levels of the production system and target market. Most commercial producers would be well advised to start with one of the standard breed society indexes and modify their selection procedures using a process described in Procedure 4.

A breeding objective

The breeding objective is the 'ideal' animal the producer aims to breed.

It is a genetic description that includes all the animal traits affecting profit (eg sale weight and weaning rate), as well as the importance of each trait to achieve a change in profit (economic value). The breeding objective is specific to the intended market, the production system, management environment and the current level of herd performance (eg current sale weight and current weaning percentage).

Economic considerations need to include all the factors affecting returns and costs. Returns are affected by the weight and price per unit of beef product sold, and premiums and discounts applying to particular traits. Cost of supplying extra feed, time taken to manage calving heifers and the cost of labour are examples of cost factors.

Using this economic data, the value of one unit of change in each trait (eg 1kg of carcase weight) of the breeding objective is assessed. Table 1 shows an example of the traits included in the objective and the economic values of traits. Economic values allow for the time taken until traits are expressed (eg carcase weight of steer progeny occurs sooner than lifetime reproduction occurs in female progeny). The benefits passed on to later generations are also included. Negative values can occur (eg for cow weight), meaning that a 1kg increase will reduce profit. In this case, the extra costs of feeding the cow due to an increase in weight are greater than the extra value of the carcase when the cow is finally culled from the herd.

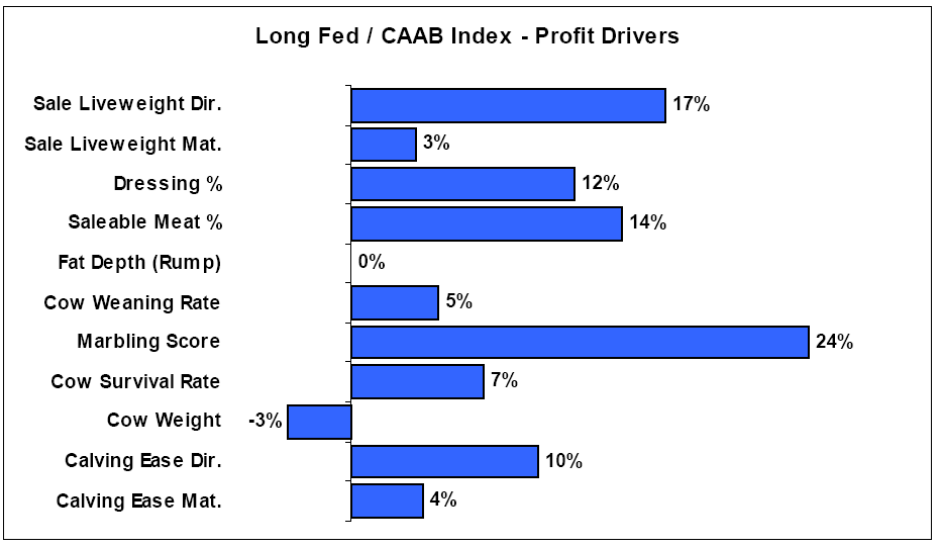
Table 1 also provides the relative economic values, which indicate the importance of each trait for breeding for intended market, taking into account the scope for genetic improvement (ie heritability). In this example, for a *Bos taurus* breed supplying a high quality export market, marble score is most important, then weaning rate, calving ease and sale weight. Trait importance can change for different production systems and market endpoints. It can also differ among breeds addressing similar markets. These relative values are often depicted graphically (Figure 1). These graphical representations of trait importance for all breed indexes are available on the BreedObject website: www.breedobject.com

All this information can be combined into one figure, the **$Index,** to rank and compare bulls on their combined genetic worth for the production system and intended market. Use this as the primary ranking for bulls being considered as sires, after which you should consider the underlying component traits in any bulls of interest to the breeding program.

Table 1: Example of trait values for a *Bos taurus* breed supplying the Japanese market

Trait	Economic values	Relative economic values
Sale liveweight – direct effects	0.614 $/kg	14.7 $
Sale liveweight – maternal effects	0.421 $/kg	3.0 $
Dressing percentage	9.568 $/%	9.9 $
Saleable meat percentage	7.808 $/%	11.6 $
Fat depth (rump)	0.000 $/mm	0.0 $
Cow weaning rate	2.239 $/%	17.9 $
Marbling score	50.913 $/score	22.2 $
Cow survival rate	2.880 $/%	5.0 $
Cow weight	–0.203 $/kg	–6.1 $
Calving ease – direct effects	2.778 $/%	15.9 $
Calving ease – maternal effects	2.778 $/%	6.4 $

Figure 1: Example of the relative importance of objective traits at the genetic level for a specific breeding objective



What is an EBV?

An animal's breeding value can be defined as its genetic merit for each trait. While it is not possible to determine an animal's true breeding value, we can estimate it. These estimates of an animal's true breeding value are called estimated breeding values, or EBVs.

EBVs are expressed as the difference between an individual animal's genetics and the genetic base to which the animal is compared. EBVs are reported in the units in which the measurements are taken (eg kilograms for weight EBVs). A value of +12kg for 40-day weight means the animal is genetically superior by 12kg at 400 days compared with the genetic base of the relevant cattle population. On average, half of this

difference will be passed on to the animal's progeny.

BREEDPLAN considers all the pedigree and performance information that is available on an animal and its relatives to produce an estimate of an animal's breeding value (ie an EBV). BREEDPLAN is a similar technology to that which has been used by the pig, poultry and dairy industries to make such dramatic production changes over the past few decades. It has worked wonderfully well for those industries, and works just as well for the genetic evaluation of beef cattle.

BreedObject™

BreedObject is a tool for formalising breeding objectives and $Indexes that can help you breed more profitable cattle. It uses BREEDPLAN EBVs. It helps you target the type of commercial herd performance you need from animals for a given market production system, and it helps you identify seedstock that will be best suited to this. BreedObject $Indexes are intended for use by stud and commercial beef producers.

BreedObject collates the BREEDPLAN EBVs on bulls into a single EBV, the $Index, which describes how well a bulls suits a particular purpose. If you are interested in more than one type of commercial production purpose, you will be interested in more than one $Index.

BreedObject is customisable to any commercial herd market production system. For any given system, the first step is to complete a trait-level analysis of which factors affect profit. In a second step, use BreedObject to assess what emphasis is justified (to address the target) on the different EBVs that are available for the animals. These differing emphases are reflected in the $Index value calculated for each animal.

Differences in the $Index values calculated describe how animals are expected to benefit production system profitability when production is for the described purpose. The $Index is an EBV for profit for this production purpose. Ranking seedstock on their $Index sorts them for their progeny's expected profitability for the targeted production system.

BreedObject $Indexes assess genetic potential for progeny performance. They tell you what to expect from progeny on average. They don't describe how bulls themselves will perform, for example during joining. Issues of structural and reproductive soundness need to be considered in the usual way. BreedObject on the web provides easy access to all vendors so you can discuss these and other matters.

Developing your own $Index is achieved in two stages. First, use your knowledge to assess trait importance for the market production system you visualise. Then, determine the $Index of EBVs that best targets the identified trait importance.

1. **Identify the commercial market production system to be targeted**

This is the most important step. Your knowledge and ability to describe this system is the key to customising your index. Think about how animals will be used, over what type of cows and in which environment, and the likely levels of production, costs and prices. Then complete the short, multiple-choice questionnaire online. Aim to use estimates and levels that apply **under good management** that you think will be **relevant into the future**.

Some other points to consider:

- **Bull breeders** – focus on the commercial market production system/s of your main clients.
- **Bull buyers** – focus on the commercial market production to be addressed by your main class of sale animal (eg steers).
- Focus on the whole production system, in general; from cow–calf production to finishing.
- Consider making separate cases where it is difficult to decide between competing systems or views of the future. It can be helpful to see how animals rank for several purposes.

2. **Assess trait importance**

The information you provide through the questionnaire is used to assess the impacts that trait changes will have on profit. These are examined using a detailed herd model. All traits that directly affect costs or returns are considered. The assessment for each trait assumes levels of the other traits remain unchanged.

The results on trait importance take into account the assessed effect on profit and the amount of genetic variation available for change in a trait. These results are illustrated graphically and are automatically available for your breeding objective.

3. **Construct the best $Index**

Once the trait importance has been determined, the $Index of available EBVs that best correlates with this is automatically constructed.

This $Index takes account of the assessed economic importance of traits, of the genetic variation for – and associations among – traits, and of any other herd-specific information you provided.

Results on the percentage emphasis being applied on each EBV are illustrated graphically, and are automatically available for your $Index.

4. **Using your $Index**

Your $Index is immediately and automatically available for use online. The applications are the same as those available to any other $Index. It can be applied to the EBVs of animals in your own herd to help with selection, to the EBVs of published sires, or to the EBVs of animals in sale or semen catalogue listings to help with bull or semen purchase.

Any $Index you derive is automatically added to the list of $Indexes that are available to you. These $Indexes are easily selected or de-selected for display, and your $Indexes can be edited or deleted at any time.

BreedObject is a commercial software available at www.breedobject.com

The software allows calculation of tailored breeding objectives using a simple questionnaire, or more sophisticated calculation of a breeding objective and an index by using a consultant. Once developed on a password-secured site, the personalised index can be applied to any animals listed on the BREEDPLAN system.

What to measure and when

Annually, review any changes that have been made to your production environment or target market. If significant changes have occurred, you may need to reset your breeding objective.

Procedure 2

Select the most profitable breed or crossbreeding system to achieve genetic progress

Guidelines for selecting the breeding system

Consider selection of the best genotype for your enterprise as part of setting the enterprise direction (refer to Procedure 1 of Module 1: Setting directions).

Assess merits of a change in breed or crossbreeding compared to within-breed selection only

Evaluate the merits of changing breeds, crossbreeding or within-breed selection alone. In general, the genetic variation within breeds is large and will allow many breeds to compete in a range of markets. So the decision about whether to move to an alternative breed or cross will be based on an assessment of whether the size of the changes needed in the traits of your current herd is so great that it will take too long to achieve by simply selecting better bulls within your existing breed or source of bulls. It is important to calculate the costs, time and effort required to implement a new breeding system to ensure that the advantages outweigh the difficulties.

Economic values calculated in Procedure 1 can help identify the most beneficial traits for improvement. But changing breeds may cause large changes in some traits, and may change the relativity between traits, such that a decision to change breeds will require an iteration of Procedure 1 to calculate a new index.

Options to change herd genetics

- Replace the existing herd by buying in an alternative breed. This is the quickest method, but also the most costly. Embryo transfer is also an option, although this may too expensive for most commercial operations.
- Build up to the desired breed or combination by crossing with bulls from the chosen breeds. This option is slower, but is generally less costly and brings with it the complementary hybrid vigour that comes from crossing genotypes during the transition to the new breed or breed combination.
- Decide what the ongoing breeding program will be: a designed crossbreeding program or a straight breeding program using the new breed.

Although ongoing advantages can be achieved by implementing a planned crossbreeding program, some of the potential disadvantages include:

- additional herd management associated with crossbreeding
- potential discounting of crossbred animals, particularly for some breeds when sold through the saleyard system or to specialised markets that specify breed composition
- time and cost required to bring the herd into ‘equilibrium’
- suitability of crossbreeding to larger herds that have more bulls and larger lines of sale animals.

Sources of information for breed and crossbreed averages for important traits are presented in Tool 4.2 and Tool 4.3. Tool 4.2 provides information about multibreed EBVs that allow valid comparisons of bulls across a selection of breeds for a range of traits. The comparison is limited by the lack of data required for head-to-head comparisons of breeds, and is currently restricted to the Angus, Hereford, Limousin and Simmental breeds. Unfortunately, little extra data has been generated and no new multibreed comparisons have been published.

After deciding on breed and whether to crossbreed, further genetic progress relies on selection of replacement bulls within the available genotypes (see Procedure 3).

What to measure and when

Consider a change in genotype when:

- potential genetic improvement (for economically important traits) within breed isn’t adequate to make the required changes for your program
- potential for marginal return on investment for an alternative breed is greater than for other investment options
- cash flow during the transition period to the new breed or cross is maintained at acceptable levels.

This is a strategic decision. The measures that are needed for an economic evaluation of options are described in Module 1: Setting directions.

Procedure 3

Buy the right bulls (or semen) to maximise progress toward enterprise profit (the breeding objective) and avoid inbreeding.

Guidelines for buying the right bulls

The purchased bulls, or semen for an artificial insemination program, need to provide the best value for the financial outlay. Regardless of the breeding program, the genetic value of a bull to an enterprise is based on how well its individual attributes fit the herd's breeding objective.

EBVs are always the best estimate of the genetic potential for a trait. Accuracies that accompany the EBV value indicate how much information has been recorded for a particular animal for the reported trait. The accuracies improve with the more information collected (see Tool 4.4).

Use EBVs related to the traits identified in Procedure 1 to select the best bulls for the breeding program, as they are important to the breeding objective

Measure the value of a bull by its 'fit' with your breeding objective

Relate the price you can 'afford' for a bull to the bull's potential earning capacity. The most profitable bulls for your herd will be those with the greatest difference between predicted earning capacity and purchase price. These bulls may not always be those with the highest genetic merit.

Use the $Index value for all bulls you are considering to compare their prices. The index value is in dollars per cow mated. As a guide to a bull's value, multiply the index value by the likely number of cows he will be mated to in his working life. For example, the bull will be used for four years over 50 cows per year (200 cows). This value is a good guide for comparing bulls. A bull with an index value of 100 compared to a bull with an index of 50 is worth $5,000 extra (ie 200 cows x $50 index points x 0.5). Multiply by 0.5 because only half of the value comes from the bull. This calculation doesn't set the price, because it depends on the average for the sale, which depends on many other factors (see Tool 4.5 for a guide to valuing your bull purchase).

Use this information to select the bull with the highest genetic value for your herd's breeding objective from those with the greatest difference between estimated earning capacity and purchase price. Tool 4.5 will assist you to avoid two common pitfalls when buying bulls:

- paying too much for the apparent 'super bull' when the second best bull is better value
- paying too much for the worst bull in a sale catalogue because he was less expensive.

Ensure that your bull supplier is accurately recording all possible traits associated with traits that are economically important to your breeding program. If a bull breeder is recording all important traits, it will be reflected in the accuracies of the EBVs presented (see Tool 4.4). As a guide, young bulls should have all EBVs displayed with accuracies between 50–60% for weight traits. Traits of lower heritability will have lower accuracies. (If EBVs aren't displayed, it generally means that trait hasn't been recorded.)

Choosing a bull is the decision point at which inbreeding should be considered. In commercial herds, a rule of thumb is to avoid successive bull purchases that have a common parent. Inbreeding is a major impediment to the genetic progress of bull breeders, and mostly they try to change genetic lines on a regular basis.

Check bulls for structural soundness at purchase and annually before mating

Remember that the physical ability of bulls to sire many calves is a primary consideration. The selection of bulls for maximum fertility based on structural soundness and libido are discussed in Procedure 1 of Module 5: Weaner throughput. Management can also play a large role in bull fertility. Prevention of infectious reproductive diseases is outlined in Procedure 1 of Module 6: Herd health and welfare.

What to measure and when

Predict the value of bulls for improving enterprise profitability

When a new bull purchase is being considered, and before mating each year:

- assess the genetic merit of prospective bull purchases
- estimate the earning capacity of bulls based on the index value and the projected pattern of use (number of cows per year × number of years used) (see Tool 4.5)
- assess structural soundness of the bull battery
- assess the accuracy of information given to you by your bull breeder (see Tool 4.4 to find information that is recorded on sale bulls and the subsequent accuracies associated with the EBVs).

Procedure 4

Modify trait emphasis in line with individual herd requirements

The process of developing a breeding objective is an essential and very sound genetic improvement principle. Even taking the easiest and most practical approach of using an index developed by a breed society – and thus using the objective developed during the development of that index – will be a sound first step in designing a breeding program. But in all breeding programs, individual requirements will be brought about by differences in the production environment and markets, and personal preferences.

Breeders may require modification of trait emphasis to:

- minimise calving difficulty because of inability (extensive enterprise or difficult topography) or disinclination to handle calving difficulties
- improve temperament due to inability to handle flighty cattle
- meet market specifications of higher yield or different maturity types
- meet personal estimations of future market requirements (ie bulls selected today won't produce sale progeny for at least 18 months, and 2–3 years in most cases).

Special requirements can easily be catered for within the bulls that are high ranking on an index. Bulls may achieve high index values for different reasons, so applying an independent cut-off on individual traits will only marginally reduce progress towards a profit objective. For example, Table 1 shows that bulls selected with high indexes can have quite varying birth weight EBVs.

Table 1: Five young Angus bulls with similar index values show variation in production traits

Name/ ID	Calving Ease Dir (%)	Calving Ease Dtrs (%)	Gestation Length (days)	Birth Wt. (kg)	200 Day Wt. (kg)	400 Day Wt. (kg)	600 Day Wt. (kg)	Mat. Cow Wt. (kg)	Scrotal Size (cm)	Days to Calving (days)	Eye Muscle Area (sq. cm)	Rump Fat (mm)	Retail Beef Yield (%)	IMF (%)	Long Fed CAAB Index
Bull A	2.4	1.7	-5	1.9	40	86	112	85	1.2	-4.3	9.4	1.2	0.4	3.3	159
Bull B	-3.6	0.8	-0.5	6.3	45	79	104	73	0.4	-1.8	12.9	0.8	1.6	3.5	158
Bull C	2.7	0.8	-3.5	3.6	42	90	107	71	1.8	-3.2	9.6	0.5	0.6	3.3	158
Bull D	0.3	1	-1.4	3.2	40	80	101	73	1.7	-3.4	11.4	2.2	0.7	3.6	158
Bull E	-2.6	0.6	-2.8	7.3	52	94	115	91	1.2	-2.8	11.2	0.3	1.3	3.3	157
Bull F	2.5	0.9	-3.2	1.7	34	88	105	76	2.3	-4.2	9.9	0.4	1	3.3	157
Breed Avg.	**0**	**0.4**	**-2.6**	**4.5**	**37**	**69**	**88**	**81**	**1.3**	**-2.6**	**3**	**-0.1**	**0.2**	**0.9**	**90**

Open PDF

Some traits that are important to the breeding enterprise do not have EBVs, and therefore those traits aren't included in the index. There is little option other than imposing independent culling on these traits, which include the structural traits (eg teats and udders).

Another decision point for control of the individual traits and for inbreeding is when allocating bulls to the mating groups.

When allocating bulls to mating groups, reduce the risk of inbreeding and dystocia and match traits, if required:

- Mate bulls with the highest EBV for calving ease to heifers, but remember that half of the genetics for calving ease comes from the maternal grand sire, so reducing calving ease may take more than one generation. Even older cows shouldn't be mated to extremely high birthweight bulls because if you keep heifers resulting from that mating, they will carry genes for high birthweight.
- If possible, mate bulls from a breed with a lower mature size to heifers. (This is especially effective in a crossbreeding program where differences in mature size and hybrid vigour can cause increased birthweights, and therefore increased calving difficulties.)
- Match strengths and weaknesses of cow groups by allocating different sires. An example may be earlier maturing (low frame size) cows may be mated to later maturing bulls, or vice versa, if maturity type is important to your objective.
- Minimise inbreeding by preventing the mating of bulls with daughters or with cows that have a common parent (half-brothers and half-sisters).

What to measure and when

- Calving ease EBV for bulls allocated to weaner heifers, or birth weight EBVs when calving ease EBVs are not available.
- Male parentage of all cows in the herd. (Do this in age groups if individual identification is not recorded.)
- Monitor growth rates, turn-off age and turn-off fatness (see Module 7: Meeting market specifications).
- Monitor feedback from kill sheets and note any unwarranted trends that may need correction (see Module 7: Meeting market specifications).

Procedure 5

Implement sound culling, management and marketing policies to complement the genetic improvement program

For some traits, it may be more cost-effective to make improvement by culling non-performers or by management. Repeatability can be as important as heritability for traits that are repeated annually, such as calving success and weaning weight of the calf. Fertility traits tend to have lower heritability but are economically important in most breeding programs. In some enterprises, it is more efficient to improve fertility by culling non-performers, or by improving nutrition or management.

Management influences – especially nutrition – can overcome some genetic deficiencies. For example, lower fattening ability is not a problem if nutrition is adequate, such as in feedlot finishing.

One of the most important nutritional considerations is the time of calving. In principle, timing for mating should coincide with timing for reliable high quality feed (see Module 3: Pasture utilisation).

The chosen market should also be considered as a variable in the enterprise mix. Strategic decisions about which market to target should be made based on sound economic considerations. Chasing a high priced market may be a false economy if major changes to the breeding program are required.

For example, herds with high calving rates (greater than 85%) and a breeding program of selecting heifers by short joining (6 weeks) at a young age (15 months) will select for heifers with early age at puberty. If empty cows are culled after pregnancy testing for the second calf, the remaining cows in the herd will have short post-partum anoestrus. Both early age at puberty and short post-partum anoestrus are associated with improved lifetime reproductive performance. A culling procedure based on these principles will make only a small genetic improvement but it will improve the repeatability of these traits. Selecting for repeatability of a trait (ie selecting young animals for traits that will be repeated at older ages) is likely to improve profit more than just selecting for sires with higher fertility EBVs (ie days to calving, scrotal size).

Calving ease may be used as a second example. Again, heritability is low and the trait is very complex. A single-pronged approach will be unlikely to result in large changes, but multiple approaches including genetics, culling and nutrition can be very rewarding.

Maximum returns will result from integrating genetic improvement programs, culling and management.

What to measure and when

- Performance level of economically important traits
  - calving rate
  - calves born in first cycle
  - compliance to market specifications (weight, fat, marbling)
- Nutrition and climatic conditions
  - decisions to change should not be made in extremes, such as droughts or extremely good seasons
- Age and weight at sale.

Commonly used genetics terms

Estimated breeding value (EBV) – an estimate of an animal's genetic worth for a particular trait. The estimation can be based on the animal's own phenotypes or its' relatives, for the same or different traits to the trait of interest. This is made possible by knowing the genetic relationships between animals and the genetic correlations between the heritabilities of traits. The bull and cow each contribute a random sample of their genes to their offspring, half from each, meaning that half of the EBV of each parent is the contribution to their progeny.

Breeding objective – relates the goal of the breeding program to the traits that need to be improved to contribute to the overall enterprise objective (presumably economic gain, for the most part).

Selection index – a single EBV that describes how well animals suit a particular purpose (objective). It is a weighted combination of all available EBVs into a single dollar index value ($EBV).

BreedObject™ – a software package that can calculate a dollar index ($Index) value for animals specific to the breeding objective for your herd.

BreedObject™ Software

The BreedObject website is www.breedobject.com

This site contains a live version of the program with the capacity for dollar index development online for immediate use. Online interactivity with the breed databases ensures use of the latest EBVs, and also EBV and standard dollar index display. The information section (accessible from the home page) has a list of useful references, and the home page includes links to all the breed sites.

A number of breed societies have generic, market-based breeding objectives and selection indexes available on their respective websites, allowing commercial breeders to search for bulls that fit within their target index specifications.

Angus	www.angusaustralia.com.au
Hereford	www.herefords.com.au
Poll Hereford	www.herefords.com.au
Shorthorn	www.shorthorn.com.au
Limousin	www.limousin.com.au
Charolais	www.charolais.com.au
Brahman	www.brahman.com.au
Murray Grey	www.murraygrey.com.au
Simmental	www.simmental.com.au

Breed trait averages

Some progress has been made to compile well designed lookup tables that allow a reasonably reliable comparison of differences between breeds. However, they are not currently available for the full set of breeds and traits that impact on enterprise profit.

When designing a crossbreeding program, it may be wise to seek professional help. There is a course, developed by MLA, specifically for designing breeding programs. This includes a major section on crossbreeding that could provide valuable assistance with the design of a crossbreeding program. The course is entitled More Beef from Breeding and is designed to support More Beef from Pastures clients who need to study beef breeding in more detail.

The following tables are extracted from the More Beef from Breeding course material.

How breeding systems can exploit genetics

Table 1: Sources of genetic differences

Traits of economic importance	**Within breed** (ie selecting the best within one breed – the variation is calculated as the top 10% of the breed compared to the bottom 10% in a group BreedPlan summary)	**Between breeds** (ie can you choose a better breed for the key profit factors – these figures assume starting with a British breed base)			**Hybrid vigour - interaction between breeds** (is the crossbred animal superior to the average of the two parent breeds)	
		BB	Euro	Bos. I	BB/BB Or BB/Euro	BB/Bos. I Or Euro/Bos. I
Growth	✔	✓	✔✔	✔✔	✔	✔✔✔
Reproduction	✔	✔	✔	✔	✔	✔✔
Carcase - quantity (yield)	✔	✓	✔✔✔	✗	0	0
Carcase - quality (marbling)	✔	✓	✗	✗	0	0

- ***✔ represents approximately 5% gain***
- ***✓ represents approximately 2.5% gain***
- ***✗ represents a 5% loss in desired trait***
- ***0 represents no gain***

Source: MLA More Beef from Breeding Workshop Notes

Table 2: Potential to change key factors for a southern production system tailored to a longfed export market

Description of breeding system								
Traits	Relative importance of factor*(1= most important)	Is within breed selection feasible for this factor? Ie is the factor heritable?	Selection criteria	Between breed - opportunities for gain	Are you exploiting between breed differences?	Can hybrid vigour help?	Are you exploiting hybrid vigour in your breeding system?	Suggested actions
Liveweight at point of sale	2	✔✔✔	Yes - 600 day 20kg above breed average	Yes	No	✔✔✔	No	BreedObject
Weaning rate	3	✔	Scrotal size EBV above breed average	Yes	No	✔✔	No	
Carcase yield	4	✔✔✔	No - EMA EBVs below breed average	Yes	No	✗	No	Should look at EMA EBVs?
Carcase quality	1	✔✔	No	Yes	No	✗	No	IMF EBVs new to my breed. As marbling is the most important factor any change...in breeding system would have to ensure no loss of marbling performance. Crossbreeding with Shorthorn or Wagyu could be considered.

Open PDF

***Indexing programs such as BreedObject, assist to determine the relative importance of traits more accurately.**

Multibreed EBVs

The first multibreed EBVs were released last year for four breed groups (Angus, Poll Hereford, Limousin and Simmental). This means that for the first time we can compare bulls and females directly across these breeds, whereas previously, it was only possible to compare the EBVs within breeds. At this stage it is possible to do this for gestation length, liveweights up to 600 days and carcase weight.

Table 3 presents the adjustment factors that need to be used to make direct comparisons possible across the four breeds.

Table 3: Multibreed EBV adjustment table (March 2003)

	Gestation length	Birth weight	200-day weight	400-day weight	600-day weight	Carcase weight
Angus	0.0	0.0	0	0	0	0
Poll Hereford	1.1	2.8	9	21	16	8
Limousin	9.2	6.4	13	25	17	20
Simmental	6.4	8.7	31	63	71	–

Table 3 provides estimates of the genetic differences between these breeds for the traits mentioned, using Angus as the baseline.

All that is needed to produce multibreed EBVs for a given trait, is to add to an animal's existing within breed EBV the value listed in *Table 3* for that breed. For example, to compare an Angus bull with an EBV for carcase weight of +33, with a Limousin bull that has a within breed EBV of +16, we have:

Angus bull with a value of 0 [from *Table 3*]+ 33 = 33

Limousin bull with a value of 20 [from *Table 3*]+ 16 = 36

So for the two bulls in this example the Limousin bull has an advantage of + 3 for this trait.

Further information

Research institutes where the most useful breed comparisons have been conducted are listed below. Each organisation has publications summarising and presenting the results. When reviewing any breed comparison data, consider how recently the studies have been conducted. Some breeds have made rapid progress, particularly for growth traits, over the last two decades.

- Beef CRC (2005–2012) legacy website at www.beefcrc.com – look for papers by Binden et al.
- US Department of Agriculture Clay Centre, Nebraska at www.usda.gov - look for papers by Cundiff et al.

Note: The USDA Clay Centre work in Nebraska is by far the most comprehensive, but has been conducted under North American conditions of environment, feeding and markets.

- State departments of primary industries and agriculture also provide useful resources:
  - New South Wales Department of Primary Industries: www.dpi.nsw.gov.au – look for papers by Hearnshaw *et al.*
  - Department of Primary Industries, Victoria: www.dpi.vic.gov.au – look for papers by Morgan, Graham *et al.*
  - Department of Primary Industries and Regions, South Australia: www.pir.sa.gov.au – look for papers by Deland *et al.*
  - Department of Agriculture and Food, Western Australia: www.agric.wa.gov.au
  - Department of Primary Industries, Parks, Water and Environment, Tasmania: www.dpiwe.tas.gov.au

Considering different breeds

Profitable crossbreeding

Excerpt from a 2004 presentation by Bill Hoffman from NSW Agriculture, Casino, at Grafton Research Centre. The paper is based on progress information from the regional evaluations of breeds being conducted under the umbrella of the Beef Quality CRC, with MLA funding. The focus is on sale cattle and as such does not cover attributes relevant to the breeding herd, such as reproduction.

1. Background

Selecting a profitable crossbreeding system that will work within the many constraints that most beef cattle producers operate under can be complex.

2. Important aspects to consider

When selecting a possible crossbreeding system, producers need to:

2.1. Consider the overarching constraints

- market options
- environment (pastures, seasonal conditions)
- existing preferences (for breed, selling methods, etc.)
- overall goals for the business.

2.2. Recognise drivers of profit – a key driver of profit is gross income which is a direct reflection of number sold multiplied by the average value.

Value is influenced by quality and weight.

Quality is difficult to describe, but will normally be associated with:

- specification compliance (fat, etc.)
- yield (dressing % and retail beef yield, or RBY)
- eating quality (intramuscular fat or IMF, etc.)

3. Breeding for a market

The ranking of these quality indicators will change according to the target market. Broadly, the beef market may be broken into three segments:

- high marbling trade (marble score greater than MS 2)
- table beef trade (high eating quality)
- manufacturing beef.

Before setting breeding objectives for the herd and developing a breeding plan, beef producers need to focus on the traits that are important in regard to the target market.

The following traits will most likely be included:

- weight
- fat depth
- yield characteristics (muscling)
- intramuscular fat (marbling).

The ranking and weightings given to the above traits will vary significantly between the high marbling versus the table beef market segments.

4. Some options for satisfying these markets

Market segment	Important traits (profitability ranking)	Possible breed type/options
High marbing	IMF (marbling) Weight (carcases) Yield	British breeds with some ability to marble (eg Angus, Shorthorn, Murray Grey) British breed selected for marbling (eg high EBVs) Japanese breeds (eg Wagyu)

Table beef	Weight Fat Yield Marbling	British breeds (eg Hereford, Angus) European breeds (eg Charolais, Limousin) *Bos indicus* breeds and crosses (eg Brahman × British) Japanese breeds (eg Wagyu)

BREEDPLAN Support

BREEDPLAN provides information to support those who require more information on BREEDPLAN and its related products (eg BreedObject). The BREEDPLAN website should be accessed for information on EBVs and BREEDPLAN products and services.

Further support is available from the Southern Beef Technology Services (SBTS) or the companion service in the north, Tropical Beef Technology Services (TBTS). Under the technical section of these websites, you will find valuable support information. Of particular value for commercial breeders will be an article entitled *Interpreting Bull Sale Catalogues* found on SBTS websites under 'Technical Documents – General Articles'.

On the SBTS website, there are a series of webinar presentations regarding the use of DNA technology within the beef industry. This is a series of six webinars that can be accessed online at any time. Companion factsheets are also available through the SBTS website or the Beef CRC website.

Bull earning capacity calculator

The bull earning capacity calculator will help you predict the estimated earning capacity of each bull based on the dollar index value and estimated number of cows to be mated.

This tool will help and should assist you to avoid two common pitfalls when buying bulls:

- Paying too much for the apparent ‘super bull’ when economically the second best bull is better value.
- Paying too much for the worst bull in the catalogue because he was ‘cheap’.

Use the index values as an initial screening tool and then it is strongly recommended that you scrutinise the individual EBVs to refine selections for the needs of your enterprise.

In the calculations that follow, a price needs to be nominated that you consider reasonable to pay for an ‘average bull’ of the particular breed, which is then equated to the average index value for the breed.

The indicative value of any bull of that breed is then derived from this average price, taking into account the difference between the bull’s index value and the average index value, which is then multiplied by the number of cows he will be mated to in his working life.

Worked example: a bull with an index value of 80 in a breed where the average index value is 40, mated to 100 cows in his working life with an average bull price of $4,000 will be worth:

= (80 – 40) × 0.5 × 100 + $4,000 = $6,000

[= (index value less the average) divided by 2* × the no. of cows + average price]

*Why divide the index value by 2? Because as with all EBVs when valuing a bull you are only accounting for half the genetics; the other half comes from the cow.

Note that the indicative values so derived are break even purchase prices and as such are the upper limit of what you should pay for the marginal genetic worth of the bull over and above breed average.

Also note that for the values to be relevant for you, the chosen index needs to be based on costs and returns similar to those in your enterprise. While it is unlikely to be the same actual value if you use a ‘generalised’ index, such as those developed by breed societies, the ranking of bulls should be very similar by both methods.