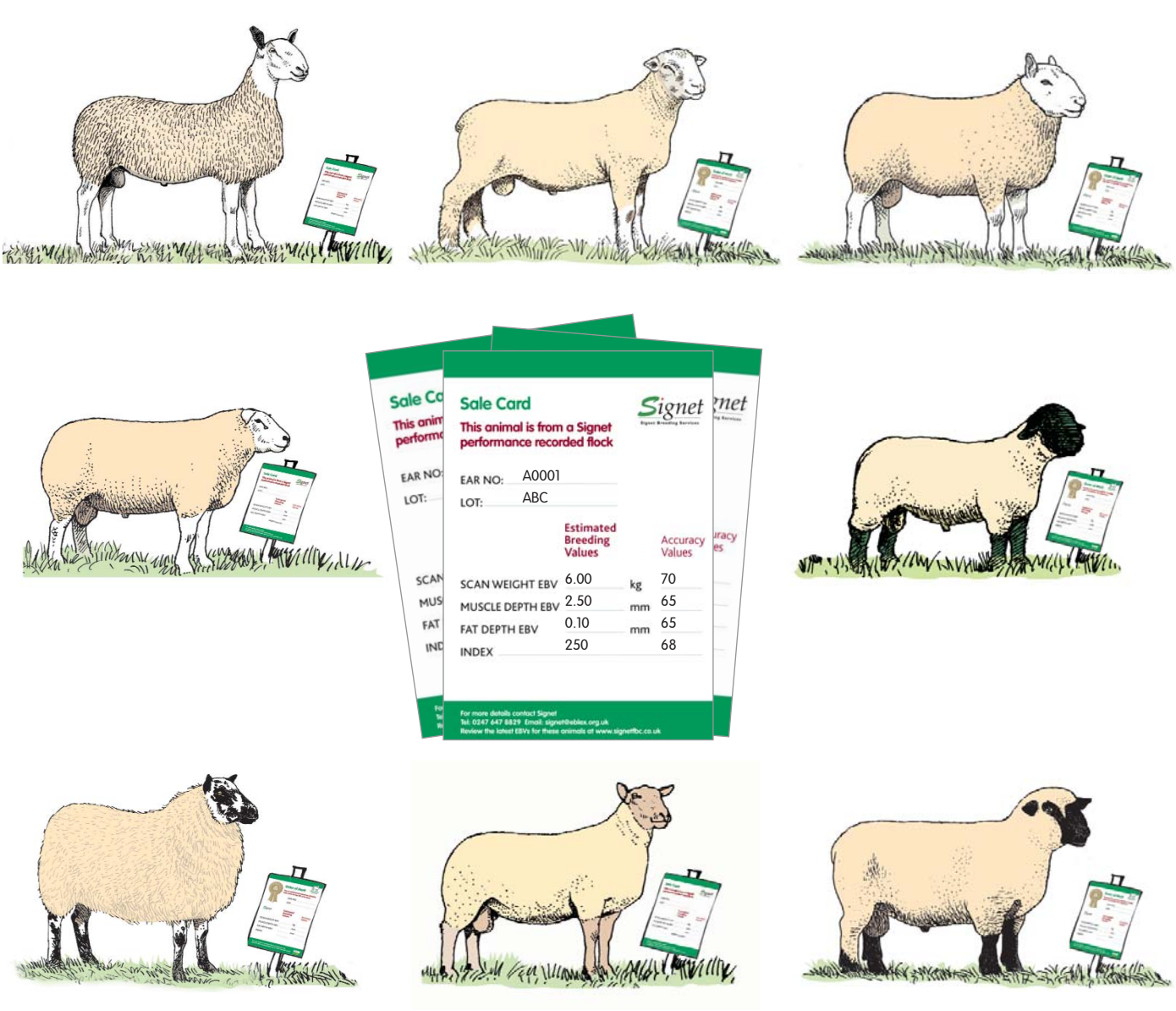
PERFORMANCE RECORDING YOUR PEDIGREE FLOCK



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Performance Recording Your Pedigree Flock

How recording benefits pedigree breeders

Contents

1. Why should I record my flock?

Performance recording gives pedigree breeders and ram buyers an objective way to assess the genetic potential of rams selected for breeding.

Recording adds value to pedigree breeders

As Estimated Breeding Values (EBVs) become more widely promoted, rams with high EBVs regularly achieve £300–£400 premiums at ram sales. More importantly, clearance rates are higher than those for unrecorded flocks.

In an EBLEX survey over 90% of pedigree producers believed that interest in performance recording had risen in the past two years. With commercial buyers actively seeking recorded rams with the right EBVs, it clearly pays to record.

Commercial buyers now actively seek rams with the right EBVs, which makes recording pay.

Table 1: Typical flock results

	No. of Progeny	Days to Slaughter	Carcase Weight (kg)	Extra Value
Borrins Farm				
High Index Ram	**77**	**134**	**19.68**	£2.78 direct benefit and leaner carcases
Farm Stock Ram	**77**	**142**	**18.99**	
Harrop Hall				
High Index Ram	**38**	**166**	**18.61**	£2.68 direct benefit and leaner carcases
Farm Stock Ram	**41**	**171**	**17.82**	

Source: Defra funded ADS trial

Performance recording:

1. **Improves breeding decisions by using EBVs to:**
   - Identify ram lambs to be retained as stock sires
   - Make mating decisions within the breeding flock
   - Select female replacements
2. **Enables breeding stock to be marketed more effectively:**
   - Buyers can purchase rams with confidence
   - Rams can be compared to those bred in other flocks
   - Better quality rams are produced for sale
3. **Makes more money from pedigree sheep production**

Recording adds value to commercial producers

With recorded rams, commercial sheep producers can enhance flock productivity and profitability.

In terminal sire breeds, rams with:

- high scan weight EBVs will:
  - increase carcase weights
  - reduce days to slaughter weight
- high muscle depth EBVs will:
  - enhance carcase conformation
- low fat depth EBVs will:
  - produce leaner carcases

Defra-funded trials show this benefit can be worth an extra £2.50–£3.00 a lamb. (See Table 1)

In maternal breeds, increases in the number and weight of lambs weaned will substantially improve the profitability of both hill and lowland breeding flocks.

A recorded ram can deliver over £600 added benefit during its working lifetime – a highly cost-effective investment.

2. Planning your breeding strategy

1. Establish your objectives,

these may include:

- Selling pedigree rams to other pedigree breeders
- Increasing numbers of commercial rams sold off-farm
- Achieving a premium for rams through the provision of EBVs
- Selling semen from recorded rams to other breeders
- Increasing the average price of rams sold by auction
- Raising the flock profile by winning silverware at local shows

2. Understand your customer's needs,

but do not assume they are the same as yours.

Use Table 2 to determine which traits are important in your flock and which are important to your customers. From this list of important EBVs you can establish an appropriate breeding strategy for your flock.

Table 2: Breeding objectives of buyer and seller

	Flock Breeding Objectives				Customer's Breeding Objectives			
	Increase	Maintain	Decrease	Not important	Increase	Maintain	Decrease	Not important
Traits influenced by EBVs								
Example: Growth rates		✔			✔			
Growth rate								
Muscle depth across the loin								
Fat cover across the loin								
Gigot muscularity								
Milking ability								
Prolificacy								
Mature size								
Worm resistance								
Other heritable traits								
Soundness of feet								
Longevity								

3. What do I have to do?

Accurate and timely on-farm data collection is at the heart of any recording system.

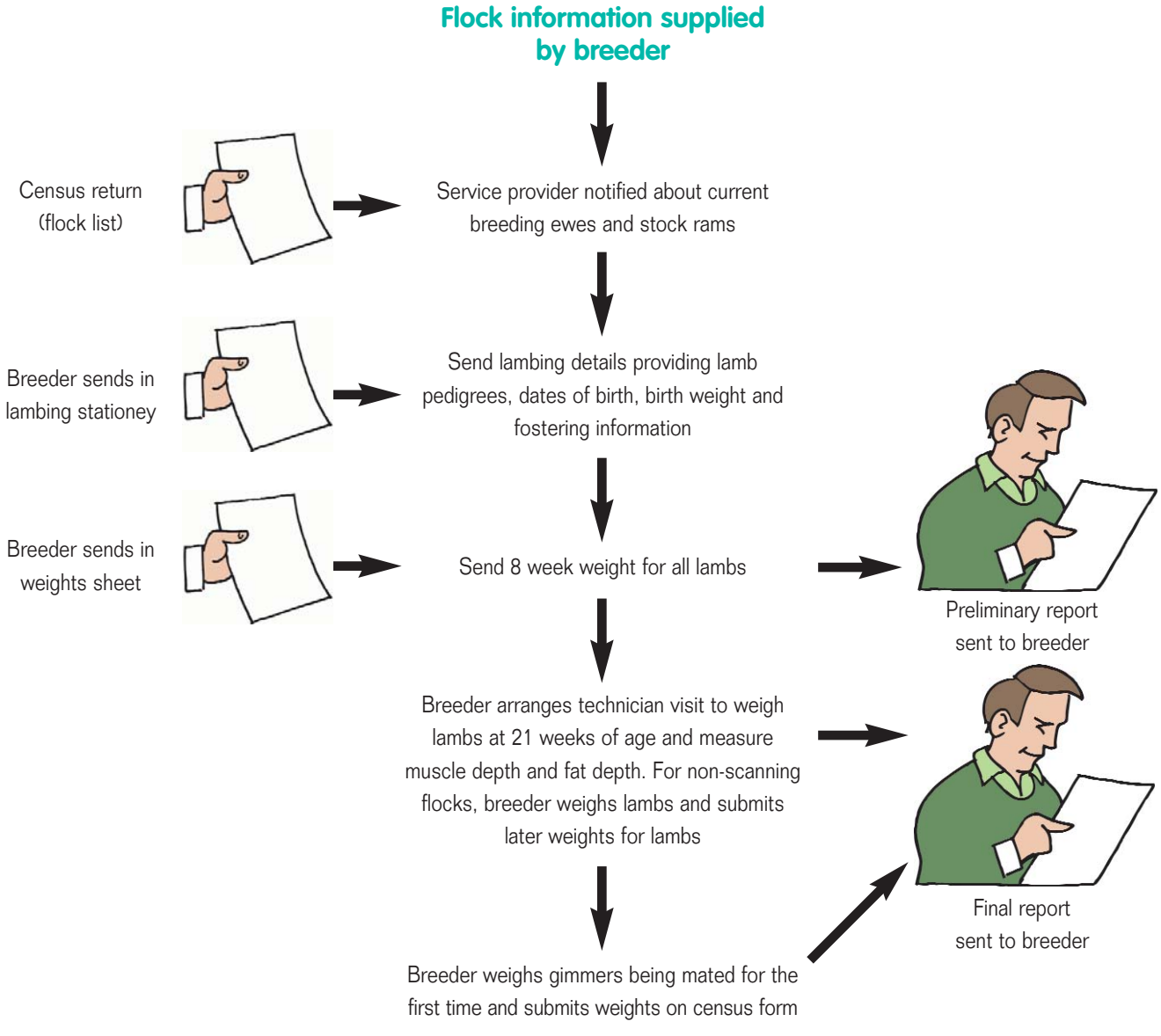
You can opt to scan your flock and receive a pre-arranged visit from a technician when lambs are around 21 weeks old. Lambs will be weighed then measured for muscle and fat depths using an ultrasound scanner.

The breeding services delivered to Hampshire Down, Suffolk and Texel breeders work slightly differently, because these Societies are members of BASCO and pedigree data for their members can be accessed directly.

Starting recording with Sheepbreeder takes just a few simple steps:

1. Fill in a contract based on flock size
2. Work with your service provider to get breeding ewes' pedigrees established on the Sheepbreeder database
   (A Breed Society can sometimes supply this)
3. Send details of lamb crop to your service provider or request lambing stationery
4. Register to use scanning service if required

Figure 1:



4. Estimated Breeding Values

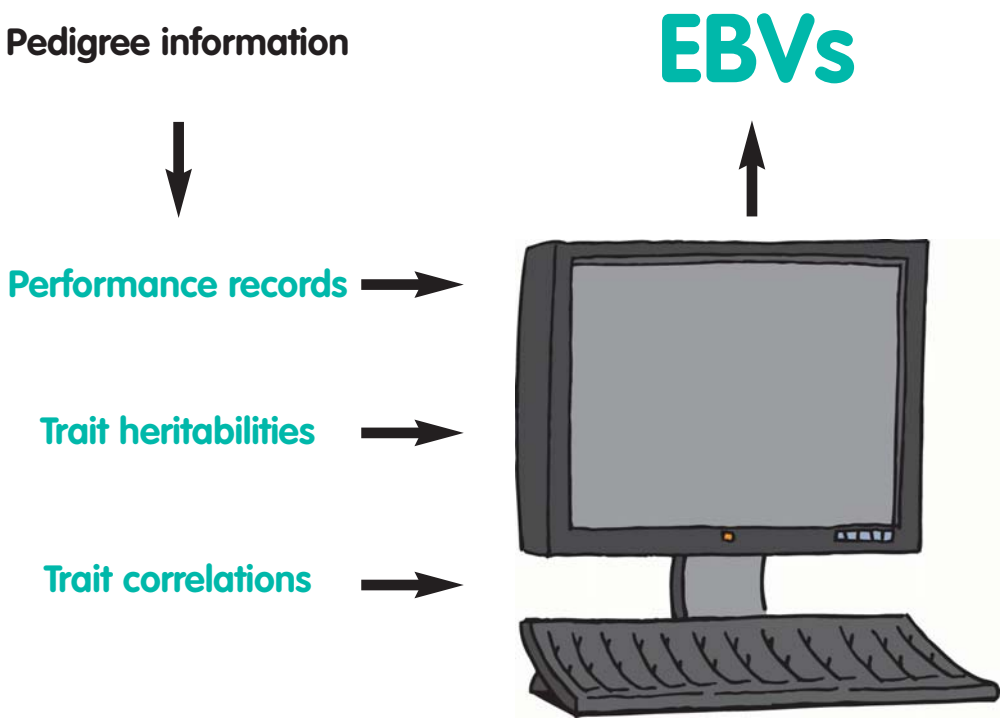
The pedigree and performance data collected is analysed using a procedure called BLUP (Best Linear Unbiased Predictor).

This calculates how much of each animal's performance is due to breeding potential and how much is due to its environment. Breeding potential is expressed in units known as Estimated Breeding Values, or EBVs.

EBVs provide a measure of an animal's breeding potential for a specific trait. The standard set of traits and recently introduced additional ones are set out in Tables 3 and 4 (overleaf).

EBVs take into account performance data collected on an individual animal, its known relatives, the relationships between performance traits (correlations) and the degree to which traits are inherited from one generation to the next (heritabilities).

Figure 2: How EBVs are calculated



EBVs are easy to interpret
for example:

A ram with an EBV of +6 for scan weight is estimated to have the genetic potential to be 6kg heavier at 21 weeks of age compared to a ram with a scan weight EBV of 0

EBVs are expressed in the same units as the recorded trait (eg kg for 8 week weight) and they relate to a common baseline. This baseline of zero relates to the average breeding value of lambs born in the year when the within flock – or across flock – analysis was first produced.

A ram will only pass on half its genes to its lambs so EBVs must be halved to estimate the average genetic worth of a ram's progeny.

4. Estimated Breeding Values (cont)

Table 3: Standard performance traits

EBV	Trait	Raw Data
Litter Size	Prolificacy	This trait is defined as the total number of lambs born (alive and dead) when pregnancy reaches full term.
Maternal Ability (kg)	Maternal ability of ewe, relates to milk production	The component of a lamb's growth to eight weeks of age that is influenced by the ewe's breeding potential for milk production.
Eight Week Weight (kg)	Growth rate to 8 weeks of age Maternal ability of ewe	Weight at 8 weeks of age. To achieve an adjusted 8-week weight, lambs must be weighed between 42 and 84 days of age.
Scan Weight (kg)	Growth rate to 21 weeks of age	Weight at scanning time, when lambs are 21 weeks of age.
Muscle Depth (mm)	Carcase muscling	Measured at 21 weeks of age* using ultrasound measurements at the third lumbar vertebra.
Fat Depth (mm)	Leanness	Measured at 21 weeks of age* using three ultrasound measurements taken at the third lumbar vertebra.
Mature Size (kg)	Ewe efficiency	Ewe liveweight at first mating.

* The optimum age to scan lambs is at 21 weeks of age. At this age lambs are expressing sufficient differences in their muscle and fat measurements to enable accurate analyses to be undertaken.

Table 4: Additional performance traits

EBV	Trait	Raw Data
Carcase Lean Weight (kg)	Muscle yield	Quantity of muscle tissue in the carcase assessed using Computed Tomography (CT) image analysis of breeding stock at 21 weeks of age.
Carcase Fat Weight (kg)	Leanness	Quantity of fat in the carcase assessed using Computed Tomography (CT) image analysis of breeding stock at 21 weeks of age.
Muscularity (mm)	Carcase shape	Thickness of the muscle tissue in the gigot assessed using Computed Tomography (CT) image standardised to a fixed femur length.
Faecal Egg Count (FEC)	Worm resistance	Faecal samples are taken from lambs at 21 weeks of age and submitted for laboratory analysis to measure the worm egg count in the sample.

5. Breeding Indexes

EBVs help select breeding stock for specific traits; but they can also be combined into breeding indexes.

Each trait is weighted within the index according to its economic importance in meeting a specific breeding objective or objectives.

Table 5: The five Indexes

Index	Breeds using the Index
Terminal Sire Index	Charollais, Hampshire Down, Ile de France, Meatlinc, Poll Dorset, Suffolk, Texel and Vendeen
Maternal Index	Lleyn and Poll Dorset flocks
Longwool Index	Blue Faced Leicester
Welsh or Carcase+ Index	Welsh hill breeds, such as Beulah, Lleyn, Welsh Hardy Speckle and Welsh Mountain
Hill 2 Index	Blackface and North Country Cheviot

5.1 Terminal Sire Index

Using this index to select superior terminal sires helps increase lean meat yield in the carcase, whilst limiting any associated rise in fatness.

Weight data and ultrasonic measurements of muscle and fat depth are used to predict total carcase muscle and fat.

Relative economic weightings of +3 and -1 are then applied to produce an overall index on which rams can be ranked. In recent years the use of Computed Tomography has enabled breeders to directly measure the quantity of muscle and fat in the carcase.

Table 6: Converting ultrasonic on-farm measurements into a breeding index

Raw data	Estimated Breeding Value
Muscle Depth →	Muscle Depth EBV → EBV for Carcase Muscle → Plus 3 → **Index**
Scan Weight →	Scan Weight EBV → EBV for Carcase Muscle / EBV for Carcase Fat
Fat Depth →	Fat Depth EBV → EBV for Carcase Fat → Minus 1 → **Index**

5. Breeding Indexes (cont)

5.2 Maternal Index

The Maternal Index will enhance lamb survival and pre-weaning growth rates by improving maternal performance. This index is particularly useful in self-replacing flocks, where lamb numbers reared to weaning has a major impact on flock profitability. The Maternal Index is usually calculated using EBVs for Litter Size, 8-week weight, and Maternal Ability. The Lleyn Maternal Index uses the EBVs for 8-week weight and Maternal Ability.

5.3 Longwool Index

The Longwool Indexes used within Blue Faced Leicester breeding evaluations are designed to enhance the carcase quality of longwool rams and their progeny, enhancing their financial value as crossing sires. The main difference between the two indexes is the weighting placed upon ewe mature size. Most EBVs are used within the construction of the Longwool indexes.

5.4 Hill-2 Index

The Hill-2 Index has been designed to enhance overall ewe productivity by improving several traits simultaneously.

Using the index to choose female replacements will result in increased ewe mature weight, maternal ability, longevity and the number of lambs reared to weaning. Lamb growth rates will increase resulting in lambs with heavier carcase weights at a constant age.

Most EBVs are used within the construction of the Hill Index, taking into account breeding goals associated with hill sheep production and their relative economic value.

5.5 Welsh or Carcase+ Index

The Welsh or Carcase+ Index identifies sheep with superior breeding potential for maternal ability, lamb growth and carcase quality.

Commercial producers selecting rams with high indexes will breed ewes with superior maternal ability and lambs that grow efficiently with an improved proportion of lean meat in their carcases.

The index encompasses two breeding goals:

- **Maternal ability** – assessed through the performance of a ewe's lambs at approximately 8 weeks of age and is represented by the Maternal EBV.
- **The lamb's own potential for growth and carcase composition** – assessed through scanning measurements of fat and muscle depth, together with weight at scanning. This goal is similar to the Terminal Sire Index.

6. Types of evaluation and flock connectedness

Flocks can be evaluated independently (within flock) or as part of an across flock evaluation (Whole breed or Breeding Group analysis).

- Within-flock analyses are produced as soon as data is received. They are not driven by data deadlines. EBV comparisons between animals can only be made within the same flock.
- Breeding Groups have across-flock analyses, which are produced to a strict timetable. EBV comparisons can be made between members of the same group.
- A Whole breed analysis enables every recorded flock within the breed to have their data evaluated within the same across flock analysis. This enables EBVs to be compared across the breed. Data is analysed according to a series of deadline dates. Many breeds now have a Whole breed analysis.

Across-flock evaluations

"An outstanding sheep is more likely to be found amongst 5,000 ewes than in a flock of 60."

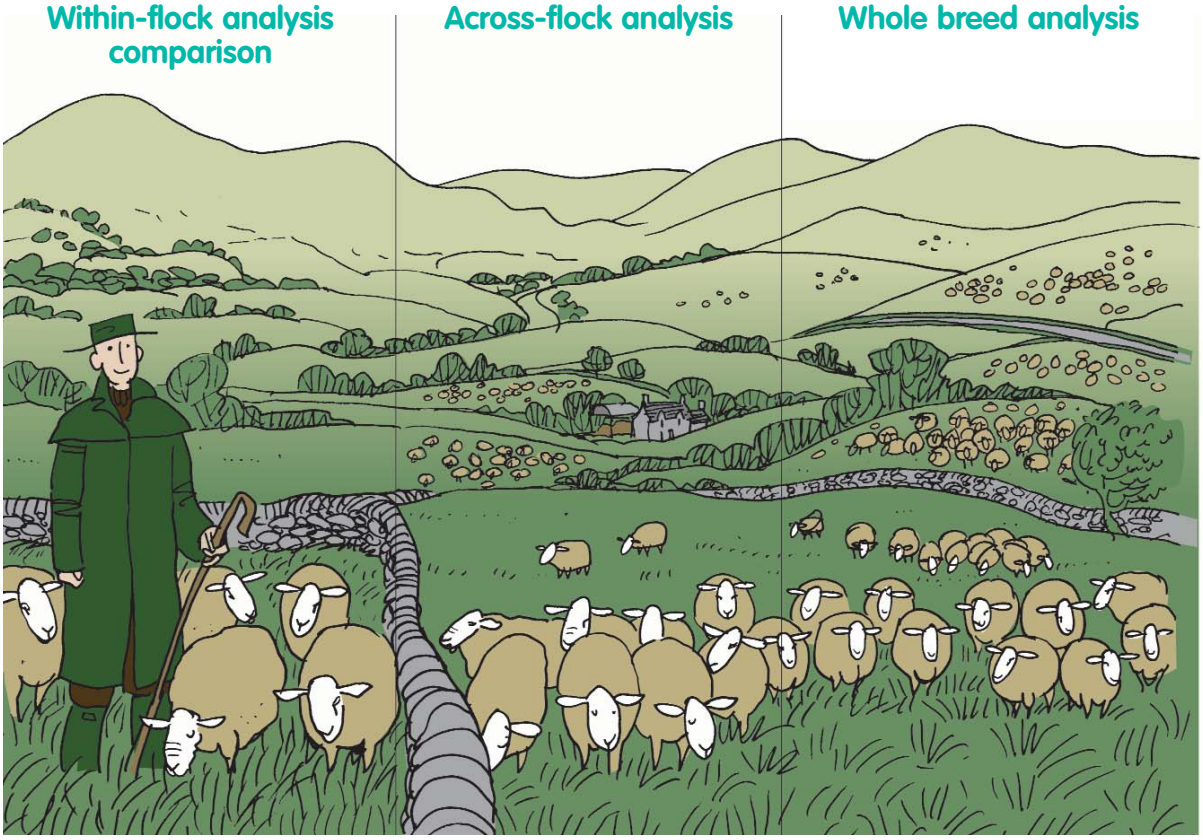
In the past, animal performance in different flocks could not be compared as flocks operate in different environments and management systems.

BLUP can account for environmental differences and produce EBVs that can be compared across flocks, provided reasonable numbers of related animals are recorded in different flocks creating genetic linkage between flocks.

Traditionally, this linkage has been established by using **Reference Rams** through cooperative breeding groups known as **Sire Reference Schemes**. The wide use of popular bloodlines provides additional linkage. This approach has now been extended in many breeds to produce "Whole breed analyses".

Figure 3:

6.1



6. Types of evaluation and flock connectedness (cont)

6.2 Flock connectedness

The level of genetic linkage between flocks can be measured and is referred to as "flock connectedness". Flock connectedness indicates how confidently the EBVs for sheep recorded in one flock can be compared to those recorded in other flocks in the same analysis.

Connectedness is a measure of the number of genes that animals in different flocks have in common. It is calculated using the pedigrees of all animals recorded to 8 weeks of age. Connectedness status is split into three categories Green, Amber and Red. BLUP analyses are always "risk adverse". This means EBVs tend to be scaled towards a group average when animals being analysed have little performance data behind them or when pedigree linkage within the analysis is limited. This is a good reason why Red flocks should improve their connectedness.

Conversely, flocks comfortably above the green threshold will gain little from increasing flock-to-flock connectedness.

Improving flock connectedness

Flock connectedness status can be improved by developing genetic links to other recorded flocks.

Options for breeders:

- The quickest, and best, way to generate high levels of flock connectedness is to mate a proportion of the flock (typically 30 ewes) to a Reference Ram or a Stock Sire that has been widely used in recorded flocks. This usually involves AI, which for logistical reasons may not always be practical.
- In principle, using shared stock rams for natural service can generate similar levels of flock connectedness to AI. However, it is more difficult to obtain high numbers of progeny across several flocks using this strategy.
- Many breeders could improve connectedness by purchasing rams from well-connected flocks. New stock rams should produce high numbers of progeny, which are fully performance recorded, to create strong links.
- Choosing fully performance-recorded rams is important to breeders looking to improve connectedness status. It helps if it has a lot of performance recorded relatives or is sired by a ram that has been widely used in recorded flocks.
- Once progeny are on the ground, retain high index lambs from these well-connected sires for breeding.
- Try to use at least one ram in the flock for more than one year. This will improve genetic linkage between years, enabling BLUP to account for seasonal management differences.

Table 7: Connected flock status

	Flock status	Across flock comparisons	Linkage
Green	Well connected	Can be made with confidence	Maintain at current level
Amber	Limited connectedness	Should be made with more care	Should be improved to reach acceptable level
Red	Poor connectedness	Across flock comparisons should be made with caution. However, within flock rankings are accurate	Should be greatly improved to enable accurate across flock comparisons

7. Accuracy Values

An EBV predicts the breeding merit of an animal for a specific trait. The degree to which this EBV reflects the "true" breeding merit of the animal depends on how much we know about its performance relative to the rest of the population.

Accuracy Values indicate how much we know about an animal and its relatives for a specific trait.

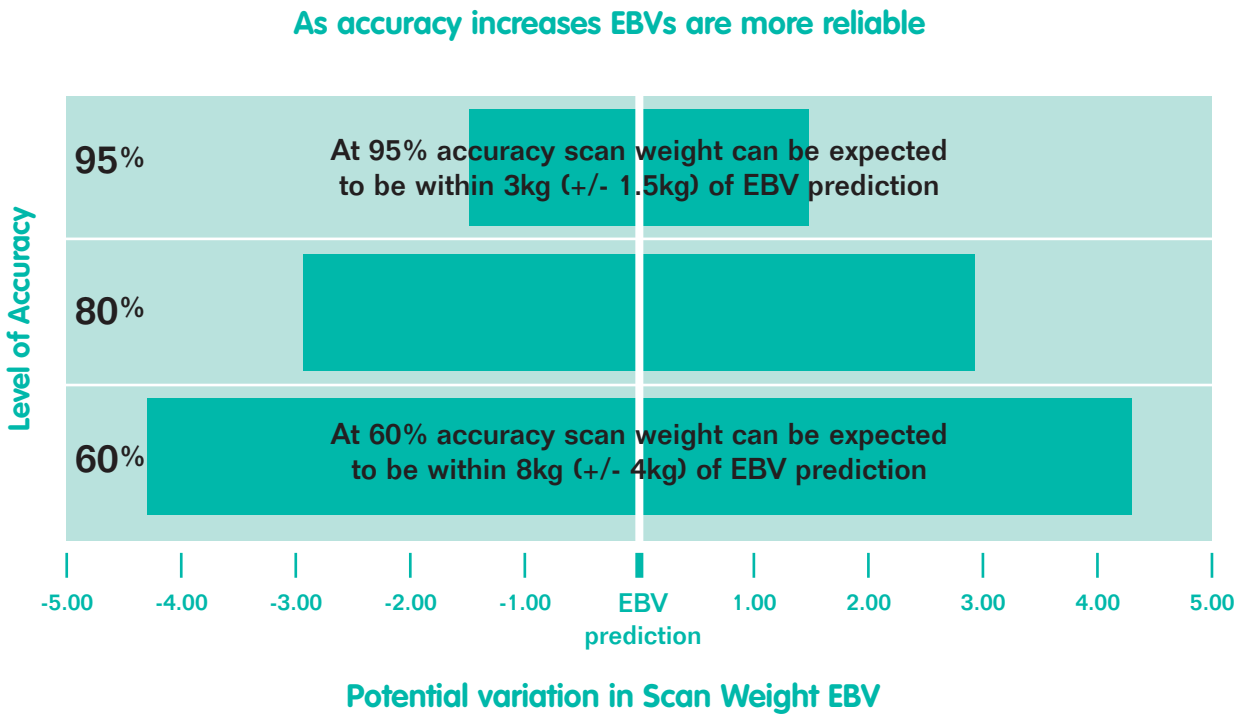
Why accuracy matters

Accuracy Values indicate the likelihood of an EBV changing (up or down) as more information on the animal becomes available.

Accuracy values account for the risk involved in making breeding decisions and provide buyers with the confidence that an EBV is accurate.

For any trait, the accuracy of the EBV is influenced by several factors:-

- Amount of information for the animal
- Amount of information from relatives
- Heritability of the trait
- Amount of information from traits correlated with the trait of interest and the strength of these correlations
- Number of animals being compared (contemporaries).



7. Accuracy Values (cont)

Animals with high accuracy values

Selecting breeding stock with high accuracy values minimises risk in breeding decisions. Widely used stock sires, e.g. reference rams with lots of recorded relatives will have high accuracy values. Fully recorded ram lambs with lots of recorded relatives will have acceptable accuracy values.

Animals with low accuracy values

An important feature of Signet's breeding evaluations is that they are risk averse. EBVs based on limited amounts of information get adjusted back towards an average figure until more data becomes available.

Amongst those animals with low accuracy values there may be individuals with good genetics, but a lack of performance data means they are difficult to identify using EBVs.

Accuracy, connectedness and comparisons between flocks

Accuracy is not a direct measure of the quality of connections between animals in the recorded population. This is better achieved using "flock connectedness". However, the value of across flock comparisons between animals with low accuracy will be of limited benefit.

Presentation of accuracy values

Accuracy values are presented for each EBV and expressed as percentage points ranging from 0 to 99. In the example below are two rams with different EBVs and Accuracy Values. The ram lamb has superior EBVs, but his lower accuracy values indicate there is a higher chance that they may change (increase or decrease) if he has progeny recorded in future evaluations.

Recorded Stock Ram – with 80 progeny

	EBV	Accuracy
Scan weight EBV	4.6	92
Muscle Depth EBV	2.8	86
Fat Depth EBV	0.2	87
Index	£1.98	88

Recorded Ram Lamb

	EBV	Accuracy
Scan weight EBV	5.0	78
Muscle Depth EBV	3.2	67
Fat Depth EBV	0.3	69
Index	£2.15	75

Summary

Accuracy values indicate how similar an animal's EBVs are to its true breeding value.

Breeders can use accuracy values to predict the likelihood that an animals EBVs will change over time.

8. Measurement services

8.1 Ultrasound Scanning

Ultrasound scanning provides sheep breeders with the opportunity to assess the carcase quality of their sheep. This information is then analysed to identify superior breeding lines.

Why use ultrasound to assess muscling?

Unlike growth rate, it isn't easy to identify sheep with superior muscling across the loin. Ultrasound images enable breeders to select animals with superior loins and avoid those with a high level of carcase fat. While this measurement simply reflects muscle depth across the loin, research indicates that selective breeding for muscle depth can greatly enhance total meat yield.

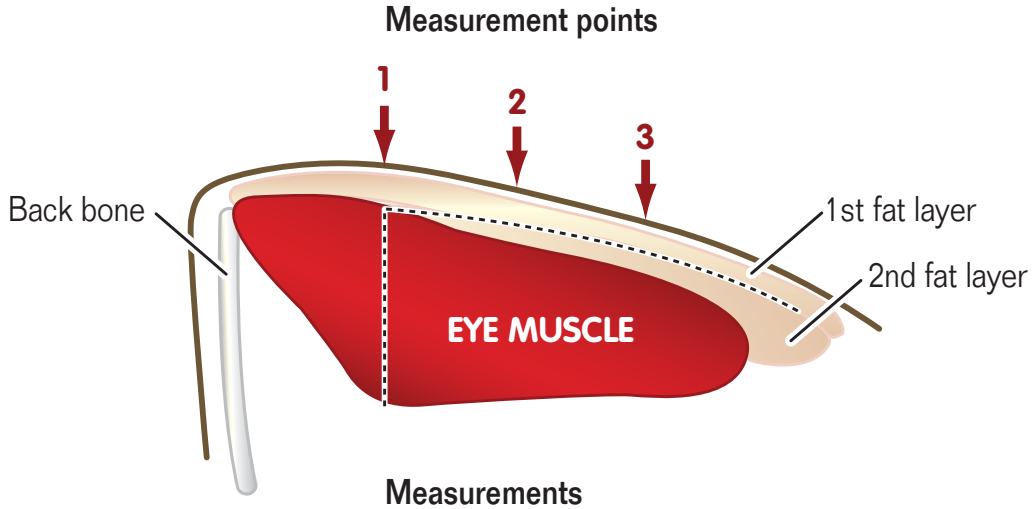
Raw Data or Estimated Breeding Values (EBVs)?

As with any raw performance data, muscle and fat depth measurements are affected by non-genetic factors such as age at scanning and flock nutrition. It is important that breeders select on the basis of muscle and fat depth EBVs, rather than on the raw data alone.

What is involved?

Sheep are scanned around 21 weeks of age. The technique involves parting the wool and applying liquid paraffin at the third lumbar vertebra at 90 degrees to the backbone. The transducer is adjusted until a clear image of the eye muscle and fat layers can be seen on the machine's screen. A single measurement is taken of muscle depth at the deepest point and three measures of fat depth are taken at 1cm intervals. These measurements are then submitted to Signet for inclusion in the forthcoming breeding evaluation.

Ultrasound Scanning Service



Measurements

1 = Maximum muscle depth and fat depth
2 = Fat depth
3 = Fat depth

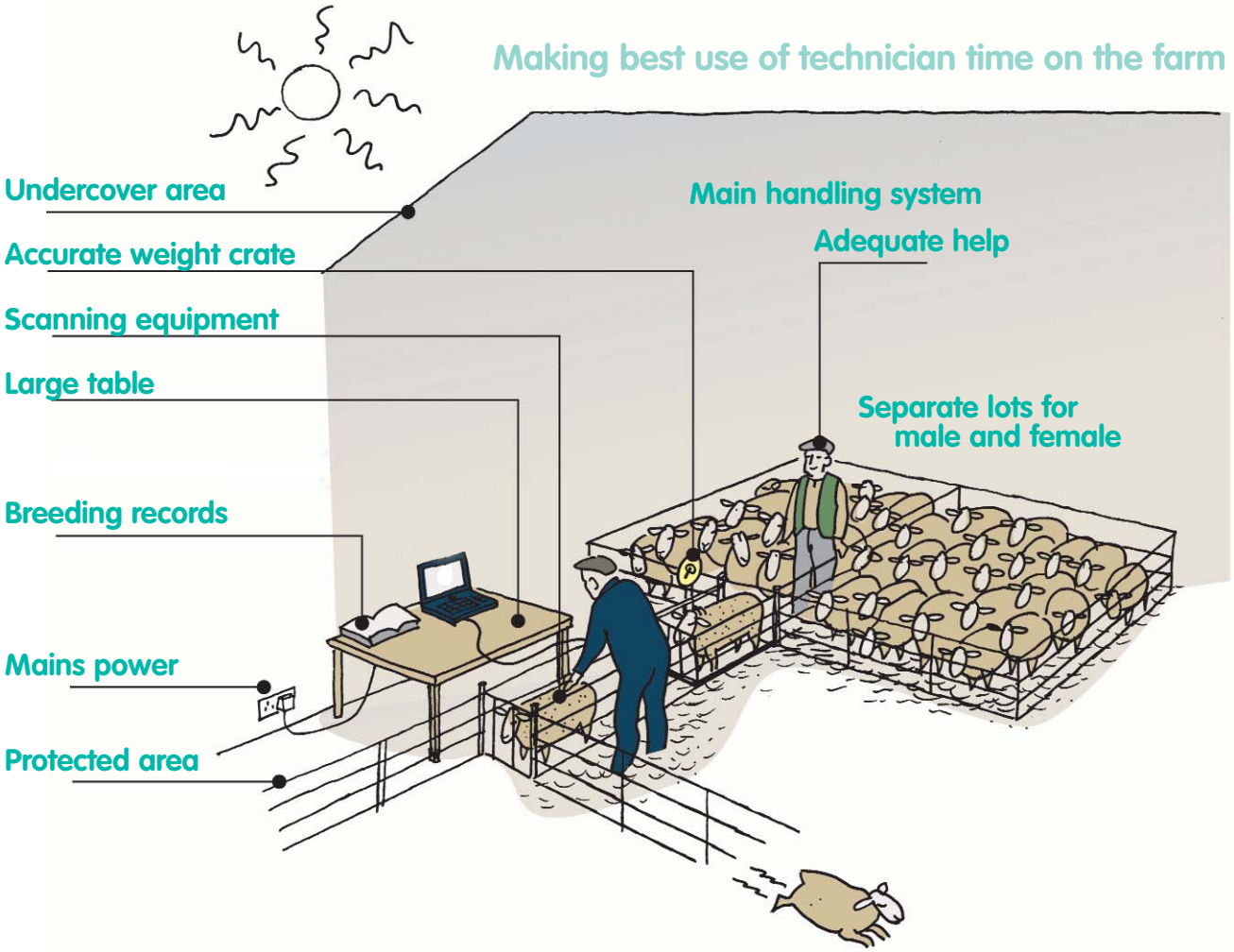
8. Measurement services

8.1 Ultrasound Scanning

Ultrasound scanning for fat and muscle depth is a valuable tool used to help predict carcase quality. It is carried out by Signet-trained staff, when lambs are around 21 weeks of age.

Ultrasound scanning machine showing frozen image of muscle and fat across the loin.

Scanning involves parting wool over the third lumbar vertebra, applying liquid paraffin to ensure acoustic contact and placing a transducer on the prepared site. This is adjusted until a clear image of the vertebra, eye muscle and fat layers can be seen. Linear measurements of fat and muscle depths are taken and downloaded to a computer.



8. Measurement Services (cont)

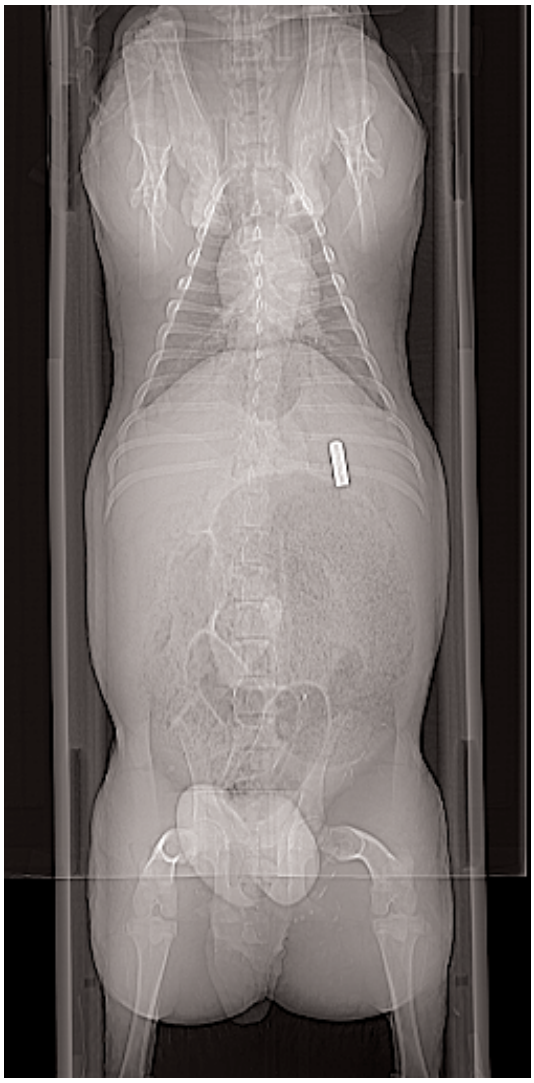
8.2 Computed Tomography

Computed Tomography (CT), which was developed for human medicine, produces images of body cross-sections, using low dose X-rays. Images are high resolution, and allow detailed body measurements to be taken in a welfare friendly way.

For sheep, three cross-sectional X-ray pictures are taken of the gigot, loin and chest/shoulder. Computer image analysis identifies areas of fat, muscle and bone. From these measurements body composition, and hence carcase composition, can be predicted with 97–98% accuracy.

CT is useful to identify outstanding animals within the breed, but it also has an equally important wider impact on breeding improvement. CT has enhanced our understanding of the relationship between on-farm ultrasonic measurements and lean and fat in the carcase. This has improved the efficiency of identifying superior animals using on-farm ultrasound. It also strengthens breeding evaluations produced across the breed.

Scout scan used for positioning cross-sectional scans



Images courtesy of the SAC CT Unit

Computed Tomography Images

A cross-sectional CT scan through the chest. Images like this are produced from a grid of tissue densities, estimated by measuring low-level X-ray absorption from a source rotated around the body.

The X-ray dosage involved is not harmful. Different densities are displayed as shades of grey. Dense tissues appear light, less dense tissues darker.

Positions of the three cross-sectional scans on the right are shown on the left-hand scout scan.

NB: CT measures density. The greyscale used for the cross-sectional scans shows air as black, fat as dark grey, muscle as light grey and bone as white.

The sheep is lying on its back in the cradle.

8. Measurement Services (cont)

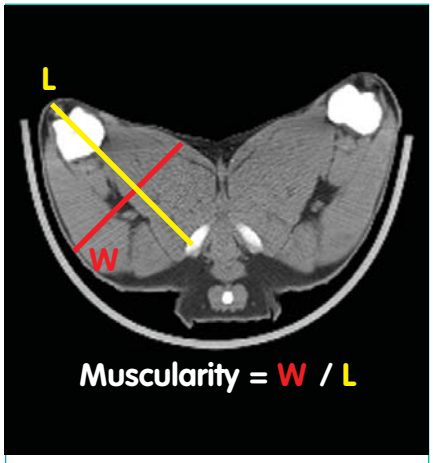
8.3 Breeding for Gigot Muscularity

Breeders who use CT have EBVs that help identify sheep with better muscularity of the hind leg or gigot.

Gigot Muscularity EBVs are produced from CT measurements of the hind leg. These measurements are positively correlated with both live weight and muscle depth measurements collected on-farm. The cost of CT scanning is currently subsidised by the Levy Boards (EBLEX, HCC, QMS).

Muscularity EBVs typically range from -5.0 to 5.0 mm and indicate how much better, or worse, an animal is relative to another. For example, a sheep with a value of 5.0 will have 5 mm greater muscle thickness at a fixed bone length of 100 mm in the hind leg, than the average sheep born in 1990.

Index-based selection has not been detrimental to the selection of sheep with good gigots, but the availability of an EBV for this trait will enable further improvements to be made.



The actual gigot measures assessed on CT scans are standardised so that they represent muscle thickness (mm) at a fixed bone (femur) length of 100 mm. The typical range for these values is 40–80 mm.

8.4 Breeding for worm resistance

Internal parasite infections can reduce growth in young lambs by as much as 25% without clinical signs of infection. Lambs raise an immune response to fight worm infection and some are better at this than others. Research has identified a genetic component to worm resistance that is moderately heritable and favourably correlated to production traits, eg growth rate.

Worm resistance can be improved through breeding and a commercial service is now available to assist producers in this quest through the production of FEC (Faecal Egg Count) EBVs.

The number of nematode parasite eggs in dung samples is measured to provide a FEC score. This is evaluated to produce FEC EBVs.

The FEC EBV identifies sheep whose genetic make-up confers resistance to nematode parasites. Low values indicate more resistance.

Selecting rams with highly negative FEC EBVs means the potential to:

1. Perform better, eg improved growth rate
2. Reduce frequency of anthelmintic treatments
3. Shed fewer nematode eggs in their dung, thus reducing levels of larval challenge for other sheep (whether these have been selected for worm resistance or not)
4. Reduce worm burden on heavily-stocked pastures over time

Flocks that will benefit most are those:

- Already experiencing high levels of worm challenge
- Where anthelmintic use is restricted eg organic flocks
- Breeding their own female replacements

The cost of CT scanning is currently subsidised by the Levy Boards (EBLEX, HCC, QMS).

9. Advances in Terminal Sire breed recording

9.1 Penalising sheep with low fat depth EBVs (The ATAN function)

Over the past decade the Terminal Sire Index has been highly effective in increasing breeding potential to produce carcases with high yields of lean meat. In recent years, some breeders have expressed concern that progeny from certain high index rams have insufficient fat cover at slaughter and asked for the index to be modified.

New breed specific indexes have been created. Relative weightings applied to yields of carcase muscle and carcase fat remain the same, but an additional penalty is now applied to animals whose fat depth EBV is below a breed specific threshold. The penalty is determined using a function referred to as "ATAN". See Figure 4.

This penalty is non-linear, so animals with an extremely low fat depth EBV face a much harsher penalty than those whose fat depth EBV falls slightly below the threshold. Animals with fat depths above this threshold are not directly affected by this change, although extremely fat animals will continue to be penalised in the usual way.

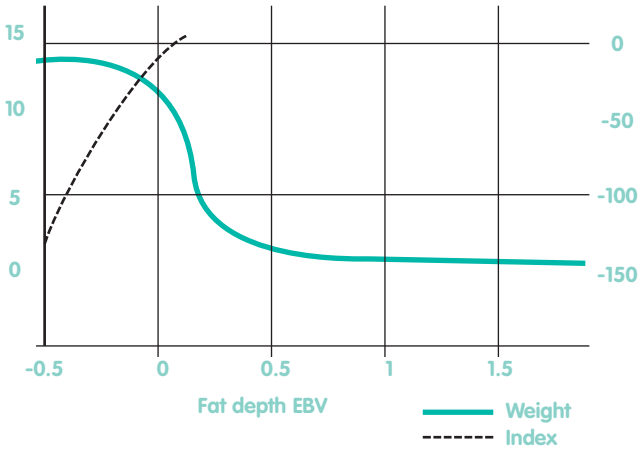
As a result, in Suffolk, Texel, Charollais, Hampshire Down, Meatlinc and Shropshire breeds a non-linear index is now produced that selects sheep with good growth, muscling and leanness characteristics, without compromising fat cover. The resulting loss in genetic progress in other useful traits is relatively small.

9.2 Suffolk Economic Index

In 2004 the Suffolk Sheep Society asked for the breeding index used for Suffolk sheep to be converted into an economic index. This index reflects the financial merit of a recorded ram's offspring, as well as its breeding merit. This provides a new way to promote recorded rams to commercial buyers.

Economic values cannot reflect every production system in which Suffolk rams are used, due to variations in cost of production and seasonal price. Therefore economic indexes should be regarded as relative values – useful to compare relative financial merit of different rams, not absolute values.

Figure 4: Weighting on fat depth EBV and impact on index



This graph shows in principal how a weighting can be applied to the fat depth EBV to modify an animal's index.

Sam, here is the original Suffolk if you don't have another.

10. Advances in Hill and Maternal breed recording

Recording large flocks – Hill and Maternal Breeds

Breeders with large numbers of commercial purebred ewes stand to gain most by improving their flocks' genetic merit.

Breeders with large flocks of lowland or hill ewes need to select stock sires with superior genetics for maternal characteristics. This is nearly impossible without using performance records and Estimated Breeding Values.

Many producers with large flocks can see potential benefits from performance recording, but are daunted by the task of collecting and recording the data.

How large flocks can benefit from performance recording without extra workload:

1. Create a breeding nucleus – breeders don't have to record their entire flock. Many find it easier to create a nucleus of their best ewes, from which rams will be bred for use elsewhere on the farm.

The key to a successful nucleus is selecting the right foundation animals. Many breeders do this by running ewes down a race to select those they like the look of. This may result in hard-working ewes in poorer condition being overlooked, while those that are barren or failed to rear a lamb (and hence in better body condition) get selected.

A better way is to apply some criteria which identify genetically superior stock – eg selecting ewes that successfully reared twins the previous year, or selecting the heaviest ewe lambs within a group. Those that do not visually appeal can still be discarded from the final selection.

2. Adjust lambing dates – lambing the nucleus flock earlier or later than the main flock could avoid a conflict in labour requirements.

However, the lambing spread must be kept tight to avoid a protracted lambing. Enthusiasm for recording tends to drop over time. The lambing can be kept tight by using teasers, reducing ram to ewe mating ratios or even using synchronisation. Be disciplined about taking the ram out and consider putting in a sweeper ram of another breed to mark the end of the lambing period for the recorded flock.

3. Recording birth weights is not essential – and on some hill units is impractical. This data is useful, but not crucial within hill and lowland breeding evaluations.

4. Not every flock needs to use ultrasound scanning – many breeding objectives associated with hill and maternal breeding programmes relate to maternal performance and growth rate; so carcase quality is a much smaller economic driver. Some breeders won't wish to focus on improving carcase traits to enhance flock profitability and so they may choose not to use ultrasound to scan lambs.

Lamb growth rate does have a large impact on several commercially important traits, so even if flocks are not going to scan it is advisable that a later weight (at around 21 weeks) is collected and submitted for analysis.

Breeders using the Welsh or Carcase+ Index should scan their flocks, because the Scan Weight, Muscle Depth and Fat Depth EBVs greatly influence the construction of the Index.

5. Collect weight data around other tasks – eg weaning or drenching to make the procedure less labour-intensive. While most breeders weigh their lambs at 8 weeks of age, an adjusted 12 week weight may be used instead. There is also flexibility in collecting 21-week weights, some flocks gather lambs later in the season and submit weights when lambs are older.

6. Use labour saving devices that make recording easier - these range from simple technology, eg distance readable tags, to more complex electronic identification. Investment will lead to labour savings and could prove highly cost-effective.

7. Involve your shepherd – whoever is involved in collecting data needs to be aware of the importance of accurate data collection. On many large estates data collection is completed by one or more farm workers, their support is crucial and can never be underestimated.

Many farms actively involve their shepherds in breeding decisions. This increases their interest in the recording programme. Take time to explain why rams are being selected using their EBVs and how it will improve flock performance. In a good breeding programme it won't be long before they are telling you!

11. Interpreting Breeding reports

Breeding reports are distributed to breeders at set times during the year. Each report updates and supersedes the last.

To accompany the flock report, a summary report is published after the main run to highlight the leading stock rams and ram lambs within the breed. You will note that where animals are not scanned, EBVs are predicted from the performance of relatives and known correlations between traits.

Table 8: How EBVs can be interpreted

EBV	A brief explanation...
Eight-week weight & Scan Weight	Selection on high EBVs for these traits will result in faster growing lambs. Selection for high growth rates also tends to result in an overall increase in mature size.
Muscle Depth	Choosing animals with high muscle depth EBVs will increase lamb muscularity and hence the lean meat content of the carcase.
Fat Depth	Selection on low fat depth EBVs will result in less fat in the carcase.
Mature Size	Choosing animals with high figures for this trait will increase mature size.
Litter Size	Selection on high EBVs will increase litter size.
Maternal Ability	This is the maternal component of the 8-week weight measurement. The higher this figure the better a ram's ewe lambs will perform as mothers (ie milking ability).

When you get your final report

1. Check the information is correct and inform the service provider of any amendments.
2. Review your genetic progress over time – are you meeting your breeding objectives? Ensure that the genetic merit of lambs in your flock is increasing year on year and identify traits that need to be improved.
3. Identify ram and ewe lambs with high genetic merit and good physical assessments to be retained. Identify those with low genetic merit to be sold. Use an up to date Breed Benchmark to assist with this task.
4. Select shearling ewes and stock ewes to be retained for breeding in the coming year based on their genetic merit and breed characteristics.
5. Identify potential stock sires from those that have performed well in previous years and homebred ram lambs with good figures. When planning to purchase a new stock ram always check its current EBVs.

12. Harnessing molecular genetics

Conventional breeding programmes are based on "quantitative genetics"; the selection of heritable characteristics that show continuous levels of variation (such as growth rate) and are controlled by a number of genes. Traditional selection has been based on the effects of the genes, rather than the genes themselves.

This is highly effective for traits that are easy to measure, with a moderate to high heritability and a large economic value.

This approach is less suitable for:

- Low heritability traits – where very little of the measurable variation in performance can be attributed to the animal's genetic makeup
- Expensive or difficult to measure traits
- Traits only expressed by one sex
- Breeds where parentage is not known

In recent years, great strides have been made in the study of molecular genetics. In the future, livestock breeding programmes will make use of information that explains what is happening at the molecular level, ie within the DNA itself.

Traits such as diseases resistance, meat eating quality, methane emissions and feed efficiency may benefit from this approach.

Molecular techniques that will influence breeding programmes include:

- Identifying a gene or genes whose location within the DNA is known
- Molecular markers. Areas within DNA (markers) that can be located through lab tests and are closely associated with areas of DNA known to be important for specific traits.
- Genome mapping which enables informed choices to be made based on the position of functional genes within the DNA.

Molecular genetics in action

DNA can be collected from blood or tissue (such as the ear) – as well as hair follicles in cattle. Scrapie genotyping is a molecular technique whereby sheep with certain genes are known to be more resistant to Scrapie. These animals can now be identified through blood testing.

Markers for specific genes affecting muscling, leanness and fertility are being used in the UK.

Image courtesy of Innovis

Investing in Molecular Genetics

Gene markers provide a great opportunity to make genetic improvement in important new traits, but breeders must determine:

- Has the marker or gene been adequately tested in your breed and in your environment to deliver the improvements in performance that are claimed? (See below)
- Will the investment in sampling be returned to the enterprise? Financial performance needs to increase; either directly – marketing the availability of marker information to lift ram sales – or due to the benefits of increasing the rate of genetic improvement within the flock.

The Importance of Gene validation

Physiological responses to genes are sometimes different in different breeds.

Genetic variation in the Myostatin gene that influences double muscling has been identified in Highland cattle. The gene doesn't have the same impact in this breed as it does in British Blues.

Which is better – an EBV or a gene marker?

To an extent the benefit of the gene marker will depend on how much of the genetic variation that can be observed in a trait is explained by the actions of that gene.

	EBV	Gene Marker
Accuracy	Variable, but typically 35–65% for young animals	In theory 100%
Amount of Genetic Variation Explained	In theory 100%	Extremely variable, but usually each marker explains a small amount of the total genetic variation*.

*Genes influencing large amounts of genetic variation are often selected for indirectly using conventional breeding strategies as their impact is more visible

In reality both techniques have a lot of offer, but a joined up approach in which gene markers can be incorporated into existing genetic evaluations will probably yield the best and most practical outcomes for British farmers.

13. Signet EBVs on the internet

A new internet search facility has been developed to enable pedigree breeders and commercial producers to access information held on the BASCO database.

The new search engine, designed by EGENES at SAC, offers a quick way to find and view the breeding records of performance recorded cattle and sheep.

Information held on the database includes

- Performance (Estimated Breeding Values and Breeding Indexes)
- Progeny
- Pedigree
- Ownership

The website enables breeding stock to be located on the basis of their name, identity or breeder. The "EBV Search" facility enables potential buyers to find bulls and rams that meet their specific breeding objectives.

To access the search go to the Signet website www.signetfbc.co.uk and click on the icon titled "EBV Search".

CROGHAM JAI HO			AB:09041				
name			flock book number				
status:	Live	date of birth:	13/12/2008	sex:	M	breed:	CHAROLLAIS

Analysis date:21/09/2010

	EBV	index*	accuracy
Eight Week Weight	5.83	132.0	89.0%
Mature Size	2.36	118.0	36.0%
Litter Size	-0.02	80.0	49.0%
Maternal Ability	0.7	118.0	46.0%
Scan Weight	12.44	133.0	91.0%
Muscle Depth	3.61	115.0	88.0%
Fat Depth	0.01	98.0	89.0%
CT lean	3.77	129.0	90.0%
CT fat	1.12	101.0	86.0%
CT muscularity	3.61	118.0	81.0%
Faecal Egg Count	0.14	93.0	52.0%
Index	452.79	135.0	89.0%

*100 = breed average

Signet Breeding Services

HYBU CIG CYMRU MEAT PROMOTION WALES

QMS QUALITY MEAT SCOTLAND representing the Scottish red meat industry

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