

The Virtual Cow – A World 1st from Holstein-UK

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Abstract

As the farming industry focuses ever closer on health and welfare, it is fitting that Holstein-UK has launched an innovative educational and breeding tool which has the potential to transform understanding of the form, movement and condition of the milking cow.

The Virtual Cow is the first fully interactive, three-dimensional, computer-generated model of the dairy cow, available through a web-based interface. It demonstrates graphically the differences in conformation between animals with various classification scores. Allowing the impact on conformation to be visualised and so helping breeders and students understand what they are looking for in the optimum cow for their system and circumstances.

The model can be viewed from any angle and rotated through 360° on any axis. Each of 18 linear type traits can be viewed individually and is accompanied by a written description of how it is measured. As a slider is moved through each of the trait scores from 1-9, the appropriate section of the cow's anatomy adapts before your eyes, showing the degree and effect that trait has on the animal. The Virtual Cow also illustrates a range of full-animal, three-dimensional body condition scores, and demonstrates locomotion scores from 1 to 9 by video clips of real cows in motion.

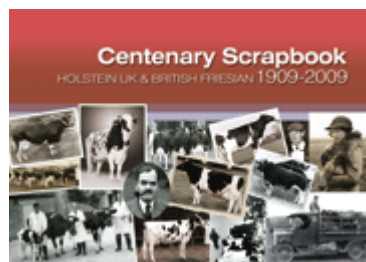
For farmers interested in bull selection, it has the added benefit of relating each trait to the linear profile of a bull (commonly expressed as a bar chart), so aiding breeding decisions and overall breed improvement.

When learning about dairy cow conformation, there is no substitute for having a real animal in front of you. But the number of animals that would need to be assembled to illustrate every score for every trait makes this practically impossible. However, with the Virtual Cow, this can be done consistently, reliably and with pin-point accuracy.

Keywords: Dairy cow, model, three-dimensional, interactive, computer-generated, web-based, linear-type, conformation, locomotion, condition, breeding, education.

1.0 Holstein-UK – 100 years of innovation

Holstein-UK is Europe's largest independent breed society, with around 8000 members and registering over 200,000 animals per year. It acts as the single herd book provider for both Holstein and British Friesian cattle in the United Kingdom, and also provides additional registration services to some eight other, independent UK breed societies, including Ayrshires, British Blue, Brown Swiss, European Angus, English Guernsey, Island Jersey, Montbeliarde and UK Jerseys.



Alongside its herdbook function of registering births and ancestry, the Society aims to promote and improve the breed, helping to increase the value of UK livestock overall, a long with extending herd life and the profitability of its members herds. It is the principle provider of Type classification services in the UK through its Centre for Dairy Information subsidiary business, which also provides database and data access services to most of the societies mentioned, along with full genetic evaluation of both Holstein and Friesian Type results.

In 2009 the Society celebrated the 100th anniversary of its foundation with a series of special events, product launches and a hard-backed "scrapbook" of people, scenes and animals from all periods of its history.

1.1 Innovative products and services



Throughout its history, the society has supported, researched, and developed new techniques and services for dairy breeders and herd owners. It pioneered the use of telephone registration services for members and more recently, the use of a web-based registration system "WebReg", available to all partner societies. For many years it has supported and encouraged younger members to develop their skills of stock judging, cattle showmanship and husbandry, through its Holstein Young Breeders programme. A section that now has its own dedicated web site at www.thehyb.co.uk, detailing field and social events at both regional and national level, contacts and a series of "how to" guides for all members.



The **Cattle Information Service** provides integrated milk recording, herd health and herd management support to herd owners throughout the UK, whether breed society members or not. In 2008 CIS won the Queen's Award for Enterprise for the continuous development of its web-based service 'Your Herd', which enables dairy farmers to easily access all the vital information to manage their herds more efficiently. This was rapidly followed by the award for 'Top Livestock Supplier of the Year' from the Royal Highland Agricultural Society, based on excellent levels of customer service, satisfaction, value for money and innovation. For clients who register their cattle, the CIS and HUK offer the 'Holstein Complete' service to further reduce the duplication and cost of integrated, multi-organisation data recording, bringing the benefits of the latest technology within reach of every dairy farmer in the simplest way possible.



The **Centre for Dairy Information** maintains a single, integrated database for all registration, production, classification and genetic evaluation data for all its partner breed societies. With a web site devoted to easy access to that data for information ranging from individual animals, bull and cow evaluations, production trends and statistics, health and welfare guides, through to innovative tools to take the hassle out of bull selection and cow mating decisions through its **Bull Selector** and **WebMate** user-friendly decision-aid tools.



As the whole farming industry focuses ever closer on dairy cow health and welfare therefore, it is entirely fitting that Holstein UK has launched a new innovative breeding tool that has the potential to transform understanding of the form, movement and condition of milking cow – the 'Virtual Cow'.

2.0 The Virtual Cow development

The Virtual Cow is the first computer-generated, three-dimensional model of a dairy cow. It has been said to be a "fully interactive, adjustable version of the traditional Model Cow - much loved by breed societies and breeders throughout the world". Developed with education firmly in mind, it graphically illustrates the differences in conformation between cows and traits at all the various classification scores.



The impetus to develop a 21st century cow model came from several directions. The traditional ceramic or plastic composite cast model, whilst often a collectable object of art in its own right, has several limitations that restrict its usefulness. At its best, it is a static image of the perception of desirable characteristics at a single point in time. The process and expense of creating a new master, casting and reproducing multiple copies has always made it difficult to adapt the ideal model as perceptions and breeding objectives change over time. Furthermore, it has always been a valid question to ask: "Is there only one 'ideal cow'?" Or do different breed societies, or even sections within a society, have different and equally valid views on what constitutes the "ideal"?

Educators, advisors, classifiers, breeders and students have frequently asked for posters and graphical examples of differing classifications scores, particularly since the advent of linear type scoring techniques. Whilst this has frequently been possible, these media have always had the limitation of being two-dimensional views of a three-dimensional real cow. When learning about dairy cow conformation there is

no substitute for having a real animal in front of you, preferably several, that illustrate differing score values. It has been calculated that to assemble a group of cows that might illustrate every possible combination of the 16 core linear trait scores would require over 140 animals! Something that would be practically impossible, particularly in the classroom situation.

The best aspect of the cast model for these purposes was that it can be picked up and rotated, or viewed from any angle, to give a perspective on how the trait looks. The judge can move around the real animal, provided she stays still for long enough, to gain the required view of each body or mammary trait he or she needs to view.

Software applications that can project three-dimensional images of an object onto a computer screen were developed originally in the building and engineering industries, particularly for Computer Aided Design and the like. The originals of these however, required near super-computer levels of processing power to operate them. So were available only to relatively few. As techniques developed the costs were gradually reduced. But it was the explosive growth of the computer gaming market that generated the vast sales that in turn allowed software engineers to turn their attention to models of animals (or even homo sapiens!) that could be viewed in 3-D and more importantly moved. Even then renditions tended to look like either cartoon characters or angular stick-models of the animal concerned. Still not very useful to project the sometimes fine and subtle differences in dairy cow conformation score.

A UK-based software company was discovered, who had begun work on interactive models of a lamb and a steer to demonstrate meat animal carcass classification scores for the English Beef and Lamb Executive ("EBLEX"). Work began in 2007 to adapt this technology to the wide number of conformation traits required for a dairy cow. After much painstaking development effort, the Virtual Cow was given its first public demonstration at the Dairy Farming Event in September 2009.

2.1 Understanding the functional dairy cow

The Virtual Cow can currently be reached from two websites: www.holstein-uk.org and www.thehyb.co.uk. During the initial 12-month launch period, the program is available through a PIN-protected login screen.

There are two main sections to the Cow model: The '**Ideal Cow**' dealing with the current view of the model Holstein animal and '**Individual Scoring Traits**' where the user can examine how each linear trait score looks on the model cow.

2.1.1 The Ideal cow

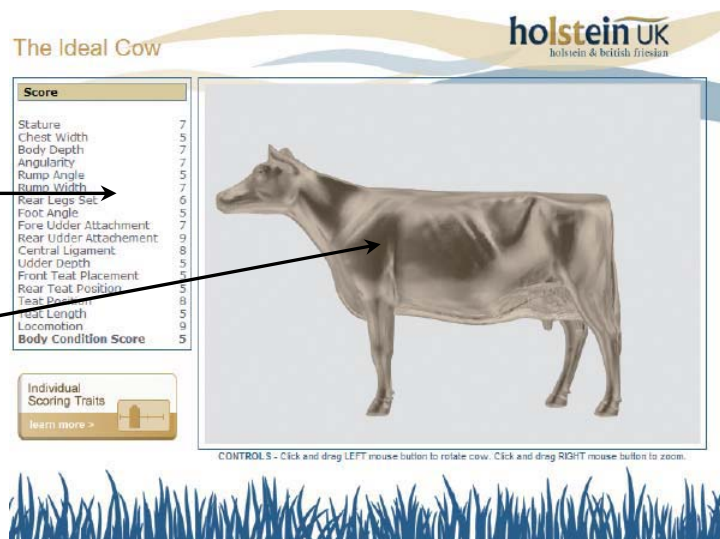
The **Ideal Cow** section depicts a series of fixed settings for the current consensus view of the cow breeders should be striving to achieve.

The linear scores for this ideal are listed on the left.

This 3D view can be rotated any way the user chooses, plus enlarged or shrunk in size using the computer's pointing device (mouse or touchpad) to give an ideal perspective view of any part of the body or trait area.

One frequent question is "Why is the cow not black and white?" During the two-year development period it was found that areas of dark colour in particular tended to hide features of the cow. Flesh tones in the udder area for example, also failed to generate sufficient contrast between shade and light to reveal differences in full detail. The silver tone adopted gave the best combination of effects to portray the full 3D image when rotated. This also means the Virtual Cow can be more easily adapted to other preferences, and is not dependent on specific colour combinations or pattern of markings.

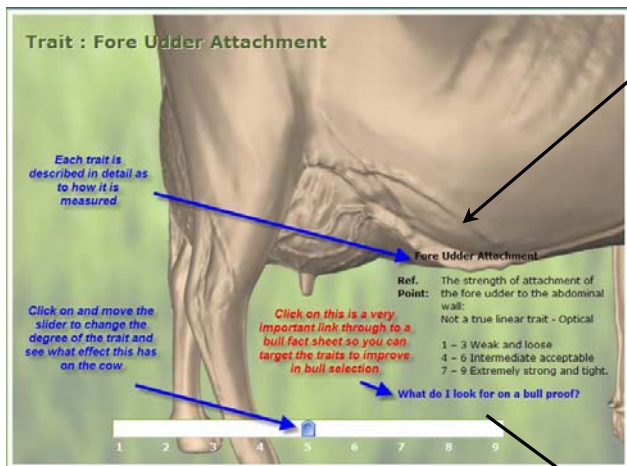
The trait scores used to create this image can easily be adapted to suit any alternative consensus or to create the ideal conformation model for other breeds or groups.



2.1.2 Individual scoring traits

Switching to **Individual Scoring Traits** means the user can select any on the 16 key linear scoring traits, plus Locomotion and Body Condition for individual focus.

Choosing any one trait moves to a high-resolution view of that area of the cow's anatomy.



Each trait is described in detail with an explanation of its own linear scores.

Moving the slider up or down its linear scale adapts the feature immediately to the morphology appropriate to the score. The user can see the effects of any change in the degree of the trait see what impact this has on the cow.

Direct links to a bull's Fact Sheet, showing linear scores in graphical format, allow the user relate any trait to the bull's linear type profile, helping to visualise that score and see the impact of a breeding decision on the structure of the animal. So aiding bull selection and ultimately, breed improvement across the national dairy herd.

Type Proof		DTAT2010 (4/10)						1477 Dhrs(UK)	492 Hds(UK)	99% Ref	Value
UK Type Proof		-3	-2	-1	0	+1	+2	+3			
Type Merit	Poor								Excellent	3.09	
Mammary	Poor								Excellent	2.33	
Legs & feet	Poor								Excellent	3.12	
Stature	130 cm								154 cm	2.78	
Chest width	Narrow								Wide	-1.35	
Body depth	Shallow								Deep	0.87	
Angularity	Coarse								Open Rib	1.92	
Rump angle	High pins								Low pins	0.15	
Rump width	Narrow								Wide	0.42	
Rear leg side	Straight								Sickled	-1.16	
Foot angle	Low								Steep	1.56	
Fore udd att	Loose								Tight	2.08	
Rear udder ht	Very low								Very high	2.72	
Udder supp	Broken								Strong	2.02	
Udder depth	Below hook								20cm above	1.71	
Front test pl	Outside								Close	0.00	
Teat length	Short								Long	0.78	
Rear test pl	Apart								Close	0.60	
Teat pos side	Close								Apart	-0.2	
Temperament	Poor								Good	0.57	
Base of milk	Slow								Fast	1.94	
Locomotion	Poor								Excellent	3.65	
Cond Score	Low								High	-1.49	

Locomotion is by definition a dynamic action. This presents the problem of depicting the movement adequately for viewers to understand each score.



17 Locomotion

Ref. Point: The use of legs and feet, length and direction of the step

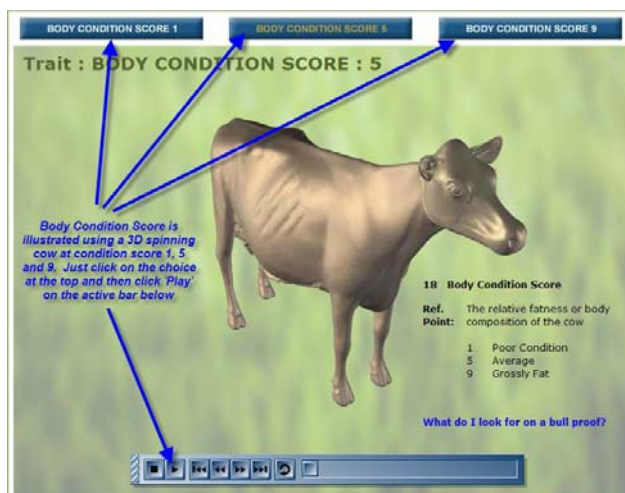
- 1-3 = Severe Abduction - Short Stride
- 4-6 = Slight Abduction - Medium Stride
- 7-9 = No Abduction - long stride

The Virtual Cow overcomes this by embedding video clips of real cows into the model.

There is a separate, 30-second sequence, for each locomotion score from 1 to 9 (with the median scores 5 & 6 combined). The viewer can select any score and play, pause or repeat the video.

Each video is complete with its own audio commentary explaining the features of the cow's gait and why she achieves that score. Complementing the written description of the scores.

This helps improve the understanding and importance of locomotion scores, leading to a long term reduction in lameness.



Body Condition Score is illustrated to a series of 3D animations, each similar to the Ideal Cow. Three scores are available, at the extremes and centre of the 1-9 scoring range.

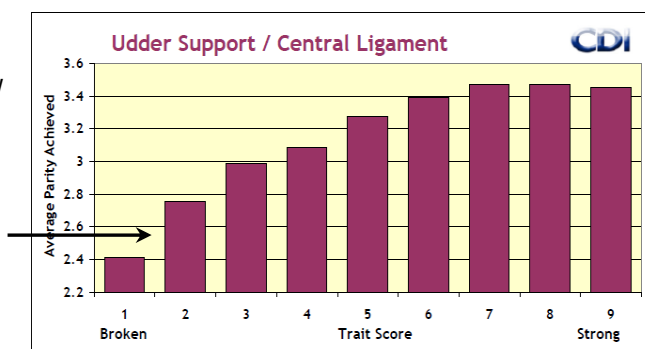
As the cow rotates to view all areas of her conformation at the chosen score, the animation can be paused or re-started, so the impact of the score value can be absorbed more easily.

2.2 Further developments

Feedback from early users is already leading to a series of valuable suggestions for the further enhancement of the Virtual Cow's functionality.

Items such as the ability to build a user's own view of an Ideal Cow have been requested, or perhaps store the model showing all the linear scores for a particular bull the breeder is considering?

Plans are already underway to incorporate recent results from the CDI on the effect that any trait score has on the typical herd life achieved by animals who were first classified as heifers.



3.0 Benefits summary

Existing and Potential Users include a number of UK agricultural colleges and universities, individual breeders and students, breeding advisors, breed associations, AI companies and Milk Records Organisations.

Several key benefits of the Virtual Cow have been mentioned already. In summary these include:

- Can be used in a wide variety of locations from classroom and lecture theatre to home and office. (With a laptop even car, cowshed or field?)
- Removes the need for a large number of live cows to be assembled to illustrate each score value.
- Enables numeric scores to be visualised interactively.
- Promotes better understanding of linear scores and classification.
- Breeders can assess a bull by viewing the likely impact of each trait on his daughters.
- Changes in trait scores are easy to follow.
- Promotes breed improvement through enhanced understanding of those traits which need to be carried forward.
- Adapts to all preferences and can cater for different breeds.

The shape and conformation of the dairy cow has changed dramatically over the last 100 years, thanks to the concerted efforts of breeders, associations, societies, advisors and breeding organisations of all types. The Virtual Cow can help to ensure that the dairy animal of the future has the constitution to lead a long, comfortable, and trouble free productive life in any herd or situation.