



THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Network. Guidelines. Certification.

AUTOMATIC TECHNOLOGY & BCS RECORDING: POSSIBILITIES, RELIABILITY AND REQUIREMENTS

Steven J. Sievert

Technical Director, National DHIA, Madison, WI USA

Manager, Quality Certification Services, Madison, WI USA

Chair, ICAR Subcommittee for Measuring, Recording and Sampling Devices



THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Network. Guidelines. Certification.

AUTOMATIC TECHNOLOGY & BCS RECORDING: POSSIBILITIES, RELIABILITY AND REQUIREMENTS

The use of images or company names does not imply endorsement or validation of respective system by ICAR or the authors, and is used for illustration of possibilities of inclusion of BCS data from automatic systems in herd recording programs



Network. Guidelines. Certification.

Traditional manual scoring uses three common scales

- 1-5 (Dairy Cattle)
- 1-9 (Beef Cattle)
- 1-10 (Dairy NZ)

Categorical data with subjective scoring (inherit bias is possible)

Frequency may be limited during lactation or specific life-stage of the animal

	BCS	Description
Thin	1 Emaciated	No palpable fat over spinous processes, transverse processes, hip bones, or ribs. Tail head and ribs project quite prominently.
	2 Poor	Tail head and ribs are less prominent. Individual spinous processes are still sharp to the touch, but some tissue cover on dorsal portion of ribs.
	3 Thin	Ribs are individually identifiable but not as sharp to the touch. Obvious palpable fat along spine and over tail head with some tissue cover on dorsal portion of the ribs.
Optimum/moderate	4 Borderline	Individual ribs are no longer visually obvious. The spinous processes can be identified individually on palpation but feel rounded rather than sharp. Some fat cover over ribs, transverse processes, and hip bones.
	5 Moderate	Cow has generally good overall appearance. On palpation, fat cover over ribs feels spongy and areas on either side of tail head have palpable fat cover.
	6 High Moderate	Firm pressure required to feel spinous processes. A high degree of fat is palpable over ribs and around tail head.
Fat	7 Good	Very spongy fat cover over ribs and around tail head. "Pones" beginning to be obvious. Some fat around the vulva and in crotch.
	8 Fat	Cow very fleshy and over-conditioned. Spinous processes almost impossible to palpate. Cow has large fat deposits over ribs and around tail head, and below vulva. "Pones" are obvious.
	9 Extremely Fat	Cow looks patchy and blocky. Tail head and hips buried in fatty tissue and "pones" of fat are protruding. Bone structure no longer visible and barely palpable. Animal's mobility might even be impaired by large fatty deposits.

In the dairy cow, body condition is an indicator of the amount of stored energy reserves and changes with different stages of lactation. Fresh cows in peak lactation tend to be in a negative energy balance and therefore lose body condition. Late lactation cows, dry cows and low producers are in a positive energy balance and gain condition. There is no one ideal body condition score. There is a range of desirable scores which change for individual cows over the different stages of each lactation.

Dairy farmers should regularly evaluate the body condition of their cows and heifers so they can fine-tune feeding and management practices. Adequate body reserves are necessary to maintain health, production and reproductive efficiency. Underconditioned cows are prone to reduced milk production and poor persistency of lactation. Overly conditioned cows are predisposed to calving difficulties, fatty liver syndrome, impaired reproduction and metabolic disorders.

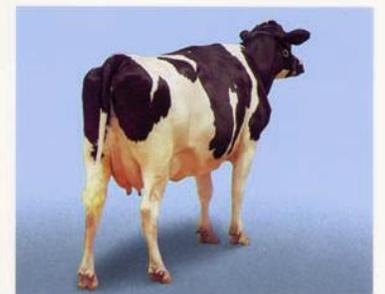
Body condition scoring of cattle is an essential management tool for the progressive dairy farmer. It can be mastered with a little training and good observation skills, using both sight and touch to evaluate each cow.



BCS = 3



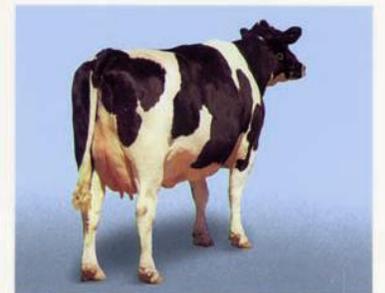
BCS = 1



BCS = 4



BCS = 2



BCS = 5

Assessing BCS using the DairyNZ method

Key points

- Body condition score (BCS) is a subjective assessment of a cow's energy reserves, rating the "fatness" of a cow on a scale of 1 to 10, where 1 is emaciated and 10 is obese.



THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Challenges with the 'Golden Standard'

Network. Guidelines. Certification.

A quick look at performance in manual scoring

- It is accepted that human variation is 0.25 BCS score when using 1-5 BCS scale
- Reluctancy by some human scorers to use the full range of BCS
- Some scorers use 0.50 incremental scores, others use 0.25 incremental scores
- Suggested that BCS <2.5 or BCS >4.0 that human scorers should use only 0.50 increments
- Multiple human scorers agreed with absolute BCS 58% of the time
- Deviation by human scorers from absolute BCS 33% of the time

In the dairy cow, body condition is an indicator of the amount of stored energy reserves and changes with different stages of lactation. Fresh cows in peak lactation tend to be in a negative energy balance and therefore lose body condition. Late lactation cows, dry cows and low producers are in a positive energy balance and gain condition. There is no one ideal body condition score. There is a range of desirable scores which change for individual cows over the different stages of each lactation.

Dairy farmers should regularly evaluate the body condition of their cows and heifers so they can fine-tune feeding and management practices. Adequate body reserves are necessary to maintain health, production and reproductive efficiency. Underconditioned cows are prone to reduced milk production and poor persistency of lactation. Overly conditioned cows are predisposed to calving difficulties, fatty liver syndrome, impaired reproduction and metabolic disorders.

Body condition scoring of cattle is an essential management tool for the progressive dairy farmer. It can be mastered with a little training and good observation skills, using both sight and touch to evaluate each cow.



BCS = 3



BCS = 1



BCS = 4



BCS = 2



BCS = 5

Photos by Craig Johnson



THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Automated BCS Systems

Network. Guidelines. Certification.

Simultaneous ID recording with BCS measurement in automatic systems

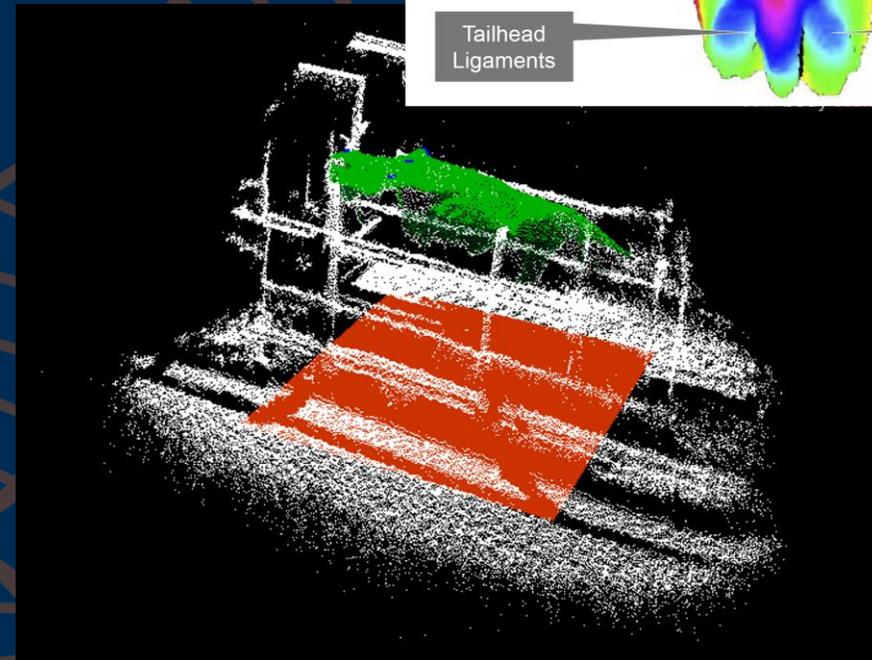
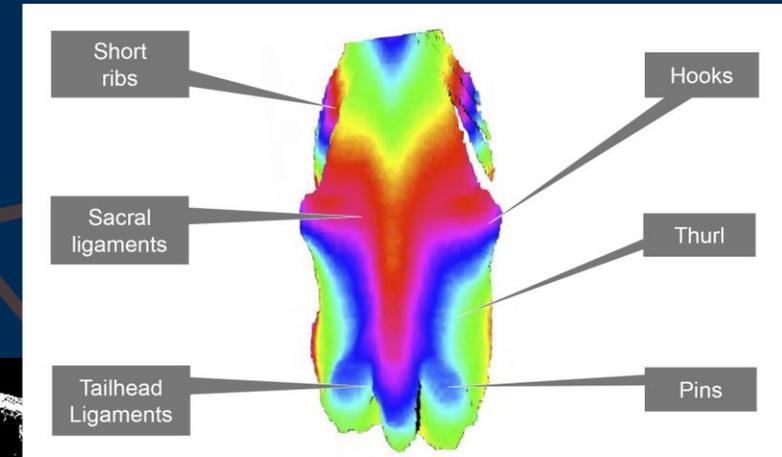
Frequent low-cost measurements (daily)

Use of Thermal or 3D images to estimate BCS from specific body points (proprietary IP)

Two approaches – cows are stationary or cows are moving single file under camera

Automated systems may also provide additional useful data

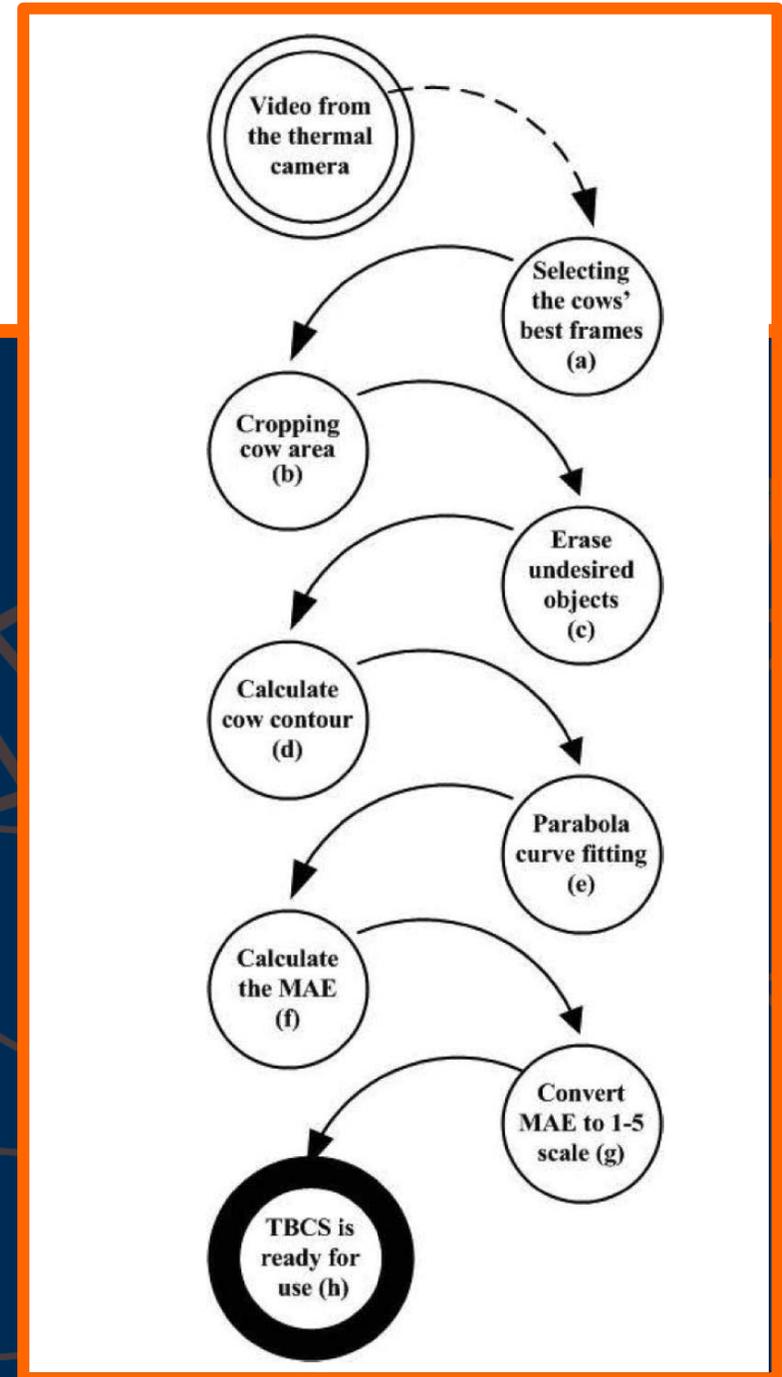
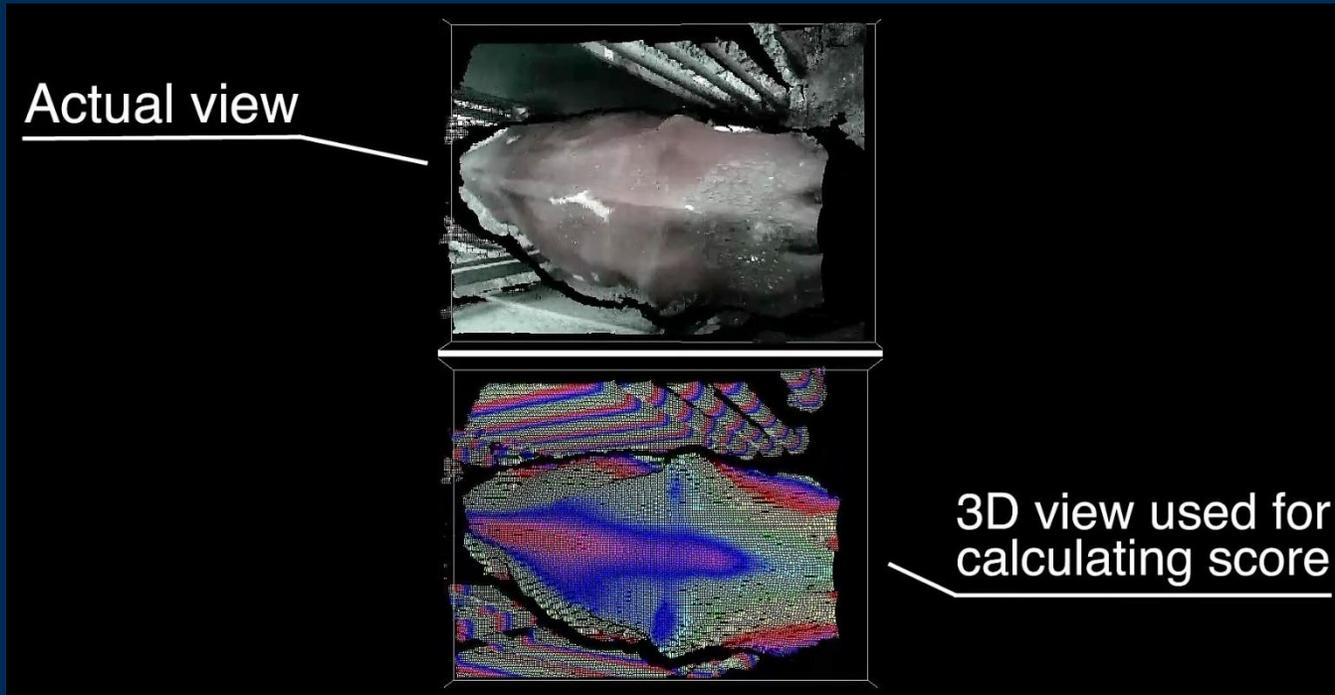
- Whole body imaging in stationary systems
- Conformation estimates
- Lameness/motility estimates through 'in-motion' systems





THE GLOBAL STANDARD
FOR LIVESTOCK DATA

From a Thermal or 3D image to BCS Score





THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Comparison of Manual BCS with TBCS

Network. Guidelines. Certification.

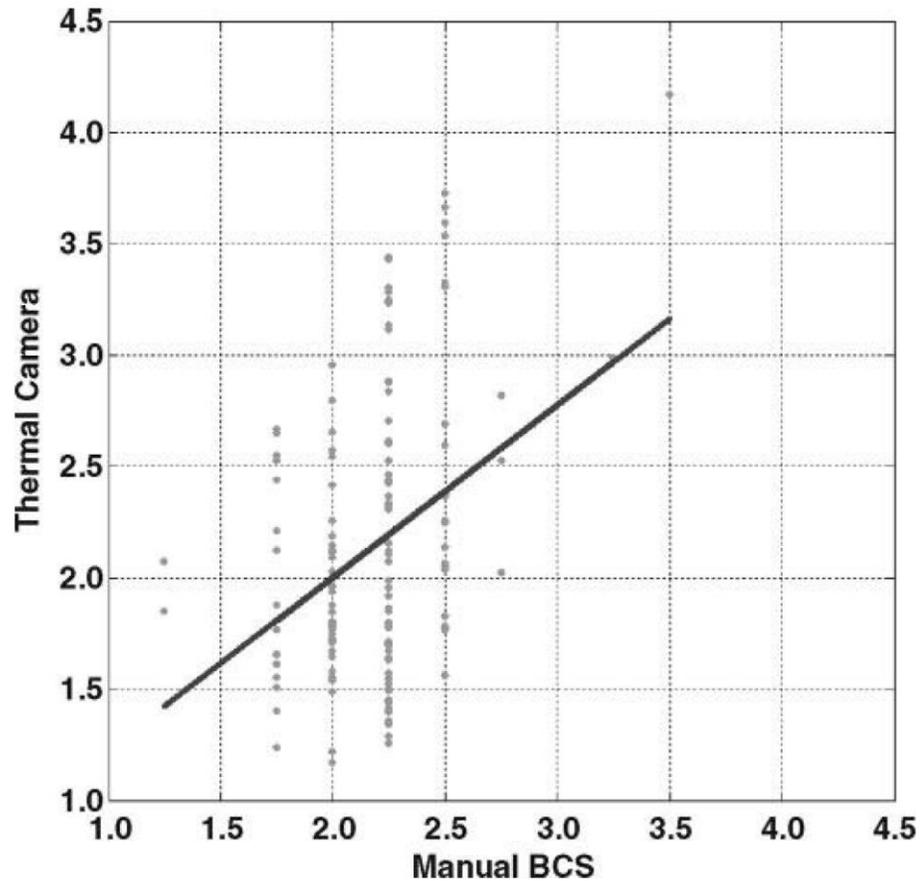
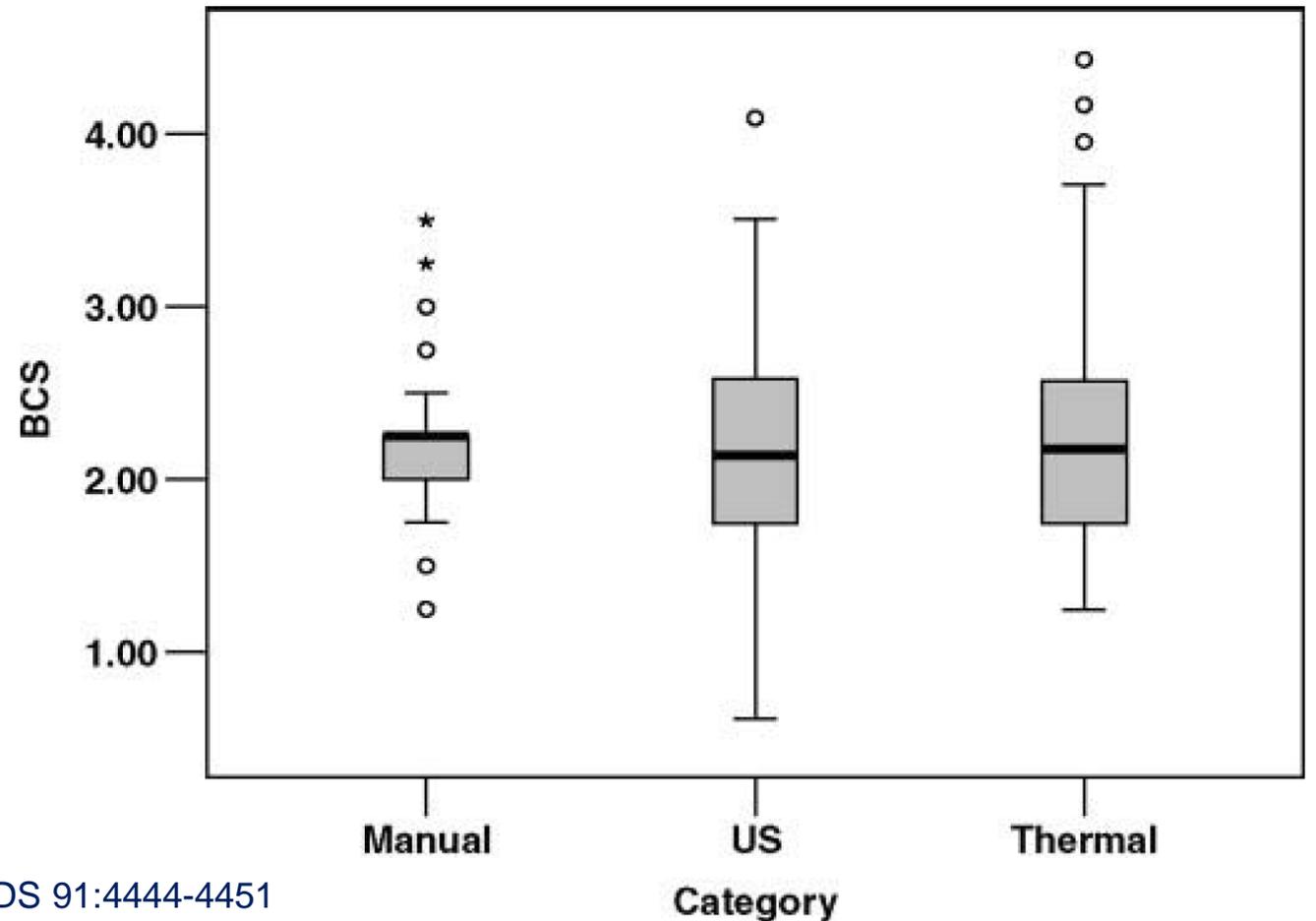


Figure 4. The link between the thermal camera scoring and the manual BCS.



JDS 91:4444-4451



THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Comparison of Manual and Automatic BCS

Network. Guidelines. Certification.

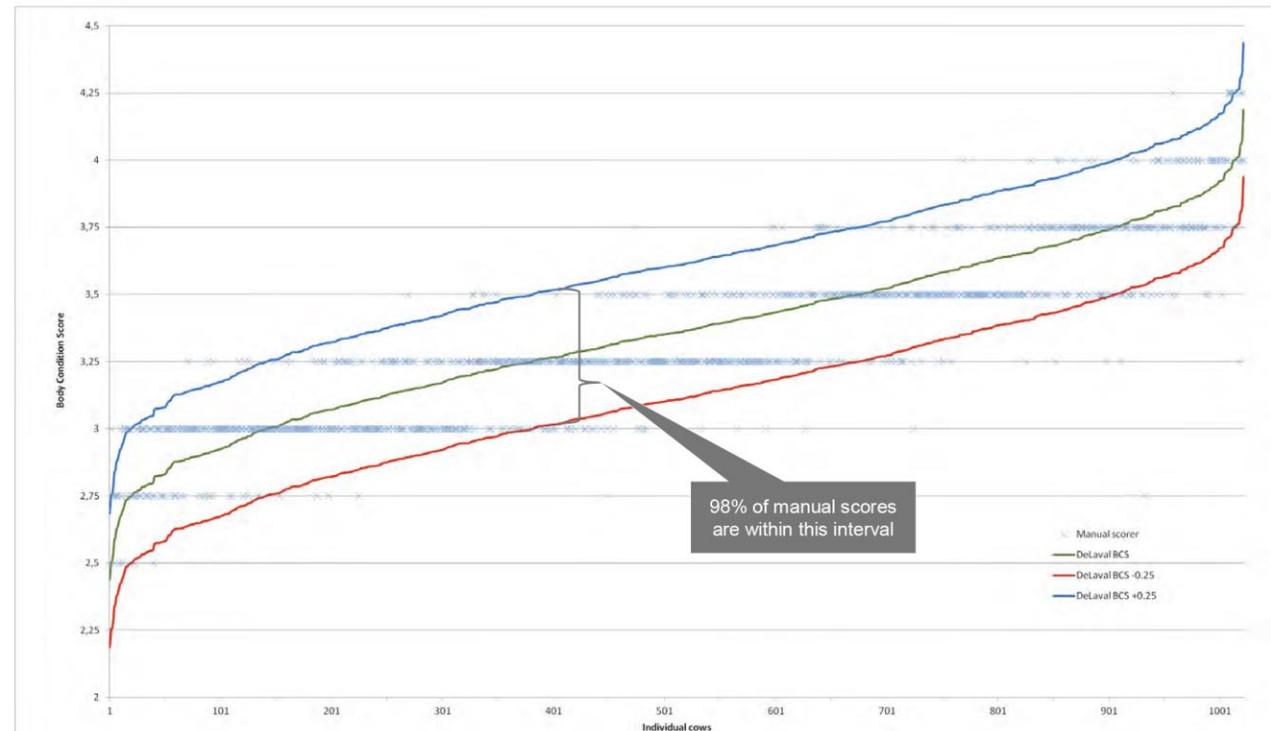
Multiple Manufacturer Internal Validation Studies

In this example, courtesy of DeLaval:

- 98% of manual BCS was within 0.25 of automatic system scores
- Scoring is on continuous scale but limited observations at extreme low and high BCS

Statistical analysis on variation between categorical scores and continuous scoring on a similar scale is inappropriate but the it appears the repeatability is lower or similar in studies

Performance testing 1022 cow farm





THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Comparison of Manual and Automatic BCS

Network. Guidelines. Certification.

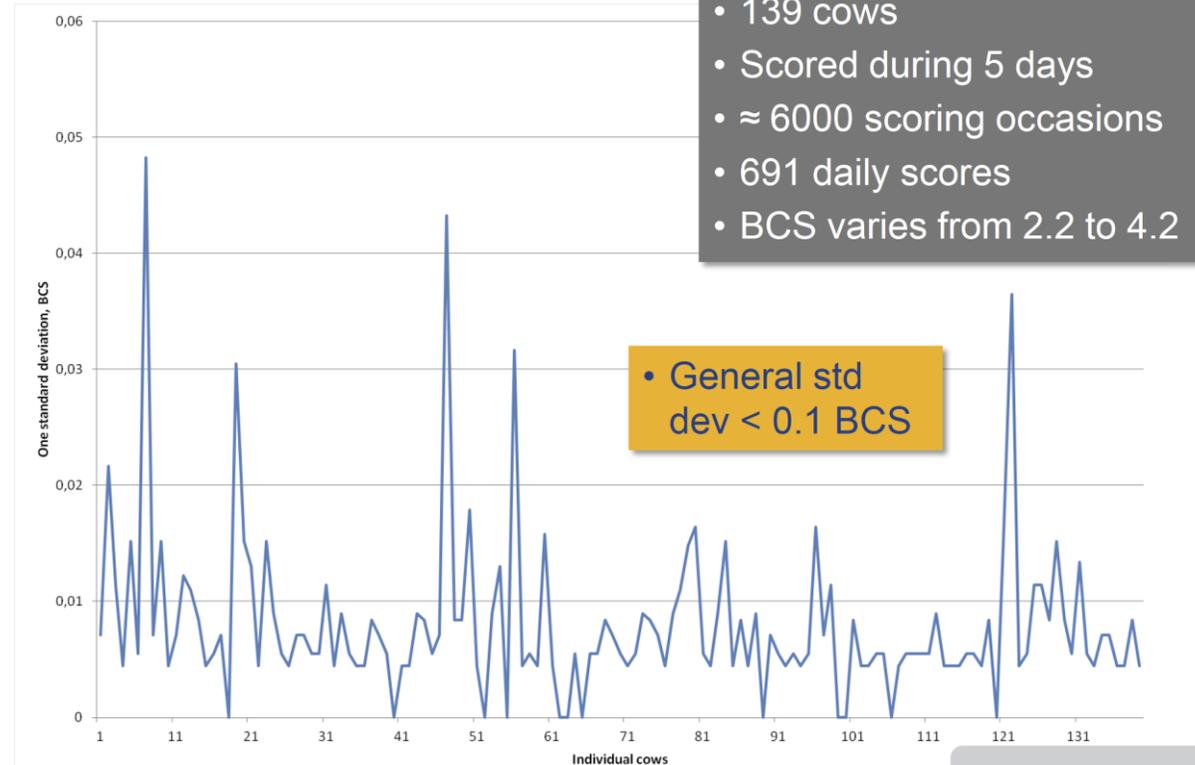
Multiple Manufacturer Internal Validation Studies

In this example, courtesy of DeLaval:

- SD was <0.1 BCS
- Scoring is on continuous scale but limited observations at extreme low and high BCS

Statistical analysis on variation between categorical scores and continuous scoring on a similar scale is inappropriate but the it appears the repeatability is lower or similar in studies

Repeatability Standard deviation Test farm 1

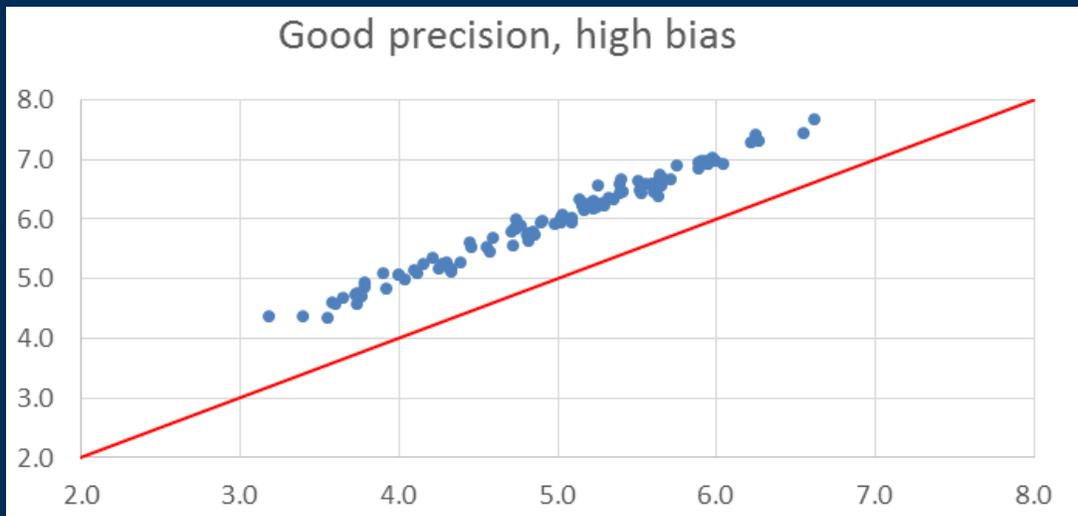
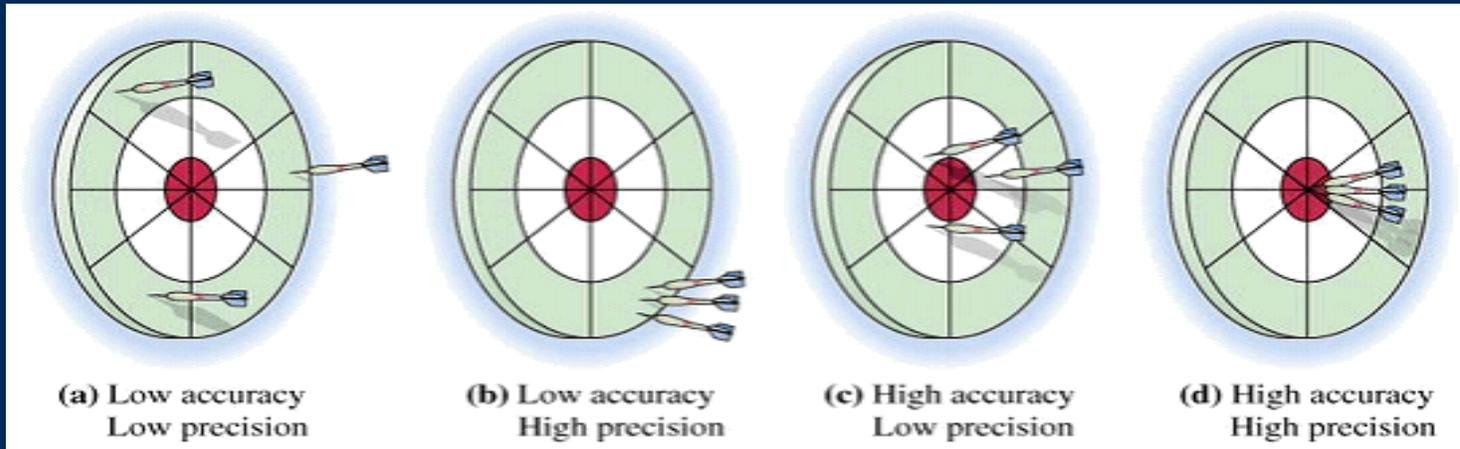




THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Do We Need Accuracy or Precision?

Network. Guidelines. Certification.



Point to Ponder with BCS Scoring on Usability

ACCURACY vs. PRECISION

With repeated (daily) estimates of BCS, is precision more important than the absolute value?

We are looking for changes (delta) over time/lactation

- Individual cow changes
- Groups of cows (pen/string/life stage)

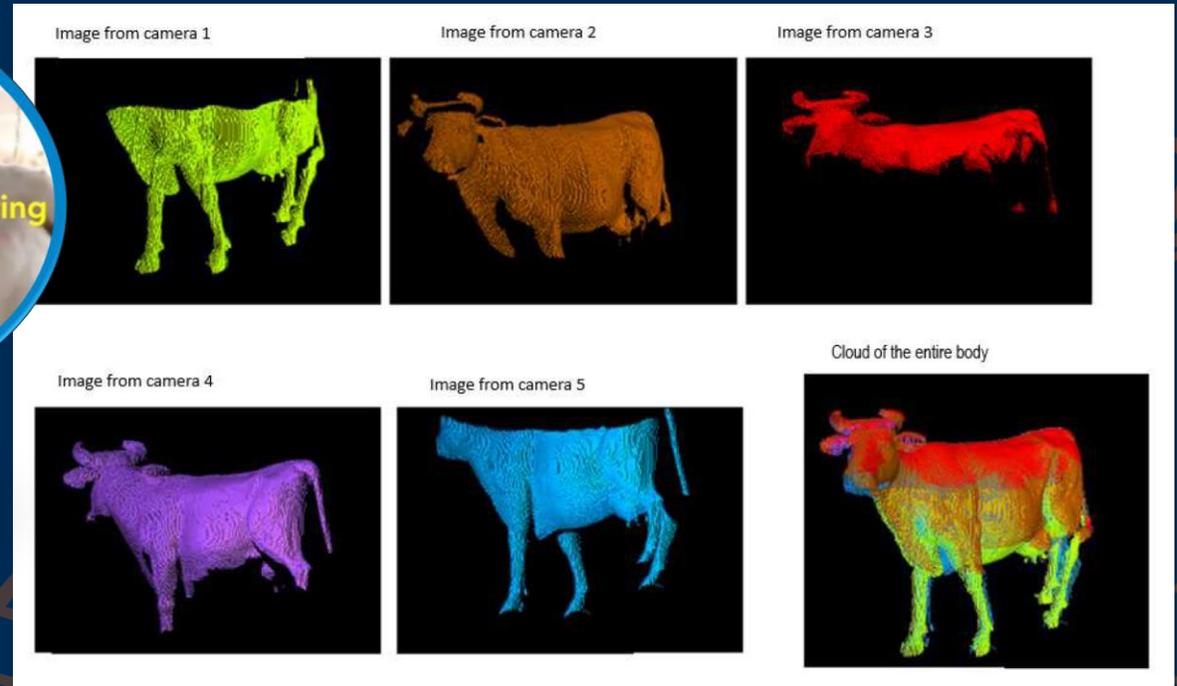
Can we make an adjustment for the 'system effect' if deemed necessary?



THE GLOBAL STANDARD FOR LIVESTOCK DATA

Stationary BCS & Conformation Systems

Network. Guidelines. Certification.



Usable BCS and conformation estimates

Non-automated system but combined with other periodic observations, provides quality data for herd management and genetic evaluations

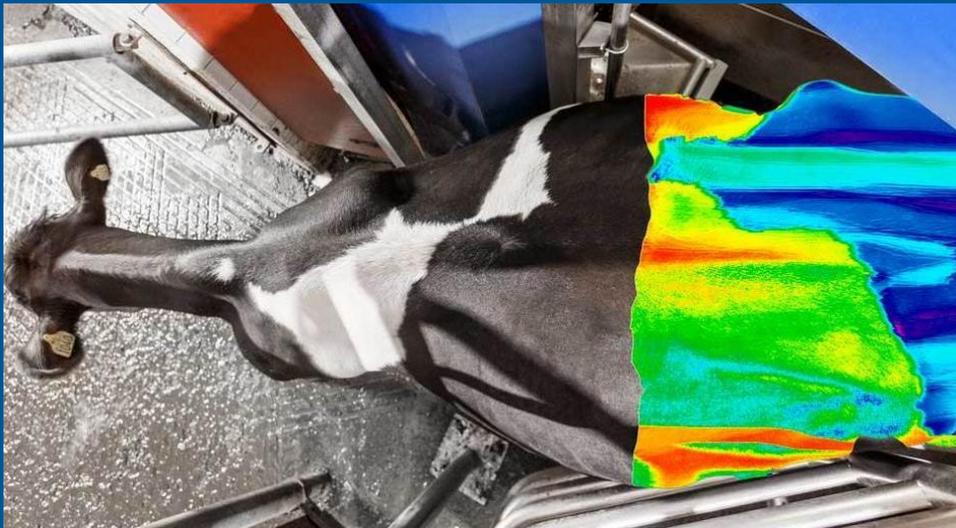


THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Automated BCS System Considerations

Network. Guidelines. Certification.

Turning Data into Useful Information



System validation while protecting manufacturer IP?

Sensitivity to light/darkness?

Sensitivity to hide colour, hair length, cleanliness?

Other physical system requirements?

Accuracy, repeatability and reproducibility of BCS values?

Consistency over time?

Algorithm or software updates?

Does the system require periodic calibration, maintenance and/or adjustment?



THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Network. Guidelines. Certification.

AUTOMATIC TECHNOLOGY & BCS RECORDING: POSSIBILITIES, RELIABILITY AND REQUIREMENTS

Robert Fourdraine

Assistant Director, Dairy Records Management Systems, Raleigh, NC, USA

Chair, ICAR Animal Data Exchange (ADE) Working Group



THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Animal Data Exchange

Conformation Score Event (59 Includes BCS)

Score (1 to 9)

List of all traits can be found at:

[ICAR/icarConformationTraitType.json](#) at

[ADE-1 · adewg/ICAR · GitHub](#)

Scoring Methods

Manual

Automated

Device

Name	From	Type	Description
resourceType	icarResource.json	string	Always icarConformationScoreEventResource
meta		icarMetaDataType	Meta data (source creation and update dates etc)
id	icarEventCoreResource.json	string	Unique ID for each event
animal		icarIdentifierType	A scheme+ID combination that identifies the animal.
eventDateTime		icarDateTimeType	Date and time of the observation
location		icarIdentifierType	A scheme+ID combination that identifies the location (herd/farm)
traitLabel		icarIdentifierType	A scheme+ID combination that identifies the national/local recording systems label for that trait
responsible		string	Name or identifier of the person responsible for the action/observation
contemporaryGroup		string	Optional identifier for the contemporary group that influenced the trait observed.
score	icarConformationScoreEventResource.json	number	Numeric 1-9 score (decimals allowed in some countries and some scores)
traitScored		enum	A value from the full list of conformation traits. For BCS use <small>BodyConditionScore</small>
method		enum	Manual or Automated
device		icarDeviceReferenceType	Details of the device (if any) used for automated scoring.



THE GLOBAL STANDARD FOR LIVESTOCK DATA

Network. Guidelines. Certification.

Angularity
Back Length
Back Width
Body Condition Score
Body Depth
Body Length
Bone Structure
Central Ligament
Chest Depth
Chest Width
Claw Angle
Flank Depth
Foot Angle
ForePasterns SideView
Fore Udder Attachment
Fore Udder Length
Front Legs FrontView
Front Teat Placement
Height At Rump
Height At Withers
Hind Pasterns SideView
Hock Development
Length Of Rump

Locomotion
Loin Strength
Muscularity
Muscularity Shoulder SideView
Muscularity Shoulder TopView
Muzzle Width
Rear Legs RearView
Rear Legs Set
Rear Legs SideView
Rear Teat Placement
Rear Udder Height
Rear Udder Width
Rounding Of Ribs
Rump Angle
Rump Length
Rump Width
Skin Thickness
Stature
TailSet
Teat Direction
Teat Form
Teat Length
Teat Placement RearView

Teat Placement SideView
Teat Thickness
Thickness Of Bone
Thickness Of Teat
Thickness Of Loin
Thigh Length
Thigh Rounding SideView
Thigh Width RearView
Thurl Width
TopLine
Udder Balance
Udder Depth
Width At Hips
Width At Pins



THE GLOBAL STANDARD
FOR LIVESTOCK DATA

Network. Guidelines. Certification.

Are There Other Considerations?

Additional Conformation Traits?

Other Scoring measurements that should be considered (currently 1-9 score with decimal)

Are there Sensor Data Proxys that fall outside the current ADE definition?