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# Summary of Sensor Devices Task Force Work and Charting a Course Moving Forward

Steven Sievert Chair, ICAR Sensor Devices Task Force 19 June 2019



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## Challenges in Modern Herd Recording

Are We Listening? Livestock are ideal candidates for repeated measures – What can I tell you?

> Producers are saying I made the investment -How are you going to use my farm/herd data?

Recording organizations are looking for guidance – What do we do?



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Martin Burke, ICAR

Kees de Koning, Netherlands









Franz Josef Auer, Austria



Christa Egger-Danner, ZuchData

Harrie van den Bijgaart, Netherlands

Reinhard Reents, Germany

**Clement Allain, France** 

Brian Wickham, Ireland/NZ

Jeroen van den Ban, Lely

Cecilia Bågenvik, DeLaval



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Classification, Qualification & Potential ICAR Approval of Sensor Devices Dissemination of Recording Guidelines using Data from Sensors Development & Distribution of Best Practices for Data Collection from Sensors



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Current State of Sensor Technology Technology is Improving and Changing Rapidly and Easily Adopted by Producers

Many Isolated Packages without Integration or Linkage

Sensor Users Behave as a 'Community of Practices' – no True Standards or SOPs

Validation, Maintenance, and Calibration Protocols are Missing

There is both System Bias and Individual Sensor Bias



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SD-TF Survey – Priorities Identified by Members





#### Sensor Devices Task Force

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	Facts about the Sensor Devices Task Force • Members of the Sensor Devices Task Force <read more=""> • Terms of Reference of the Sensor Devices Task Force</read>	ICAR Sensors Overview • File (as.xlsx) available < read more>	Sensor use survey report <read more=""></read>
۱	<read more=""> <ul> <li>Test Centres</li> <li><read more=""></read></li> </ul> <li>Meeting of the SD TF in Zutphen <ul> <li><read more=""></read></li> </ul> </li> </read>	Sensor Trait Characterisation • File (as .xlsx) < read more>	
	Cuidelines for Sensor Devices are currently under finalisation	<ul> <li>Sensor Research</li> <li>4D4F Third Annual Report <read more=""></read></li> <li>4D4F Technology Warehou <read more=""></read></li> <li>4D4F Best Practices Guide <read more=""></read></li> <li>4D4F Dairy Sensor Researcher </li> <li>4D4F Dairy Sensor Researcher</li> </ul>	ise on Sensor Devices ch Report

## New Sensor Device Page on ICAR website

## Links to:

Survey Results Sensor Summary Table Trait Characterization/Validation External Research/Publications Draft Guidelines (upcoming)



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Multiple Ways to Classify Sensor Data

Different Needs for Accuracy & Precision





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## **Add New Section to Guidelines**

Overview of Data Use from SD Systems Automated Animal ID & Data Capture Data Connectivity Data Credibility

- \* Missing Data Points
- \* Outlier Handling
- \* Data Smoothing

Data Transfer and Usability Standards

Linked to Specific Performance Standards in Other Sections of ICAR Guidelines.

Linked to Sensor Device/System Testing Guidelines (Section 11)

#### ICAR GUIDELINES

ICAR has updated how we structure and present our Guidelines. The new format makes them easier to browse and to access your specific interests. All feedback is welcome. Please note that the content has not changed.

- Section 01 General Rules
- Section 02 Cattle Milk Recording
- Section 03 Beef Cattle Recording
- Section 04 DNA Technology
- Section 05 Conformation Recording
- Section 06 Al and ET Data and Fertility Analysis
- Section 07 Bovine Functional Traits
- Section 08 Certificate of Quality
- Section 09 Dairy Cattle Genetic Evaluation
- Section 10 Identification Device Certification
- Section 11 Milk Recording Devices
- Section 12 Milk Analysis
- Section 13 On-line Milk Analysis
- Section 14 Alpaca and Goat Identification and Fibre
- Section 15 Data Exchange
- Section 16 Dairy Sheep and Goats
- Section 17 Buffalo Milk Recording
- Section 18 Breed Associations





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Animal ID is More Important Than Ever



The 'official ID' of an animal most likely will not be the same as ID associated with sensor measures

- •Animals may have multiple IDs over their lifetime
- Animals may have multiple IDs on their body at once
- Databases will need to have protocols for ID crossreferencing and validation
- Need protocols for on-farm validation of the ID system and for data transfer/custody



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## **Reliable Data - Auto ID Systems**

Example: 2x20 Parlor, ID at the entrance

**ID rate 98%** 

- 100 cows = 5 loads
- 98% ID = 2 cows missed in 5 loads
- On average the missed cow is in mid load Data of 10 cows is assigned to wrong cows

RESULT: DATA RELIABILITY = 80% 20 cows out of 100 assigned with wrong data





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**Raw Data** VS. **Estimated Data** VS. **Displayed** Data VS. **Usable Data** 

Handling of missing data points

- How are missing points estimated?
- Mean of actual data only?

Outlier handling and exclusion

Data smoothing

Range of accurate measurement for sensor

**Data Precision** 

## **Evaluation of algorithm**

- Test data set to send through system algorithm to validate output?
- Protecting IP must be a consideration



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## **Connectivity is a Concern**

How is the value computed?

**Estimations?** 

Mean values without missing data?

Affects the quality of data entering the system





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#### **Equivalency to Traditional Test Day Data**

• Define parameters that approximate the accuracy and precision of traditional milk recording parameters like milk yield or composition

#### **Separate Classes of Data**

• Currently Supervised or Owner Sampler Test Types – will we have a test type or class for specific sensor data?

#### Weighting of Data

•Data collection rating system that puts relative weight on data type, collection interval, and parameters measured

#### **Use Validated Data Directly**

•New parameters may deliver data with acceptable accuracy and precision and the data is used with minimal editing

### **Exclusion of Certain Data**

•Results from specific parameters may be deemed to be unsuitable for herd recording programs at the present time

## How Will We Value Sensor Data?



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## Data Usability Standard

**Standard Template for each Measurement** 

Includes Data Use, Species, System and Scheme along with A, R, & R

**Overview of use described in new section of ICAR Guidelines** 

SC/WG with expertise will adopt format and provide performance standards for each trait or measurement

**Brings clarity to manufacturers & MROs** 

#### Trait (required)

Full Name	Body Condition Score
Common Abbreviation	BCS
Record Identifier Code	BCS

#### Data Type and Usability

Туре	Animal Management	Benchmarking	Genetic Evaluation
Quantitative	Yes	Yes	Yes
Qualitative	NA	NA	NA

#### Species (required)

Species	Notes/Comments
Cattle – Dairy	All life cycle stages
Cattle – Beef	All life cycle stages

#### System/Source (required)

System	System Code	Format
Visual Score	V or 1	a1 or i1
Camera	S or 2	a1 or i1

Schema/Scale (required) - a cross-reference or equivalency table to be supplied

Schema	Schema Code	Schema Format	Data Range	Data Minimum Resolution	Data Format	Notes
Dairy Cattle (NA, UK, EU)	DC	a2	1-5	0.25	f3.2 or i3	i3 format when multiplying BCS x 100
Beef Cattle	BC	a2	1-9	1	i1	
New Zealand	NZ	a2	1-10	1	i1	

#### Limits of Error for System Validation

Schema		DC			BC		NZ				
System	Repeatability [Sr]	Reproducibility [SR]	Accuracy	Repeatability [Sr]	Reproducibility [SR]	Accuracy	Repeatability [Sr]	Reproducibility [SR]	Accuracy		
Visual Score	0.50	0.75	0.50	0.50	0.75	0.50	0.50	0.75	0.50		
Camera											



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Sensor Approval and Validation

Development of ICAR guidelines for sensors
New testing & validation protocols
Co-innovation & cooperation with manufacturers Guidelines for Sensor Device Testing, Approval, Calibration or Routine Checking Procedures will be added to Section 11

Draft Guidelines under Review and will be handled by RSD-SC

Target November 2019 followed by ICAR Board review and vote by General Assembly

Routine Procedures & Best Practices

Installation protocols
Routine calibration and monitoring procedures
Development of best practices for recording organizations



# ICAR THE GLOBAL STANDARD FOR LIVESTOCK DATA

#### Section 11 - Guidelines for Testing, Approval and Checking of Recording and Sampling Devices List of Procedures

- [Overview] Guidelines for Testing, Approval and Checking of Recording and Sampling Devices
- [Procedure 1] Procedure for Application for Testing of Recording and Sampling Devices or Sensor Devices and/or Systems
- [Procedure 2] Procedure for Testing of Traditional Milk Recording and Sampling Devices
- [Procedure 3] Procedure for Testing of Automatic Milk Recording and Sampling Systems
- [Procedure 4] Procedure for Testing of Sensor Devices and/or Systems
- [Procedure 5] Procedure for Evaluation of Installation and Routine Calibration Procedures for Recording and Sampling Devices
- [Procedure 6] Procedure for Evaluation of Installation and Routine Calibration Procedures for Sensor Devices and/or Systems
- [Procedure 7] Procedure for Computerized Solutions for Periodic Checking of Recording and Sampling Devices
- [Procedure 8] Procedure for Computerized Solutions for Periodic Checking of Sensor Devices and/or Systems
- [Procedure 9] Procedure for Test-Day Practices Using Recording or Sensor Devices and Electronic Identification Simultaneously
- [Procedure 10] Procedure for Test-Day Practices for Obtaining Milk Samples on Individual Animals from Sampling Devices
- [Procedure 11] Procedure for Labeling of ICAR-Certified Devices
- [Procedure 12] Procedure for Annual Reporting of ICAR-Certified Devices in the Marketplace by Manufacturers
- [Procedure 13] Procedure for Annual Reporting of ICAR-Certified Device Usage and Satisfaction by Member Organizations
- [Procedure 14] Procedure for ICAR Certification of Devices

## **Revisions to Section 11**





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## **ICAR Universal Coding Systems for Devices**

Development and delivery by Interbull (tentative) on behalf of ICAR

Will include traditional recording devices and sensor devices/systems

Allow for data source characterization by member organizations, data handlers and data users

In addition to device code, system would include:

-Manufacturer -Software Name -Data measured

-Device Name -Software Version -ICAR Status -Other Marketplace Names -Firmware (if applicable) -ICAR Status Date



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Work of SD-TF concludes at ICAR 2019 in Prague

Recording and Sampling Devices SC (RSD-SC) assumes responsibility for guidelines revisions

What's Next?

RSD-SC develops new testing protocols and continues manufacturer outreach

ICAR SC and WG adopt data usability standard, providing performance standards for each sensor measurement or trait

Interbull works with RSD-SC to develop and deliver universal coding system for all devices

ICAR Board to set direction with respect to appropriate level of certification, approval, verification, validation or other term for sensor devices/systems and data generated from them.