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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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# Data Capture & Flow Challenges

- Quality of LAN or Internet Connection at Dairy
- Many Different Versions of Software – Updates Not Installed
- Frequent Updates of Software Creating Data Field Errors
- Random or Arbitrary Data Fields Created by Dairyman
- Lack of Real-Time Connection – May Only Be Daily or Weekly
- System is Too Complex/Labour Intensive for Dairy
- Inconsistent Data Definitions
- Data Quality – Missing or Incomplete
- ID Truncation/Translation/Cross-Referencing

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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**

# 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

- Milk Yield & Composition
- Milk Flow Rate & Duration
- Live Body Measurements
- Live Activity Measurements
- Feed Efficiency Measurements

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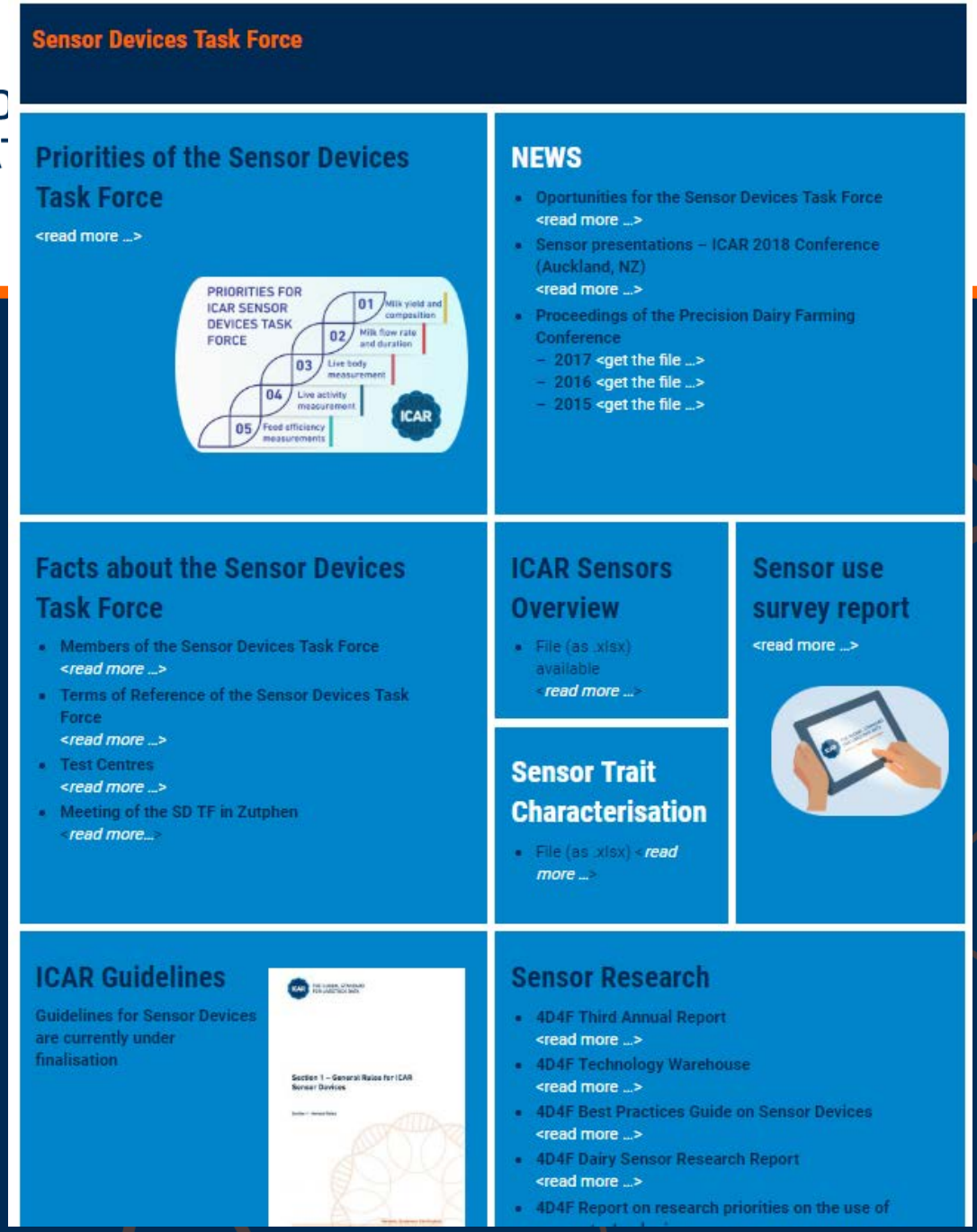
# New Sensor Device Page on ICAR website

**Links to:**

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



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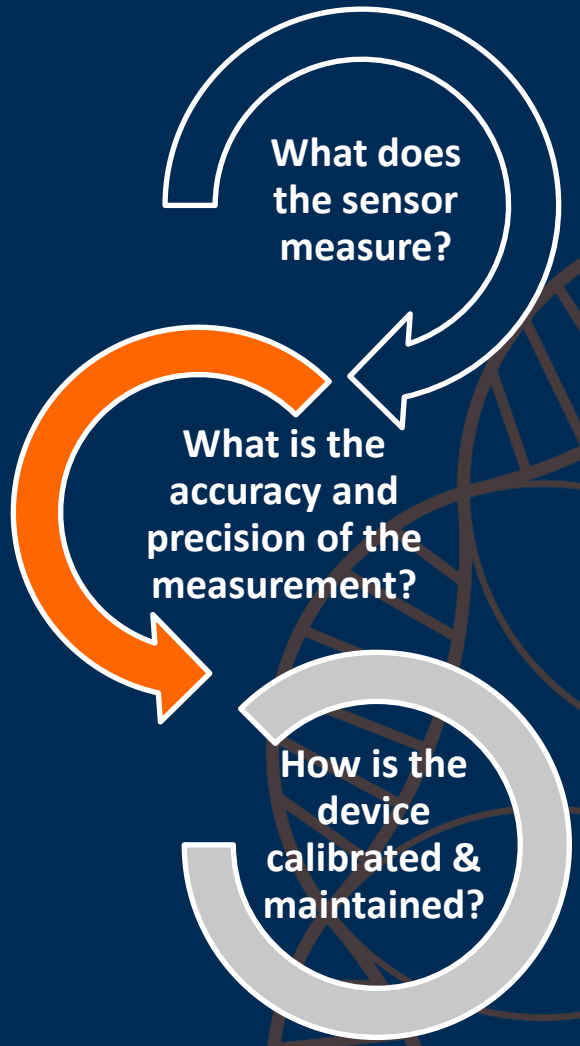
# Reviewing Sensor Devices




We cannot determine suitability of data until we know and understand the measurement

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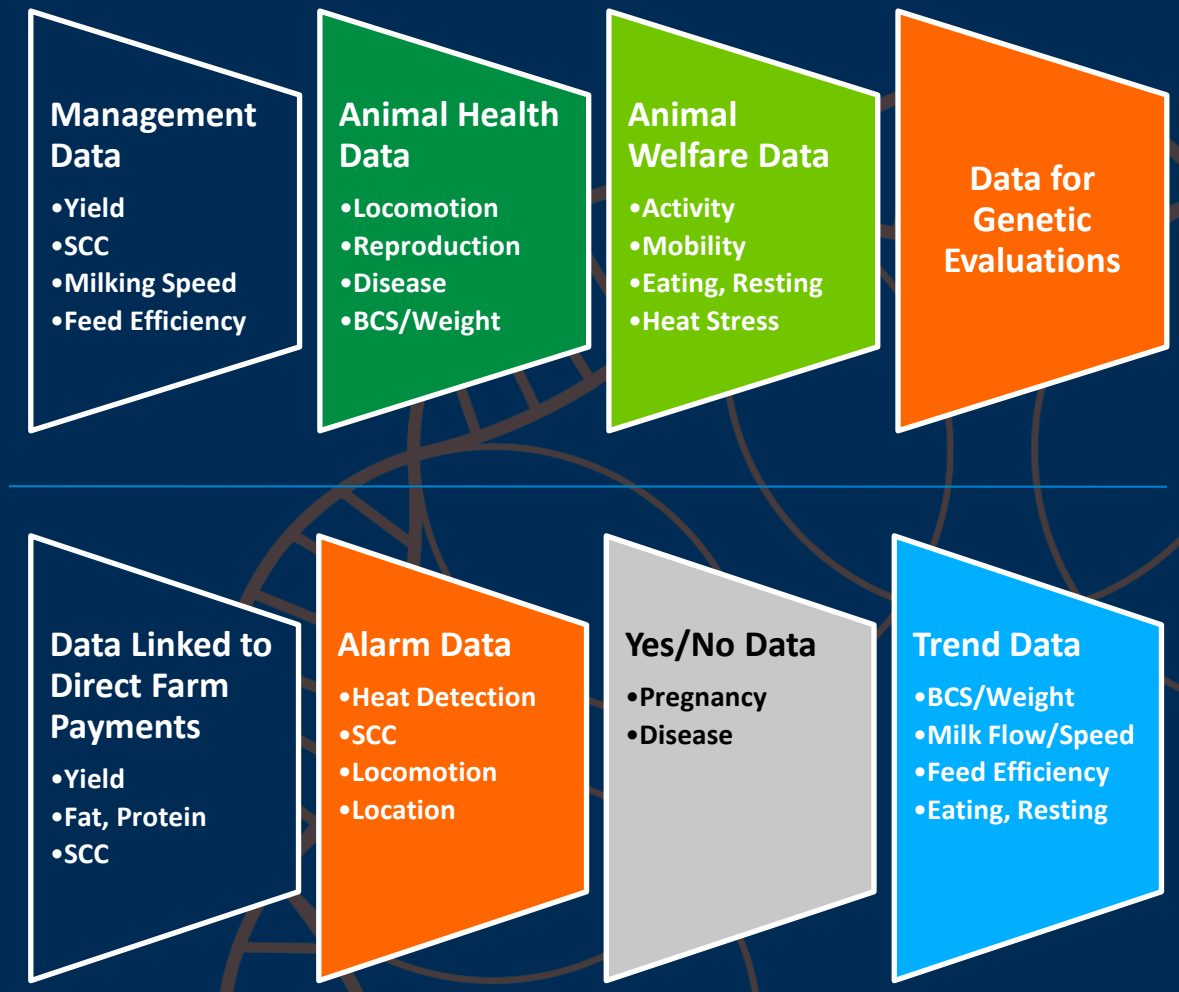
# Multiple Ways to Classify Sensor Data

# Different Needs for Accuracy & Precision



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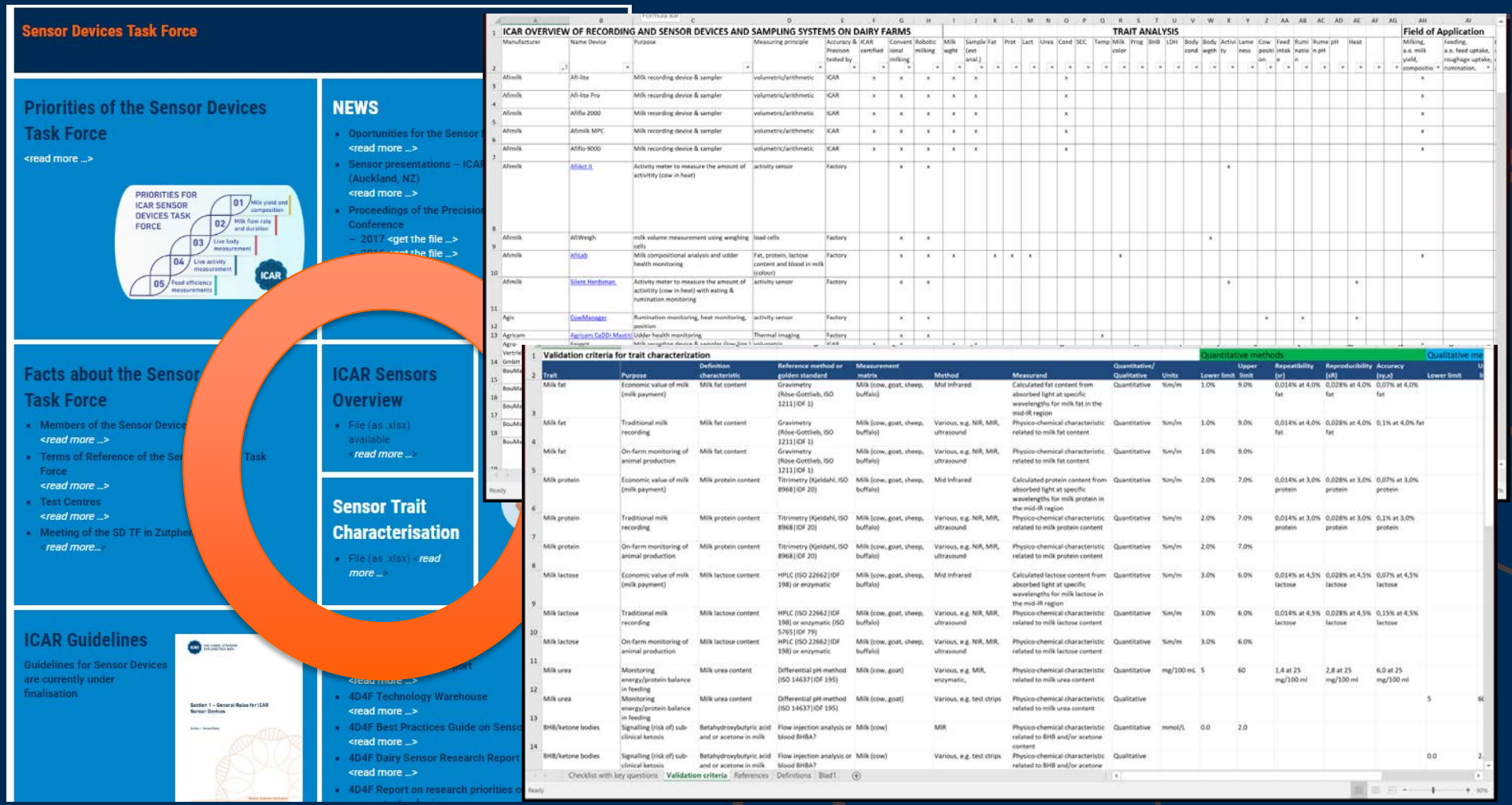

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# Add New Section to Guidelines

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)

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# Animal ID is More Important Than Ever

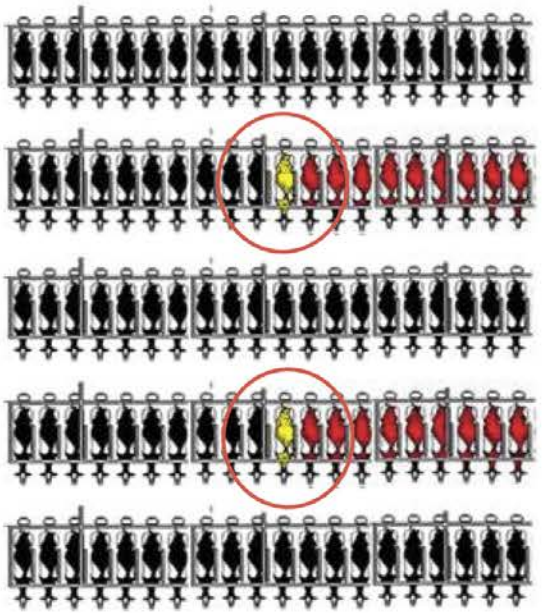
- The 'official ID' of an animal most likely will not be the same as ID associated with sensor measures
- Animals may have multiple IDs over their lifetime
- Animals may have multiple IDs on their body at once
- Databases will need to have protocols for ID cross-referencing and validation
- Need protocols for on-farm validation of the ID system and for data transfer/custody

# 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

# Raw 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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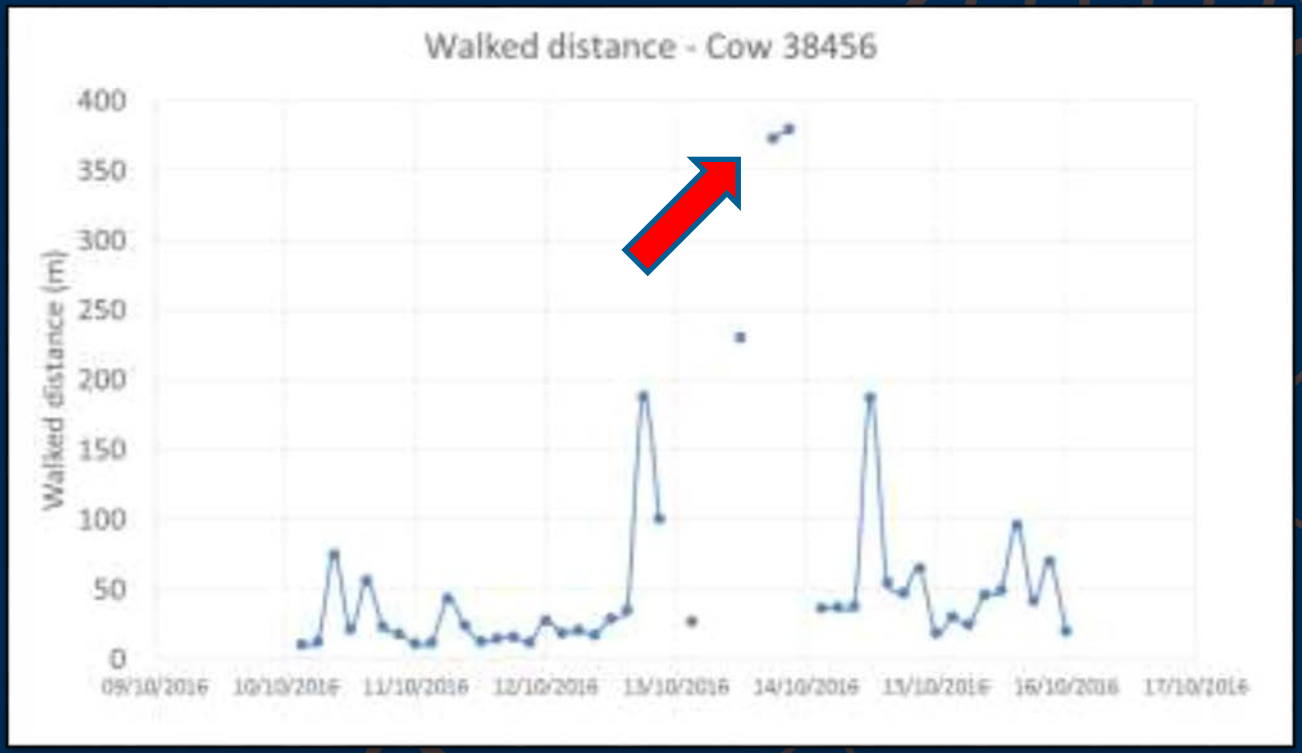
# Connectivity is a Concern

How is the value computed?

Estimations?

Mean values without missing data?

Affects the quality of data entering the system



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# How Will We Value Sensor Data?

## 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

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# Data Usability Standard

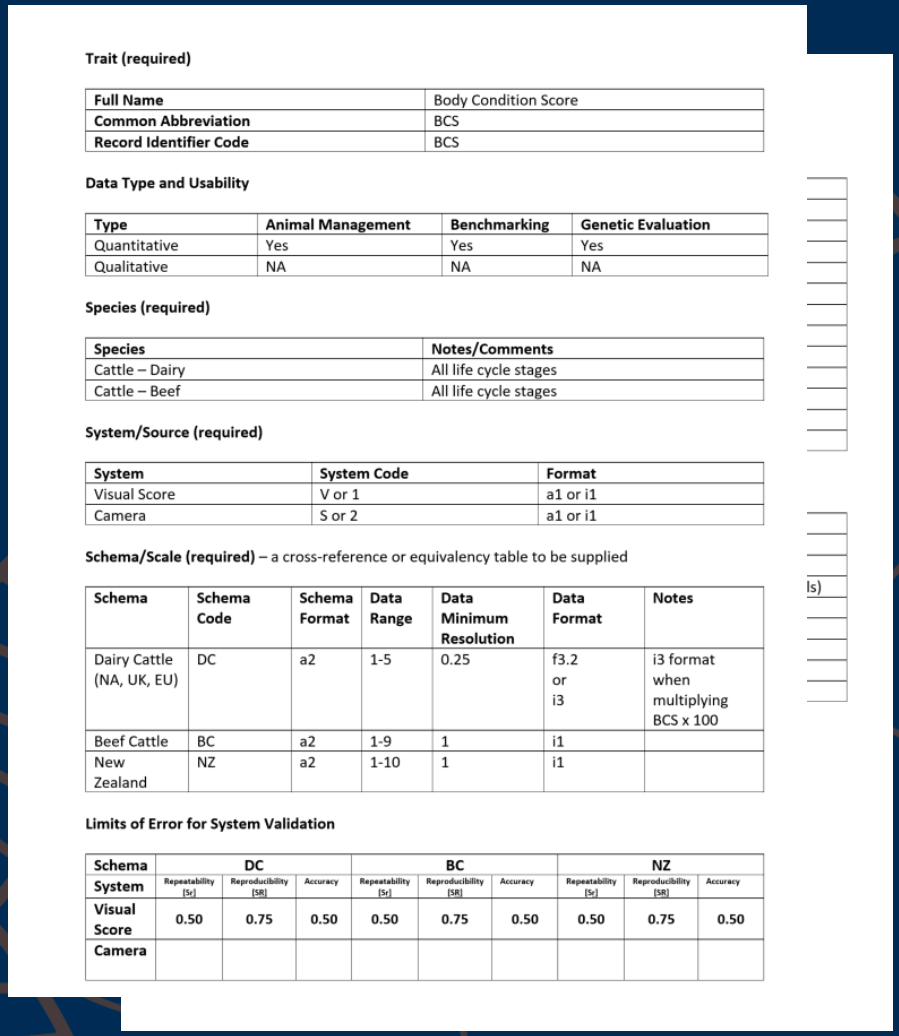
**Standard Template for each Measurement**

**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**

| Type | 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

## Routine Procedures & Best Practices

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

**Guidelines for Sensor Device Testing, Approval, Calibration or Routine Checking Procedures will be added to Section 11**

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

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

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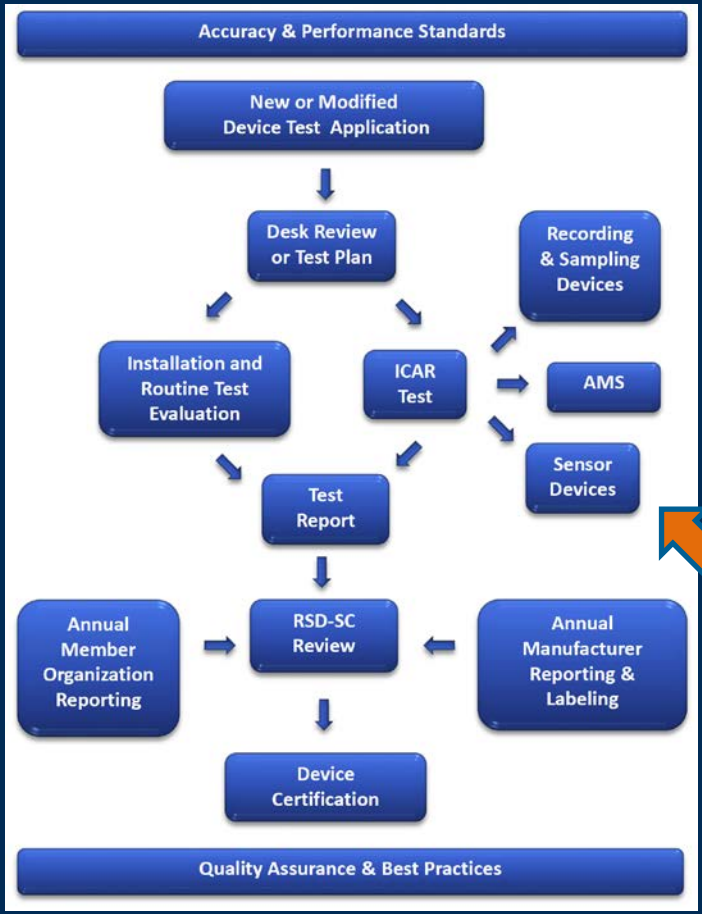
# Revisions to Section 11

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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

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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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# What's Next?

Work of SD-TF concludes at ICAR 2019 in Prague

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

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.