



THE GLOBAL STANDARD  
FOR LIVESTOCK DATA



# Sensor data for animal health and welfare

## *Present perspectives and future applications*

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WHFF Conference, Puy du Fou, France

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## BWYPEX & ICAR FTWG



- **Brian Wickham Young Persons Exchange Program**
  - Opportunity for young people within ICAR member organisations to research an “ICAR topic of interest”
  - Travel fund for interaction with organisations in other countries
- **ICAR Functional Traits Working Group**
  - Together with **IDF**
  - Guidelines on the **use of sensor data**
  - Development of **reference values** for rumination
- **BRAND NEW?!**  
→ What can we use it for?



ICAR FTWG, IDF and experts workshop 10/2023 in Vienna

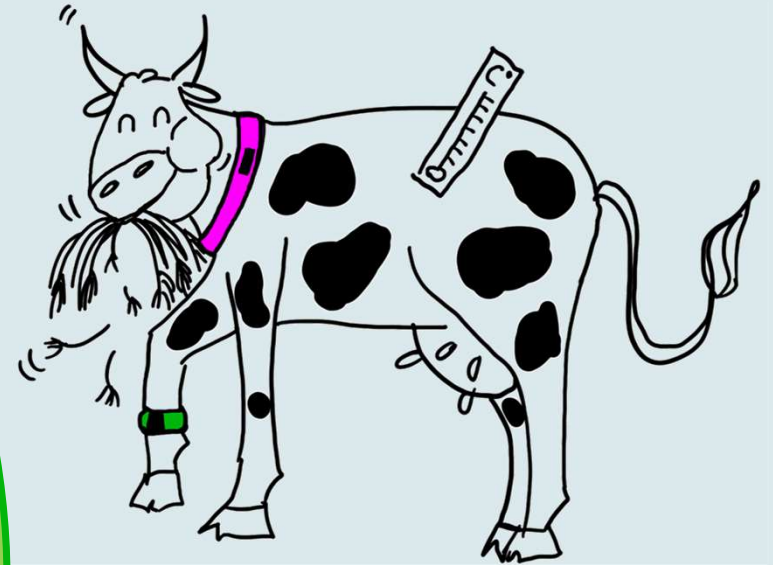


## Sensor data from dairy cows!

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- **Wearable sensor devices** measuring **cow behaviour**
- Activity, standing and lying time, rumination and feeding time, reticular temperature,...
- **Herd management:**
  - Oestrus detection
  - Calving detection
  - Health alarms
  - ...

**Large amount of high-resolution data for individual cows!!!**





## BRAND NEW – Sensor data from dairy cows!



- Potential fields of application?
- Use for animal health and welfare improvement?
- **Guided interviews** with five persons related to ICAR and member organisations
  - Research institutions
  - Breeding organisation
  - A.I. company
  - ICAR
- **Qualitative content analysis**





## Interview questions



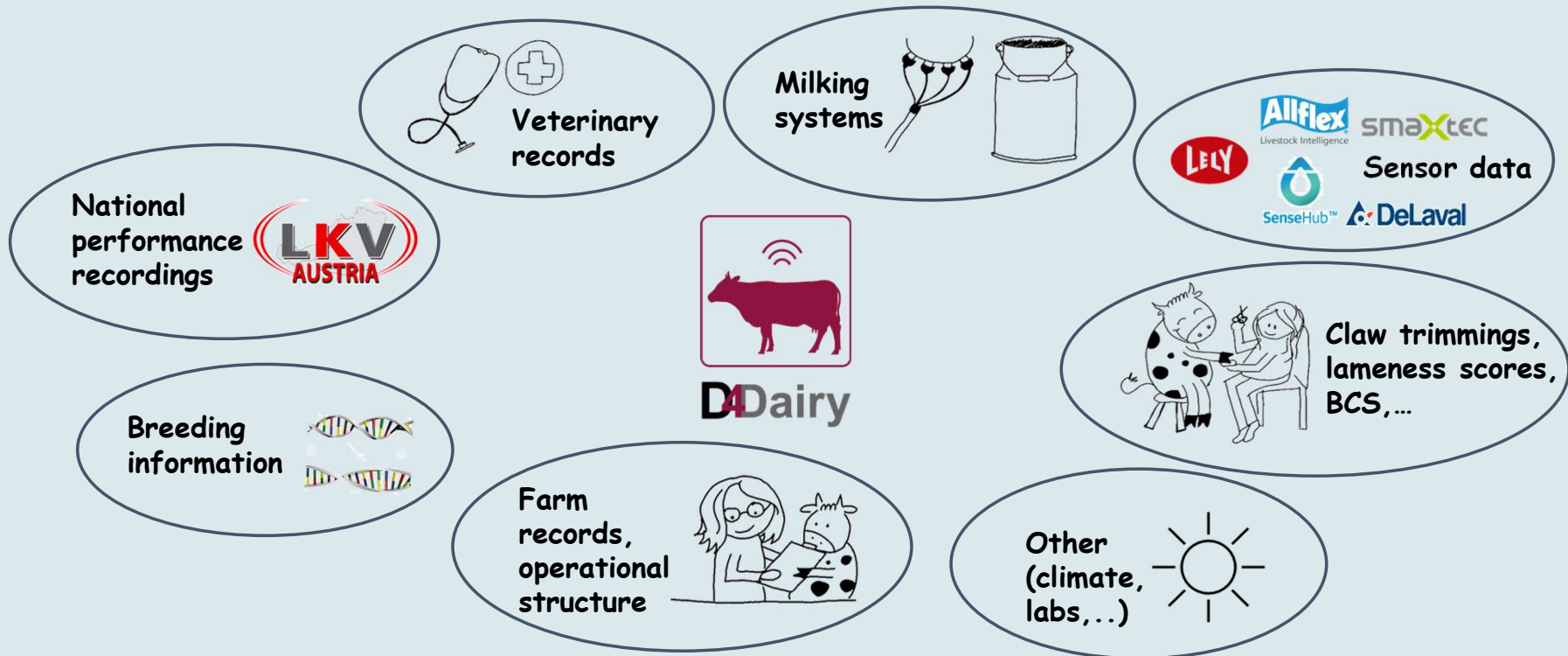
- What is the **greatest potential** of using sensor data beyond their intended application for farm management?
- How do or would you **use sensor data in your organisation**? What is the status quo and are there plans for the future?
- Which **challenges** have you already encountered or are you expecting? How would you tackle them?
- What do you **expect ICAR** to provide in terms of sensor data use?
- How can sensor data contribute to **health and welfare improvement**? Which **traits** are most interesting?
- How important will sensor data be for the **dairy sector in the future**?



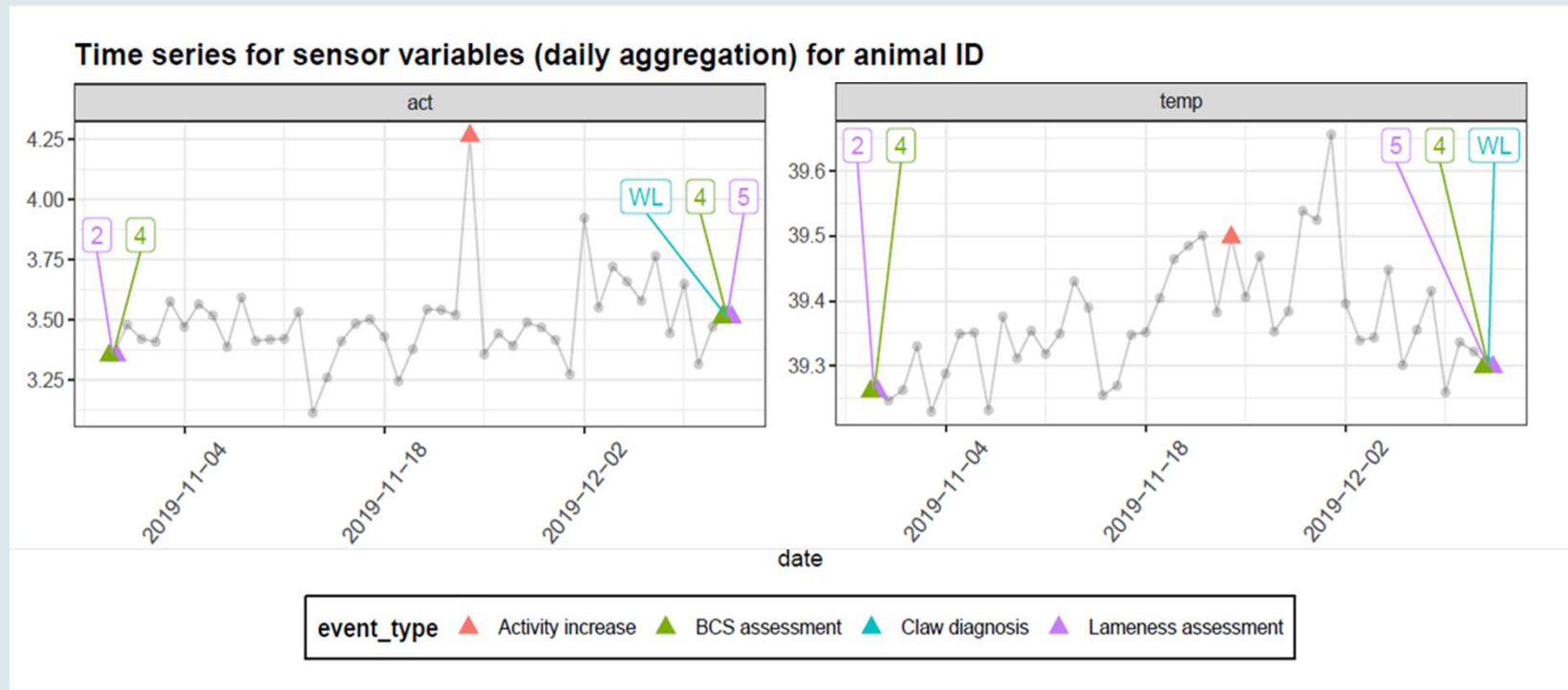
# Potential of and applications for sensor data



- Benefit emerges when **integrating** it with other farm data and historical information for e.g. disease predictions



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# Potential of and applications for sensor data



- Smart applications including **benchmarking across farms**
- **Beyond farm level:** DHI and milk recording organisations can **add values to existing services** or broaden their **service portfolio**

KlaueCheck in RDV LKV herd manager

KlaueCheck

Jahr: 2020

Merkmal: ohne Einschränkung: alle Betrieb

Grenzwert:  10%  25%

Anzahl Tiere: 57

	Betrieb	Vergleichsgruppe	untere 10%	obere 10%
Durchschnittliche Kuhzahl	57			
Durchschnittliche Anzahl Kalbinnen	9,7			
Anteil Kühe mit Abgang Klauen und Gliedmaßen	3,5	0	7,2	0
Anteil Kühe mit tierärztlicher Diagnose Klauen und Gliedmaßen	0	0	0	0
Anteil Kühe mit Klauenpflege	91,2	100	73,3	100
Anteil Kalbinnen mit Klauenpflege	20,6	9	0	97
Anteil Kühe gesund (KP aber kein Befund)	19,3	39,3	11	77,7
Anteil Kühe mit KP und Klauenbefund	71,9	56,3	93,8	21,6
Anteil Kühe mit Klauenpflege in ersten 100 Tagen in Milch	45,6	38,2	14,7	70
Anteil Kühe mit Alarmbefund	43,9	26,2	61,2	6,6
Anteil Kühe mit Klauenpflege mit Alarmbefund in 100 DIM	15,8	8,4	26,2	0





# Potential of and applications for sensor data

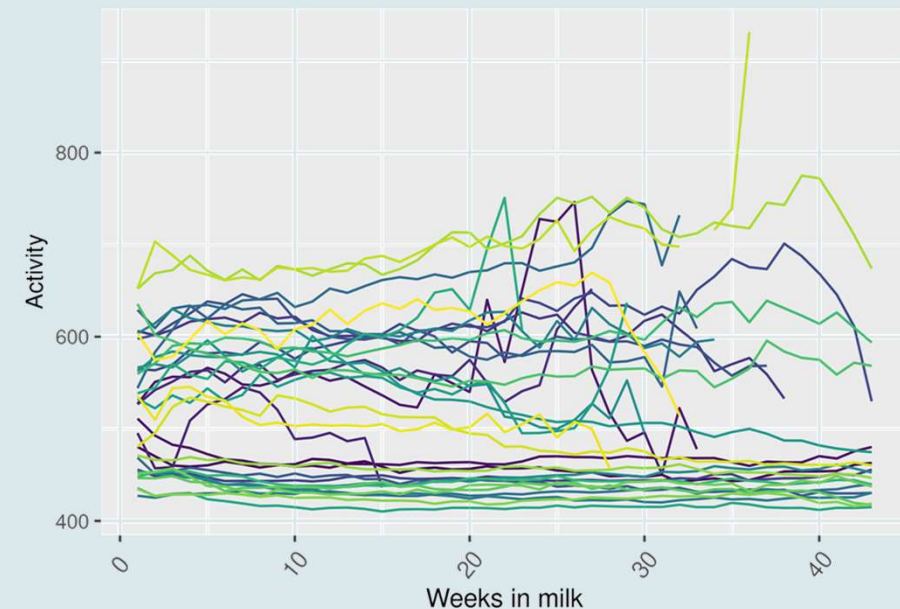


- Genetic evaluation
  - Large scale phenotyping

	timestamp	temp_raw	act	heat_index
1:	2019-06-01 00:00:00+00:00	NA	NA	NA
2:	2019-06-01 00:02:00+00:00	38.77	6.05	1.20
3:	2019-06-01 00:12:00+00:00	39.38	5.47	1.04
4:	2019-06-01 00:22:00+00:00	39.55	4.90	0.93
5:	2019-06-01 00:32:00+00:00	39.58	4.50	0.83
---				
87738260:	2022-01-13 08:10:00+00:00	39.17	4.50	0.00
87738261:	2022-01-13 08:20:00+00:00	39.16	4.79	0.00
87738262:	2022-01-13 08:30:00+00:00	39.03	3.36	0.00
	0+00:00	39.07	4.29	0.00
87738264:	0+00:00	39.07	2.66	0.00

87738264

Mean activity level per farm over lactation



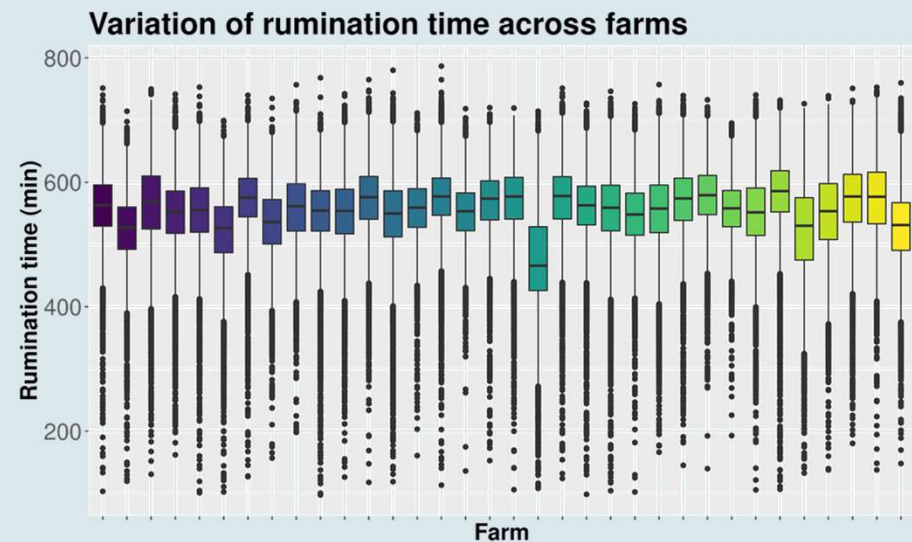
- New traits or proxies for complex traits (e.g. resilience)
- Improve existing traits – closer to animal's physiology



## Status quo and...

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- **ICAR initiative on validation of sensor systems**
  - Understand what these systems are able to do
  - Accordingly define purpose of the data use
- **Research focus on data exploration**
  - **Variation** of the behaviours across animals, farms, sensor systems,...

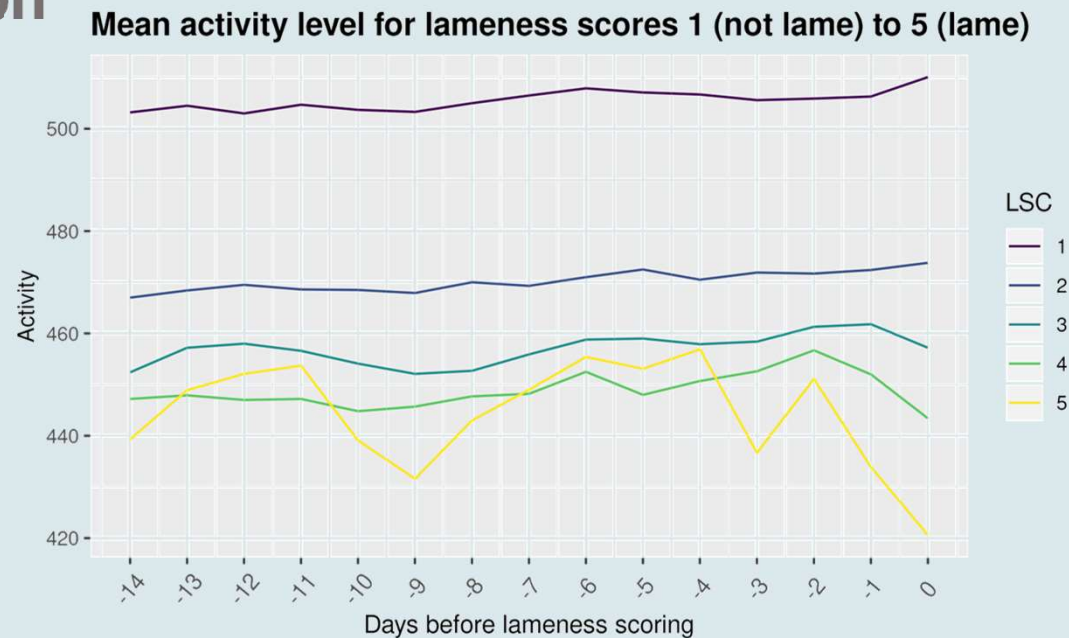




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  - **Variation** of the behaviours across animals, farms, sensor systems,...
  - Differentiate **physiological variation** and **deviations due to diseases** or other influencing factors

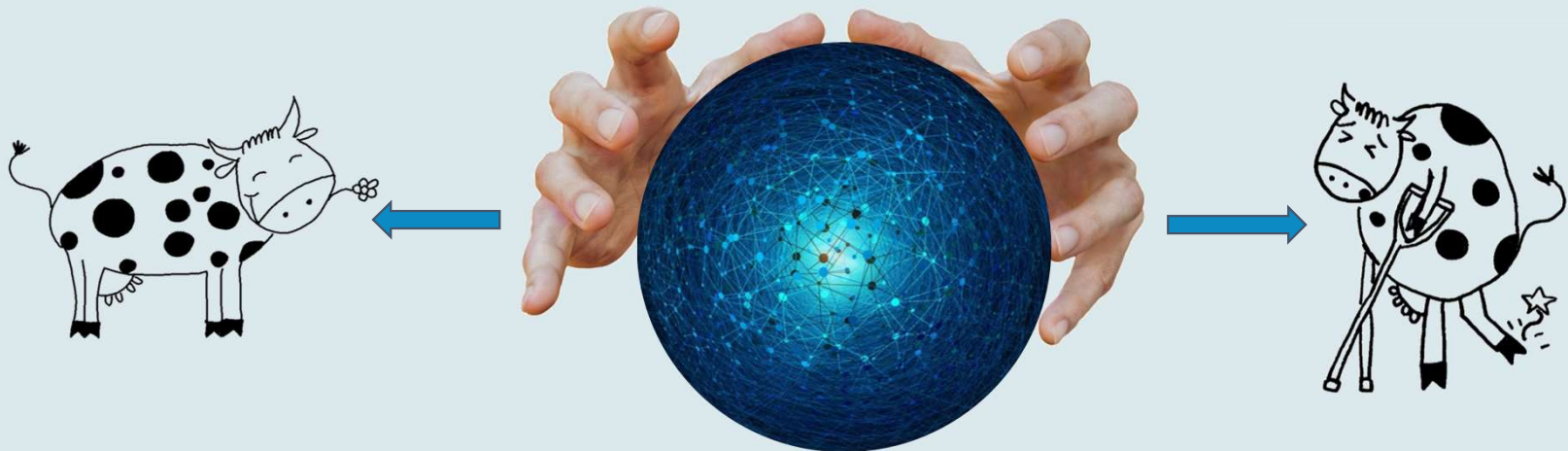




## Status quo and...

ZUCHT  
DATA

- Exploring potential for **disease predictions**



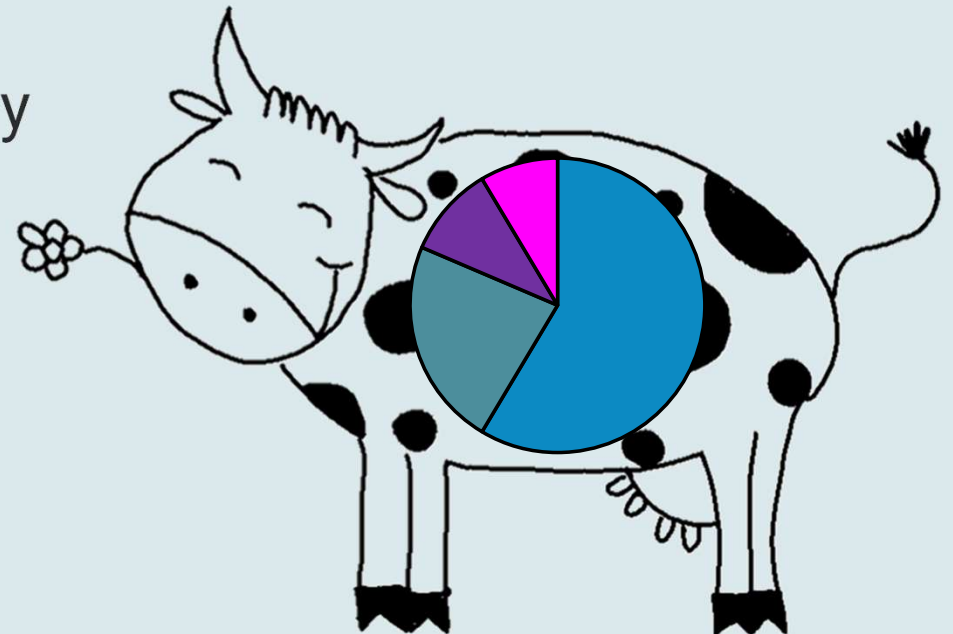
- Development of **new traits** for genetic evaluation related to fertility
- Development of new technologies  
→ **Computer vision** to mimic observations



## ...and future plans



- Coordinate collaborative efforts to getting **access to sensor data**
- Approaches to **standardise data** across farms and sensor companies
- Definition of **new traits** and possibility for introducing **new evaluations**
  - Heat stress, resilience or fertility related
  - **Superior** to current evaluations
  - **Lower costs** for phenotyping
- New **modelling approaches** for on-farm modelling applications



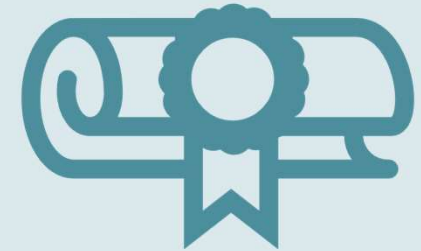


## Challenges



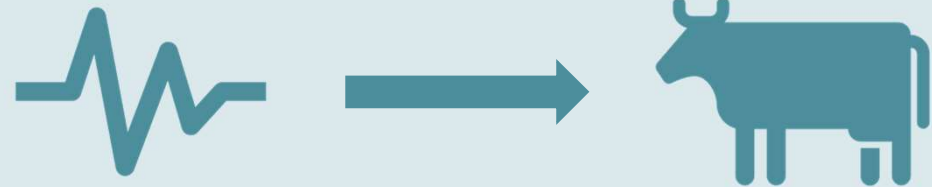
- **Data accessibility and availability and data ownership**

- Farmers' consent and data confidentiality
- Data provision by sensor company
  - economic interests and company policies
- Do organisations have to pay for data in the future?

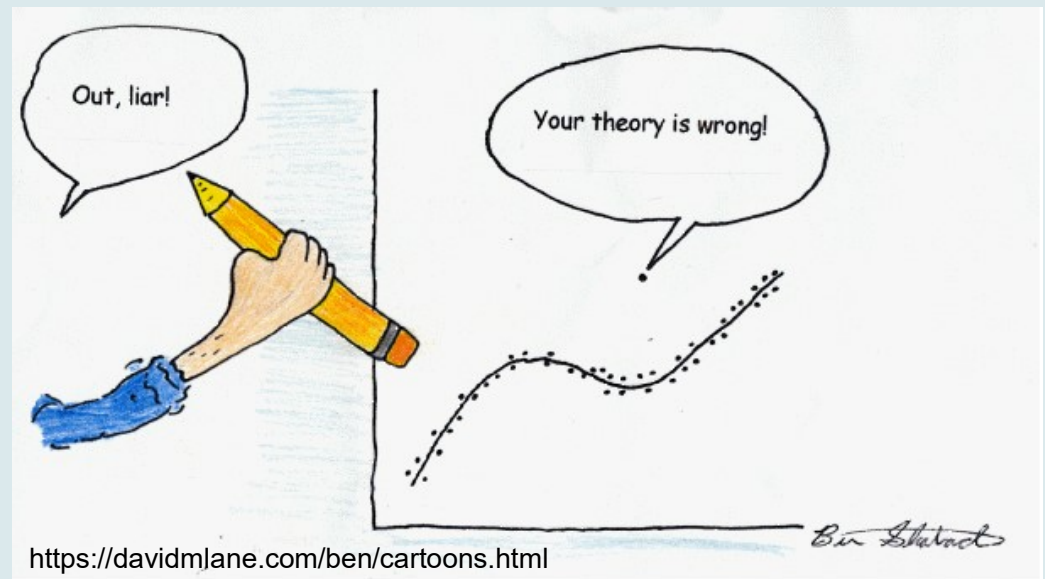
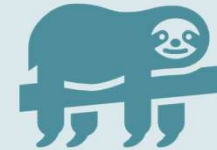


- **Lack of detailed information on sensor parameters**

- Translation of sensor measurement into output value
- Validity of parameters
- Accuracy of alerts
- Calibration of sensors



- **Reference values for sensor measurements**
  - Physiological spectrum
  - Desirable behaviour
- **Differentiation of measurement errors, outliers, disturbances and meaningful deviations**

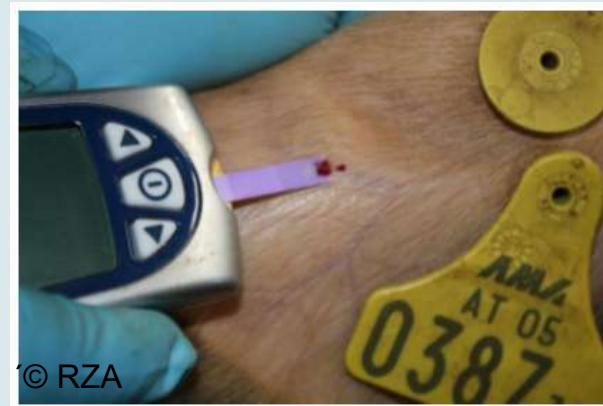
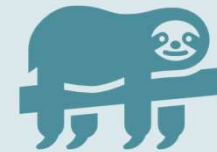




## Challenges

ZUCHT  
DATA

- **Reference values for sensor measurements**
  - Physiological spectrum
  - Desirable behaviour
- Differentiation of **measurement errors, outliers, disturbances and meaningful deviations**
- **Gold standard** for predictions or development of proxies
- **Lack of standardisation** between sensor devices



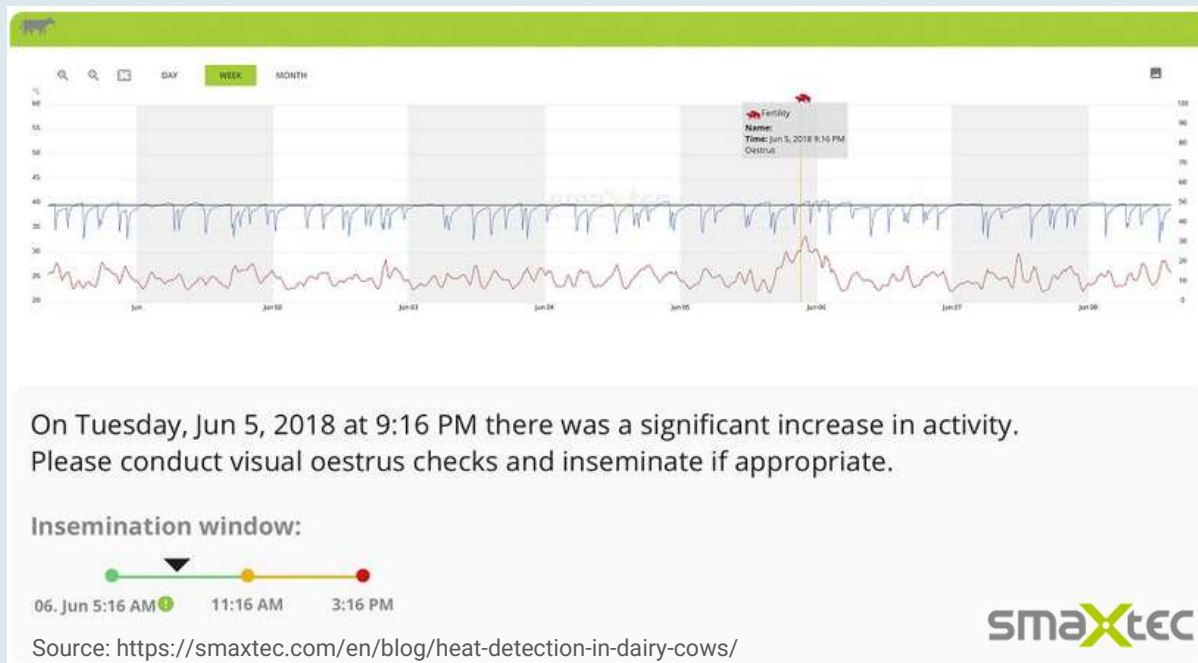




# Challenges



- **Optimisation for herd management**  
Measurement or alarm must serve management purpose and may not be suitable for other purposes





## Strategies to overcome challenges



- **Much experience within research organisations**
  - ‘Ruminate the data’
  - Lack of resources and potential for grant application
- **Integration of data science and domain knowledge**
  - Data editing, modelling and interpretation of results
  - Develop ontologies based on domain knowledge
- **Collaborative efforts**
  - Strengthen research (infrastructure, results)
  - Open data approach
  - ICAR as advocate towards manufacturers

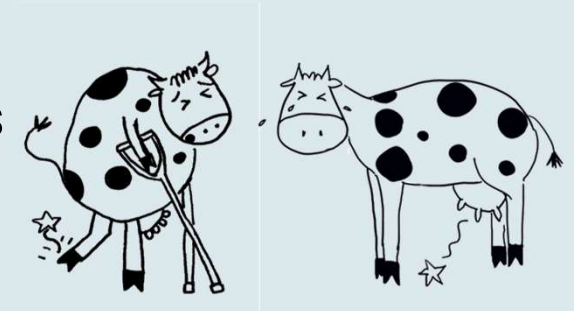


# Animal health and welfare



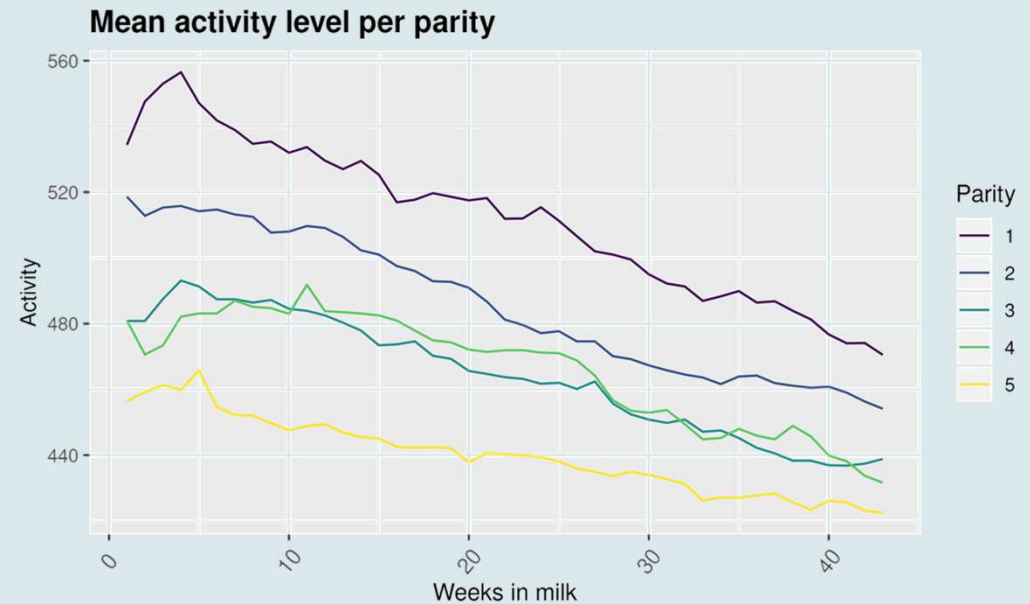
- **Farm level**

- **Easier identification** of cows with potential health issues in large herds
- **Early detection** and intervention



- **Research**

- Improved understanding of **normal behaviour** of cows
- Explore relation with parity, age, breed, and diurnal patterns

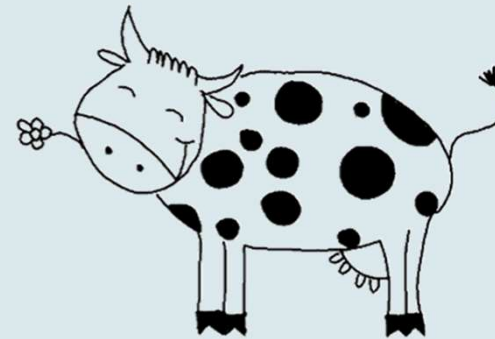




## Animal health and welfare



- **Downstream production and service providers**
  - **Data-driven assessment** and reporting of cow health and welfare status across animals, farms, regions,...
  - **Benchmarking tools** for improving animal health and welfare on farms
  
- **Breeding for improved animal health and welfare**
  - More resilient animals
  - Animals less likely to have health issues
  - Traits closer to animal physiology





## Importance for the future of the dairy sector



- Overall impression was **high importance**
  - Rating 1 (not important) to 10 (important): **8 or 9**
- Improvement of **farm management**
- **Usefulness for farmers** has to be first priority
  - Otherwise sensors will not be used
  - Mutual client as link to sensor companies
- **Objective monitoring** of animal welfare
- **Not ready yet!**
  - Careful with promising solutions and applications too soon
  - ‘You can ring the bell once’



I thank **ICAR** and **ICBF** for hosting and  
**ZuchtData** for allowing me to  
participate in the **Brian Wickham Young  
Persons Exchange Program!**

The logo for the International Cattle Breeding Federation (ICBF), featuring the lowercase letters 'icbf' in a blue, sans-serif font with a small green square above the 'i'.

ICAR would like to acknowledge the 11 Members who help fund the inaugural Brian Wickham Young Persons Exchange Program



+  
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