




INTERNET OF COWS – OPPORTUNITIES AND CHALLENGES FOR IMPROVING HEALTH, WELFARE AND EFFICIENCY IN DAIRYING

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ICAR, Prague 2019

FFG Promoting Innovation.
Federal Ministry Republic of Austria Digital and Economic Affairs
Federal Ministry Republic of Austria Transport, Innovation and Technology
vienna business agency A service offered by the City of Vienna

Background

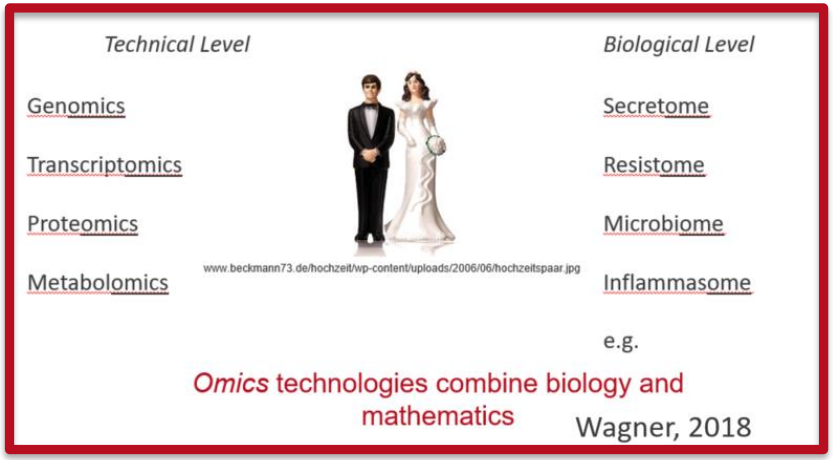
- **Growing world population** (currently 7.5 billion; 2050 9.7 billion (UNO, 2015)) – efficiency
- **Climate change –** resilience, emissions
- **Consumer concerns –** food safety, animal health and welfare
- **Growing farms** – workload, pressure for optimisation and sustainability
- **Enormous technological progress** also in cattle farming
- Digitalisation - **many new opportunities and challenges**

Technological advances

Genomics (VanRaden, 2019)

Country	2009	1/2019
United States and Canada	22,344	3,020,00
France	8,500	550,000
Germany	3,000	785,000

OMICS technologies



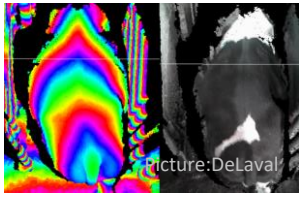
Robotics and Artificial Intelligence

automatic milking systems

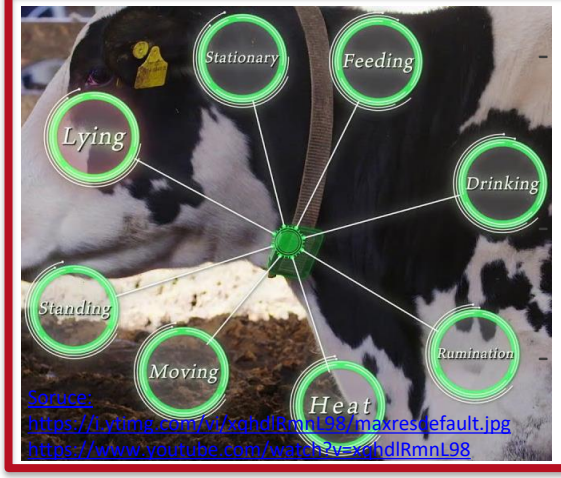
automatic feeding systems

3D Cameras to detect e.g. BCS

others



Information technology



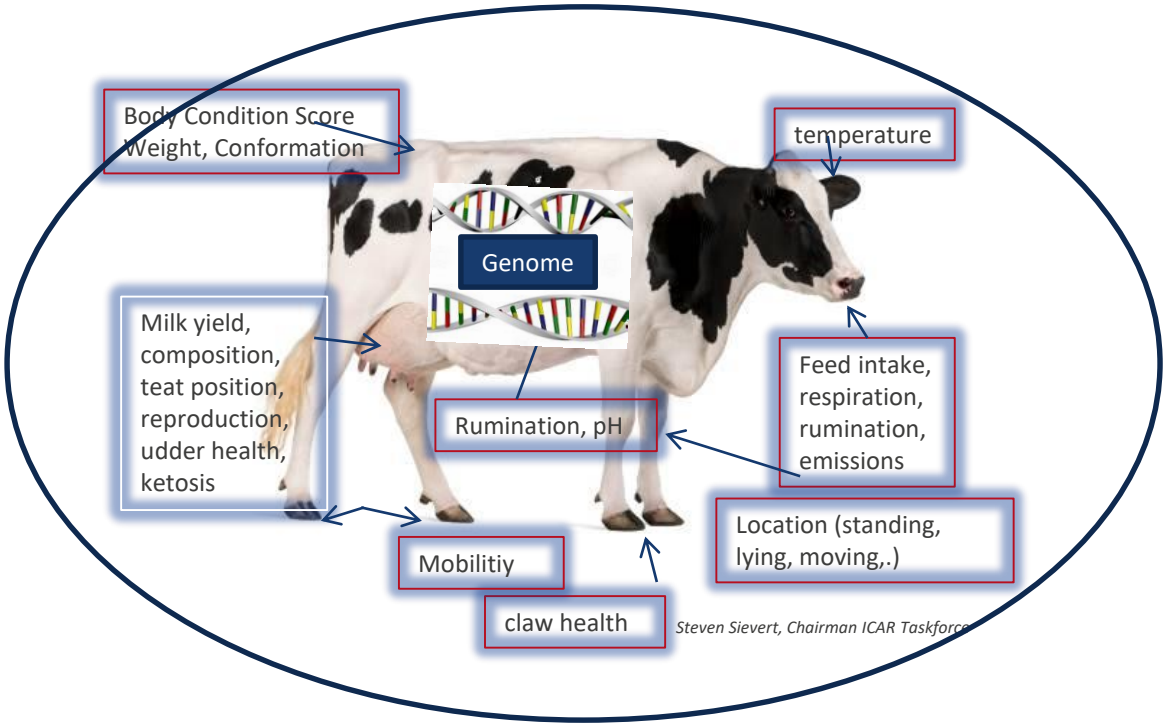
Large variety of miniatualized low-power smart sensors
Low-power wireless communication
Embedded data analytics

New technique brings many new phenotypes

Many data
(5 Vs – Volume, Velocity, Variety, Veracity, Value)

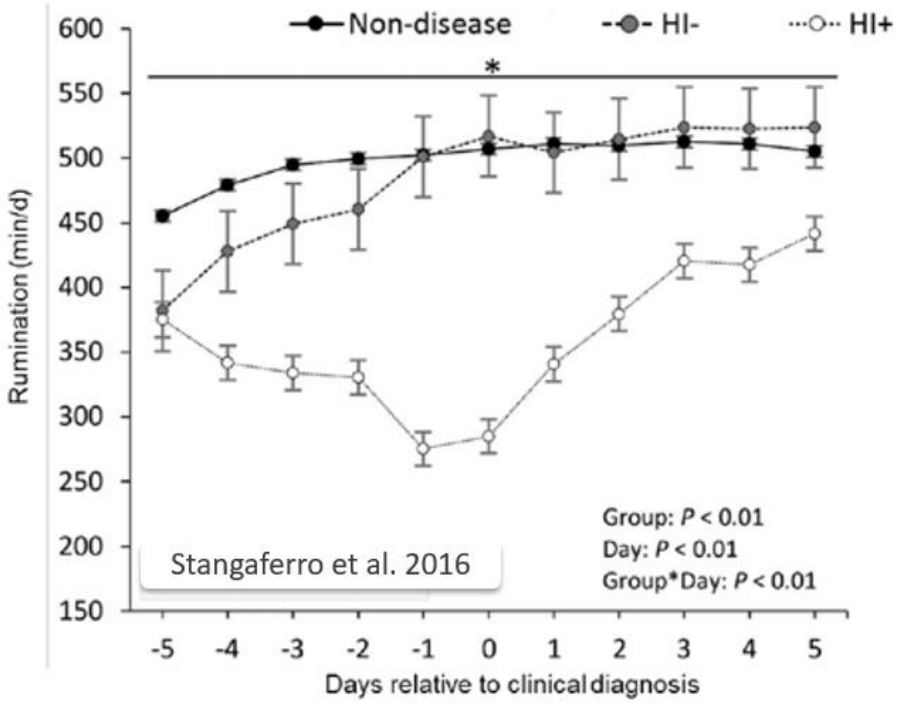
Algorithms to derive parameters!

Animal with genotype and phenotypes



Technological advances allow **precise monitoring of animals and environment** in realtime!

Rumination and ketosis

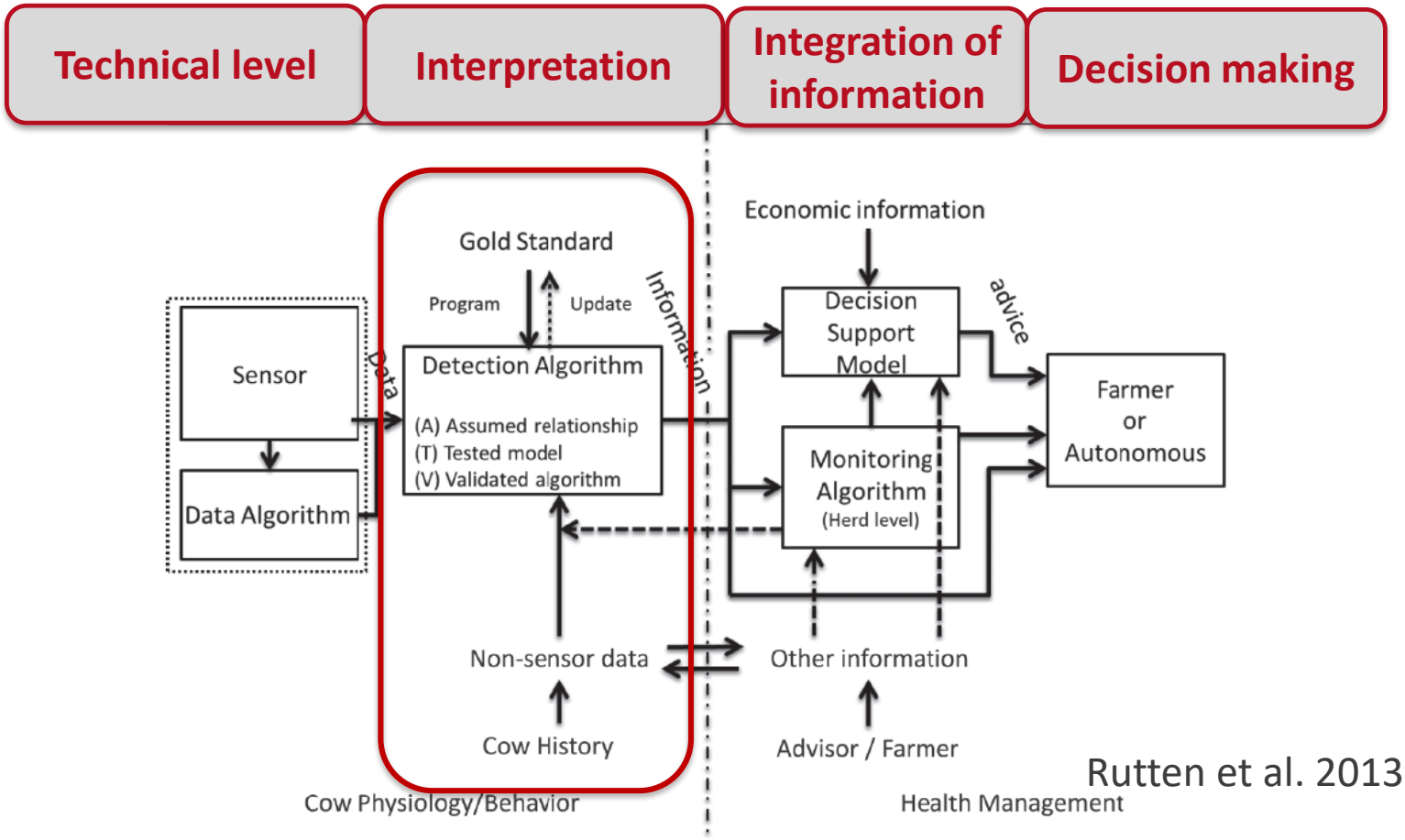


Stangaferro et al. (2016):

- significant reduction in activity already 5 days before clinical diagnoses
- Detection rate 91% (49/54)

Attention: alarm based on activity only is not specific!

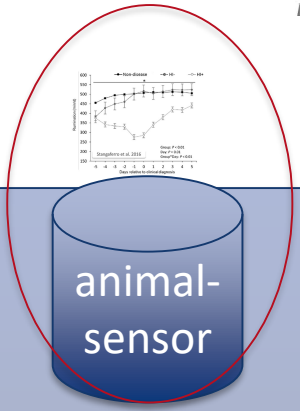
Sensor to support herd management



Rutten et al. 2013

Little communication and integration so far

Many isolated solutions



slaughter

dairy company

weather

claw trimming

animal-sensor

labs

others

Performance recording

Pedigree

Lab data (e.g MIR, feed, milk bacteriology)

Calving/ Insemination

Observations

Claw health

Vet diagnoses and treatments

Movements

Housing/ Feeding,..

Genome data

Slaughter

Other (e.g. auctions,..)

milking system

feeding

vet data

welfare

Central cattle databases since decades

AUTOMATION ON FARMS

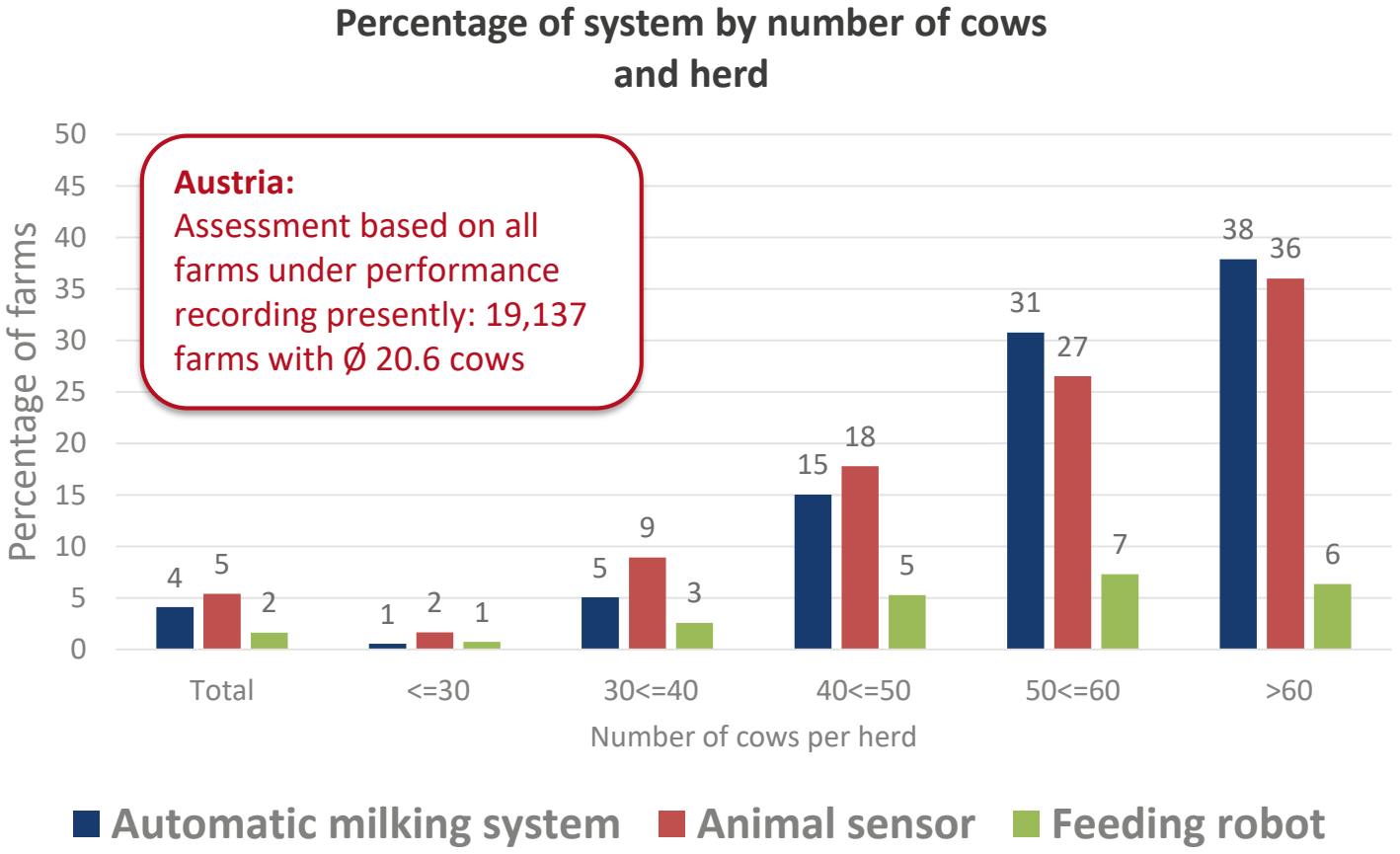
How frequently are these systems used in Austria?

automatic milking systems (AMS)

animal sensor (activity,..)

feeding robot

Frequency of AMS, animal sensors and feeding robots in Austria (D4Dairy: status 5/2019)



(D4Dairy, LKV-Austria, 5/2019)

Further big increase is expected concerning online-survey!

WHAT DO FARMERS EXPECT ?

Data integration is important for farmers and vets

(ADDA-survey: participation – farmer: LW 19.1%, vets 20.8%)

Importance of integration of data into one plattform:

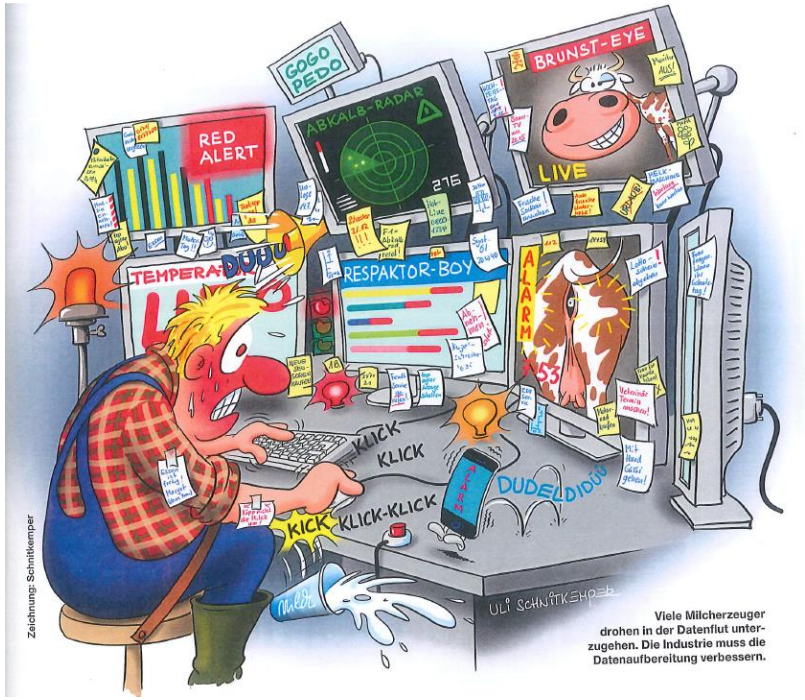
% very important and important

	Farmer	Veterinarian
Bacteriological milk sample	81	87
Bulkmilk samples	78	70
Diagnoses and treatment data	73/72	72
Disease status	72	83
Findings from labs	63	88-89
Services of performance recording		79
Results of feed analyses		78

Perner et al. 2016; Weissensteiner et al. 2018

80 % of the farmers want integrated communication of systems on farm.

Farmers don‘t want…..

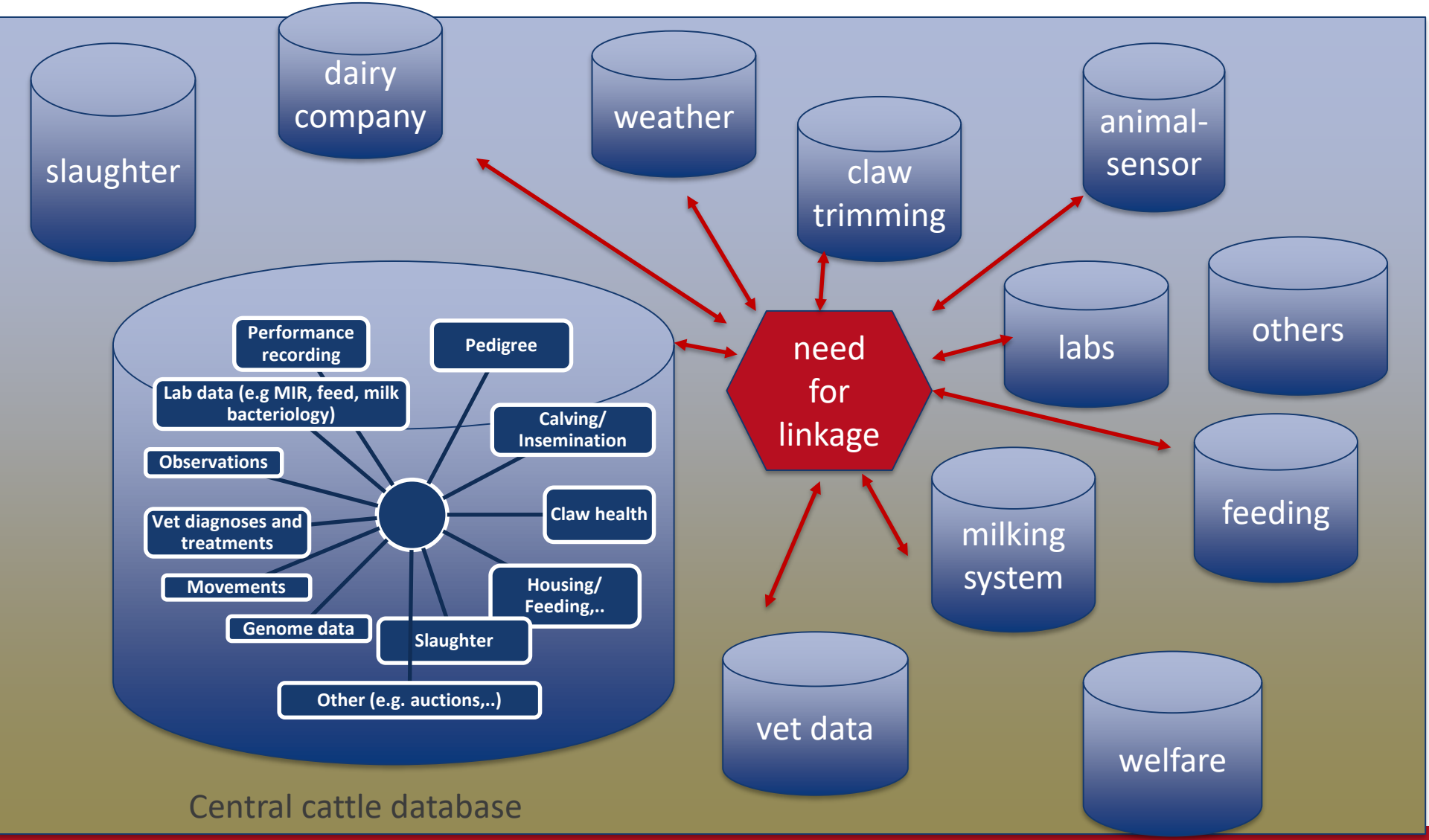


Topagrar, 5/2018

- receive results in pdf
- isolated solutions
- indicate one dataset more than once

Expect best service out of device and data !

Linkage between systems

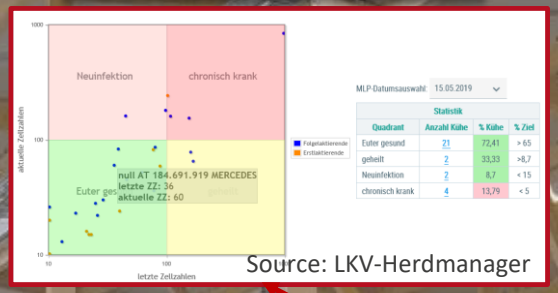


OPPORTUNITIES DUE TO DIGITALISATION

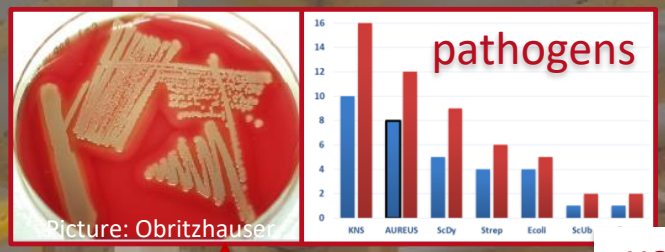
Internet of Cows – to improve welfare, health, efficiency

D4Dairy

somatic cell count

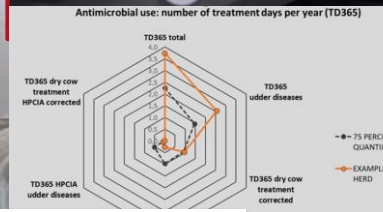


Source: LKV-Herdmanager



Picture: Obritzhauser

use of antibiotics



Picture: ZAR

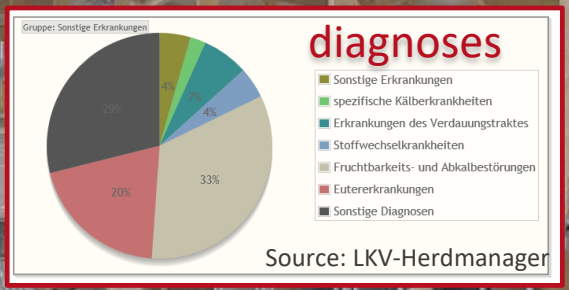
claw health


Picture: Pesenhofer

feed quality


Picture: Biomin

diagnoses

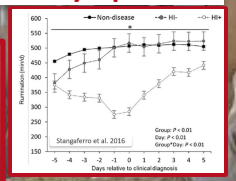


Source: LKV-Herdmanager

welfare parameters

need for linkage and advanced analyses

rumination, activity, pH..

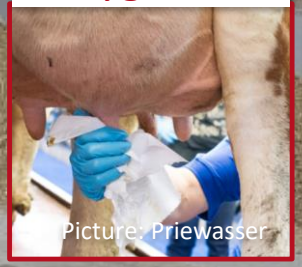


feed intake

daily milking information


Picture: ZAR

hygiene


Picture: Priewasser

others (MIR,.)

climate

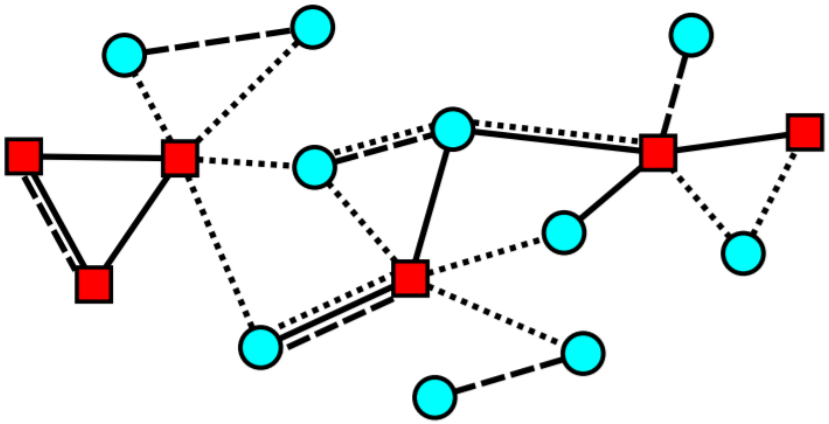
housing climate

housing system

Big Data

Challenge - systems are complex:

Complex Systems are co-evolving multiplex networks (Klimek, 2019)



D4Dairy:
Disentangle causative relationship for diseases (Multi layer approach). What interacts with what, how long, how strong, under which conditions?

States of individuals/companies... change as a function of the networks. Networks change the states of the individuals.

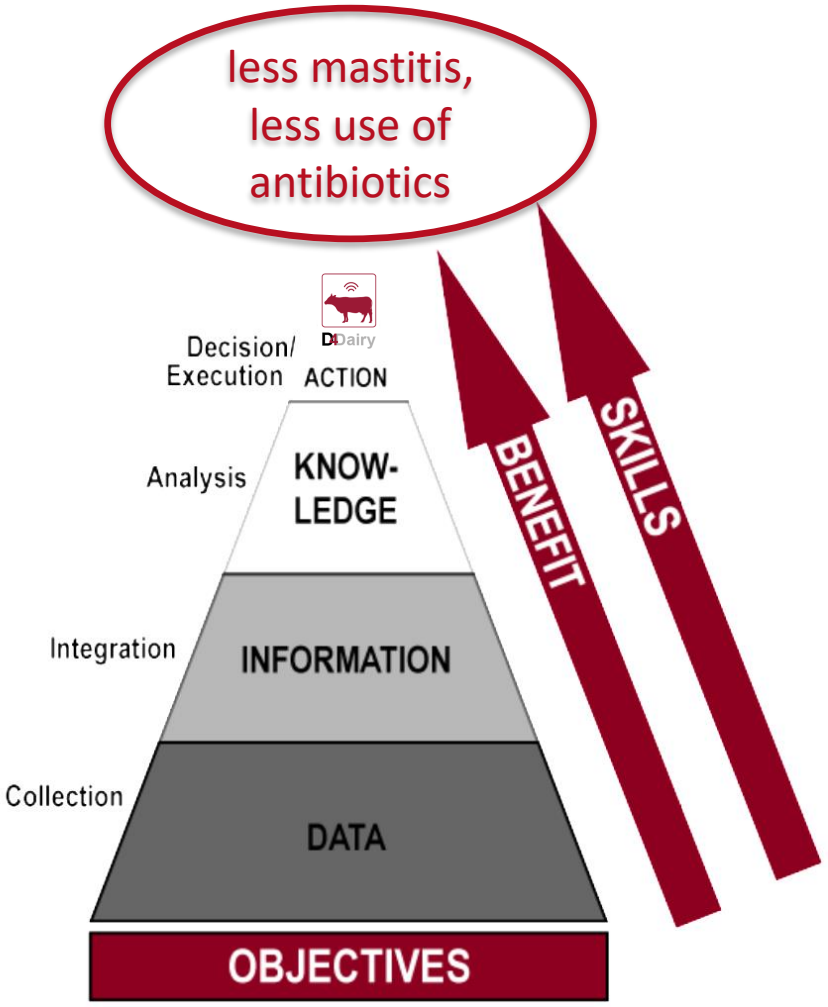
Learn about causative relationship above correlations!

Digitalisation should achieve…

- better decision support tools
- process optimisation by
  - collection
  - integration
  - analysis
- ..

Improved value and benefit

Decision support for improvement of udder health
e.g. targeted treatment, dry-off strategy



Opportunities due to digitalisation

- **Reduction of work load for farmers**
- Better and precise parameters **for prevention and early detection of health disorders**
- **Higher heritabilities and increased genetic gain**
- Improved possibilities for **monitoring of animal health and animal welfare**
- **Optimisation of processes – saving of resources**
- **Sustainable and more efficient production**

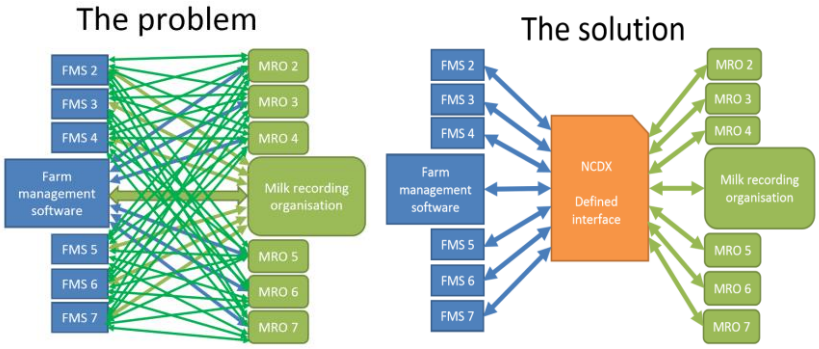
CHALLENGES

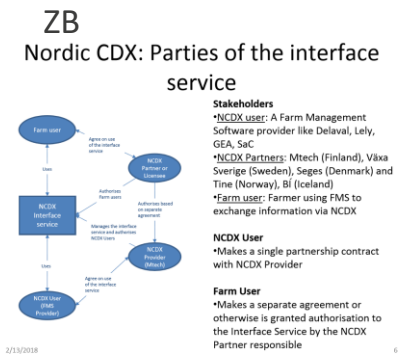
Where is work needed to be done ?

Interoperability of systems

Interoperability of systems: communication at farm / with external systems

- many different systems with many different standards
- each information at the right time on the right place according privacy, transparency and data protection issues …





Kyntälä, 2018

Various examples – NCDX, JoinData, 365Farmnet, ….!

Functionality and trust in the system is crucial!

Data Integration / Data communication

Network

- Communicate data

Harmonise

- Data formats (“36 C” vs. “100100 Celsius”)
- Data meaning (“36 C” vs. “96.8 F”)
- Data quality (“36 C” vs “36.7 C”)
- e.g. diagnoses, ..

Access

- Give access to data
- Protect ownership (Römer, 2018)

www.icar.org

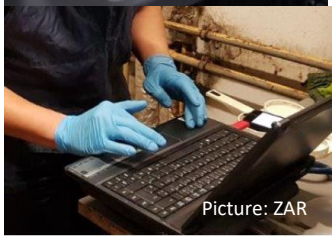
Importance of ICAR for standardisation – important that these standards are also used !

Communication between systems

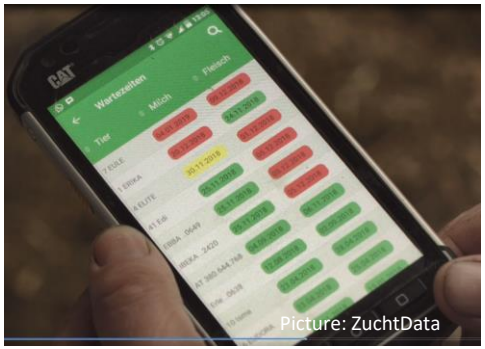
Avoid multiple recording of data

Example: treatment of cow by vet – till action in robot (seperation of milk or stop of milking of cow)

from veterinarian to automatic milking system



treatment and electronic documentation



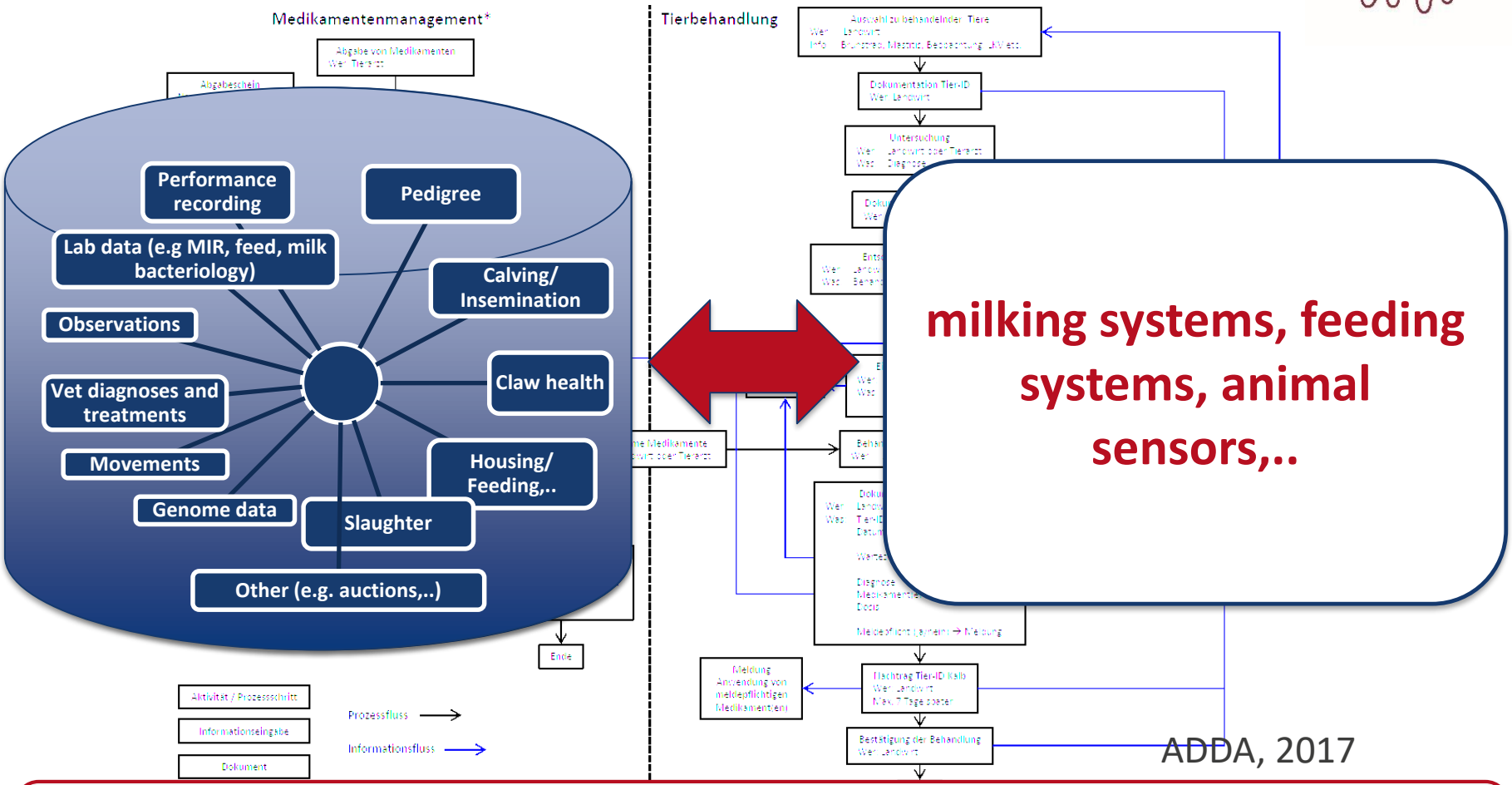
waiting period for milk

milk seperated or cow stopped for milking

AIM: one data entry only for each dataset – no multiple recording!

Communication between systems

Avoid multiple recording of data



ADDA, 2017

Start with simpler steps – presently not even communication of animal-ID, calvings, inseminations,… is standard!

Comparability of results

- **Comparability of results / Standardisation**
  - are results from labs comparable across labs?
  - are results from different sensors comparable ?
  - ..

Example for data integration

Results of bacteriological milk samples in herdmanagement tool of RDV (Project ADDA – 1.10.2014 – 30.9.2017)

Udder health > Infections >

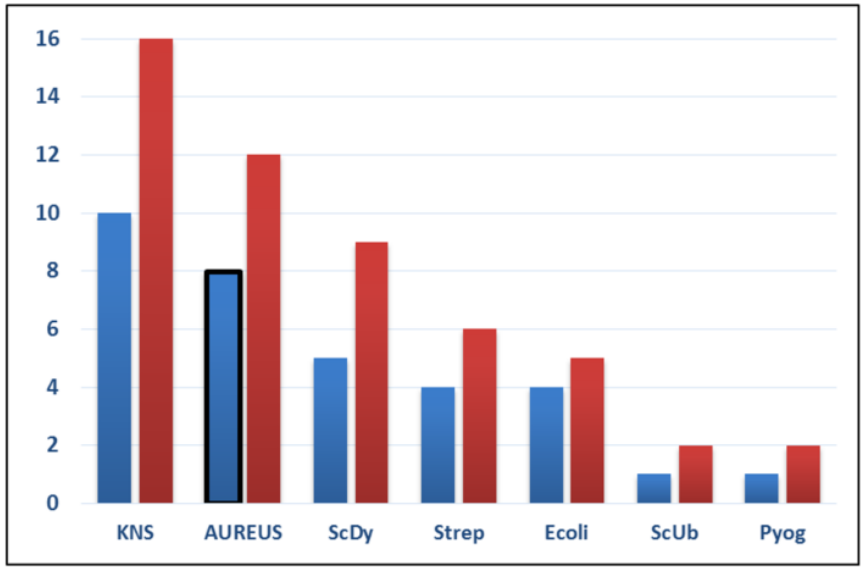
Results of bacteriological milk samples

- Pattern of pathogen
- Pattern of pathogen per lactation
- Pattern of pathogen per lactation stage

Date from: 01.03.2017 Date to: 01.03.2018 Display

Number of cows and udder quarters per pathogen

Total Nr. of cows: 101
Nr. of cows with culture result: 50
Nr. of infected cows: 23
Nr. of infected quarters: 52



Picture: Suntinger

Necessary measures:

- Standards of analyses in lab and definition of findings harmonised (guideline developed) √
- Data protection issues elaborated and solved √
- Development of analyses and benchmarks for herd management tools (see poster Suntinger et al. 2019; Obritzhauser et al. 2019) √

Challenges

- **Interoperability / Communication**
- **Comparability of results / Standardisation**
  - are results from labs comparable across labs?
  - are results from different sensors comparable ?
  - ..
- **Integration of different data in system**
  - correlation between traits
  - …
- **Data privacy protection**
  - data protection
  - privacy / „ownership“ / purpose
  - business interests
  - …
- **Access reliable internet** (partly)

Federal Ministry
Republic of Austria
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D4Dairy

NIEDERÖSTERREICH

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A service offered by
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D4Dairy - General

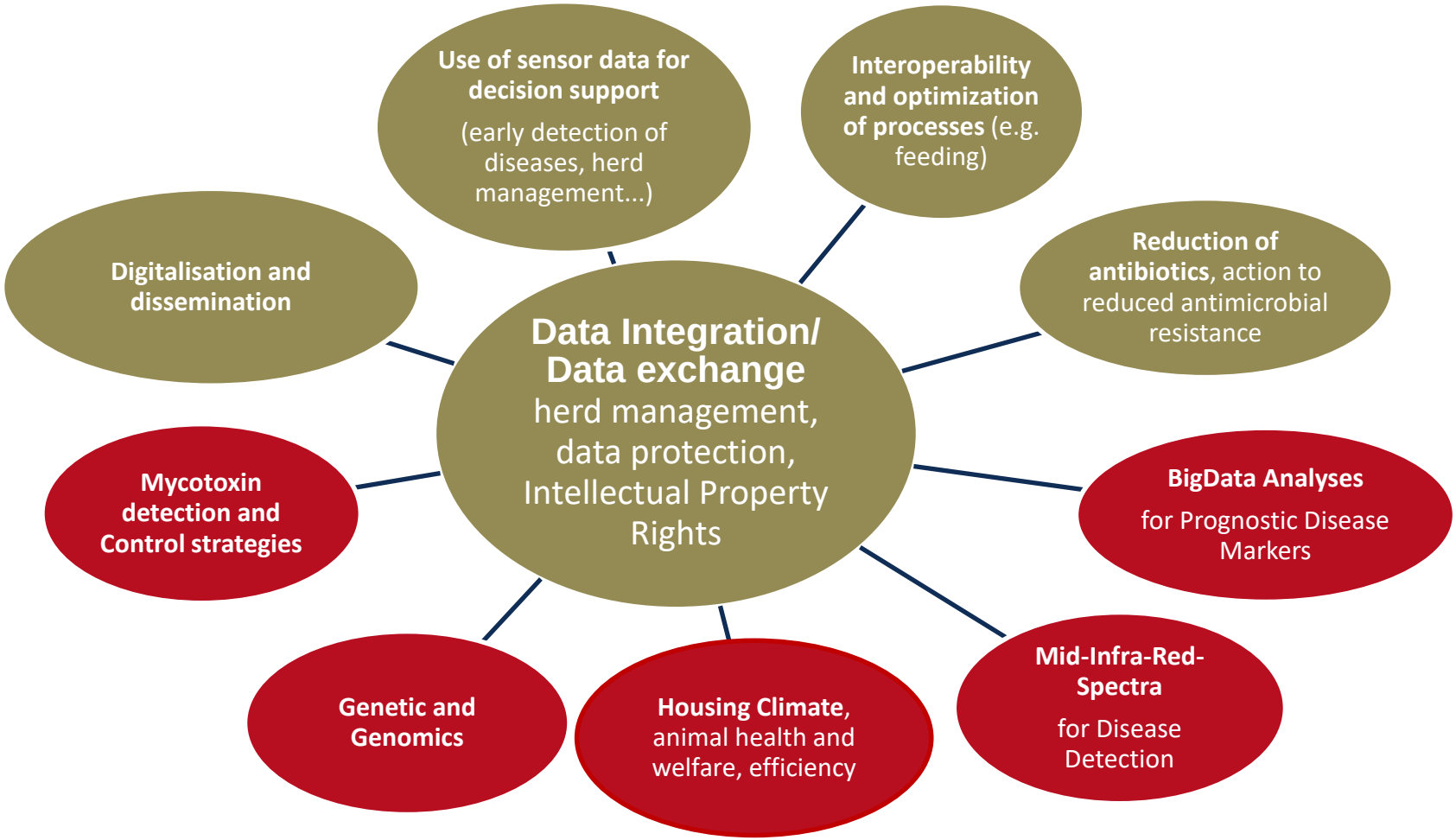
D4Dairy – Digitalisation, Data integration, Detection and Decision support in Dairying

Project period: 1.10.2018 – 30.9.2022

Partner: 31 Economic, 13 Scientific partners

Budget: 5,5 Mill Euro (50% from Economic partners)

Focus of data driven research within D4Dairy



D4Dairy – Project partners

13 Research Partners

AGES

MEDIZINISCHE UNIVERSITÄT WIEN

BUNDESMINISTERIUM FÜR NACHHALTIGKEIT UND TOURISMUS
HBLFA RAUMBERG-GUMPENSTEIN LANDWIRTSCHAFT

TU Graz

research & testing BLT wieselburg
BUNDESMINISTERIUM FÜR NACHHALTIGKEIT UND TOURISMUS
HBLFA FRANCISCO JOSEPHINUM WIESELBURG

vetmeduni vienna

BOKU

FFoQSI

COMPLEXITY SCIENCE HUB VIENNA

LIÈGE université Gembloux Agro-Bio Tech

HOCHSCHULE FÜR Agrar- und Umweltpädagogik

LfL Tierzucht

Wallonie recherche CRA-W

31Company Partners (along value chain)

PLF Agritech EU Ltd
Technology Enhancing Production

Allflex
Livestock Intelligence

AMA AGRARMARKT AUSTRIA

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arbeitsgemeinschaft rind

Berglandmilch eGen

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BIOMÉRIEUX

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TGD
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tgd
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ZuchtData
EDV-DIENSTLEISTUNGEN GMBH

Cooperation partners for specific topics

LELY

DeLaval

GEA

Summary – Internet of Cows

- Many **new opportunities** due to technological advances
- **Better tools for to improve health, welfare, efficiency**
- Communication and use of advanced technology can increase benefit – **farmer expects communication between systems**
- **Challenges** (harmonisation, communication, business interests, data protection,…)
- **Multidisciplinary approaches** to solve challenges
- **Cooperation** is key for success
- **Benefit for farmers and community are essential** !

Acknowledgement

Many thanks to colleagues contributed to topics covered by this presentation:
M. Suntinger, F. Steininger, M. Mayerhofer, K. Linke – ZuchtData; J. Kofler, W. Obritzhauser - University of Veterinary Medicine, Vienna; F. Grandl and J. Duda - LKV Bavaria; F.J. Auer, M. Koblmüller – LKV Austria; F. P. Majcen - Chamber of Agriculture, Vienna; S. Thurner – Complexity Science Hub/Medical University Vienna; F. Papst, K.U. Römer –Technical University, Graz; M. Fallast - smaXtec; A. Turkaspa - SCR by Allflex and other colleagues from partner organisations in D4Dairy

This work was conducted within the COMET-Project D4Dairy (Digitalisation, Data integration, Detection and Decision support in Dairying). That is supported by BMVIT, BMDW and the provinces of Lower Austria and Vienna in the framework of COMET-Compentence Centers for Excellent Technologies. The COMET program is handled by the FFG.

Cooperation is base for success with digitalisation

Thank you for your attention!

www.d4dairy.com or www.d4dairy.eu