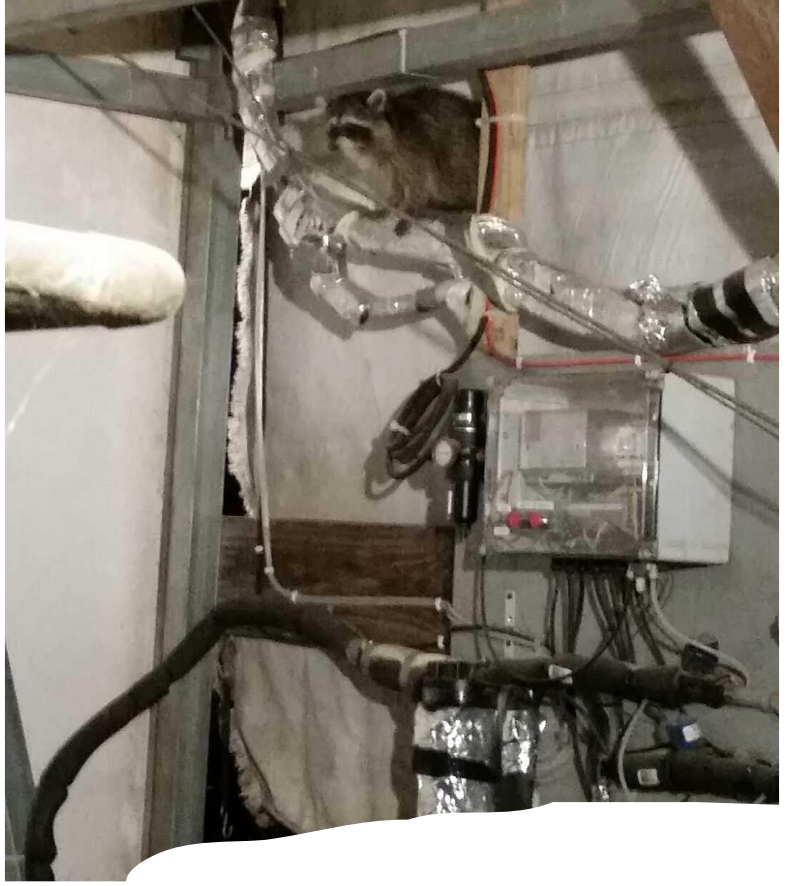
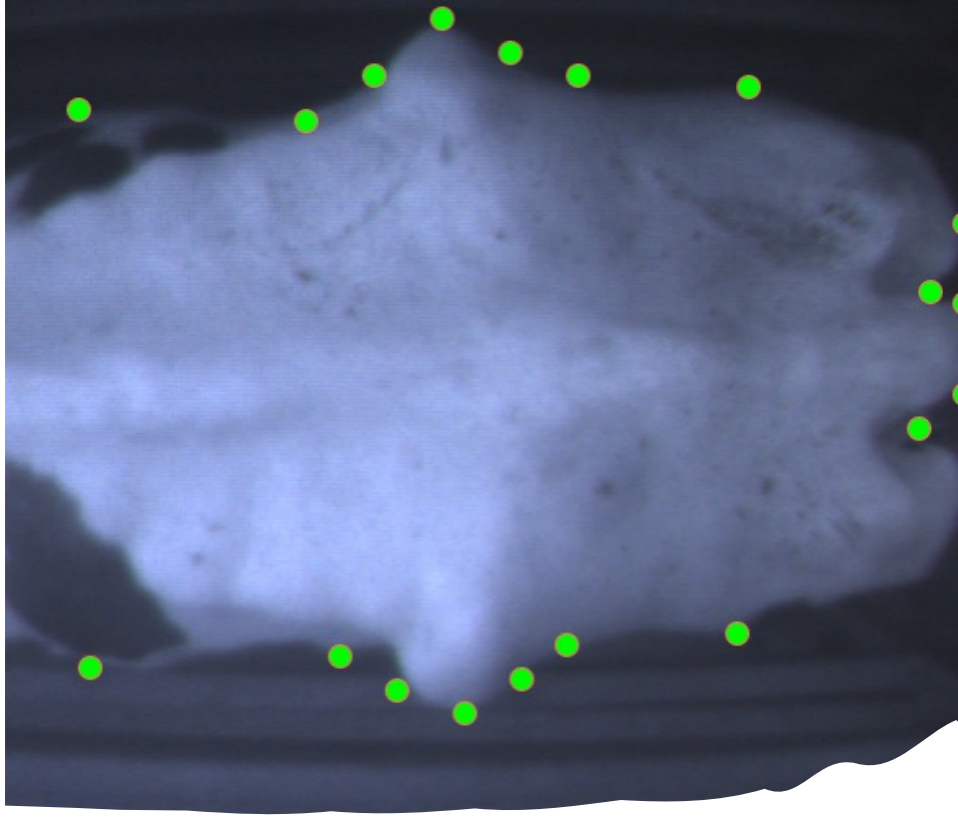
New Types of Sensors

Jeffrey Bewley, PhD, PAS
Analytics and Innovation Scientist
Holstein USA, Inc.

U.S. Registered Holsteins
FOR MAXIMUM PROFIT
HOLSTEIN ASSOCIATION USA, INC.

WKU SmartHolstein Lab





18 Years of Technology Work


WKU SmartHolstein Lab
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Dairy Farm Tech 1.3

Created by: PROGRESSIVE DAIRY · IFCN Dairy Data · Knowledge · Inspiration

SMALL

Small companies are defined as technology start-ups whose innovation is touching fewer than 100,000 cows.

ADIS · agricam · AgriGates · Animall.in · AREETE · ArkeaBio · ARMENTA™ BeCows We Care · Athian · bankbarn · Bezoar Laboratories · BINSENTRY · BIOFILTRO · BLUE OCEAN BARNS · brainwired · BROLIS HERDLINE · CATTLE EYE · CATTLE SCAN · CATTLE GURU · CERES TAG · CHIMERTECH PRIVATE LIMITED · chordata · CisGEN · CONCEPT DAIRY · COWEALTHY · COWOW · Dairycs · DAIRY LIGHT PROVEN SCIENCE · DairyOffice · delmos · DVARA Holdings · eCow · eio DIAGNOSTICS · EMGENISYS · EXCIPLEX · FarmHealth Guardian · Farmnote · FARM TREE · FaunaTech · Figured · FodderTech · FYTO · Grassa GREEN REFINED SOLUTIONS · HALTER · HATO agricultural lighting · HEALTHY COW CORPORATION · hydrogreen NUTRITION TECHNOLOGY · INSYLO DIGITAL ANIMAL FEED SUPPLY CHAIN · KRIMANSHI · KUHdo · Labby · Lasso · LEMNA · LUCI · MARGINSMART DAIRY ANALYZER · MIDWEST GRAZING EXCHANGE · Mileutis · Milkwilla · MilkingCloud · miRobot · MooMa Empowering Farmers · moonsyst CATTLE MONITORING · mooofarm · myanimi · Nano Discovery · Nofence · OmniEye · ONFARM · OneCup AI LIVESTOCK ID · Pastoral · PastureMap · peoplecor · PHARM ROBOTICS · RenaissanceAg · ROVIBEC AGRISOLUTIONS · Rumin8 · SomaDetect · Smart Soaker by Agpro · TDLogix · TEC2FIT · The Lab 004 · HOOF HUB · TURBOCOW · VERI seal · viehworld besser handeln. tierisch gut. · VOLTA GREENTECH · wicow · Zeddy · zelp

MEDIUM

Medium companies are defined as early adoption companies who are touching between 100,000 and 1,000,000 cows.

Accu-trim HOOF ANALYZER · Acumen DETECTION · agolin · Agrimesh Technologies · AHV · ALL4 HOOVES · ams GALAXY usa · anitra · AOTOSO · automed · Axiota · Biolectric · BoviSync · cainthus by Ever.Ag · Cattle Care · Connecterra · cynomys · DAIRY ENTELIGEN FORECAST · DAIRY HEALTH & Management Services · DAIRYMARGIN TRACKER · dpn · ENGS Systems Innovative Dairy Solutions · FARM CHAMPS · FarmIntel · FBN · Feedlync By Cowconnect · FERA · 丰顿科技 FOIDN TECHNOLOGY · FOSS · HANSKAMP Innovation for dairy farming · HERDSTRONG TruCore Precision Monitoring · Hokofarm Group · Hoofcount · GRAND RIVER ROBOTICS · inBarn · iYOTAH · Kingswood COMPUTING · LWR · Mastatest · milc group · MILKTECHNZ · milk moovement · MIMIRO · MmmooOgle · Moocall connecting you to your animals · MooMe · My Dairy DASHBOARD · native · Pasture.io · Peacock TECHNOLOGY · PROTEKTA · SCIO by Consumer Physics · smaXtec · TERRA NutriTECH · UniDairy 和牧兴邦 · VALMETAL · Vytelle · stellapps · VYLA

LARGE

Large companies are defined as those working with technology (research, development or acquisition) whose products touch more than 1,000,000 cows.

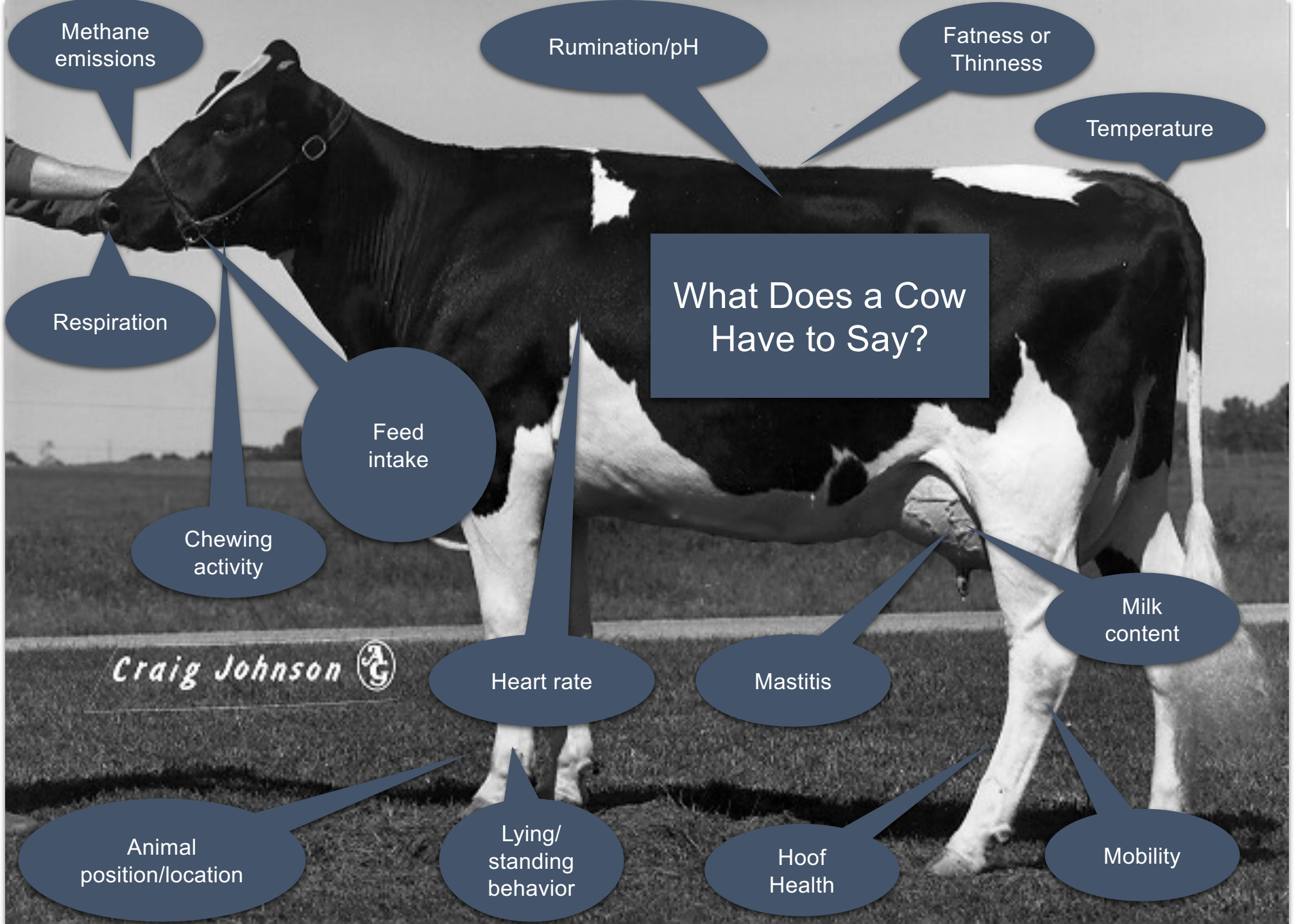
AAD Advanced Animal Diagnostics · ADISSEO · afimilk · Ajinomoto · Alltech · amelicor · balchem · BINMASTER · BouMatic · Cargill · ceva · 科湃腾 Copartner · COWMANAGER · DDW · DAIRYMASTER · DATAMARS · DeLaval · DSM · Elanco · Ever.Ag · EYMU All For Farms · FarmTrace · fodjan · FÖRSTER TECHNIK · Fullwood JOZ · FutureCow · GALLAGHER · GEA · Genus · GOHE 国科农牧 · HALO SYSTEMS · herdwatch · Holm & Laue · iDDEN · Intellync · KEENAN an Alltech company · LELY · levno · LIC Automation · MADCAP DAIRY SOFTWARE · MADERO DAIRY SYSTEMS · MERCK Animal Health · Micro Technologies AmerisourceBergen · Mtech · nedap · nutreco · PARNELL living science · prompt · Pearson Milking Technology · ROCK RIVER LABORATORY, INC. AGRICULTURAL ANALYSIS · SenseHub · STgenetics · Teatwand · TOPCON Agriculture · TRANSOVA genetics · uniform agri · Urban · URUS · vas · VES-Artex a TURNTIDE company · WAIKATO MILKING SYSTEMS · 新牛智能 XINNIU INTELLIGENT · ZISK · zoetis

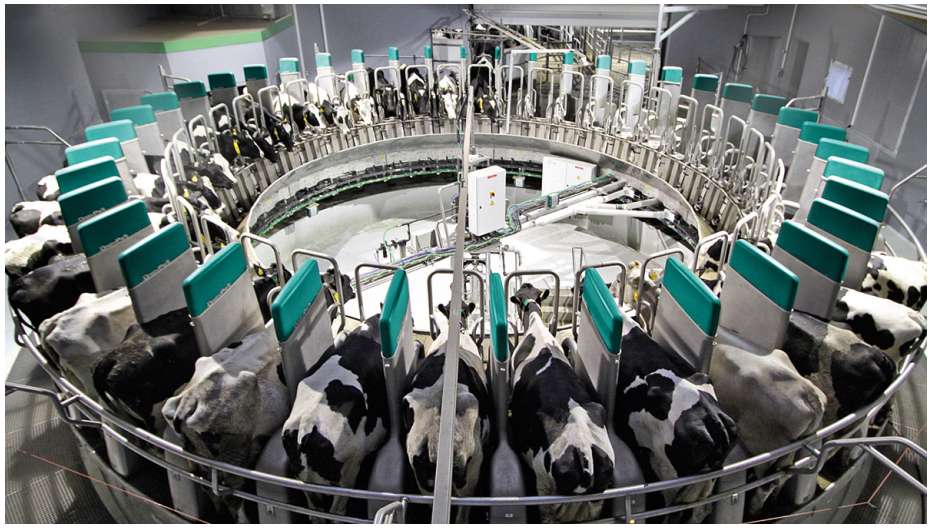
This poster tracks companies developing and deploying 21st Century technology advancements for use in handling, milking or managing cows or youngstock on dairy farms globally. Technologies that offer solutions for use in farming applications or in the dairy supply chain are not included. Manure-handling technologies are not part of the scope of this project. However, technologies for the management of enteric methane and a farm's carbon footprint are included.

Companies displayed on the map are startups or may be partially / fully owned by other companies. Companies owning or investing in these new technology brands may also be included. Companies that solely distribute technology owned by others are not included.

Disclaimer: This poster is meant to be inclusive. If you feel your technology company has been inadvertently left off or inaccurately categorized, please email the poster's creators to be added to future versions. Follow linkedin.com/groups/12742633/ for updates.

For feedback contact: Torsten.hemme@ifcndairy.org; walt.cooley@progressivepublish.com
Date updated: October 10, 2023


Methane emissions
Rumination/pH
Fatness or Thinness
Temperature
Respiration
What Does a Cow Have to Say?
Feed intake
Chewing activity
Craig Johnson
Heart rate
Mastitis
Milk content
Animal position/location
Lying/ standing behavior
Hoof Health
Mobility



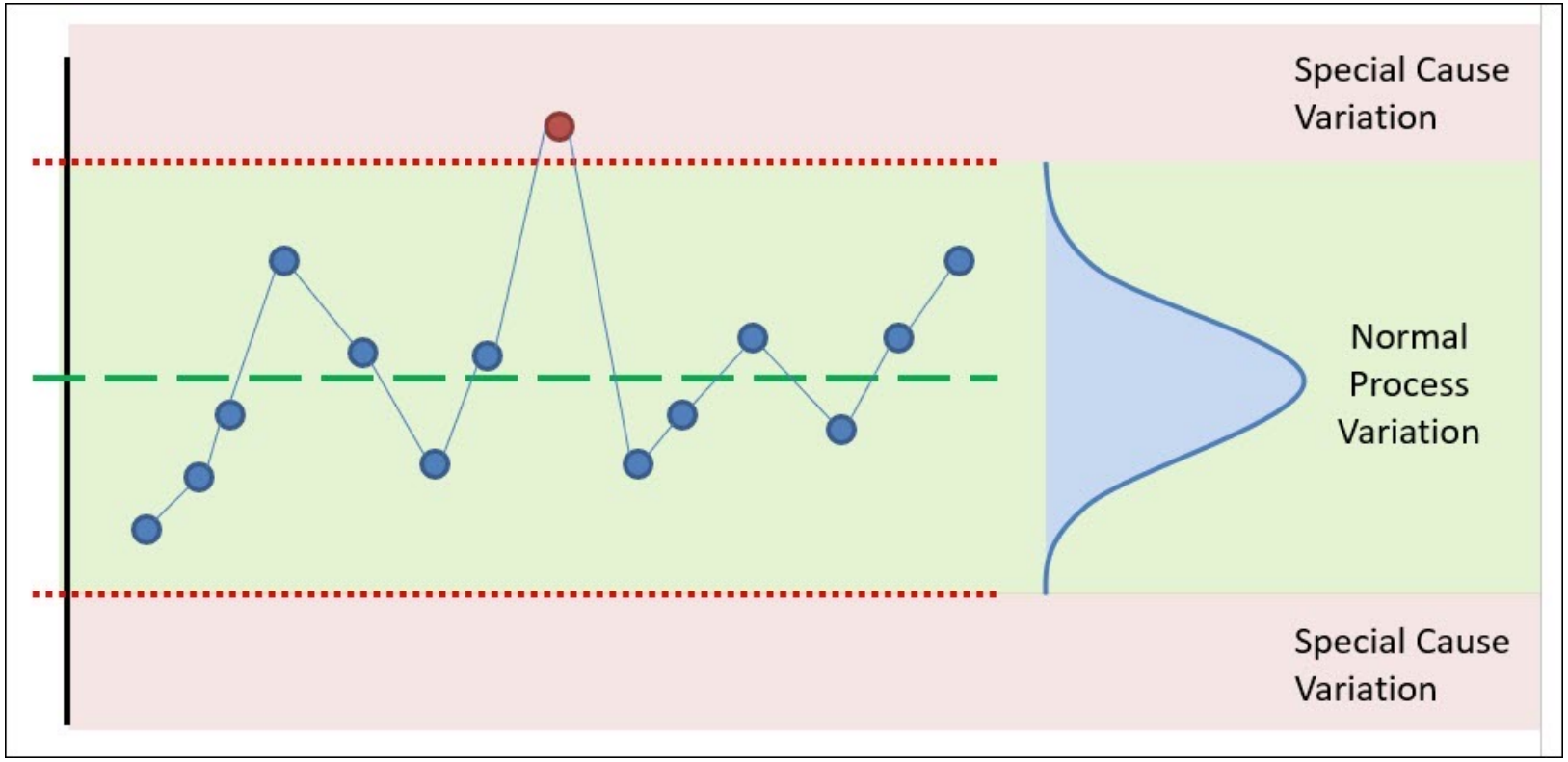
Automated Milking Systems


Automated Calf Feeding

Precision Dairy Monitoring

- Milk
- Behavior
- Physiology
- Conformation

Management by Exception

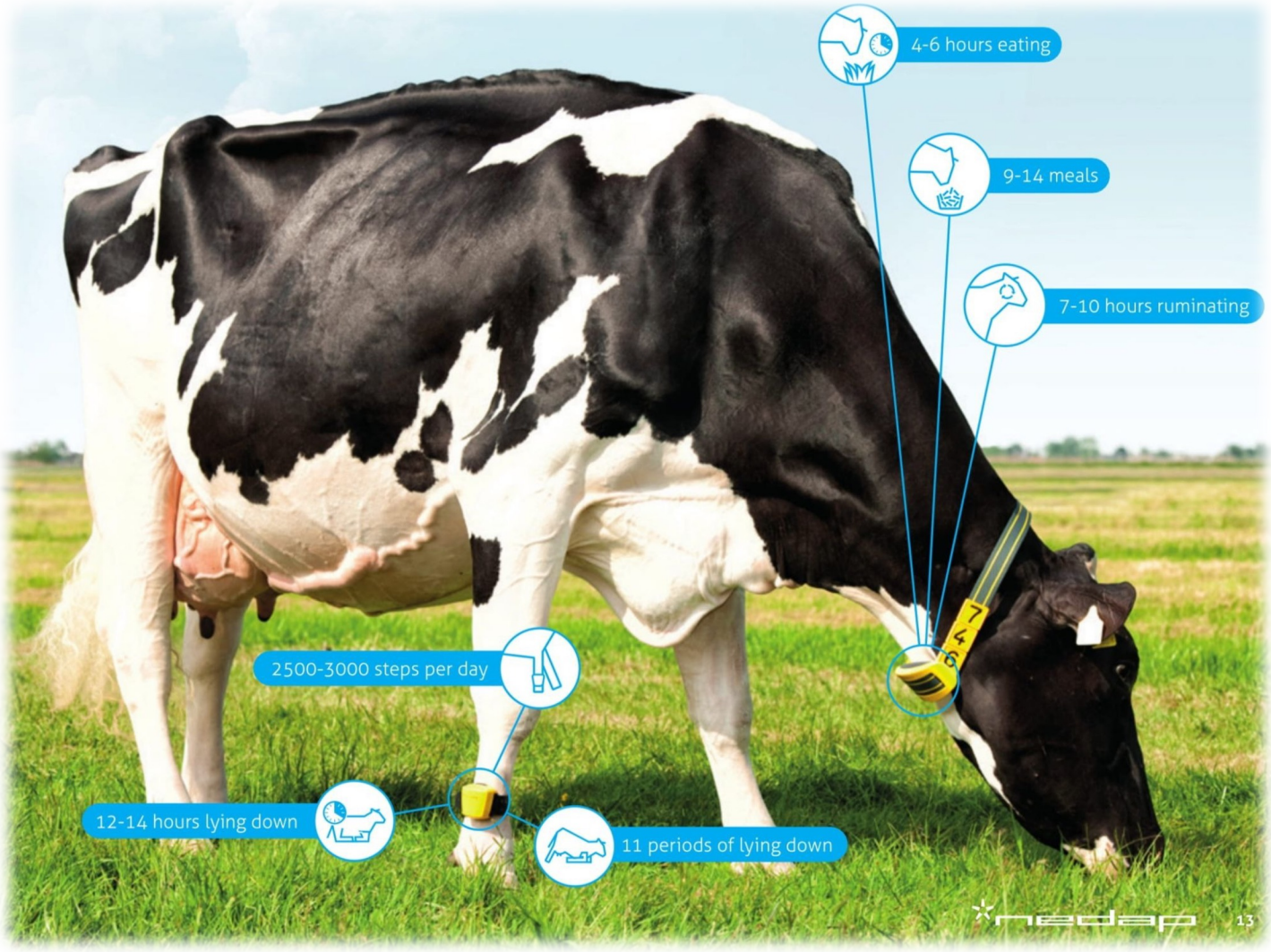


Precision Dairy Monitoring Applications

- Estrus Detection
- Mastitis Detection
- Fresh Cow Disease Detection
- Lameness Detection
- Calving Detection
- Genetic Traits
- Management Monitoring

Wearables, Machine Vision, and Milk Analyses

Wearable Technologies



WiCow: vaginal temperature, calving detection, estrus detection

AfiAct 11 Leg Tags: ID for parlor, lying, steps, activity

smaXtec Classic Bolus: temperature, drinking, rumination, activity

CowManager Ear Sensor: temperature, activity, rumination, eating

Herddogg HealthTag™: activity, temperature

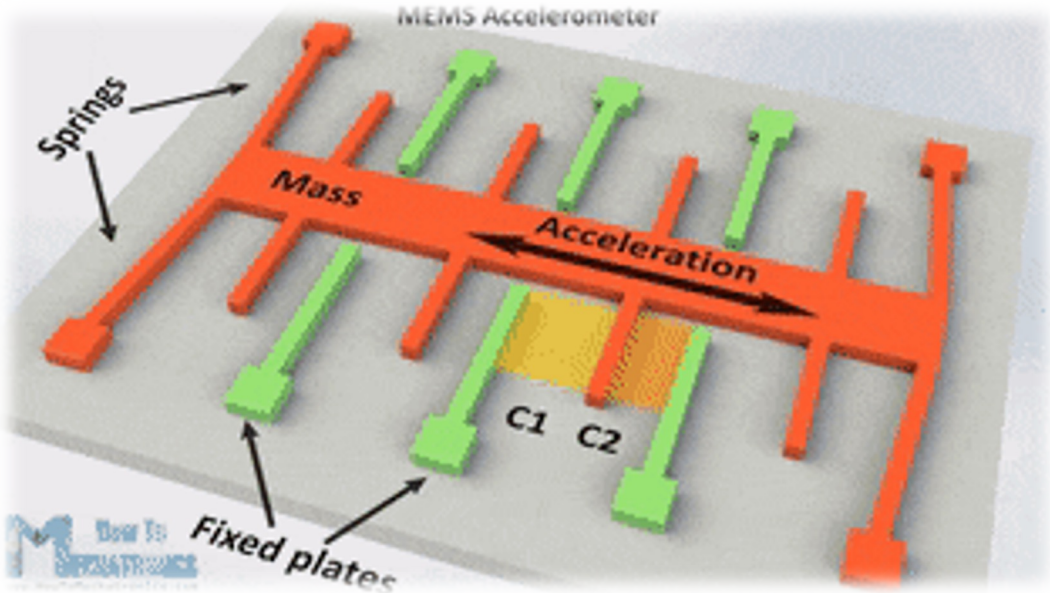
Nedap CowControl™ Neck Tags: location, activity, rumination, eating

Nedap CowControl™ Leg Tags: lying, steps, activity

At the SmartHolstein Lab, each cow wears multiple technologies to monitor behavior, health, and fertility. These technologies, similar to human Fitbits, use accelerometers. They ensure cows get enough rest and feed, and detect health issues early for prompt intervention.

WKU SmartHolstein Lab

Accelerometers and Behaviors



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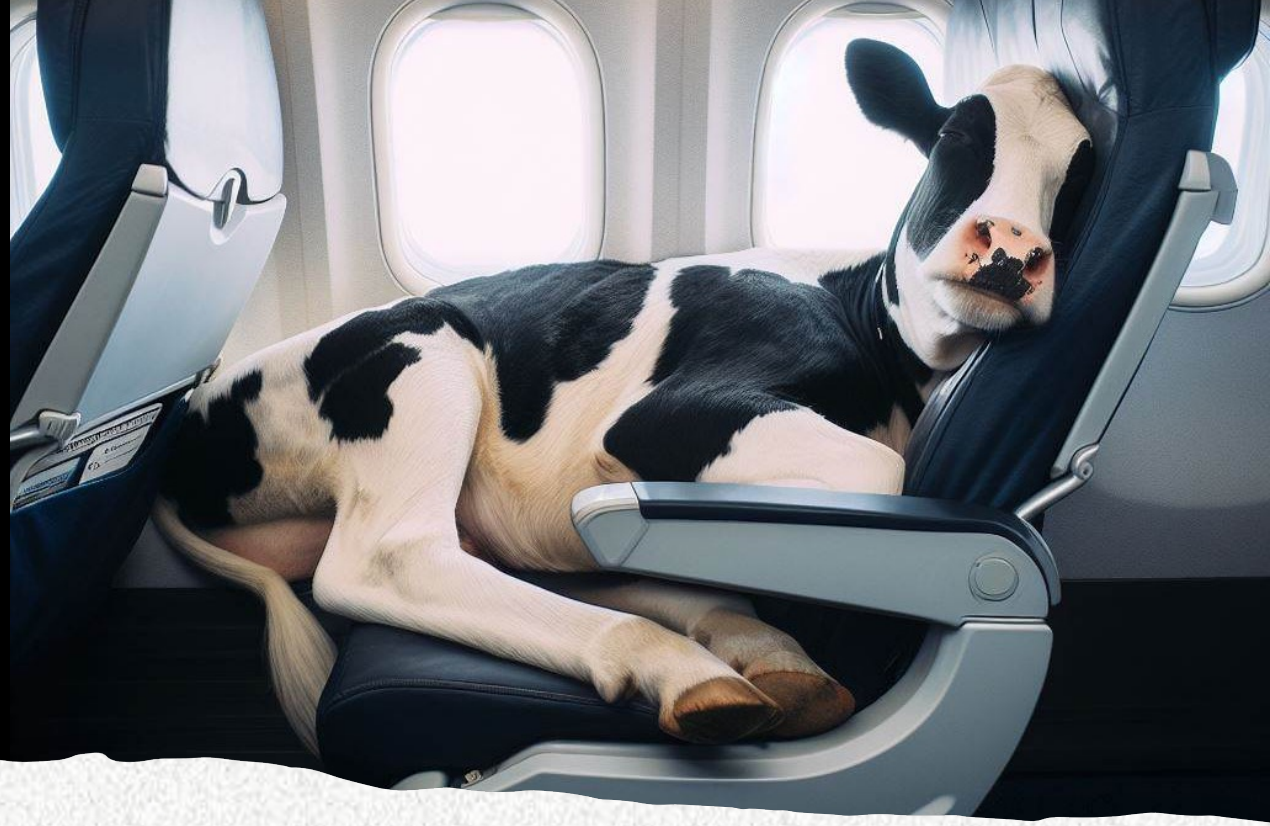
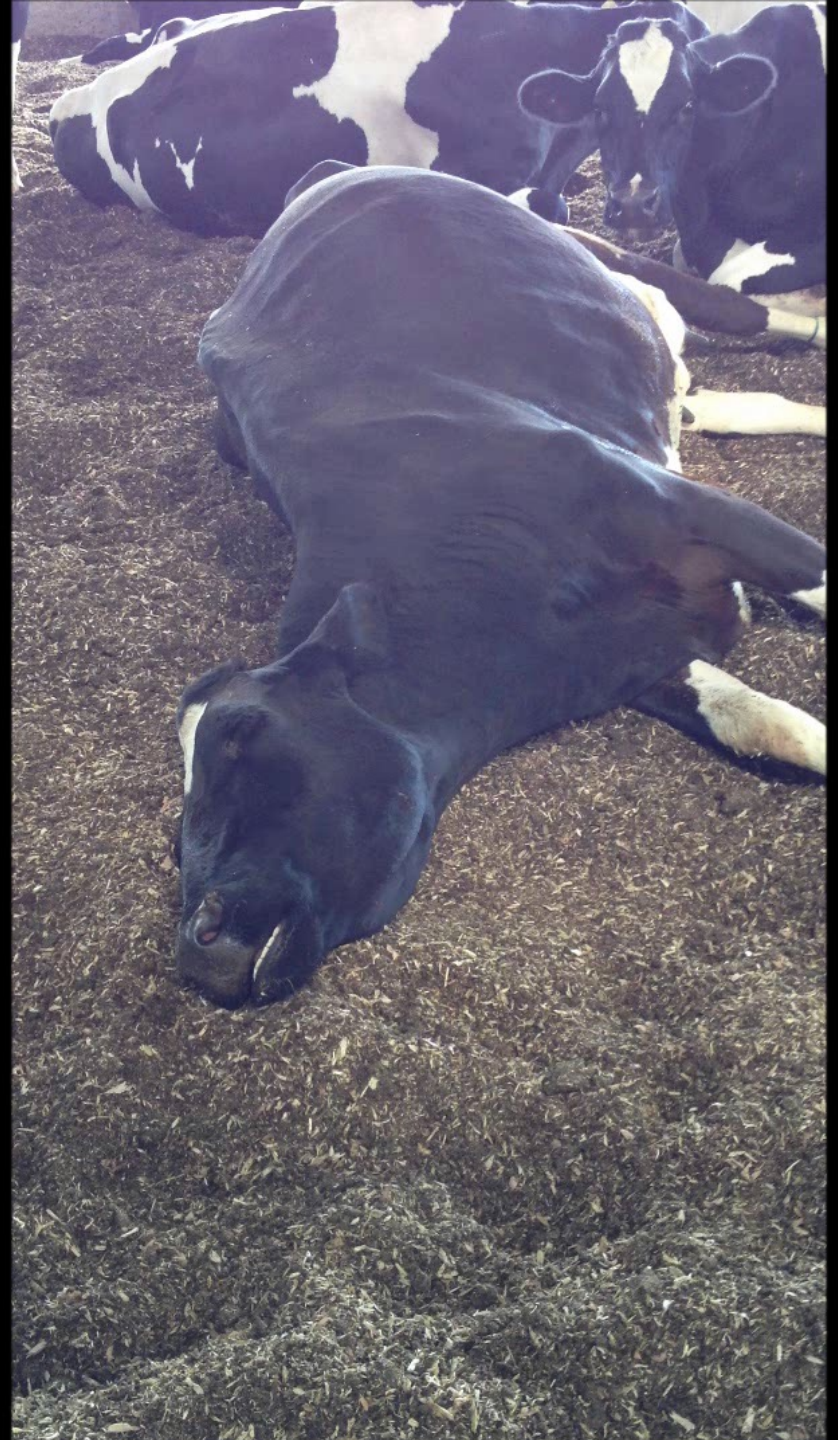


Does Dairy Cow Sleep Matter?



Sleep

Rest Quality

ChordataDairy™

First health microchip optimized for dairy

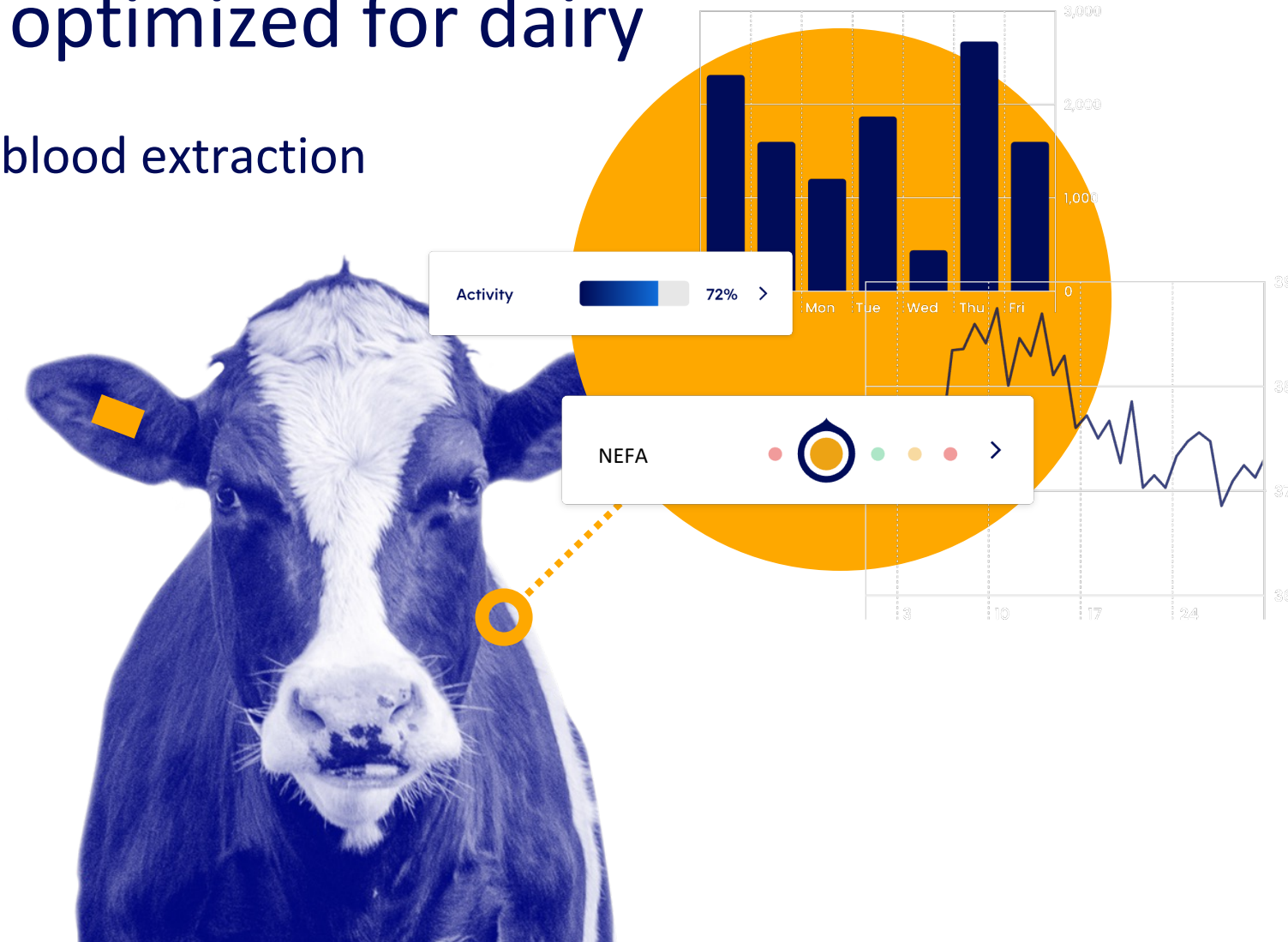
Real-time measurement without blood extraction

- ✓ Progesterone for Fertility
- ✓ BUN, BHB and NEFA for energy status
- ✓ Body temperature

With a smart ear tag monitoring

- ✓ Lameness
- ✓ Movement
- ✓ Behaviour

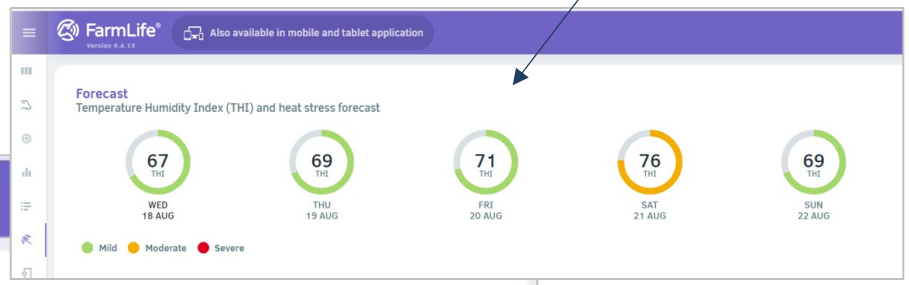
And API data integration from other technologies



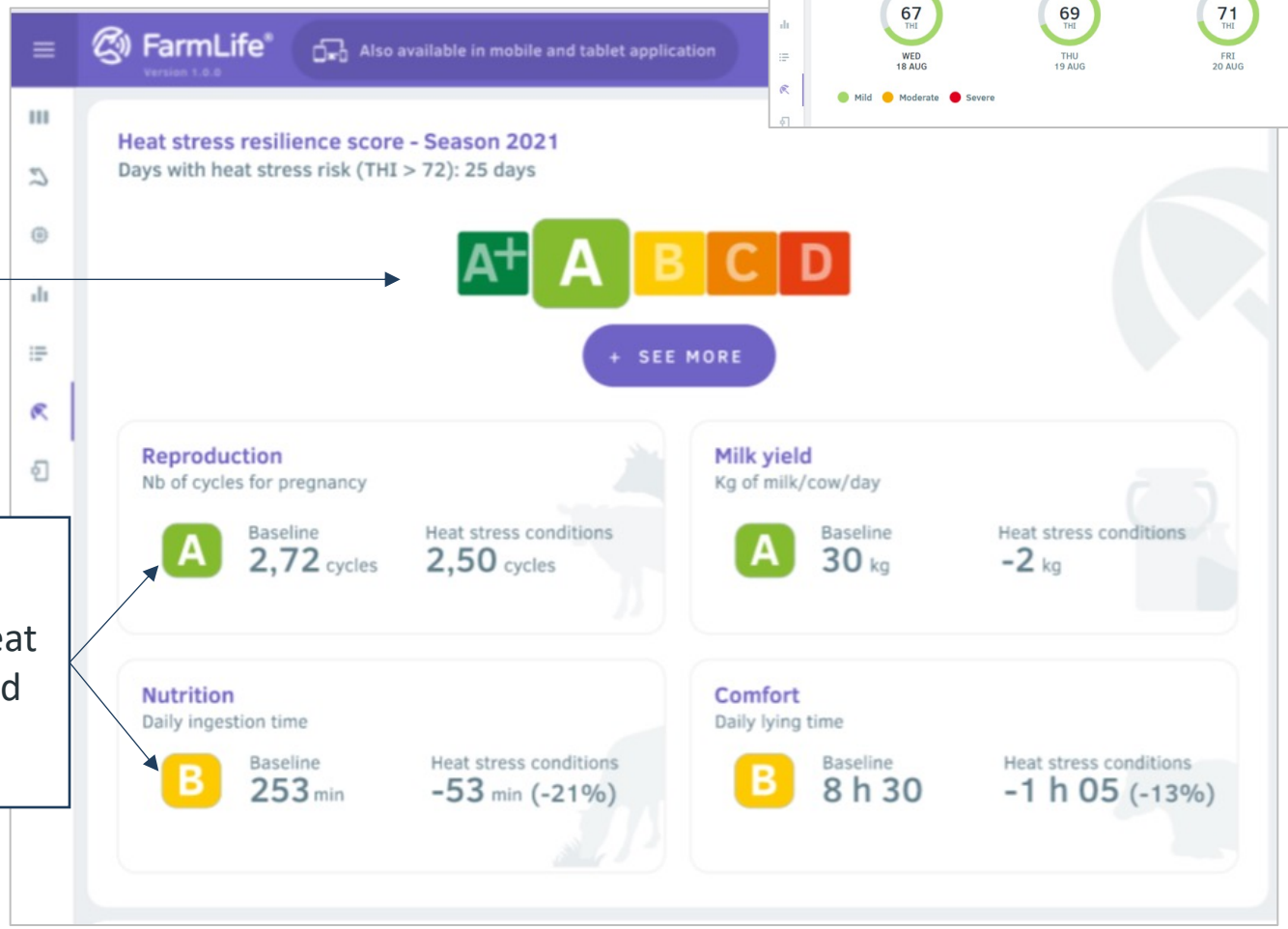
Heat'Adapt®

Heat stress services within FarmLife®

Local Temperature Humidity Index (THI) forecast from virtual weather stations

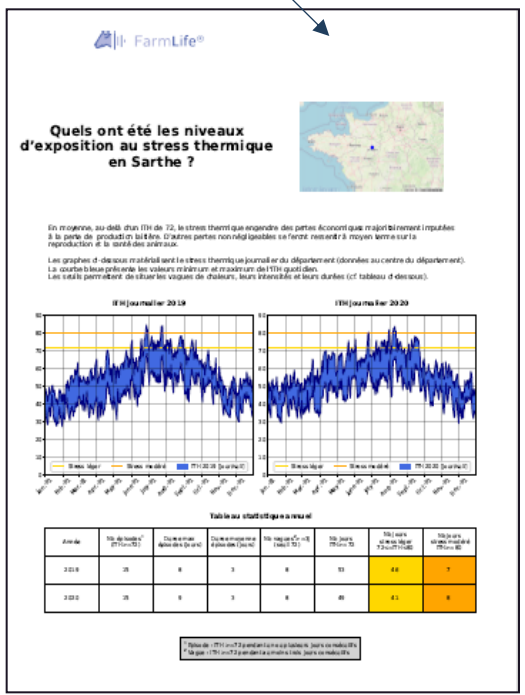


Resilience score



Performance indicators
Baseline vs days with risk of heat stress due to temperature and humidity conditions

THI and loss estimation for average farm in the same region



Best Place to Put a Device?

Ear

+ Easy to put on
+ Small size
- Easily caught and torn out

Leg

+ Stays on well
- Harder to put on
- May collect manure

Neck

+ Logical location for behavior
+ Stays on well
- Neck growth

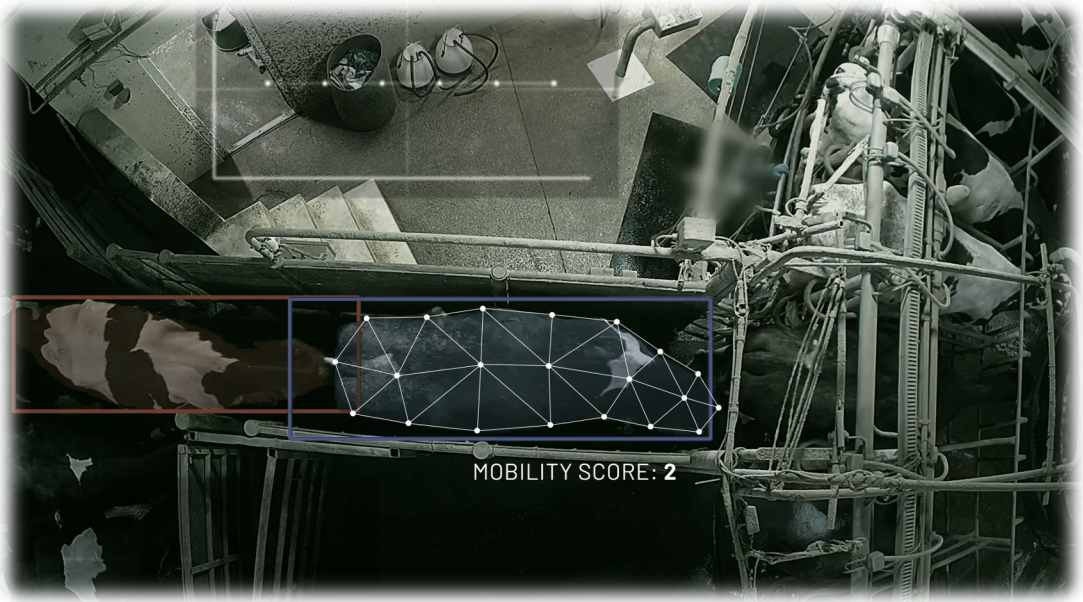
Tail

+ Good location for calving behavior
- Falls off
- May cut off blood flow

Reticulorumen

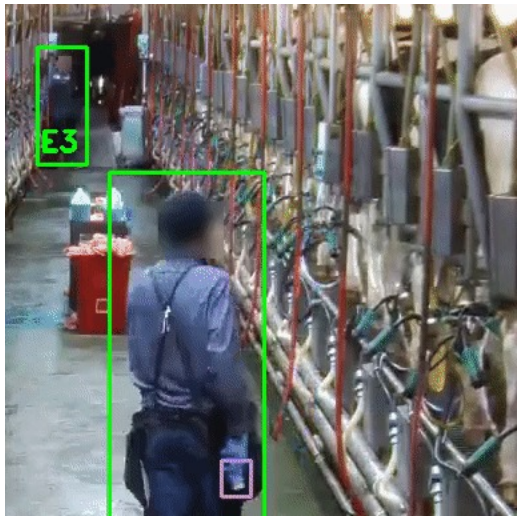
+ No exterior device
+ Multiple measures simultaneously
- Can’t reuse devices

Future Opportunities In Machine Vision



CATTLE EYE

BOVICA²IR



Cattle Care

DeLaval
Body Condition Scoring

Computers and Electronics in Agriculture 148 (2018) 226–236

Contents lists available at ScienceDirect

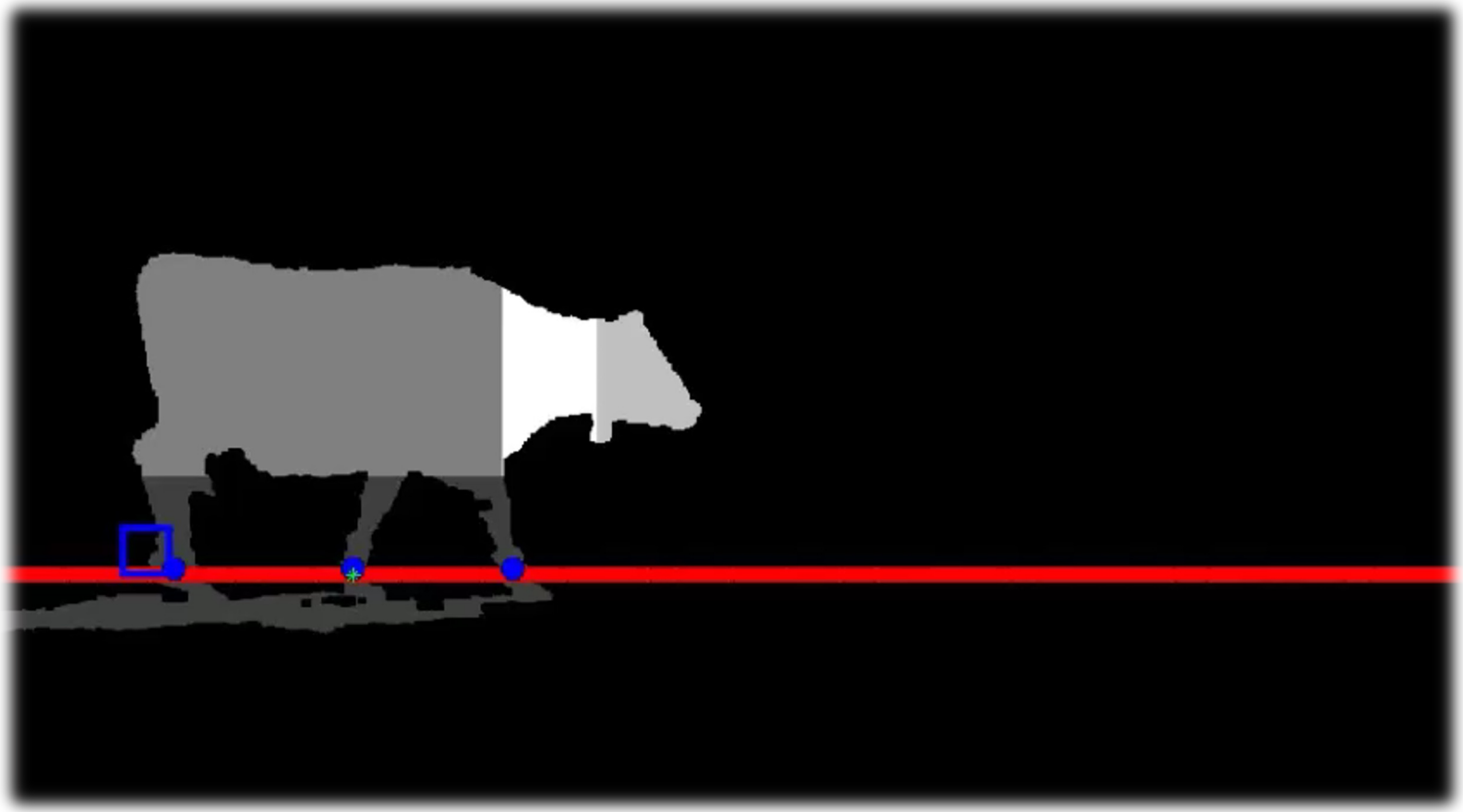
Computers and Electronics in Agriculture

journal homepage: www.elsevier.com/locate/compag

Original papers

Automatic lameness detection in dairy cattle based on leg swing analysis with an image processing technique

K. Zhao[a,b], J.M. Bewley[c], D. He[a,d,e,*], X. Jin[b]

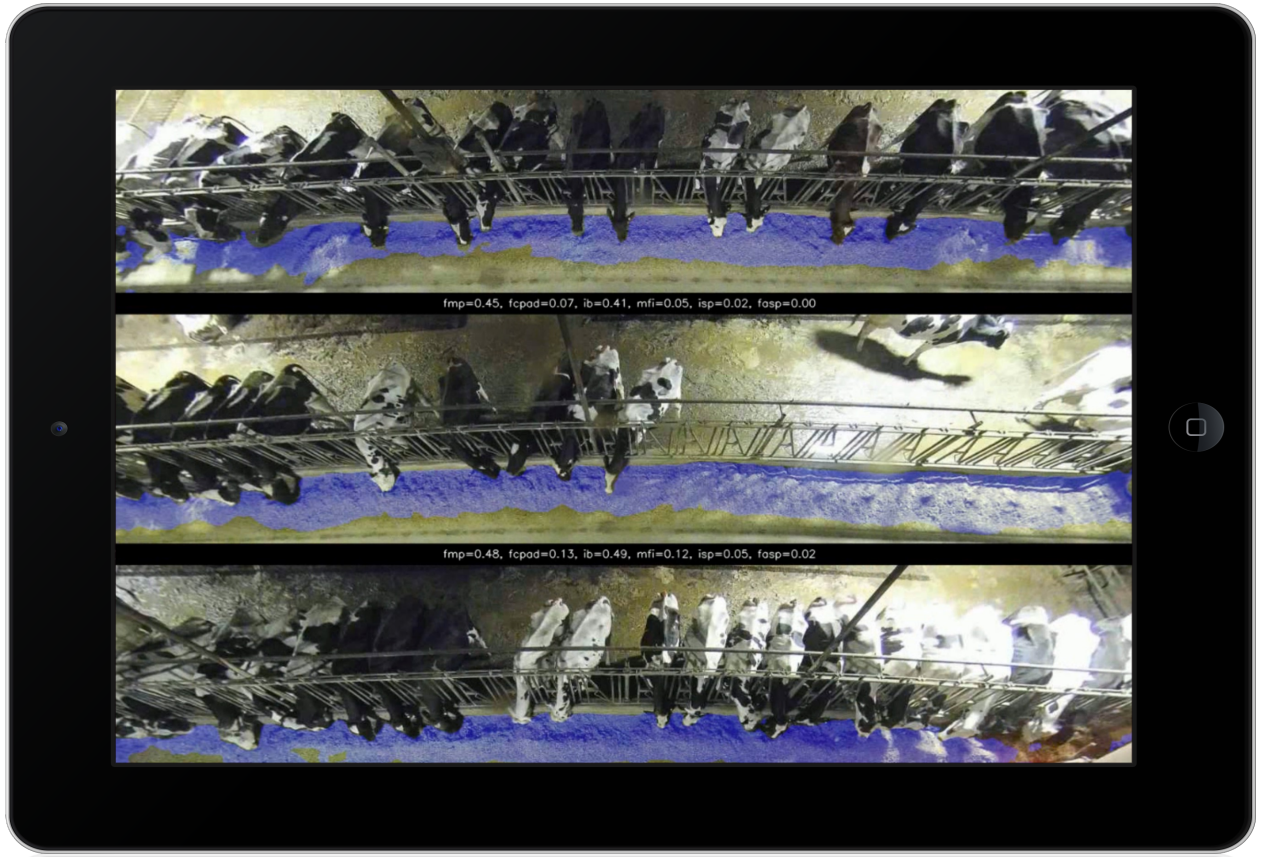


Digital Dermatitis Detection (Dopfer)

Monitoring cow behavior by pen 24/7

Monitoring feed availability and determining when feed events happen

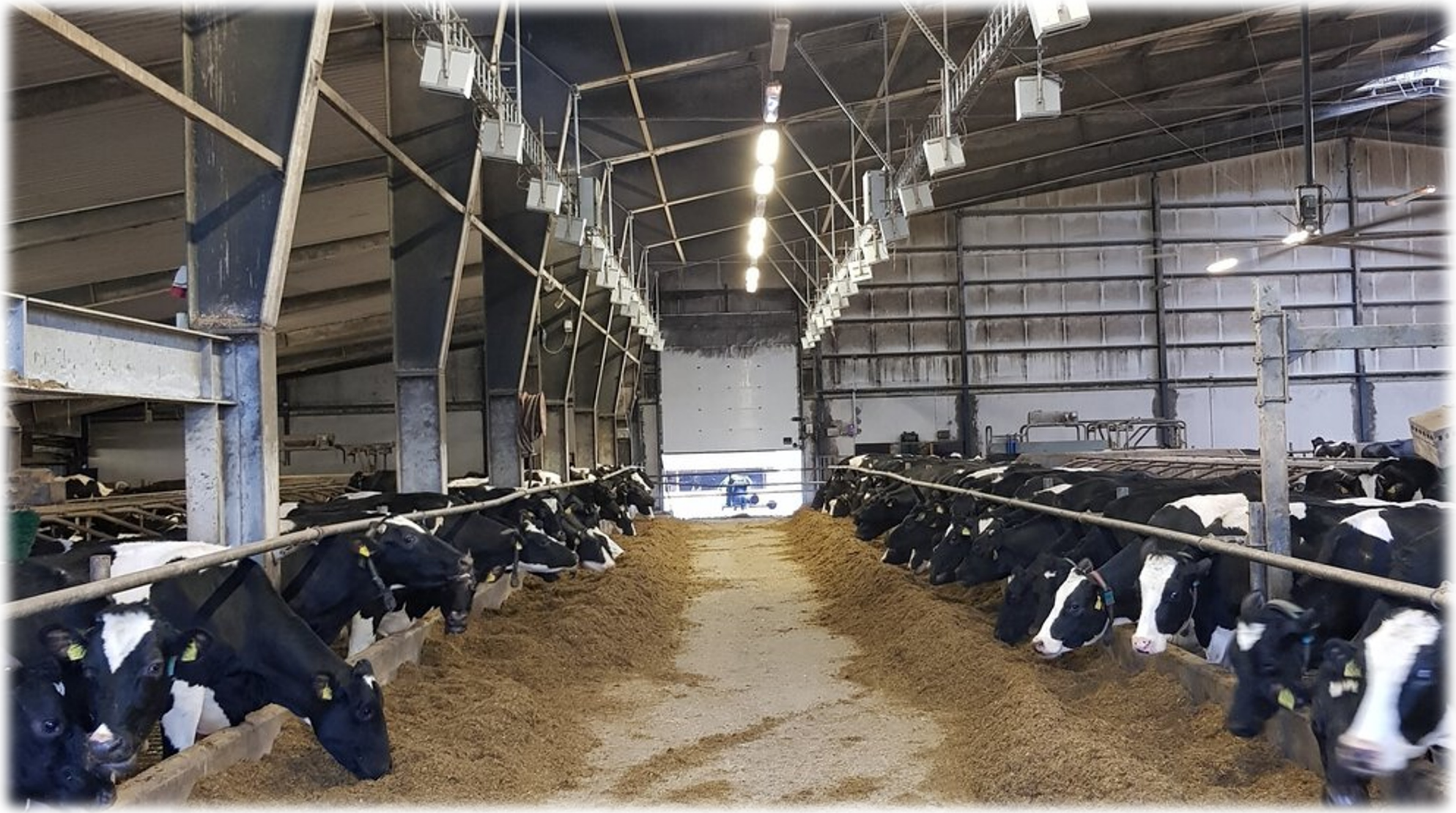
Before a feed delivery



After a feed delivery

Cattle Feed Intake System (CFIT)

VIKINGGENETICS
innovative breeding



Labby
Optical intelligence for milk

GEA

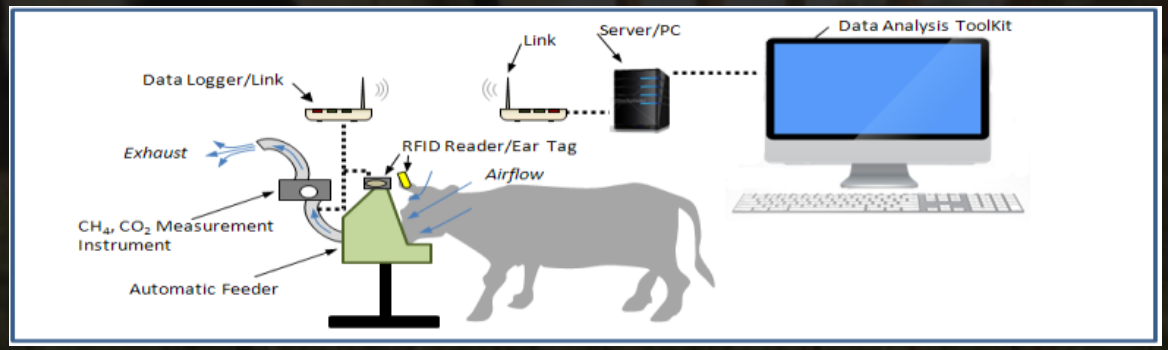
Inline Somatic Cell Count

Spectroscopy

- Visible, near-infrared, mid-infrared, or radio frequency
- Indirect identification through changes in milk composition
- AfiLab uses near infrared
    - Fat, protein, lactose

Methane Emissions

C-LOCK INC.



The Opportunity

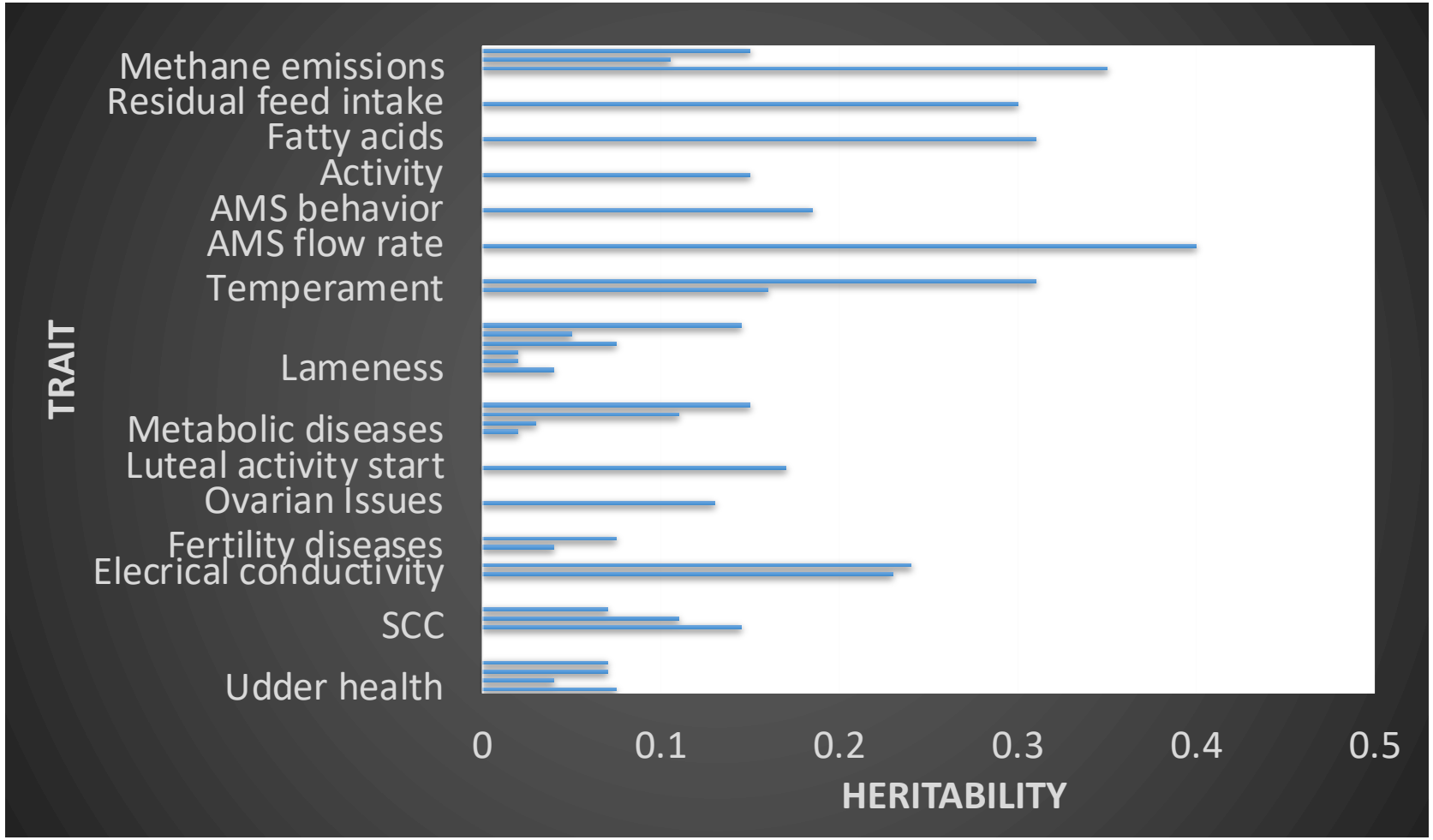
- Previously unavailable, consistent, objective measures
- New or improved traits
- Traits may be incorporated into robustness assessments
- Improved data accuracy

Animal (2015), 9:2, pp 191–207
doi:10.1017/S1751731114002614

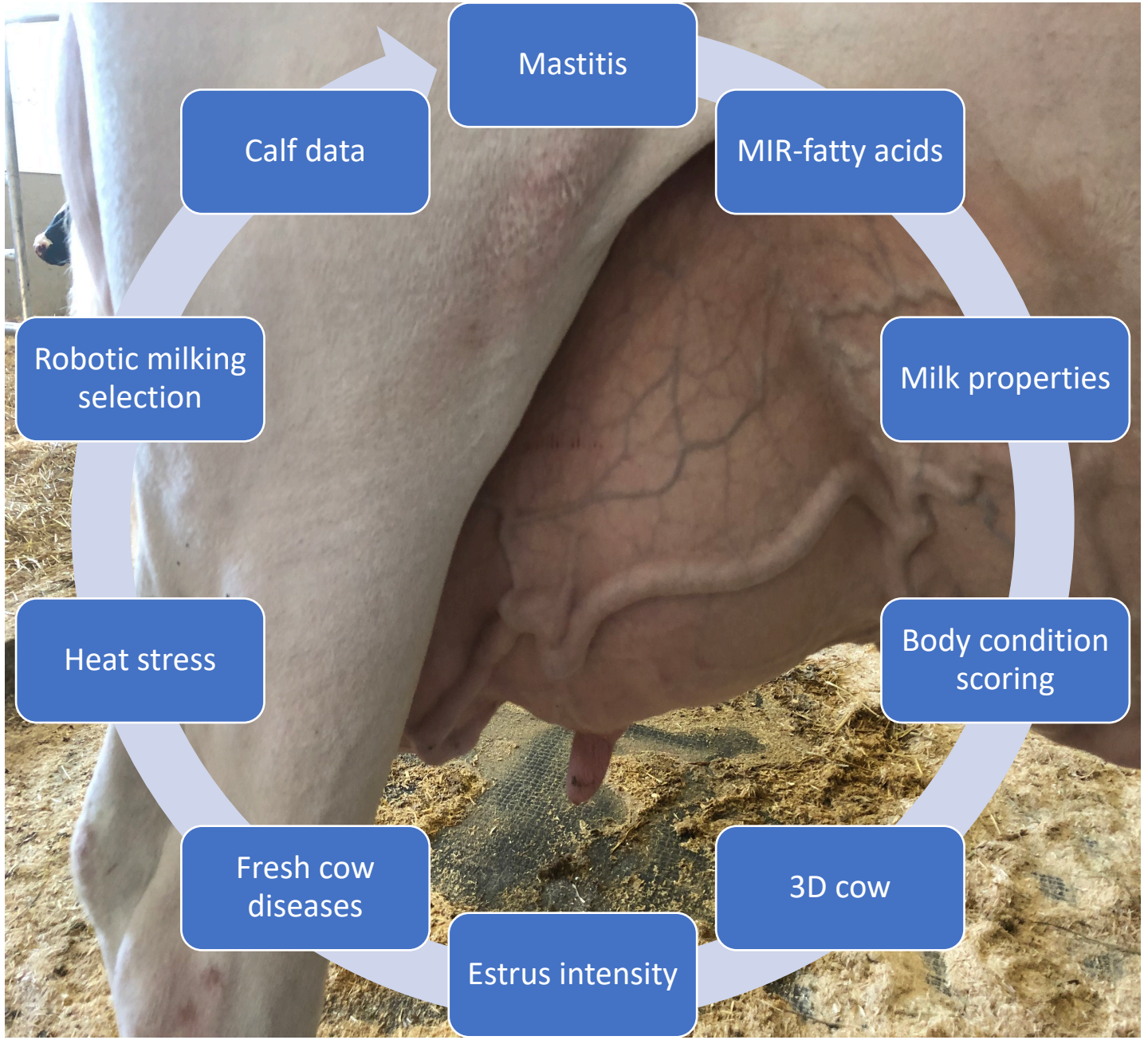
animal

Invited review: overview of new traits and phenotyping strategies in dairy cattle with a focus on functional traits

C. Egger-Danner[1†], J. B. Cole[2], J. E. Pryce[3], N. Gengler[4], B. Heringstad[5], A. Bradley[6,7] and K. F. Stock[8]



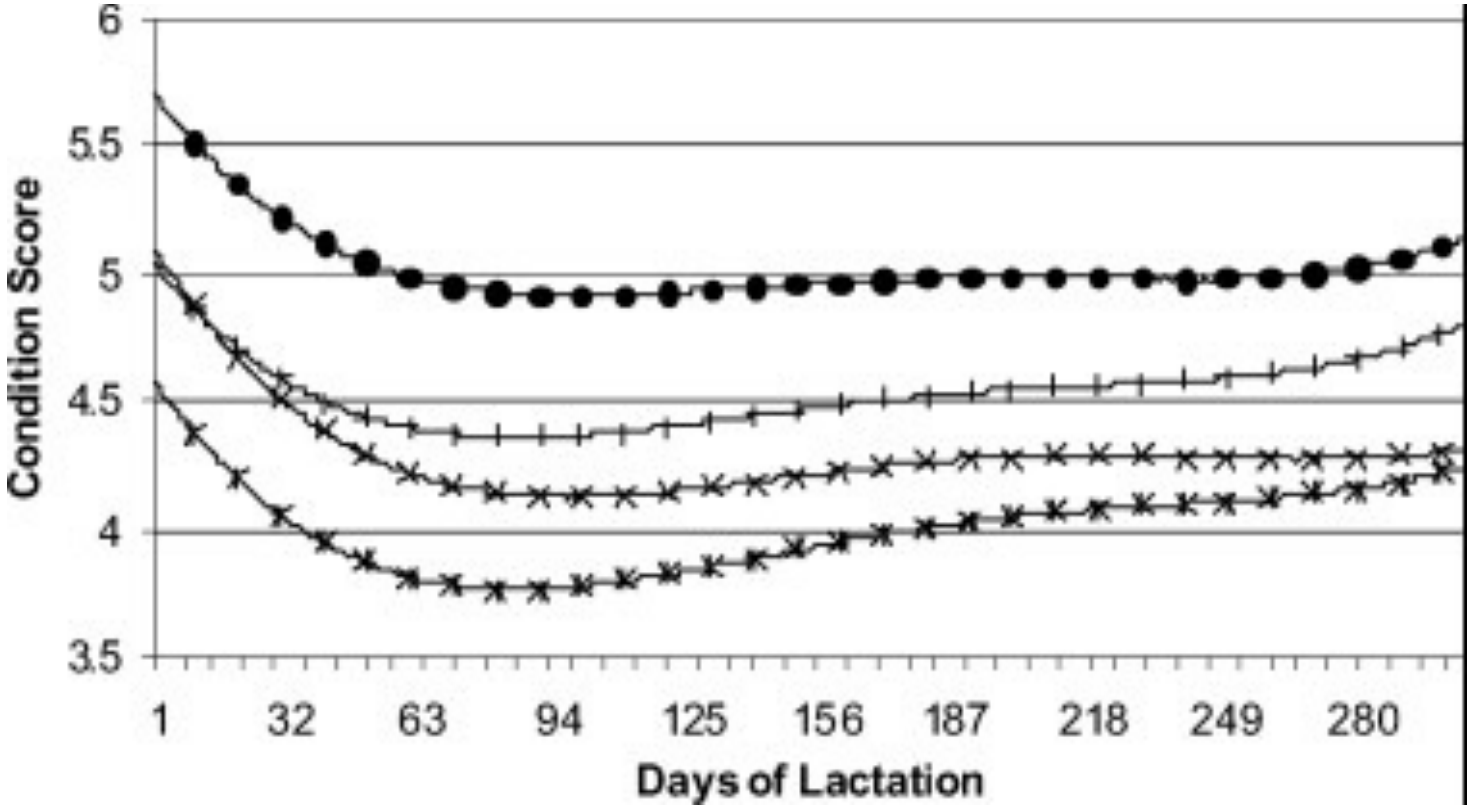
Novel Phenotypes



J. Dairy Sci. 86:2205–2212

Genetic Evaluations of Dairy Bulls for Daughter Energy Balance Profiles Using Linear Type Scores and Body Condition Score Analyzed Using Random Regression

M. P. Coffey,* G. Simm,* W. G. Hill,† and S. Brotherstone†
*Animal Biology Division, Scottish Agricultural College,
West Mains Road, Edinburgh EH9 3JG, UK
†Institute of Cell, Animal and Population Biology, University of Edinburgh,
West Mains Road, Edinburgh, EH9 3JT, UK



BCS Heritability ~ 0.20

Body condition score for the top (× and *) and bottom (+ and ●) two sires ranked on profit index (PIN)


Holstein International
Record breaking donor with 71 embryos from 1 single IVF!
– p.15
313
JANUARY
2020
Heat tolerance
Why heat tolerance should be in our genetic evaluations
'I honestly think there is too much emphasis on breeding with genomics' – p. 40
Interview Marc Comtois / The secret of AOT / All new sire proofs

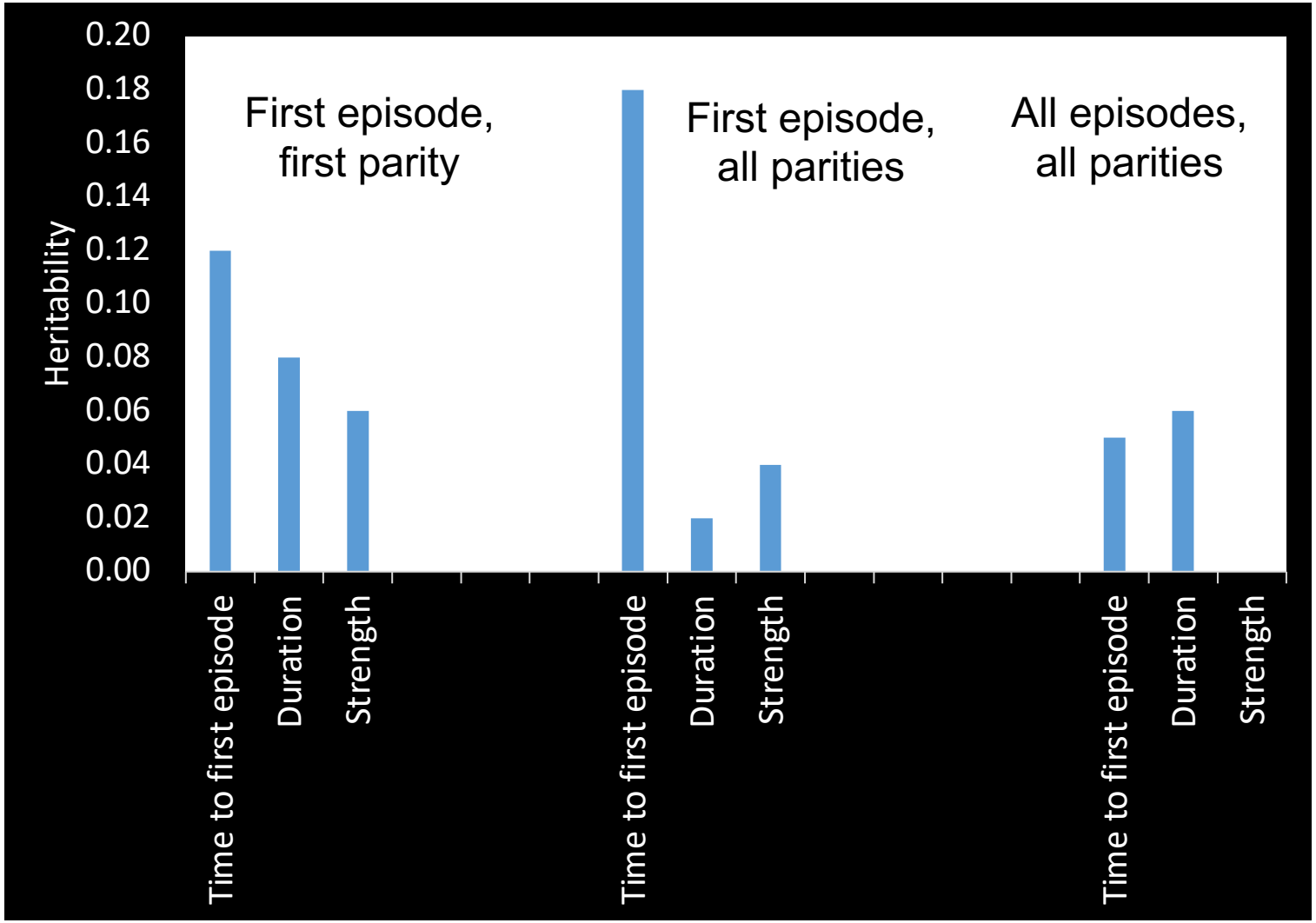
Heat Stress

J. Dairy Sci. 92:4683–4688
doi:10.3168/jds.2008-1736

Short communication: **Genetic variation in estrus activity traits**

P. Løvendahl*[1] and M. G. G. Chagunda†
*Department of Genetics and Biotechnology, Faculty of Agricultural Sciences, Aarhus University, Tjele DK 8830, Denmark
†Sustainable Livestock Systems Group, Scottish Agricultural College, Dairy Research Centre, Midpark House, Bankend Road, Dumfries, DG1 4SZ, United Kingdom

High activity for cows and heifers



AMS Derived Udder Traits

Traits based on herd classification	h^2		Traits based on AMS	h^2
front udder attachment	0.25		udder depth 1	0.56
front teat placement	0.31		udder depth 2	0.56
teat length	0.38		udder depth 3	0.52
udder depth	0.39		distance front teats 1	0.60
rear udder height	0.26		distance front teats 2	0.53
udder support	0.22		distance front teats 3	0.45
rear teat placement	0.29		distance rear teats 1	0.45
			distance rear teats 2	0.38
			distance rear teats 3	0.33
			udder balance 1	0.45
			udder balance 2	0.42
			udder balance 3	0.43

CRV Coöperatie
BETTER COWS > BETTER LIFE

Niek Meijer , 2023

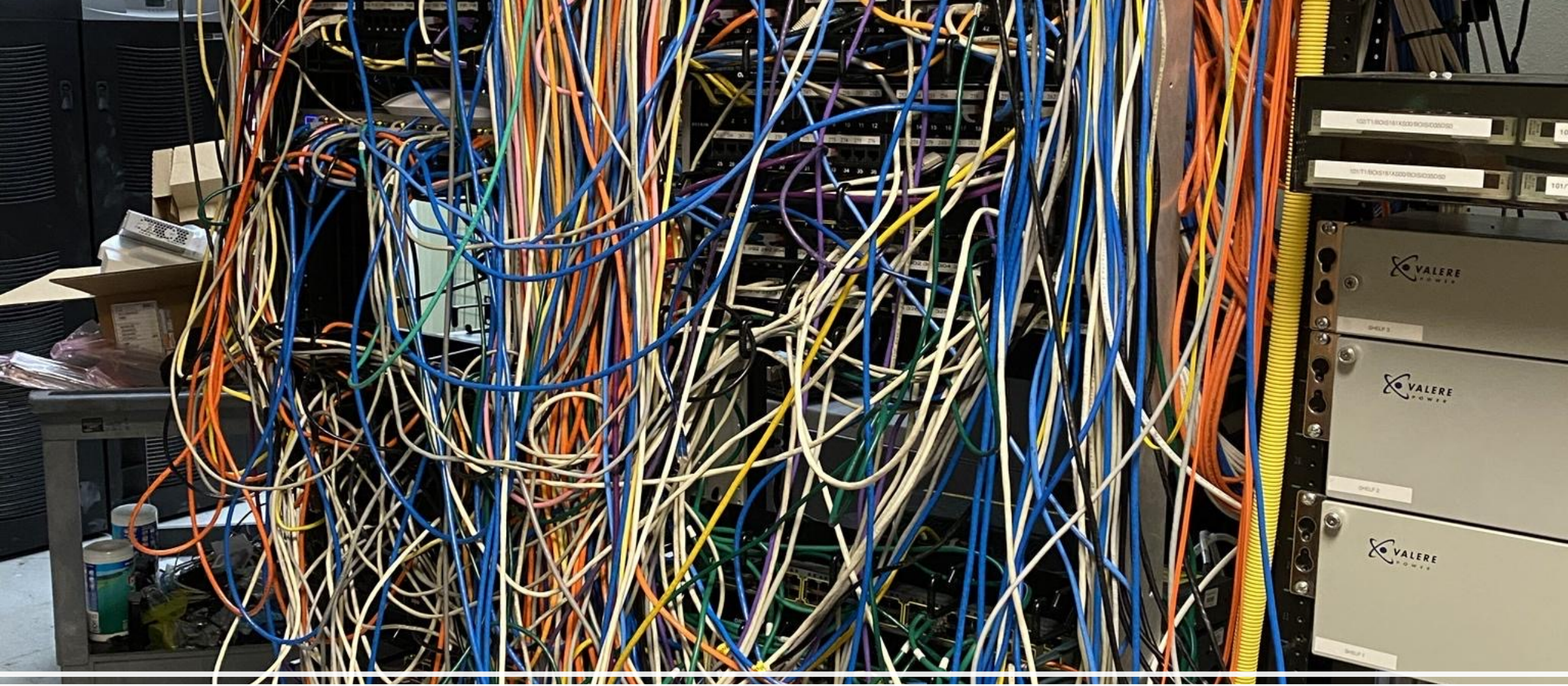
Challenges and Limitations

- Brand differences in measures
- Technology failures
- Standardization
- Calibration
- Data ownership
- Who pays for what?

What can we learn from those companies and technologies that didn’t make it?

Physical Form Problems

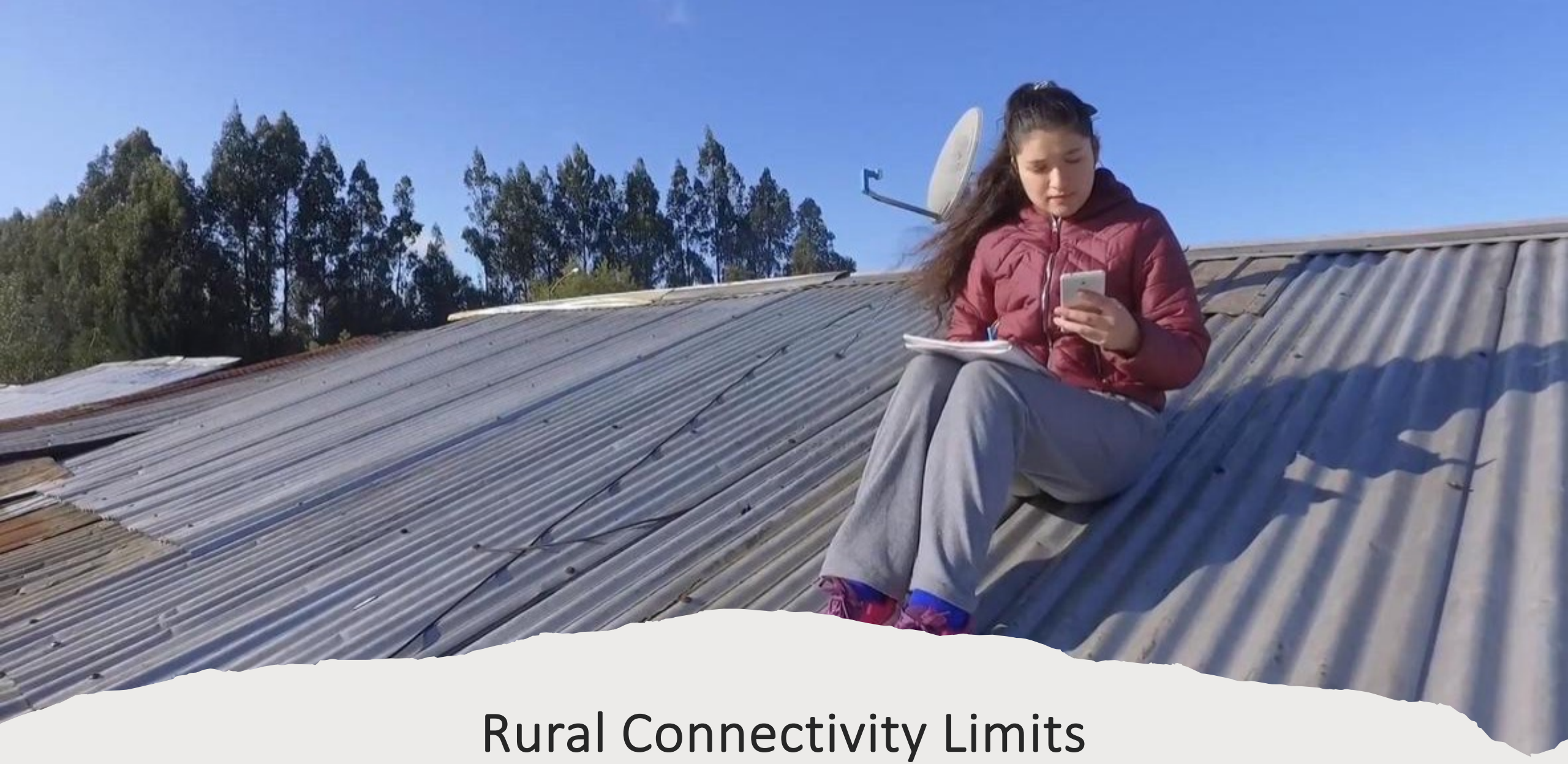
Device Integrity



Too Much Infrastructure Needed

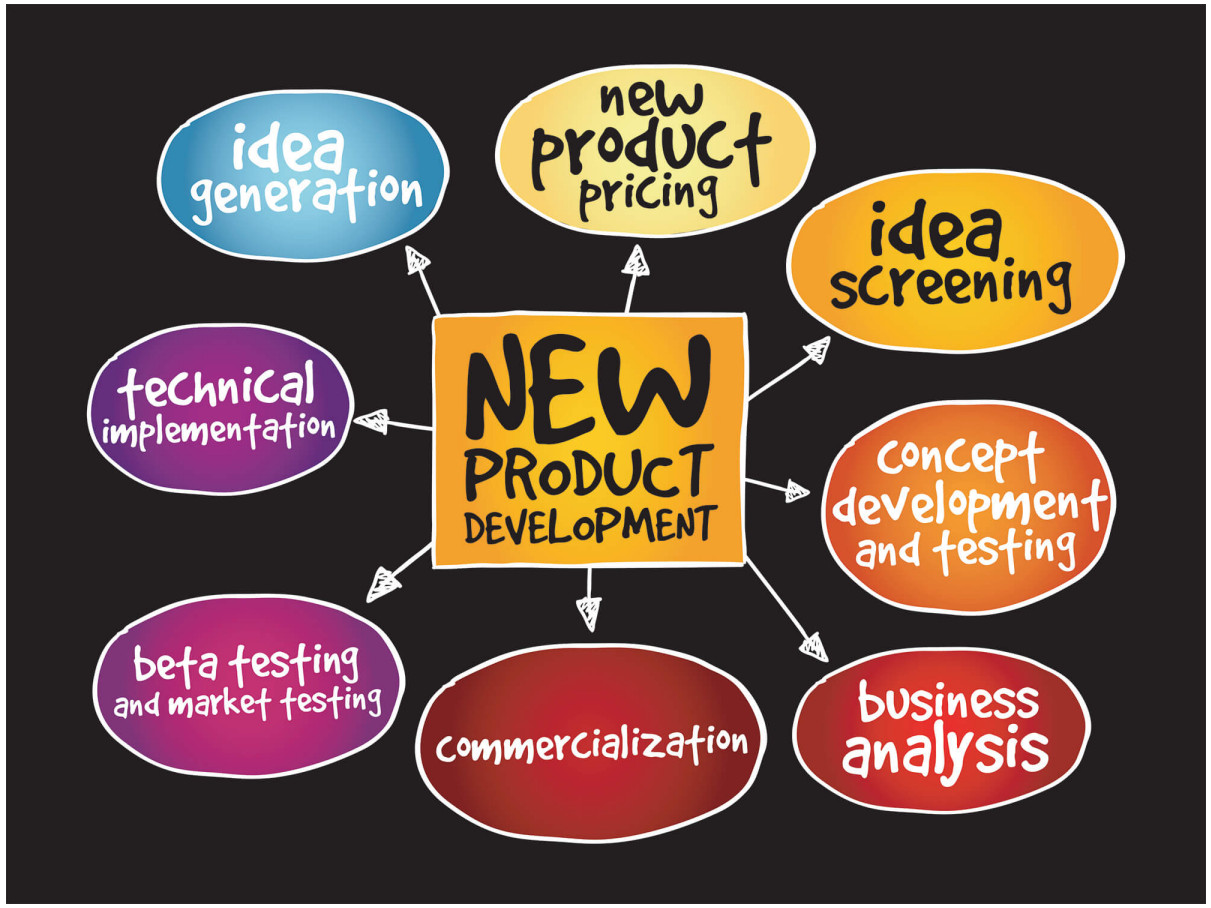
Rodents and Other Farm Realities

Camera Cleaning



Rural Connectivity Limits

Miscommunication of Development Stage




overpromise
underdeliver
expectations
success
slogan
reminder
store
memo
marketing
relations
document
service
message
delivery
target
warning
failure
goal
tech
note
pr
information
advertisement
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newspaper
writing
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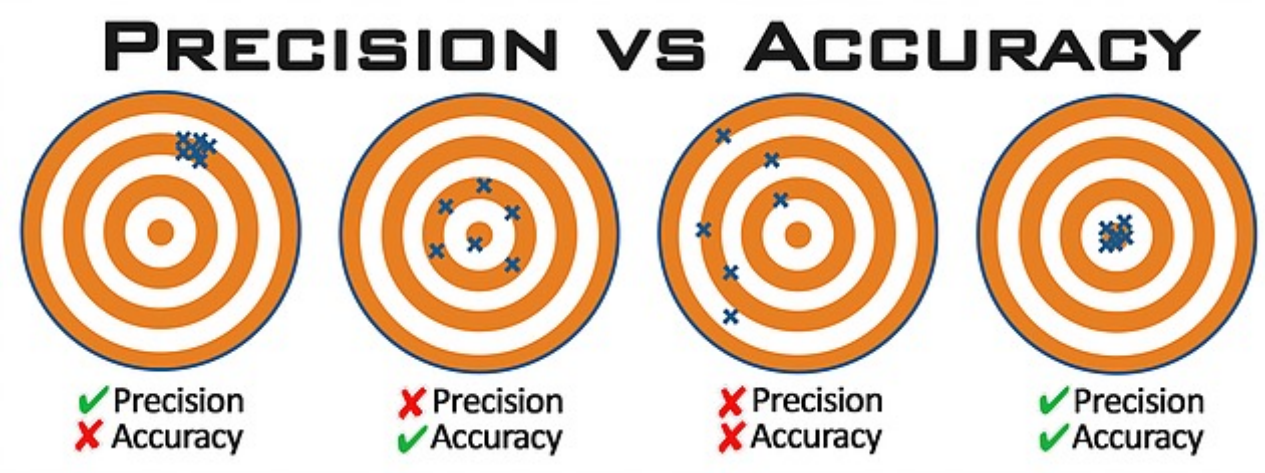
technology
sticky
perspective
product
hype
quality
symbol
expect
picture
deliver
short
advert
promise
vintage
launch
audience
design
online
new
idea
internet
teaser
detail
under
workflow

Focus on Technology, Rather than Information

Some Data Interesting but Not Useful

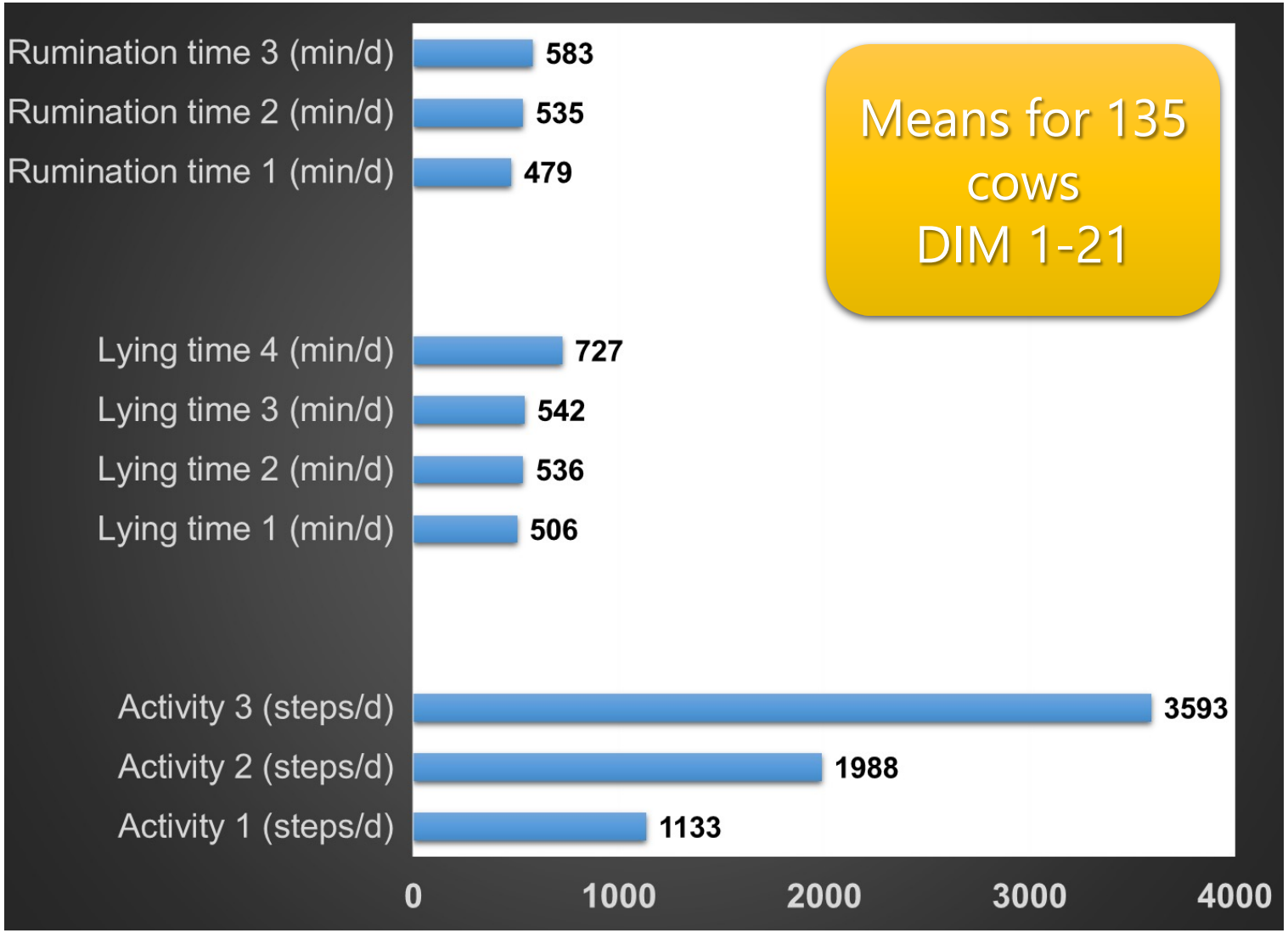
Too Costly to Justify Investment

Are we measuring the targets we intend to?



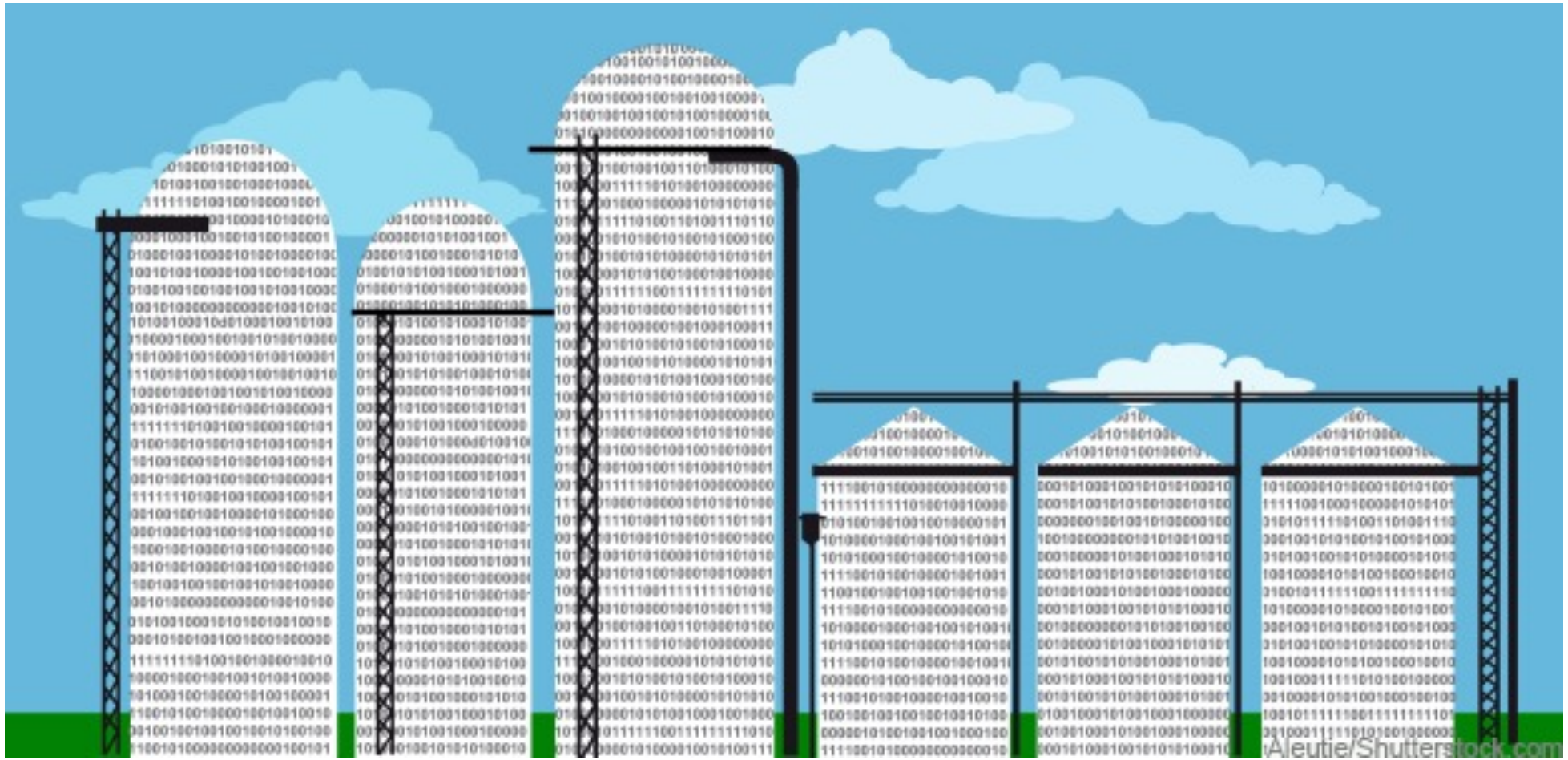
Can’t forget the need for third party validations

X ≠ X and Y ≠ Y



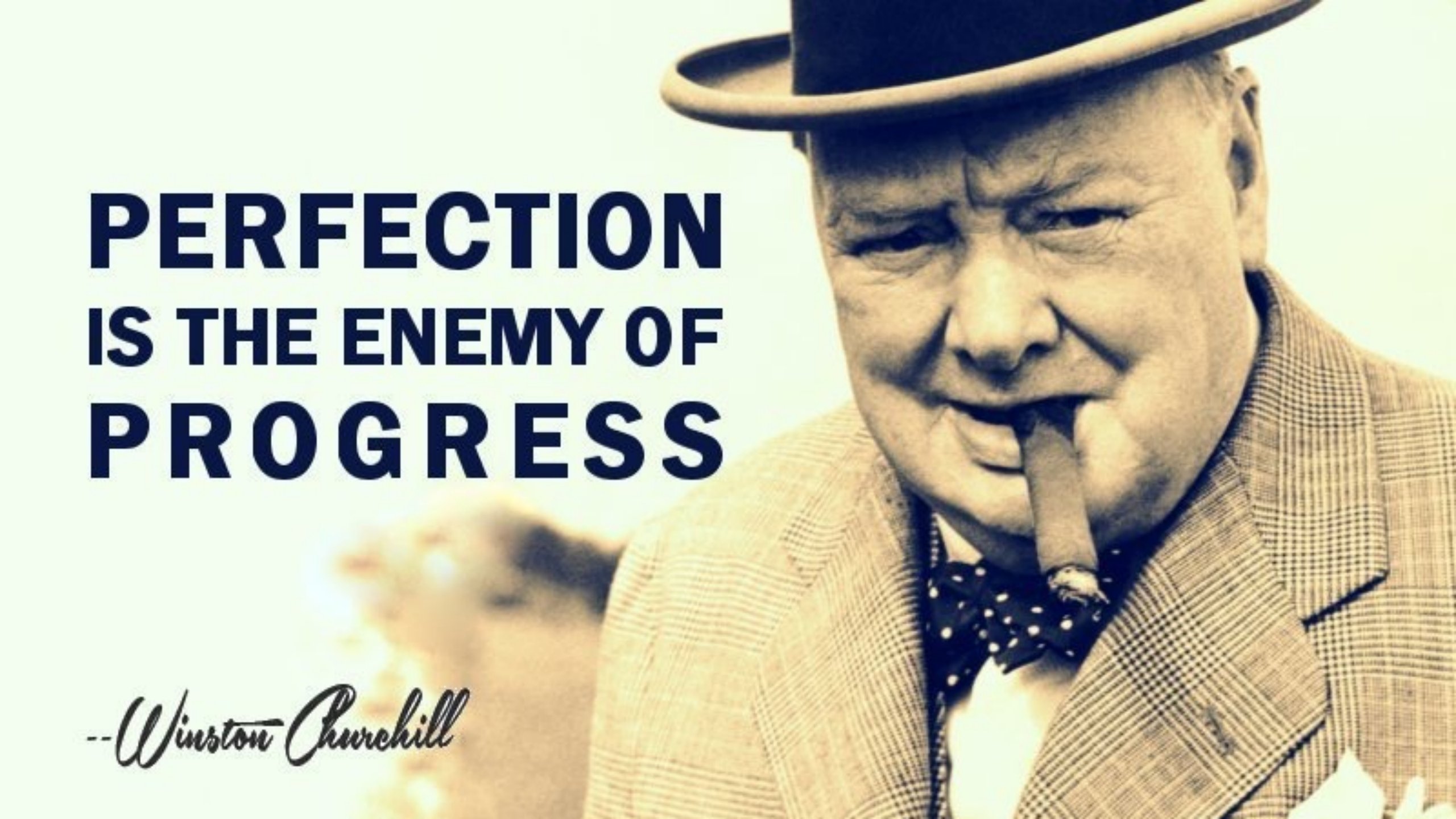
Jones et al., 2020

Data Silos



DHIA | Sensors | Genetics | Milk Buyer | Nutrition | Financial

Data Integrators


PERFECTION
IS THE ENEMY OF
PROGRESS
--Winston Churchill


Tomorrow’s technological innovations are beyond what we can imagine. Let’s dream big.

Never Lose Sight Of Her: That Beautiful Creature We All Love

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