VIKINGGENETICS
innovative breeding

Camera technology to bring large scale data from commercial herds

Presented by:

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Puy du Fou, France

FUTURE-FRIENDLY FARMING

The vision and challenge

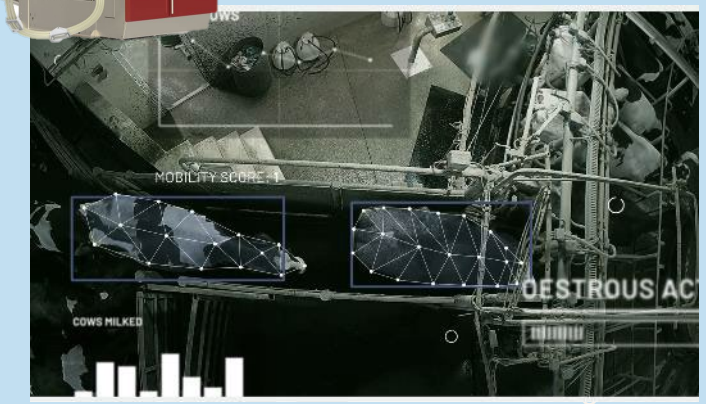
- No doubt that camera technology can produce large scale data from commercial herds
- The challenge is to transform the information content in the pictures or videoes to valuable phenotypic information

Improving management and genetic decisions

Building strong genomic reference populations for genetic improvement

Many applications in animal and plant production

- High throughput **phenotyping in plants**
- **Drone** technology
- **Tracking** in pigs and poultry
- **Milking Robots**
  - 3D camera for cow movements and teat detection
- **CattleEye** – lameness – BCS - Mobility

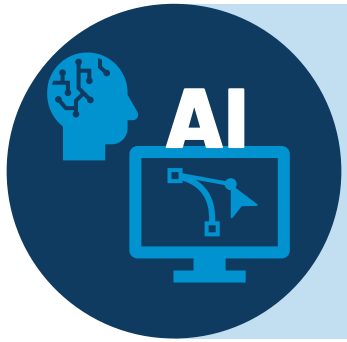


How can camera technology add value?

- Hard to measure (expensive) traits
- **Lower phenotyping costs** -> increasing amount of registrations (high throughput phenotyping)
- Round the clock - **24/7 registrations**
- **Objective** and **precise** compared to subjective phenotyping
- **Sequence of pictures or video-snapshots** compared to point-registration
- **Survelliance**

How can camera technology add value?

Document production systems (ESG and climate)



Powerful tool combined with AI-Technology and robot development

The intelligent "eye on the cow"

EXAMPLES FROM APPLICATIONS IN DAIRY CATTLE

CFIT – Cattle Feed InTake

Registrations of individual cow's feed intake and weight

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CFIT – Aim and purpose

- To develop a 3D camera system that can measure feed intake at individual cow level at each visit
- The system may not:
  - Disturb **daily routines** on farm
  - Disturb **cow behavior**
- Should be same system as for **identification**
- **Data to be used for breeding and management**

The CFIT system – registration 24/7

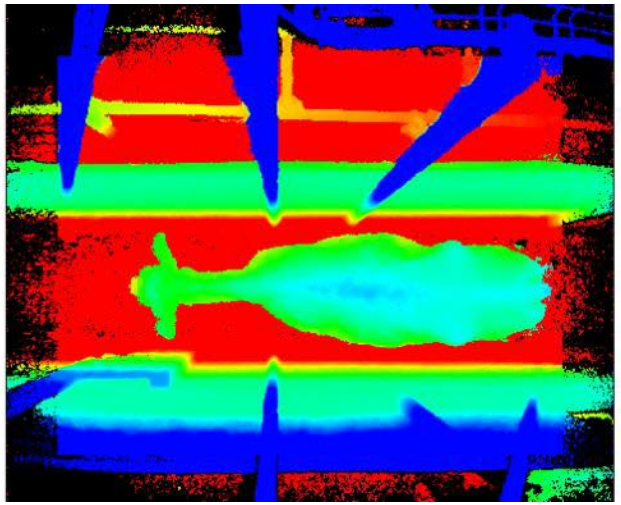
Registrations are based on **3D images** and the use of **artificial intelligence**

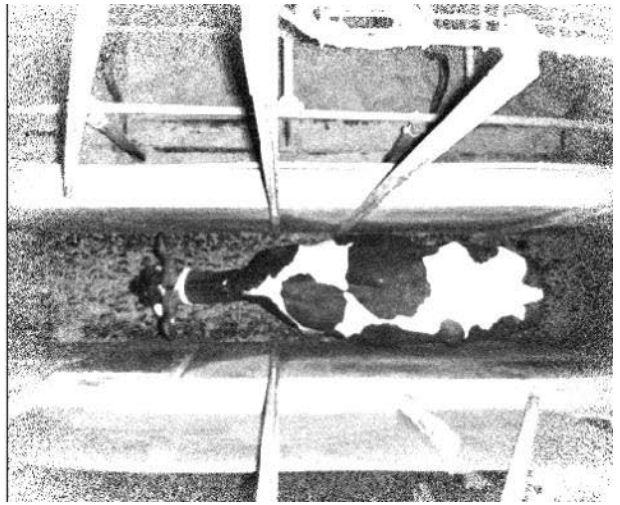
IDENTIFICATION OF COW

COW'S FEED INTAKE

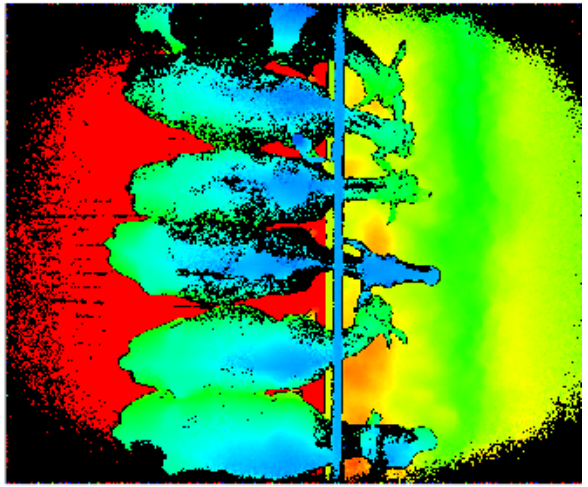
COW'S WEIGHT

Cow identification and weight measure

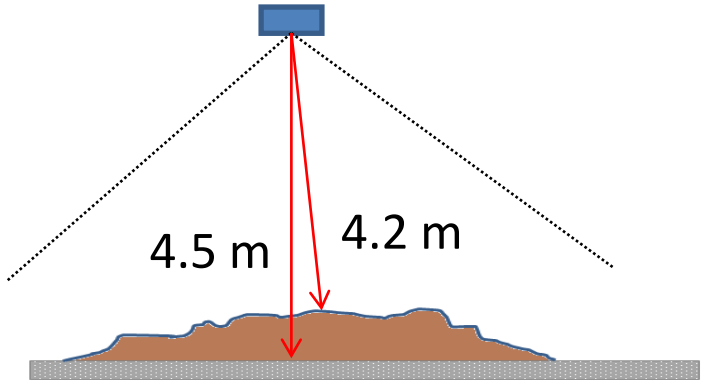




Measure of individual feed - Identification



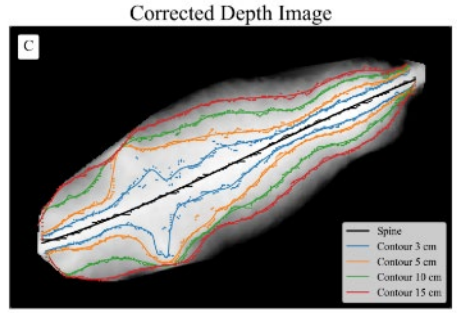
3D Camera – time of flight

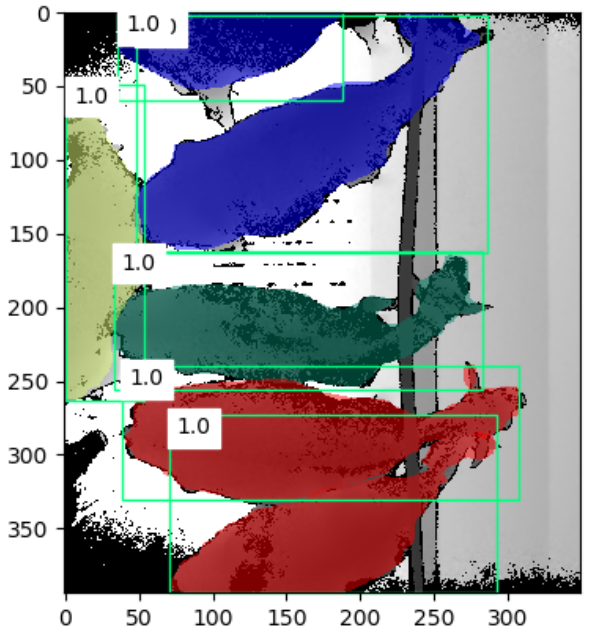


Cow Identification from Contour to MASK-CNN

- ID accuracy with contour model 95-98% in Jersey
- Change of algorithm from contour to MASK-CNN
- Including colour, patterns, contours in model
- **ID accuracy +99%** in all three breeds

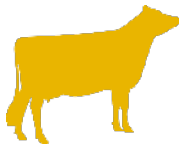
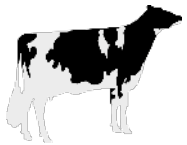
Contour





Mask-CNN

Installations and Agreements with test herds

	# cows	# herds
	4,000	7
	4,300	9
	5,300	11

Goal

10,000

registrations per breed in early 2025

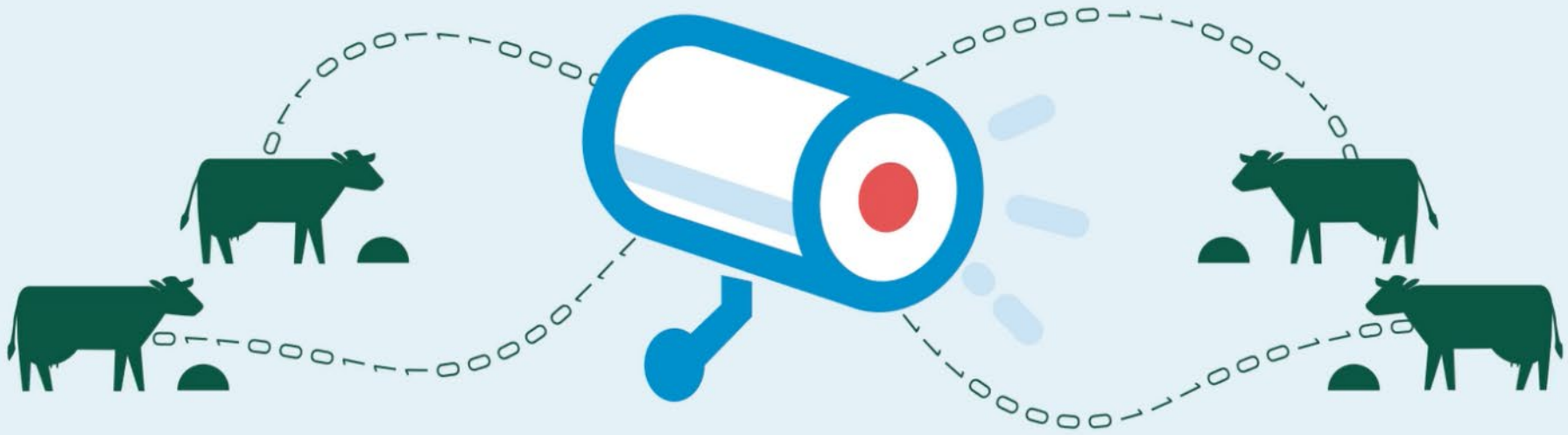
Data flow and amount 2023

1,900+
cameras

90,000,000+
images per day

700.000+
feed visits per day

100.000+
meals per day



Cattle Feed Intake (CFIT)

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Integrated system

- Algorithms
- Hardware
- Fit into the barn
- Automized system surveillance
- Event detection
- Data integration

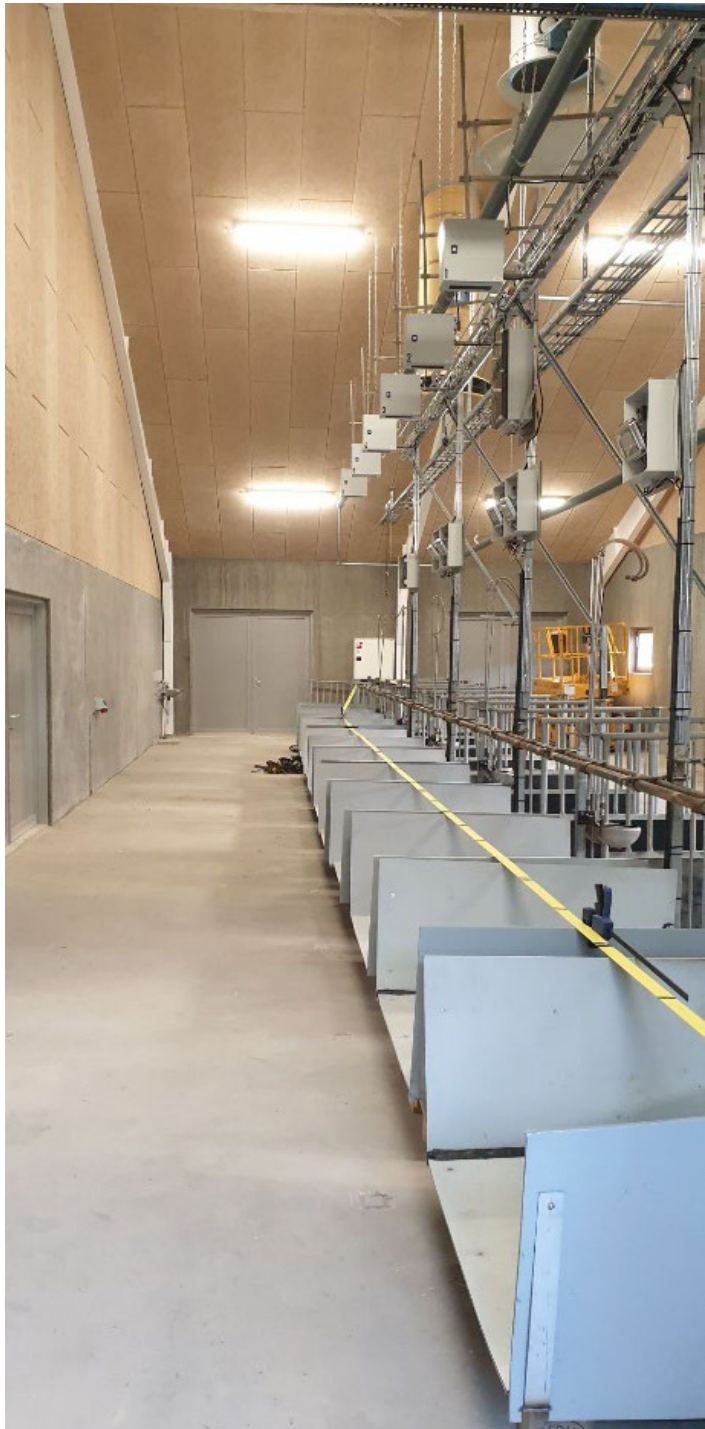
Validation study

Validation study at Aarhus University

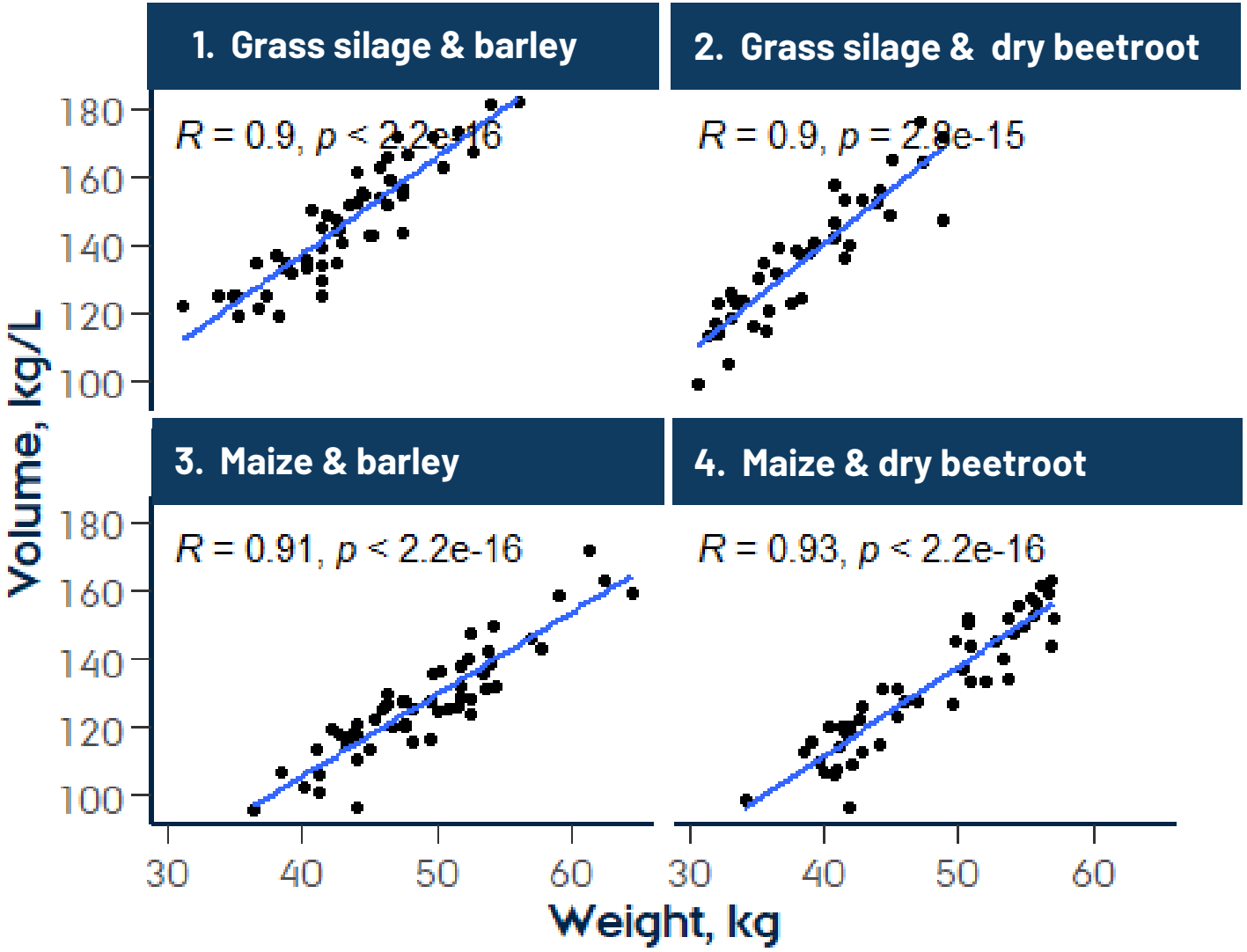
Challenge the camera system with **different feed densities** – especially with different silage types

- Measure of feed from **scales** and **cameras**
- **4 diets**:
  1. grass silage & barley
  2. grass silage & dry beetroot
  3. maize & barley
  4. maize & dry beetroot
- **48 HOL cows** in trial

Giagnoni et al.,2022

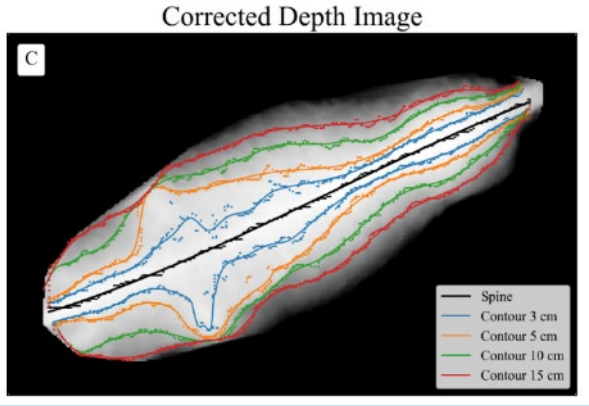


High correlation between kg and volume



Giagnoni et al.,2022

Weight Predicted versus Scale



1,329

Measurements
from 102 Jersey cows

460 kg

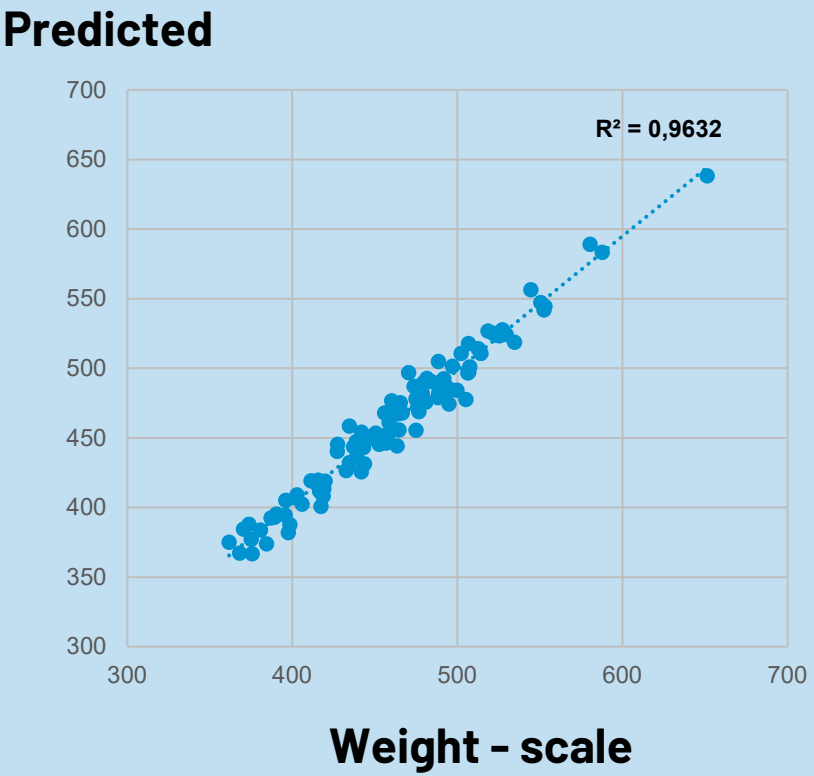
Average weight
(350-650 kg)

400

contour points
per picture

PLS

model



Preliminary genetic analysis

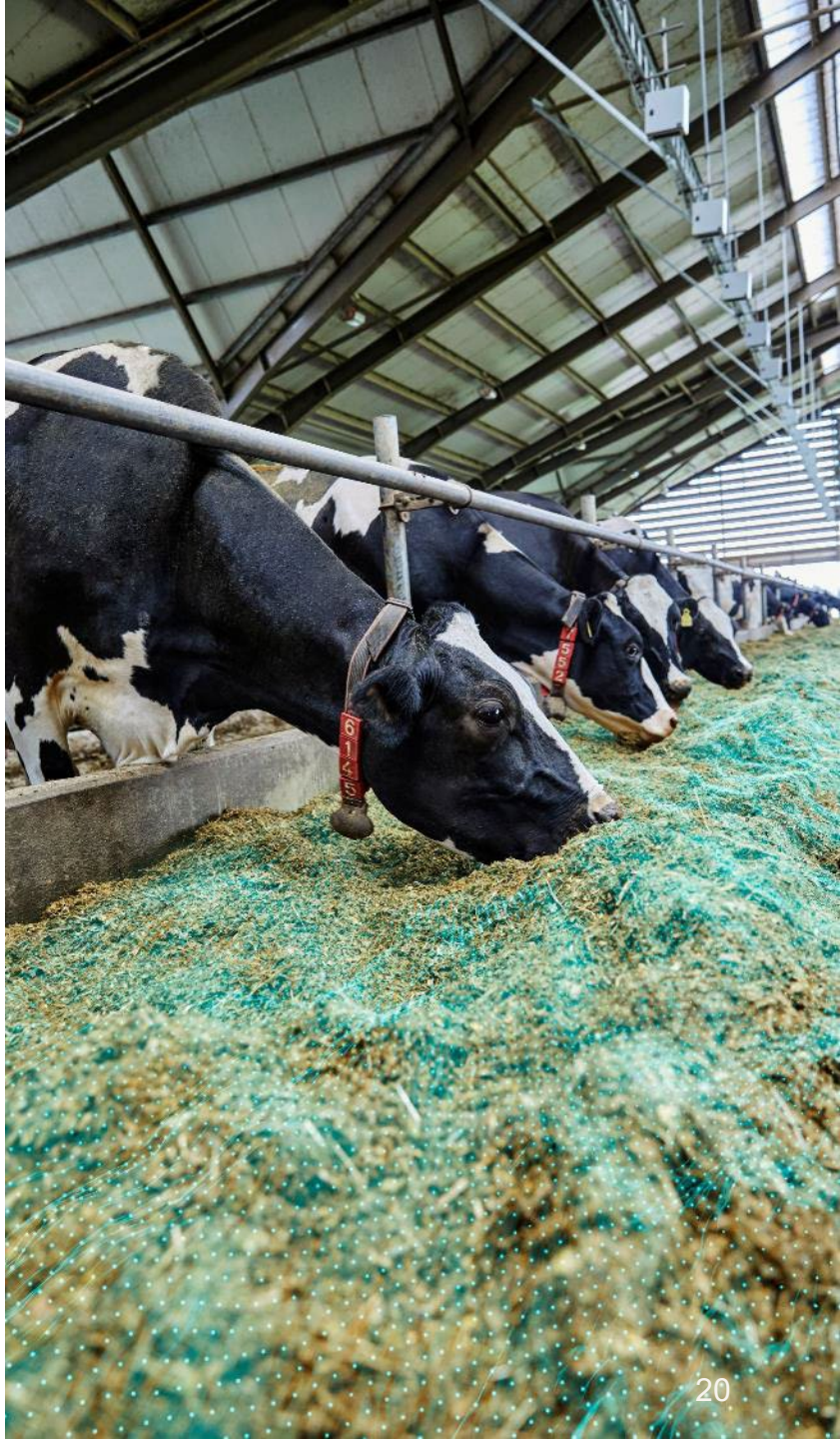
Data

Breed	Trait	Number of records	Mean	Minimum	Maximum
Holstein	DMI	**65,393**	**27.7**	**12.7**	**40.9**
	BW	**65,293**	**675.8**	**448.4**	**905.0**

Cows with phenotypes: **2,668**

Cows with genotypes: **1,824**

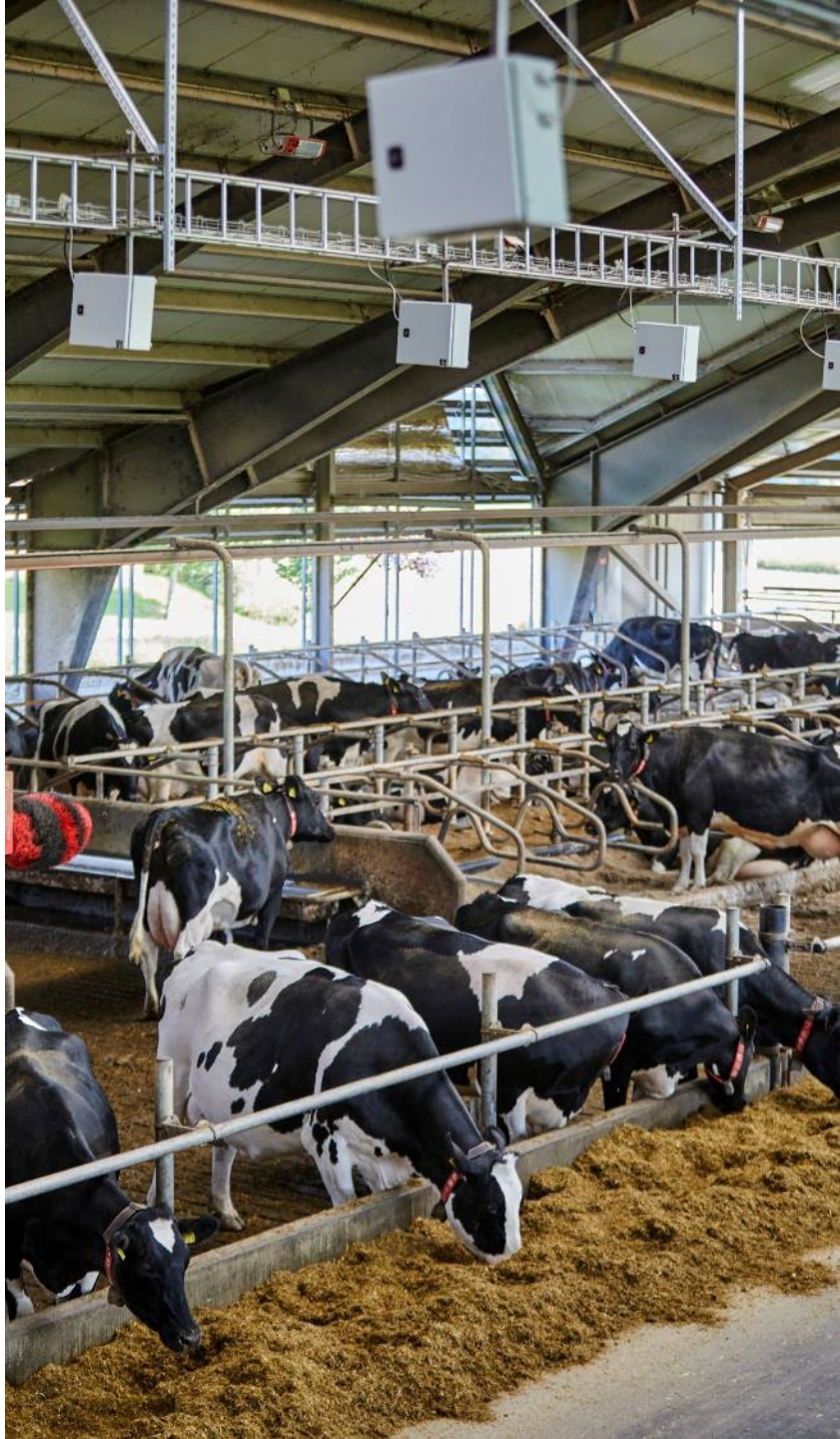
Manzanilla-Pech et al., 2023



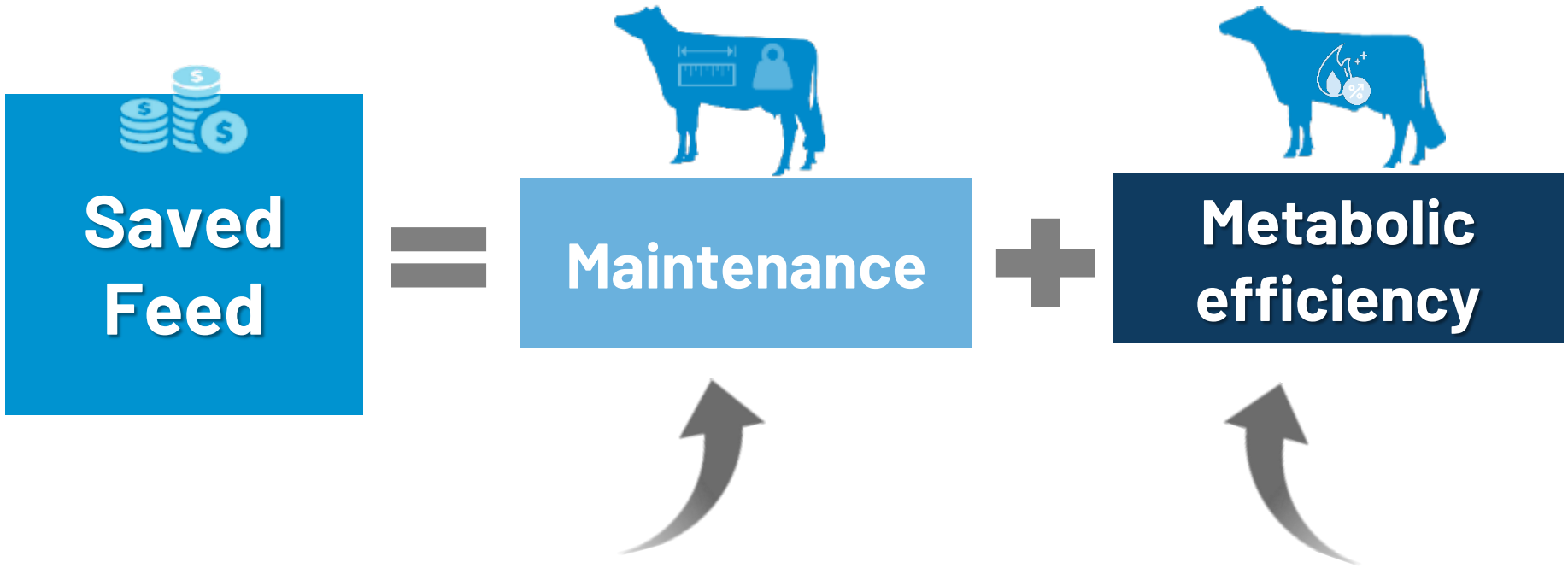
Heritabilities

Trait	Pedigree	Genomic
DMI	0.23 (0.02)	0.25 (0.02)
BW	0.47 (0.05)	0.51 (0.04)

Manzanilla-Pech et al., 2023



CFIT registrations in the Saved Feed index



The goal is to achieve reliability

50%

for the three breeds in early 2025

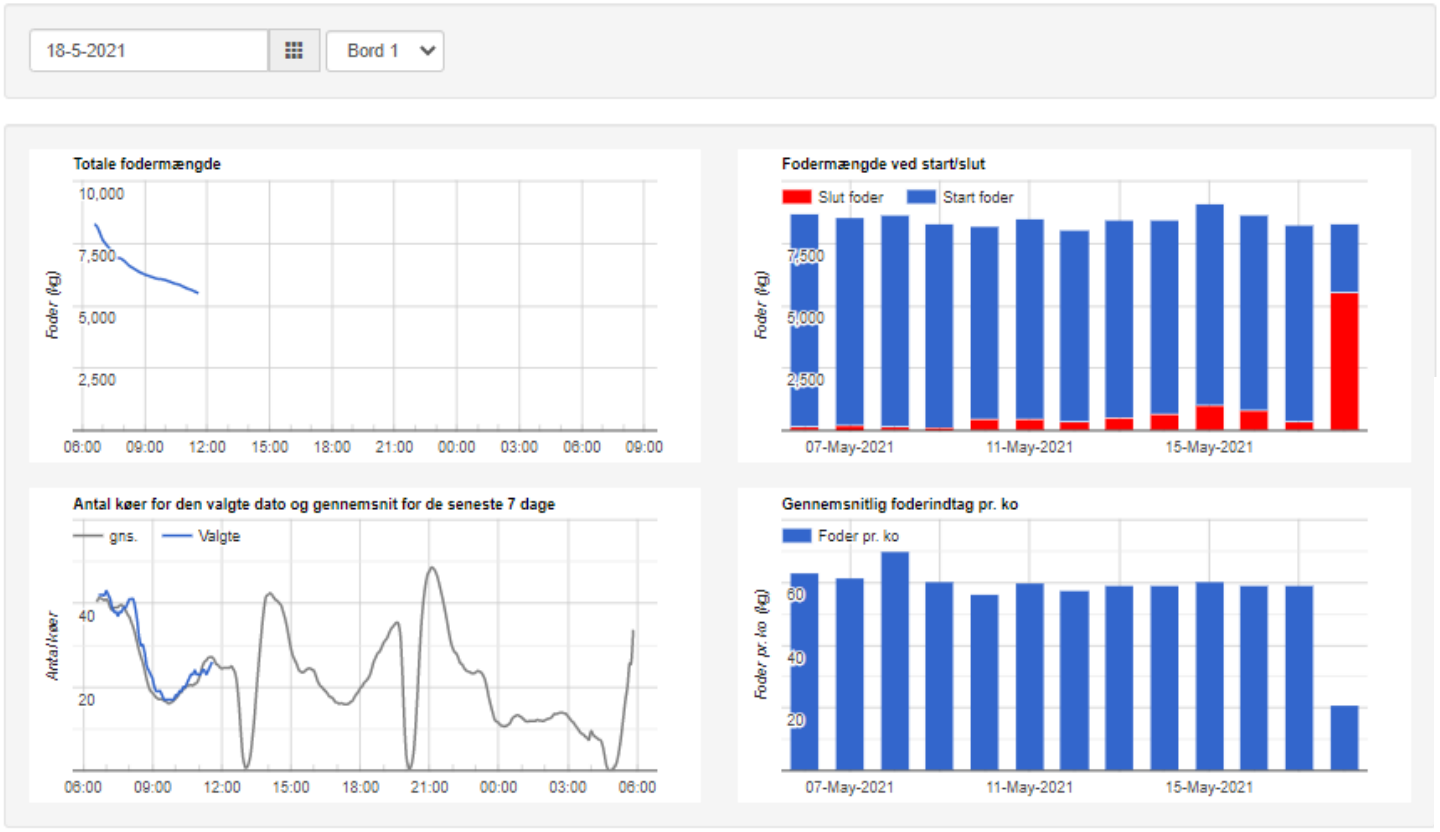
Requires information on the cow's weight

Requires information on the individual cows' feed intake, performance, weight, pregnancy etc.

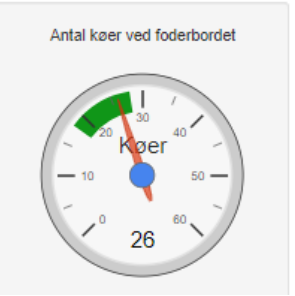
CFIT and management

Development of Management software used in the CFIT test herds

Feeding table



Herd level



Under 10% foder tilbage

Dag	Kl.	Kg
5/18/2021	-	>10%
5/17/2021	23:25:00	813
5/16/2021	-	>10%
5/15/2021	01:35:00	837
5/14/2021	00:40:00	834
5/13/2021	00:00:00	800
5/12/2021	03:10:00	549

Cow level

Køer med længst tid siden sidste måltid

Ko nr.	EKM (kg)	Tid siden måltid (tt:mm)	Lakt.nr	Dage fra klvn
056762 - 04737	40	15:41	3	181
056762 - 04542	51	9:41	3	159
056762 - 05376	32	7:53	1	177
056762 - 03879	50	5:23	5	127
056762 - 03752	56	5:15	5	123
056762 - 03393	0	5:10	7	8
056762 - 04594	44	4:52	3	177
056762 - 05374	44	4:30	1	156
056762 - 05398	37	4:24	1	114
056762 - 05024	43	4:22	2	130

Better claw health with use of Artifical Intelligence

Project period: 2023-2026

Peter Raundal, SEGES Innovation

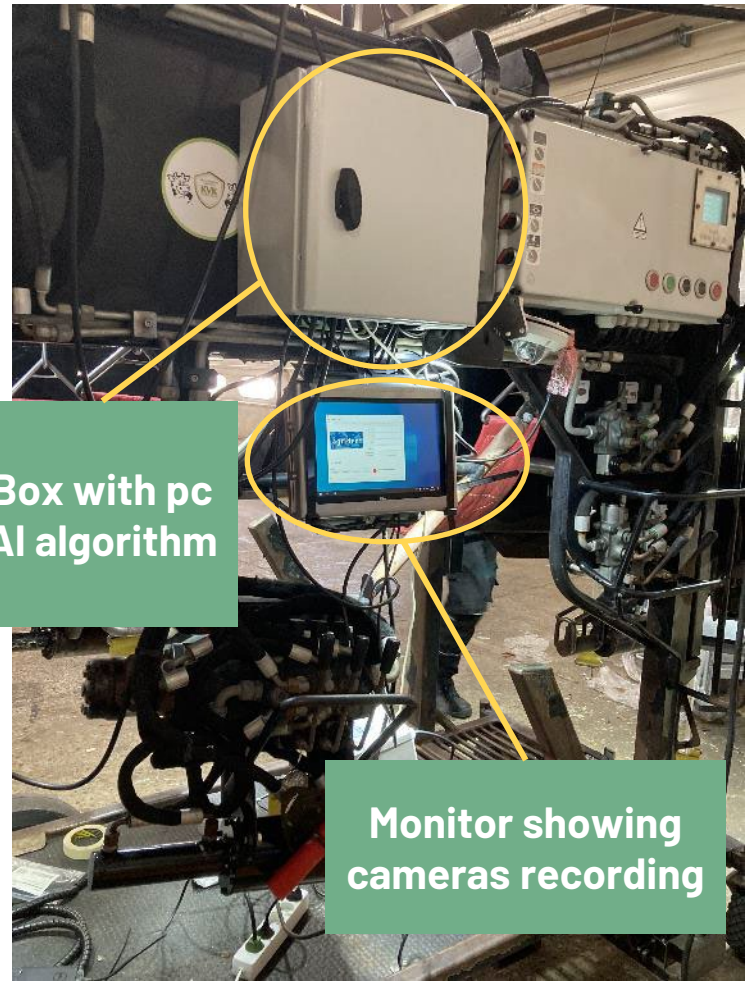
Ministeriet for Fødevarer, Landbrug og Fiskeri
gudp
STØTTET AF
Mælkeafgiftsfonden
SEGES INNOVATION

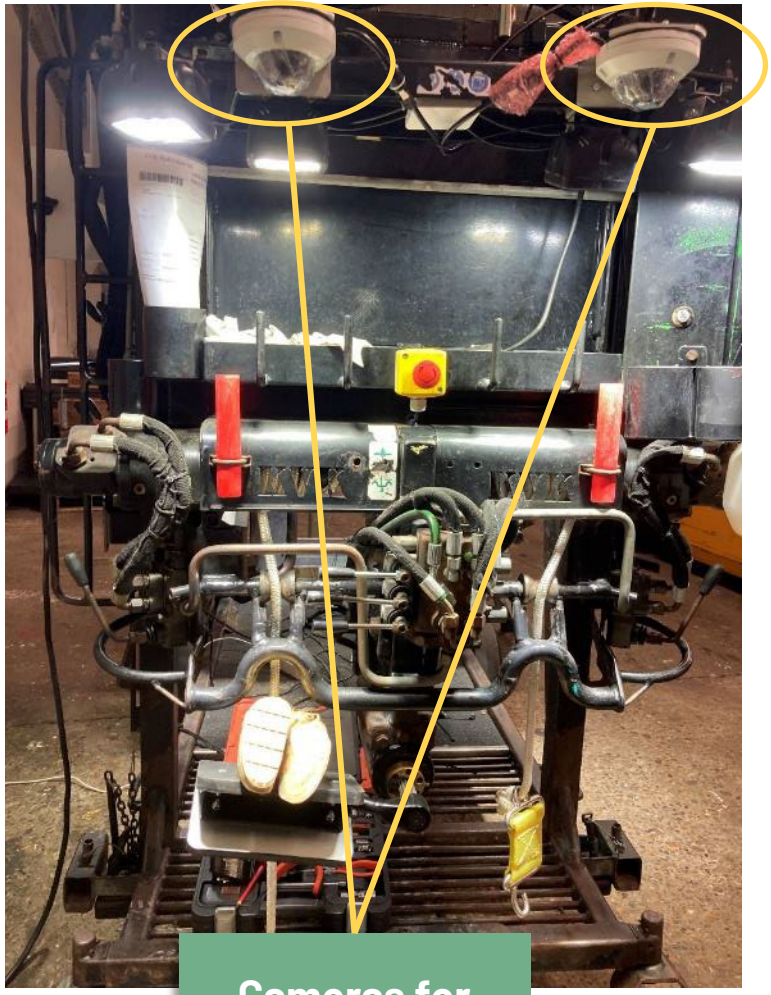
Motivation

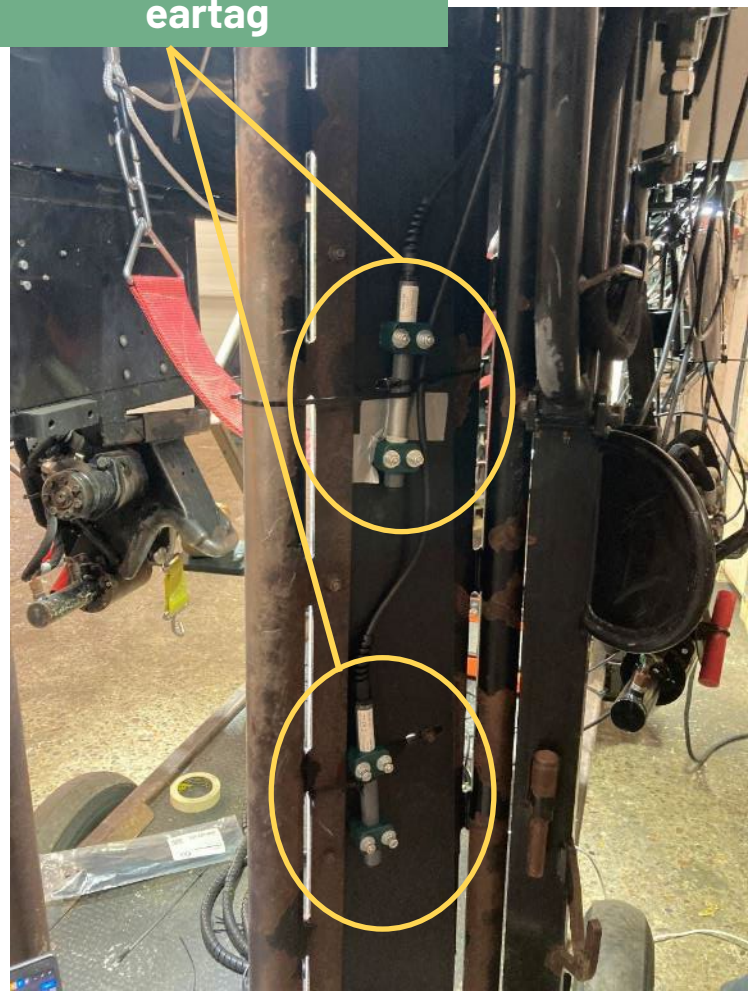
- In Denmark yearly more than **700,000 registrations** of hoof treatments
- Approximately **50%** of all hoof treatments have at least **one claw diagnosis**
- Today registrations are done **manually**

- **Automated registrations** will initiate more registrations of higher quality giving the farmer a better tool to increase claw health in own herd
- More **accurate breeding values** for claw health

Installations on the hoof trimmer box







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How does it work?

- Cameras record during hoof trimming
- **AI-model trained to recognize:**
  - A hoof (extract all other noise)
  - **Hoof trimming** – the cow registrated as trimmed
  - Model is trained to recognize **24 different claw diagnoses**
  - **Treatment** – claw bandage and/or shoe
- Registrations **uploaded to the central cattle database** (DMS)

SEGES INNOVATION

Improved animal welfare and production with use of new technologies (WelCowTech)

Project in pipeline (2024 -2027)

Lars Arne Hjort Nielsen, SEGES Innovation

SEGES INNOVATION

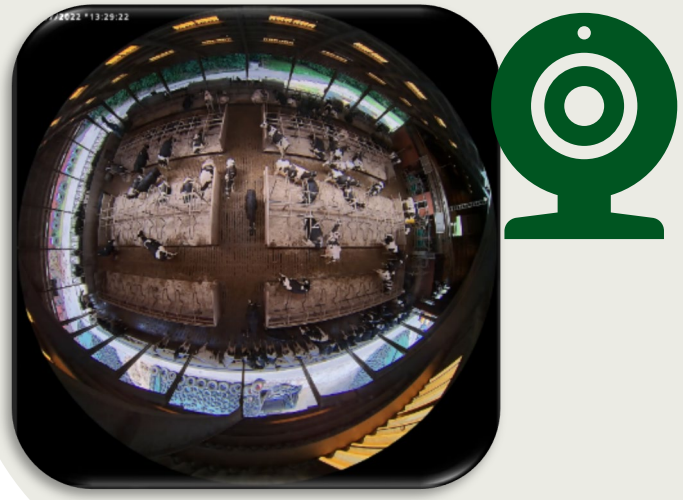
Welfare

Cattle Database
Activity measures

Milk volume
AMS etc.

Algorithms
Resiliense, Disease Detection Welfare Scores

New indicators based on vision technology



Annotated data
AI algoritms
Movements,
Welfare,
Tracking,
Other Indicators

Prototype

Prototype

New Prototype

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Value for farmer

Economic value

- Actions which increase the cows laying time and milk production (feeding and grouping)
- Early detection of sick and lame cows

Saving of workload

- Surveillance of cows through AI
- Detection of cows for hoof trimming and observation

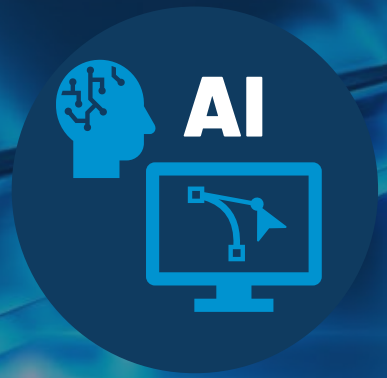
Assurance of production quality

- Document animal welfare in an objective manner
- Document variation in behaviour
- Reduced climate impact through increased longevity

SEGES INNOVATION

To sum up

Camera Technology can produce large scale data from commercial herds and provide **new phenotypes** valuable for both management and breeding



Camera technology combined with **AI technology** is an area **under huge development**

Important future tool to **improve management** and **genetics** in dairy production

Thank you!