PRECISION DAIRY CONFERENCE

BLOOMINGTON, MN

JUNE 20-21, 2023

Organized and hosted by:

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Tuesday June 20, 2023

Wednesday June 21, 2023

Sustainability

Tim Taylor, CEO, Vyla

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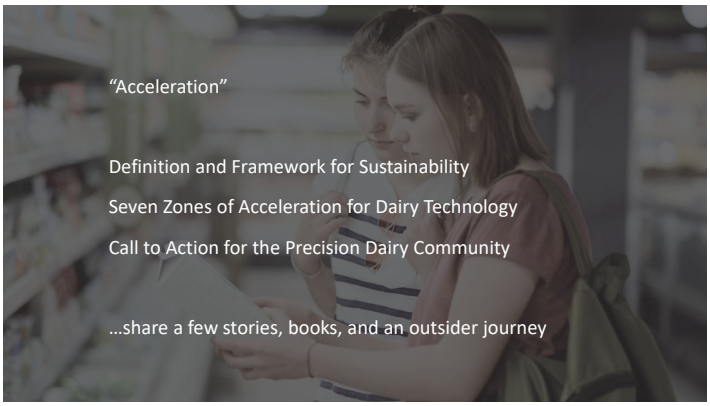

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An Ag Valley

The Valley is a "state of mind"

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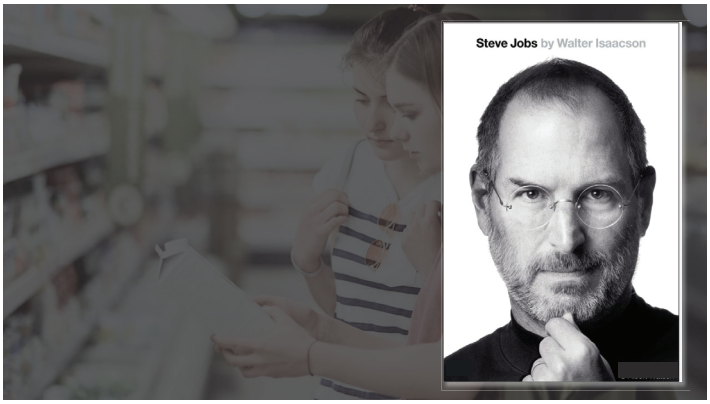

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8th Grade Assembly

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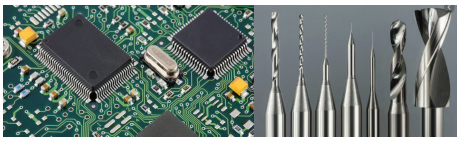
The Entrepreneurial Thing - Manufacturing



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The Entrepreneurial Thing - Software

8

My First Dairy Farm Visit

9

Sustainability Performance Platform - Connecting the Dairy Supply Chain

Nestlé — Link to on-farm systems, audits

DANONE — Flexible audits

FARM — RuFaS model, audits

VYLA

10

Sustainability

"meeting the needs of the present without compromising the ability of future generations to meet their needs"

Colorado School of Mines

11

Environmental

Socio-Cultural

Agricultural

Consumers

Geopolitical

Scientific/Academic

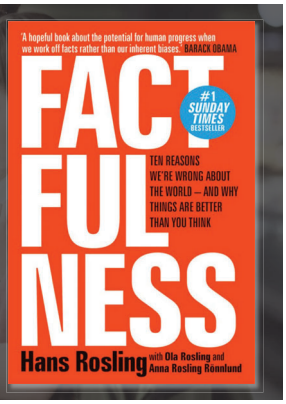
Economic

Technological

12

Underlying the discussion of

Sustainability is data-driven truth



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7 Zones of Acceleration

for

Sustainability Technology in Dairy

14

1. The Internet of Things

- IoT is the Foundation of Technological Transformation
- Ground Truth for Data-driven Decisions
- "Measure it / Manage it"

15

2. Genomics

- Healthier, Higher-Output Cows
- Improved Milk Quality and Farm Profitability
- Matching Animal Traits to Sustainability Priorities

16

Sustainability

"meeting the needs of the present

without compromising the ability of future generations

to meet their needs"

Colorado School of Mines

17

Environmental

Socio-Cultural

Agricultural

Consumers

Geopolitical

Scientific/Academic

Economic

Technological

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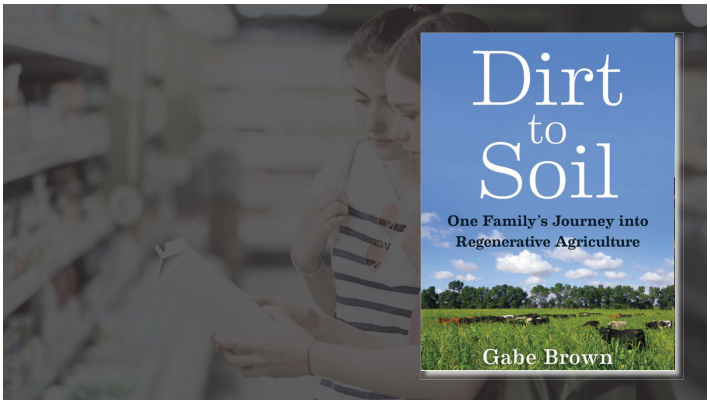
5. Soil and Water

- Regenerative Agriculture
- Water Efficiency and Management

"Regenerative Agriculture is a restorative form of farming that promotes biodiversity with a focus on healthy, living soil"

"Whiskey's for drinking. Water's for Fightin' Over"

19



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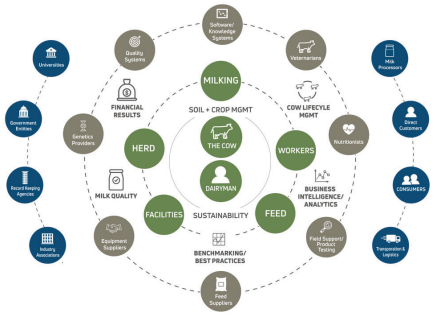
6. Generative AI

"you won't be replaced by AI, but you will be replaced by someone who is using AI"

22

7. Integration and Collaboration in the Ecosystem

- Integration between platforms is mission critical for technology acceleration
- The foundation of collaboration is data privacy and security for the farmer and trust between entities in the ecosystem



23

Sysco — Integration — salesforce, verizon connect, SAP

- $75 billion in revenue
- 14,000 delivery trucks
- Challenge: Driver workflow inefficiency / disconnected legacy systems

Outcome:

Increase from 14 deliveries/day to 16 deliveries/day per truck (+14%)

24

April 19, 1906

VOL. LV...NO. 17,617.

OVER 500 DEAD, $200,000,000 LOST IN SAN FRANCISCO EARTHQUAKE

Nearly Half the City Is in Ruins and 50,000 Are Homeless.

25

"The great earthquake and fire of 1906 was a turning point for dairies and milk dealers that served San Francisco."

Ken Morrill, Arrowhead Farms

Disruption
↓
Collaboration
↓
Transformation


George L. Perham

The Dairy Delivery Company


Tim's Weekend Transportation

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Call to Action

Pursue Collaboration → Lift for Farmers AND Suppliers

Accelerate Integration Between Platforms → Create Decision Intelligence, Efficiency

Accelerate Technology for Sustainable Farming → Feed a World of Worthy People

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Dairy Methane Emission Reductions

Mike Jerred, Cargill

Dairy Methane Emission Reductions

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Agriculture Is How We Will Address Climate Change

Cargill Ambition — Uncover the power of farmers & nutrition by doing more with less to feed the world & protect the planet

4 outcomes

Climate	Land & Water	People	Animal
• Meet 2030 pathway commitments (scope 1, 2 and 3) on carbon emissions • Reduce GHG gas emissions • Operation & transportation efficiency, portion of renewable energy • In our supply chain	• Land use, deforestation & conversion free • N,P emissions reduction • Lowering water use & improve water quality, priority watersheds & water stress areas	• Enhance farm livelihood • Make food affordable for all • Promote & Respect Human Rights	• Increase efficiency • Enhance Welfare

2

The Sustainability Story

A gallon of milk in 2007 had a **63% smaller carbon footprint** than in 1944

A gallon of milk in 2017 had a **19% smaller carbon footprint** than in 2007

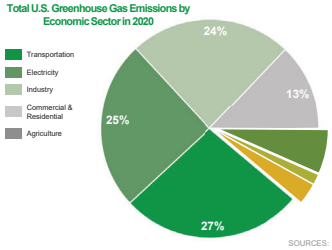
Today, **2/3 of all consumers** will pay more for sustainable products

1944 — 2007 — 2017 — Present

SOURCES:
United States Department of Agriculture

3

A Breakdown of Dairy Greenhouse Gas Emissions



SOURCES:
Environmental Protection Agency. *Sources of Greenhouse Gas Emissions.*
Environmental Protection Agency. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019.*
Massey, R., & Kientzy, D. Agriculture and greenhouse gas emissions.

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Charts here

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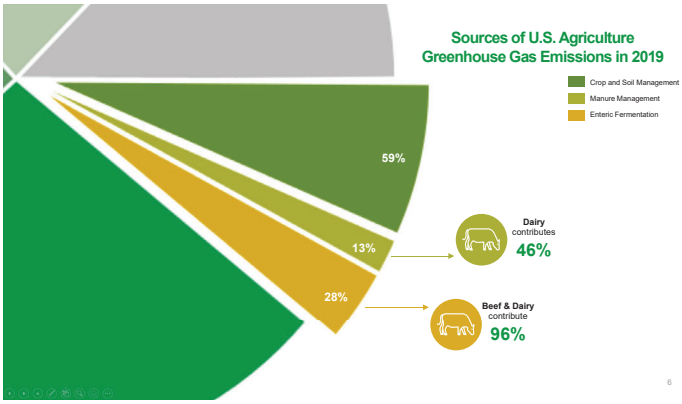

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6

Enteric Methane: A Natural Occurrence

Fermentation → Hydrogen → Methane

Primary ways to influence the animal's natural process and reduce methane output

1. Change fermentation pattern
2. Inhibit growth or activity of microbes that produce methane
3. Feed additives that use or convert methane
4. Utilize hydrogen to alleviate methane output

7

Cargill's Investment in Industry Research

Internal R&D Initiatives

Idaho CAFE's research dairy

Cornell Research

8

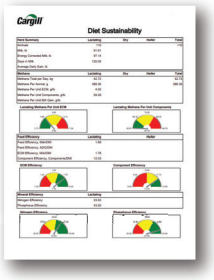
Know Your Numbers

Predict
Understand existing enteric methane emissions and efficiency utilizing our expected outcomes

Identify
Discover enteric methane reduction and efficiency opportunities, and create an action plan for further improvement

Validate
Utilize dairy MAX to validate predicted performance to actual performance to optimize for profitability and sustainability

Report
Captures quantitative data on key performance indicators to manage to your sustainability program goals


Cargill

Diet Sustainability

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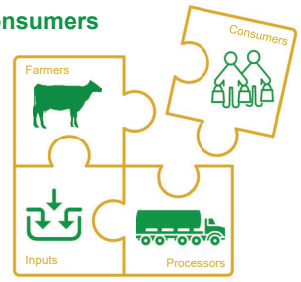
Supply Chain and Consumers

Cargill is using our position in the industry to connect stakeholders in the supply chain to consumers.

Consumers needs and opinions affect the supply chains decisions, this is why sustainability is important.



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Cargill®
Helping the world *thrive*

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11

Using Tech to Improve Sustainability

Dennis Haubenschild, Haubenschild Farm

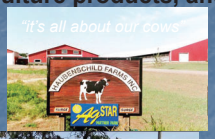
Haubenschild Farm

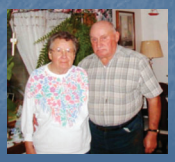
Producing many deliverables in an environmentally safe manner

1

Haubenschild Farm

Our family-run dairy farm is a responsible environment friendly agriculture business focused on the profitable, progressive, and sustainable production of high quality milk, related agriculture products, and renewable energy.





Myrtle and Donald Haubenschild, 1952 Founders

2

Haubenschild Farm History

- Established 1952
- Started w/ 128 acres
- 100 year old house and farm buildings
- No electricity
- 2 cows
- 1990s became a 3 Generation Family operation
- 1000 acres
- Modern facilities
- 1600 cows

3

Farm Objectives

Sustainable - environment-friendly farm

- Milk production
- Energy production
- Heat recovery
- Minimized odors
- Soil preservation
- Effective feed program
- Recycled water
- Improved nutrients
- Family-oriented
- Fair profit
- Fun

4

Milk Production-Today

- 1600 cows in production
- 250 in dry barn
- milking 3X per day
- 137,600 pounds per day or 16,200 gallons

5

Milk Production

- no human handling
- closed sterile system
- minimal agitation

98F to 36F instantly

3 - 6,000 gallon tankers

6

Feed Management

- Computer generated TMR
- Minimal shrinkage

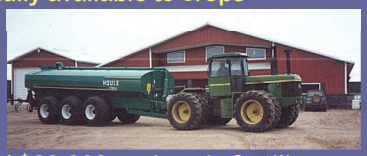
- Once a day feeding
- Recovery of unused portion
- Cost effective program

7

Nutrient Management

Soil Preservation

- Increased nutrient value of the processed manure
- More readily available to crops



- Estimated $60,000 savings in fertilizer
- Manure is a commodity
- Digestate is a soil amendment
- 90+ % odor reduction
- One cow supplies the nutrients for one acre of land – One acre supplies the forage for one cow

8

Manure Digester

Using that nondepleteable renewable resource

- 130'LX30'WX14'D
- 1/2 million gallons
- 20,000 gallons each day
- constant 100F degrees
- 1,800' of piping

- Methane production
  - via anaerobic decay

72500 cf of biogas per day
Biogas is 60% methane
& 35% CO2 50 cf/min
23 cf/kWh

9

Methane Powered Co-gen Electricity Production

- Started project June 1999
- Fully operational Oct 1999
- 150Kw generator
- Waste heat recovery for digester operation and building heat

10

Electrical Transfer

connection to power company

11

As of 11/20/2009

The system has been running for almost 24 years

Been running 95% of the time producing 130 kWh 24/7since 9/20/99

12

Biogas produced from one day's manure from 100 cows has about the same energy content as 1 barrel of oil

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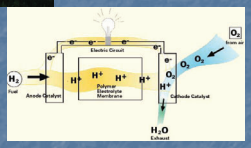
Taking that next step – Hydrogen !

Research Lab



- University of Minnesota,Biosystems and Agriculture Engineering
- Legislative Commission on Minnesota Resources
- The Minnesota Project
- John Deere
- Electric Power Research Institute

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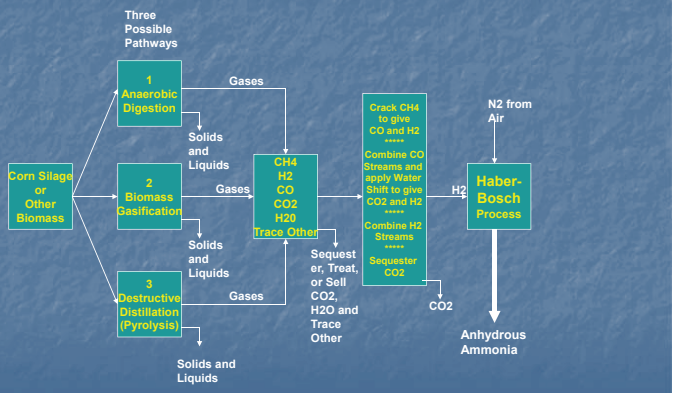
Ammonia From Biomass



15

Using Bio-gas to run a Farm Pickup

16

Sustainability in agriculture is achieved by using **all** of mother natures tools.

We have shown that we can produce hydrogen from bio-gas.

When cogeneration and tri-generation applications are used, overall energy efficiencies of 70+ % are possible.

Agriculture has to play a major roll in supplying our domestic energy needs!

Thank You, Dennis Haubenschild

17

Labor Challenges and Tech Intro Talk

Matt Lange

Financial

Dairy Labor and Tech
– A Proposal for a Standardized Approach

June 30, 2023

Matthew Lange,
Dairy Business Consultant

1

Global Approach to Labor and Tech

- Garbage Collection = Changing Profile of Labor + Productivity
- Wausau Foundry = Integration with Labor
- ChatGPT = Replacing Labor

OpenAI

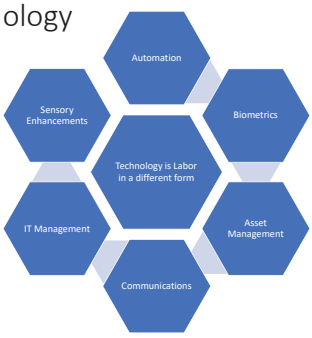
2

Dairy Labor

- What we know about labor on dairy farms today.
  - Continual challenges with limited improvements…we are still talking about labor and labor issues from the early 2000's.
  - Accessibility & Retention
    - Routine gaps in payroll
    - Turnover rate: 2.5 w-2's / Full-time Equivalent
  - $
    - Wages are continually rising: 10% to 30% increases
    - Cost has stayed the same for last 5 years: $3.35/cwt. today.
    - Wages offset by higher productivity.
  - Ironically: Little correlation to dairy farm profitability. We'll get to this later.

3

Dairy Technology



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A – E – I – O – U

- Assessment – Does it fit?
- Economics – How does it pay?
- Implementation – How do we make it happen?
- Output – Is it achieving expectations?
- "U" – Where am I in this?

5

1. Assessment

- Healthy Skepticism
  - What is it really going to do for MY business?
  - Am I ready for it?

Changes	
Labor	Management
Profile Change	Time
Productivity and/or Skill Increases	Understanding & Learning
Replacing Activities	Actions

- Decision-Tree…If "x" happens I do "y"

6

2. Economics

- Lowest labor cost does not correlate to profitability, ***but it has the potential.***
- Replacing labor with technology will be offset by depreciation and interest of capital…therefore…
  - What are we getting for what we are paying for and ….
  - Can technology provide an improvement on margin through output and consistency.
- What other capital needs to support technology?

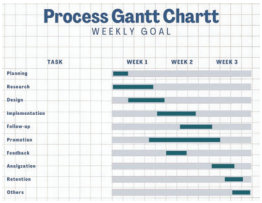
7

2. Economics

- Return on Investment
  - Productivity vs. Efficiency
  - Timeline & Impact to Cost of Production
- Debt Structuring
  - Working Capital = HOLY WATER!!!
  - $35 to $45/cwt. Total debt load. Standard is about $20/cwt.
  - Robots – 7 to 10 years. Construction – 15 to 20 years. Blend of 12.5 usually
  - P&I payments/cwt. at $4.50/cwt. approximately, standard is < $3.50

8

3. Implementation



- Integration from setup to ongoing/daily activities.
  - Shifting for time.
    - 15 minute increments of the day.
- Accountability & Training
  - Personnel responsibility
  - Adoption rates are dependent upon ***retraining***
- Learning and Troubleshooting
  - Reducing frustration and limited utilization

9

4. Output

- Technology is Knowledge & Benefit is Application
  - Data interpretation and response
  - Adaptation to new reality
- Measuring progress.
- Maximize tools.

10

5. "U" = You

- Management must shift as tech changes labor.
  - A new language: data understanding
  - A new oversight: same responsibility
- Success is dependent upon a planned and actionable strategy.
- Understanding the common denominator.
  - Time

11

Define Our Understanding of Labor & Tech

Labor and technology are valuable assets & investments.

Technology can replace labor, enhance labor output, provide task consistency, and even reduce overall labor cost over time.

Successfully achieving these outcomes however, depends on a clear understanding of needs, application, and management.

12

Financial

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Dairy Business Consultant
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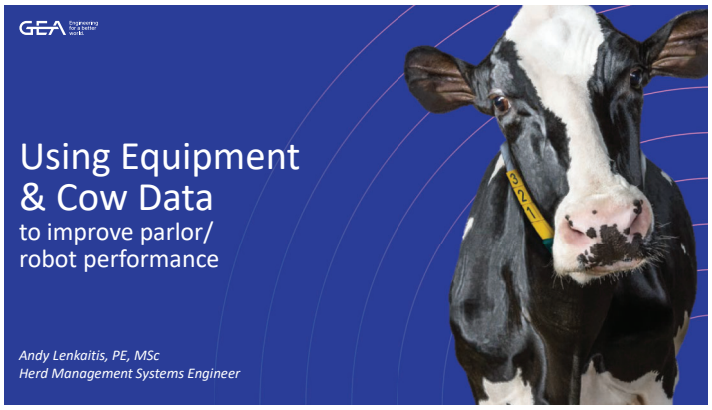
Using Equipment & Cow Data to improve parlor/robot performance

Andy Lenkaitis, PE, MSc
Herd Management Systems Engineer



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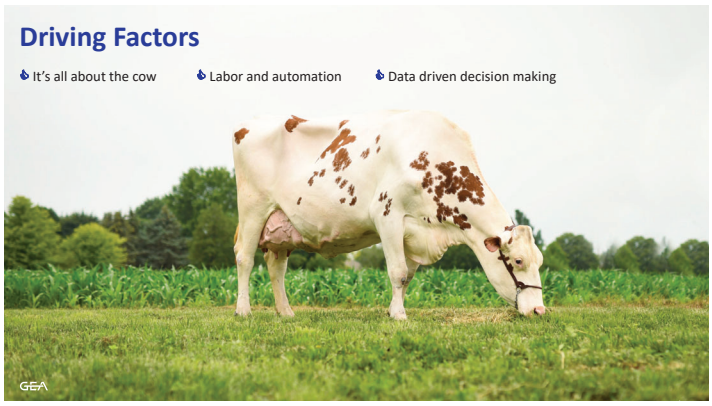

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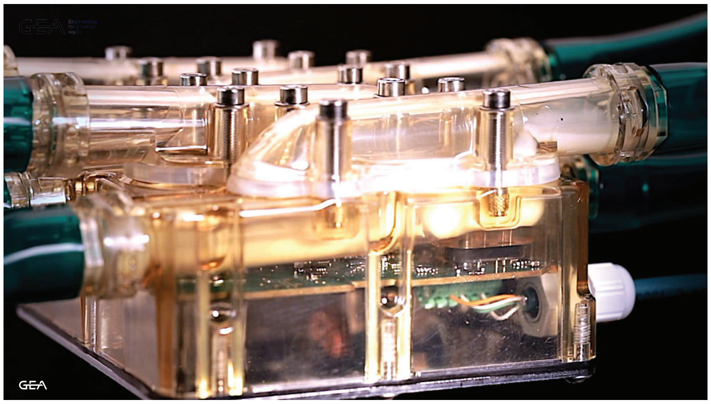

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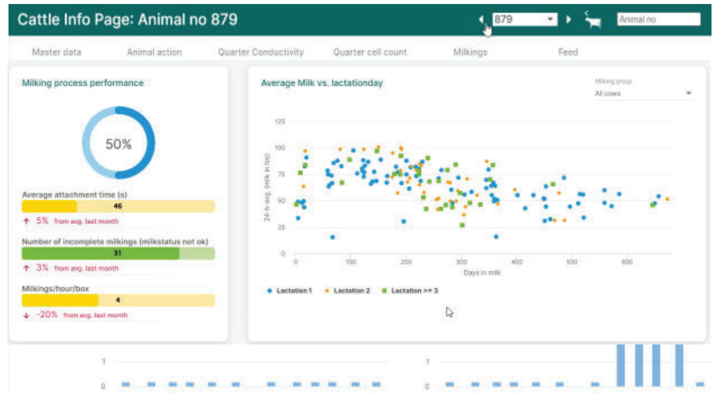
Cattle Info Page: Animal no 879
879
Animal no
Master data
Animal action
Quarter Conductivity
Quarter cell count
Milkings
Feed
Milking process performance
50%
Average attachment time (s)
46
5% from avg. last month
Number of incomplete milkings (milkstatus not ok)
31
3% from avg. last month
Milkings/hour/box
4
-20% from avg. last month
Average Milk vs. lactationday
Milking group
All cows
24-h-avg. (milk in lbs)
Days in milk
Lactation 1
Lactation 2
Lactation >= 3

8


HERD
NERD

9


Partners in Success
Central Ag Supply

10


Engineering
for a better
world.
GEA.com

11

Automation to Improve Labor

Nathan Brandt
Four Cubs Farm – Grantsburg, WI

1

2

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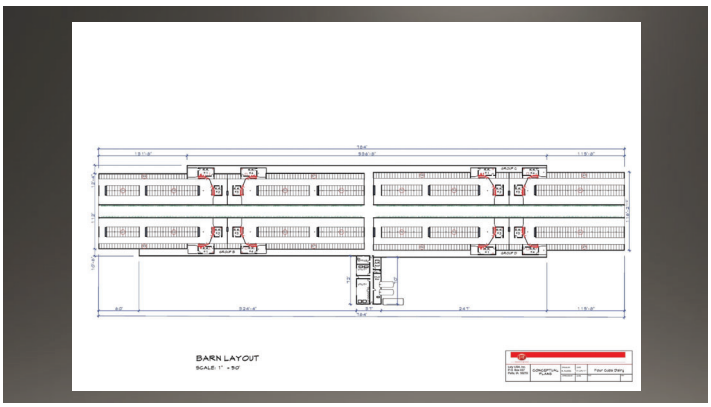

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6

7

Most Important for our Labor

- Rumination and Activity Collars
  - Directing Employees to the cows they need to take care of.
- Fresh Pen
- Sort Gates
  - Separating cows for certain tasks saves time and less disturbance to the main group.
- Fetching Fresh Heifers - 4 times in the first 10 days.
- Cross-training
- Labor Flexibility

8

FOUR CUBS FARM
SINCE 1877

Thank You

9

Carlson Dairy, LLP

Chad Carlson

1

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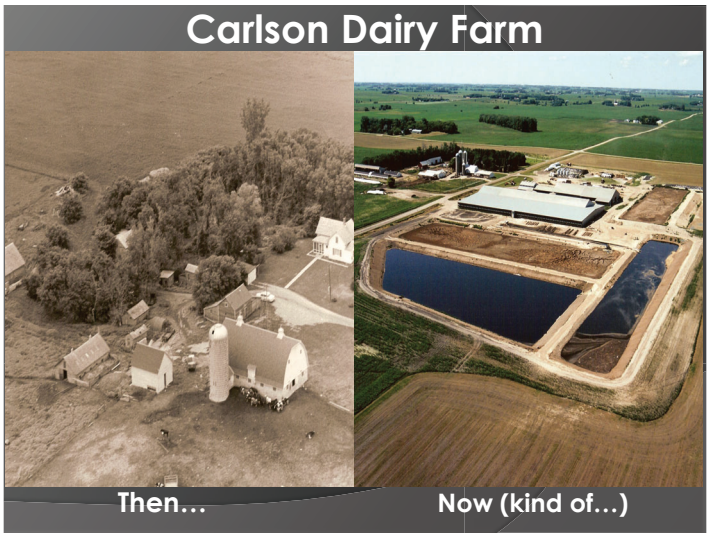

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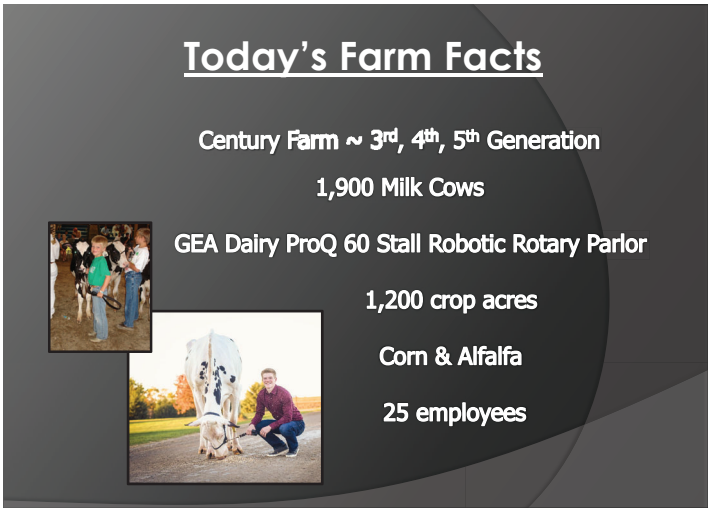

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6

Words to Live By…..

A favorite Mark Twain Quote:

"Twenty years from now you will be more disappointed by the things that you didn't do than by the ones you did do."

7

Crop Land

- 100% for Feed Use
- 2023 Crop Acres
  - 500 Alfalfa Acres
    - Haylage (Majority)
    - Baylage
  - 700 Corn Acres
    - Corn silage
    - High Moisture Corn/Earlage
- Harvest Timing
  - Haylage: Chop 4-5 crops Annually (May – Sept)
  - Corn Silage: Early Fall Harvest
  - Earlage: Mid Fall Harvest

8

Haylage Harvest

9

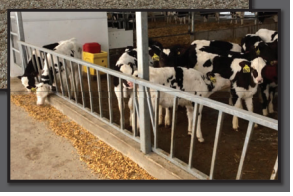
Corn Silage Harvest

10

Baby Calf Barn

11

Baby Calves



12

Automated Calf Feeders

13

Automated Calf Feeder
CALF**MOM**

14

Heifer Barn

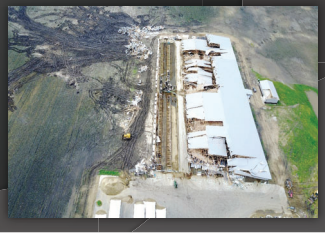
15

Home to 1000 Heifers

16

2017 = Challenging Year

Storm Hits 6-11-17



17

Storm's Silver Lining

It was the push we probably needed...

New Robotic Rotary Parlor Summer 2018

18


GEA 60-stall Robotic Rotary Parlor

19


Robot
Stalls

20

21


CARLSON DAIRY
Est. 1891

22

Feltz Family Farms

Jared Feltz

1

2

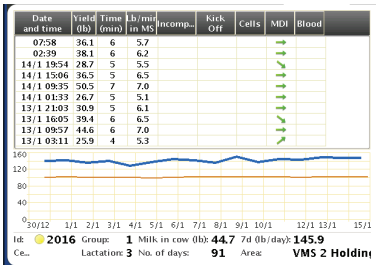
3

4

5

Our Robot Goals- 2018

Cows/robot	52-56
Milkings/cow/day	>3
Milk/cow/day	100#
SCC	100
Milking Duration	6:30
Yield/robot/day	5,000#



6

Speed Dating in WI

Don Niles, DVM
Pagel's Family Businesses

Precision Dairy Conference

"Speed Dating in WI"

Don Niles, DVM
Pagel's Family Businesses

1

PFB Philosophy Regarding New Tech

Does it make sense to us?
Does it make sense to the cows?
Where is the system in its development process?
- Our ideal point is ready but room to modify
- We are very willing to offer feedback and work with design/support

2

Cainthus

Camera Based system to monitor in-pen behavior
- Focused on feeding/feed-bunk behavior
- Installation a bit cumbersome
- Drop in place
- Uses its own cell system (Cost vs reliability)
- Cost $3.50/head/month

Provides some alerts (feedbunk empty, herd lockups too long)
Some useful graphs (Cow comfort Index, laying time by pen)

Tremendous potential for advanced herd management
Requirement for dedicated user(s) on staff
Great tool for making very good herd even better
Intriguing potential synergy with feed push robots

3

Cattle Eye

Monitoring System to access individual cows as they pass through a camera's vision
- Current uses include lameness detection
- Potential uses include body condition scoring

Only in use for two months
- Cows selected for lameness similar to what we are already identifying
- Body condition application in process

High potential system but needs work to add cost justifying value in our hands

4

Cattle Care

Camera based AI system to monitor parlor protocols and behavior
- Uses the dairy's existing cameras which greatly reduces overhead cost
- List of reports available very large and can be adjusted to parlor
- Provide a weekly conf call to continually improve product value
- Very active support and continuing innovation
- Cost $1300/mo parallel, $2000/mo rotary
- Daily reports on previous day's findings
- New "quick alerts"

5

Cow Activity Systems

Currently using Alta Cow Watch (Nedap) and SCR

Both systems now fit into "Wouldn't dairy without it" category
Significantly improved detection of estrous and sick
Allows us to assess cows without them knowing it (let cows be cows)
Relative advantages very close
- ACW accessible remotely
- SCR also offers sort gate system
- Best choice basically comes down to relative strength of support

6

Pulse Needle-Free Injection

System uses compressed gas to project medications through the skin
Originally adopted for BLV control to support surrogate ET program

Can set up for 1-5 cc injections
Can be set up for IM, SQ or ID injection
Convenient and comfortable enough to use in parlor while milking

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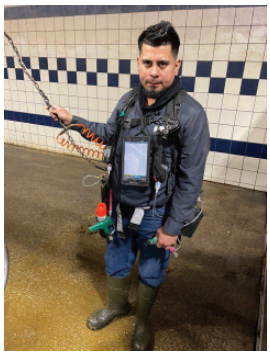

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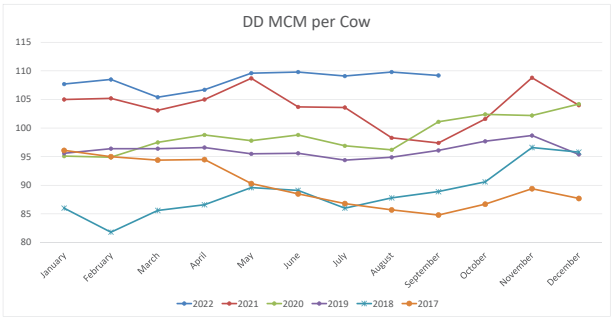

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16

Valuable Synergies

By combining different new technologies, we create valuable synergies

- Remote estrous and sick cow detection
- Comfortable treatment system used while milking
- Automatic sort gate to sort animals in need of attention

Use of the combined systems above preclude the need to lock cows

In our experience on two sites, it appears that discontinuation of daily lock-ups have resulted in significant production increases of around 10 lbs/cow/day

17

Abel Dairy Farms

Steve Abel

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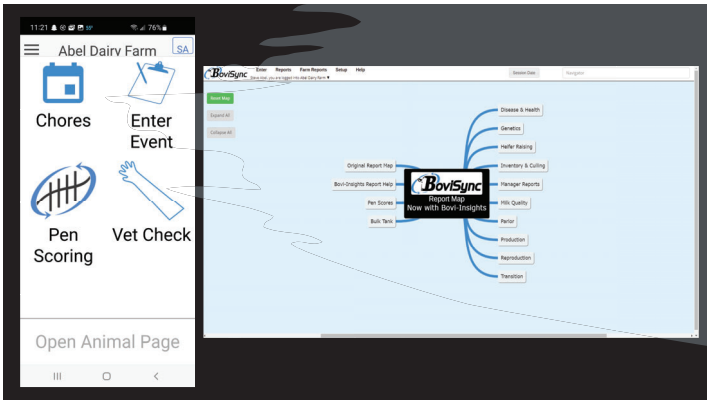
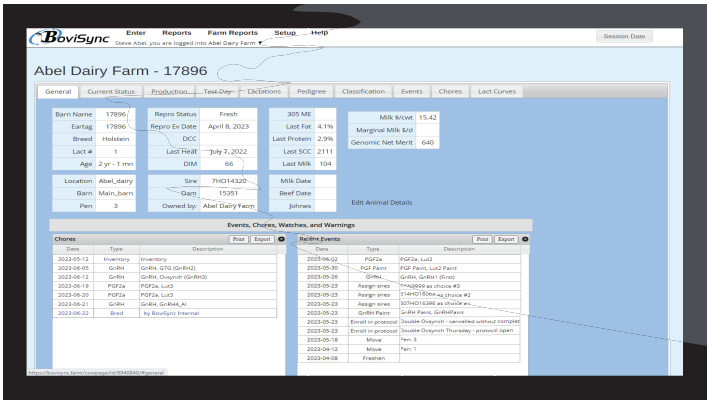
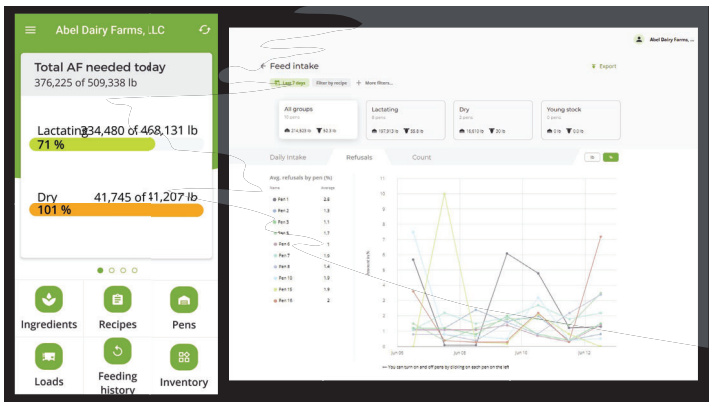

Abel Dairy Farm
Chores
Enter Event
Pen Scoring
Vet Check
Open Animal Page
BoviSync
Report Map
Now with Bovi-Insights

7


BoviSync
Abel Dairy Farm - 17896

8


Abel Dairy Farms, LLC
Total AF needed today
376,225 of 509,338 lb
Lactating 334,480 of 468,131 lb
71 %
Dry 41,745 of 41,207 lb
101 %
Ingredients
Recipes
Pens
Loads
Feeding history
Inventory
Feed intake

9


dpn

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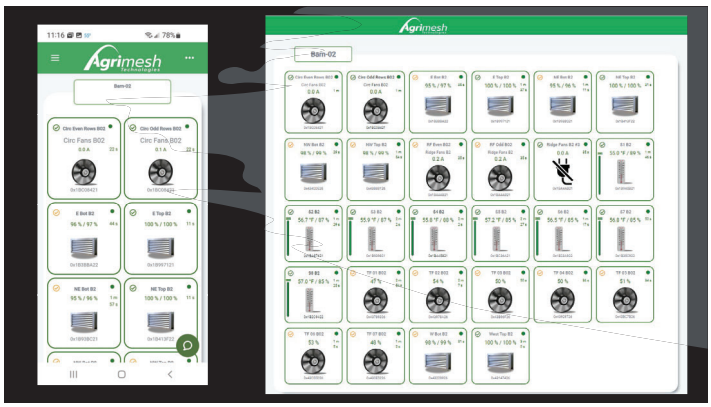
Agrimesh
Bain-02

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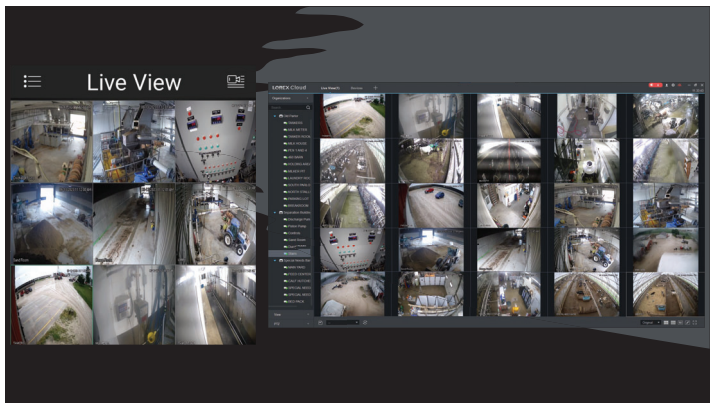
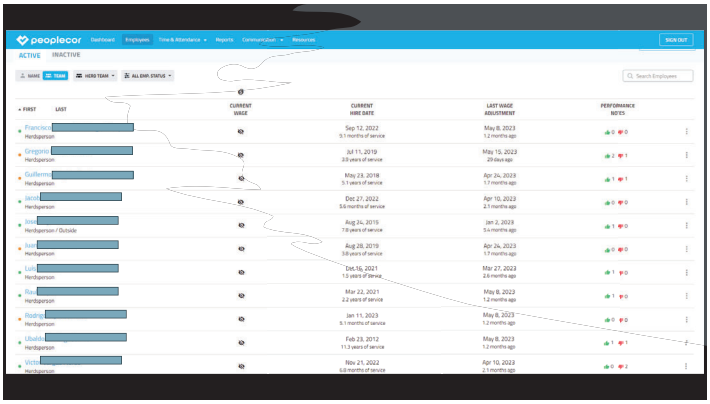
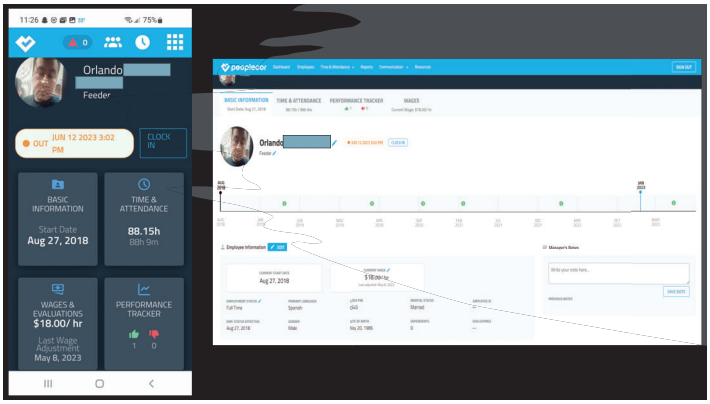

Live View

12


peoplecor
ACTIVE
INACTIVE

13


Orlando
Feeder
OUT JUN 12 2023 3:02 PM
CLOCK IN
BASIC INFORMATION
Start Date
Aug 27, 2018
TIME & ATTENDANCE
88.15h
80h 5m
WAGES & EVALUATIONS
$18.00/ hr
Last Wage Adjustment
May 8, 2023
PERFORMANCE TRACKER

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15

Labor's Lamentation, Technology's Waltz
Digitizing Dairy's Dance from Hooves to Harvest

Ryan Braun, Ever.Ag

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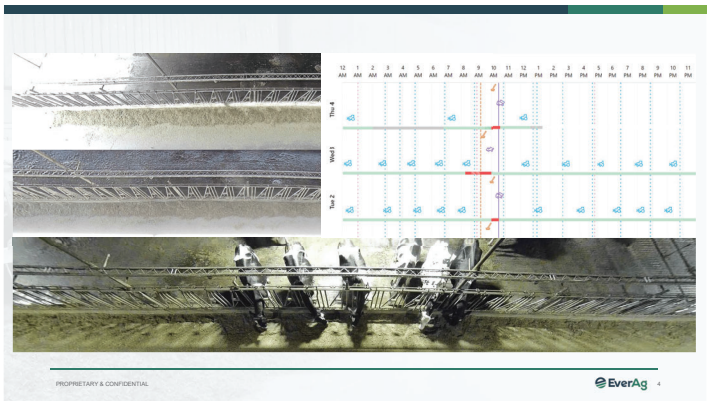

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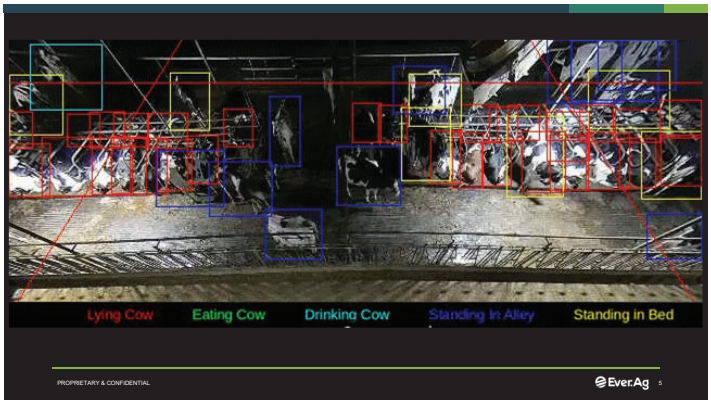

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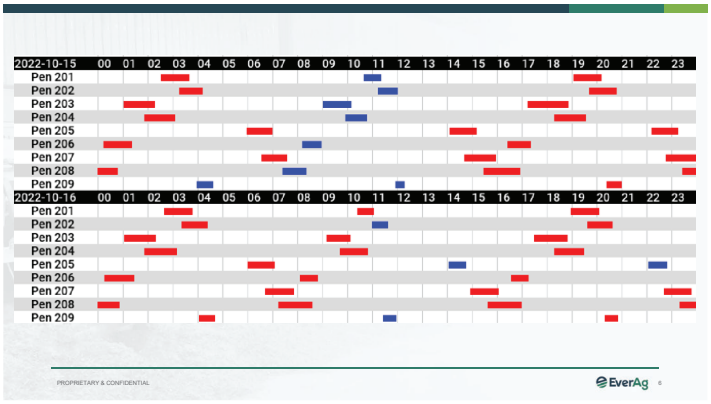

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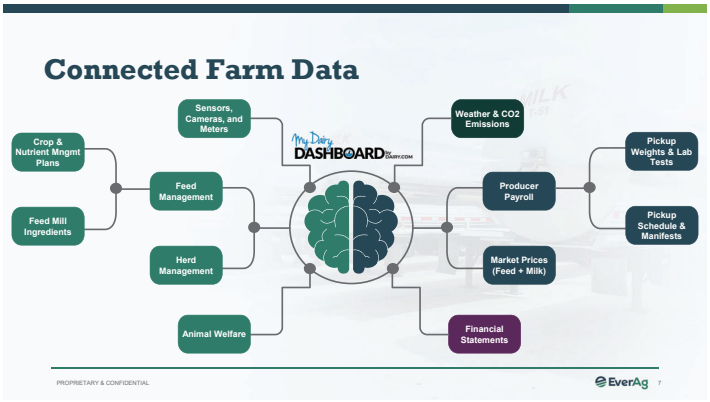
Connected Farm Data
Sensors, Cameras, and Meters
Weather & CO2 Emissions
Crop & Nutrient Mngmt Plans
Feed Management
Producer Payroll
Pickup Weights & Lab Tests
Feed Mill Ingredients
Herd Management
Market Prices (Feed + Milk)
Pickup Schedule & Manifests
Animal Welfare
Financial Statements
PROPRIETARY & CONFIDENTIAL
EverAg

7


Doubling Labor with Tech
PROPRIETARY & CONFIDENTIAL
EverAg

8


Doubling Labor with Tech
PROPRIETARY & CONFIDENTIAL
EverAg

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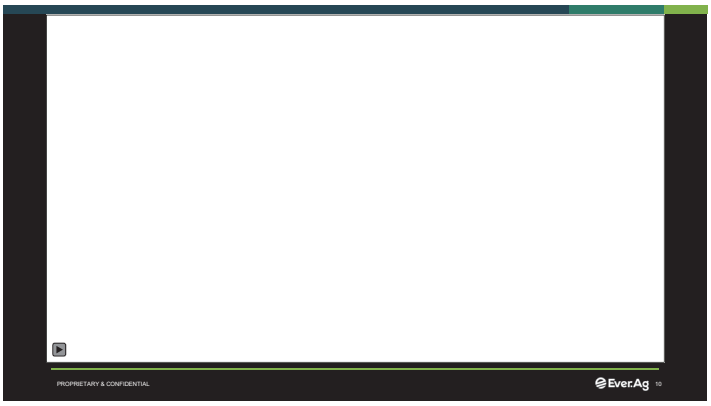

PROPRIETARY & CONFIDENTIAL
EverAg

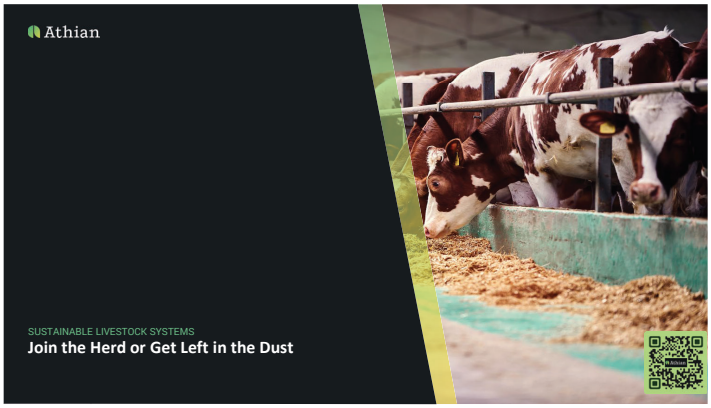
10


Ever.Ag
Thank You!
Charlie Hoffman
charlie.hoffman@ever.ag
Ryne Braun
ryne.braun@ever.ag
EverAg

11

SAINABLE LIVESTOCK SYSTEMS
Join the Herd or Get Left in the Dust

Corey Ramsden, Athian



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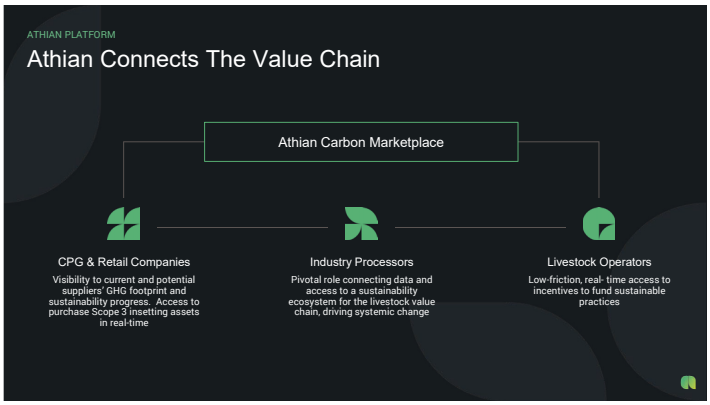

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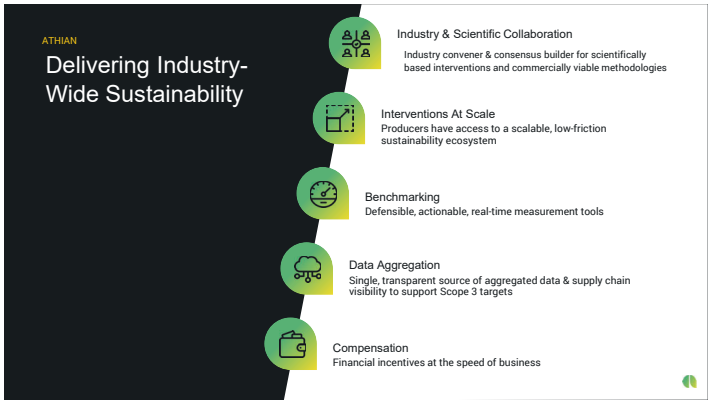

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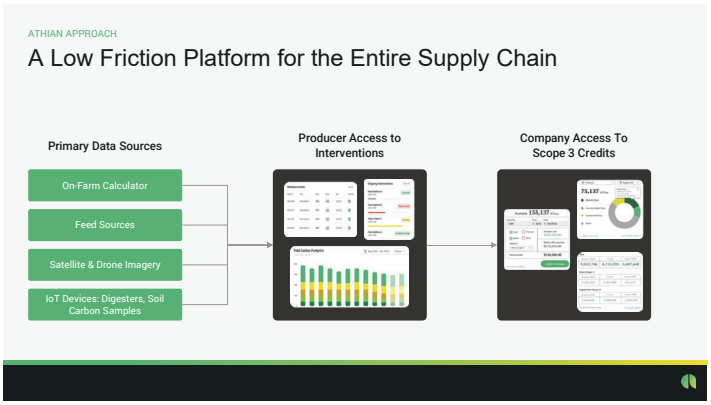

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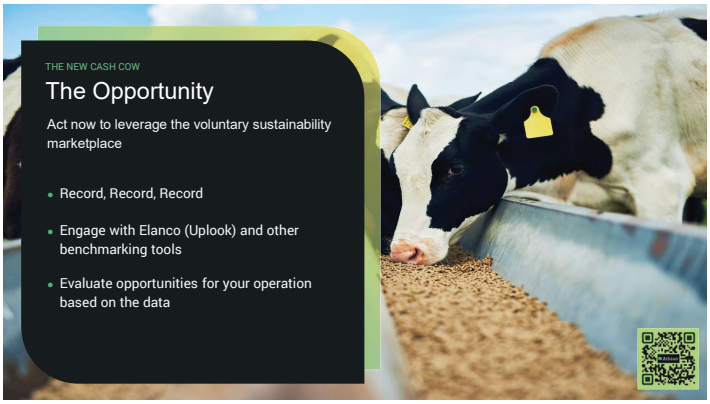
THE NEW CASH COW
The Opportunity
Act now to leverage the voluntary sustainability marketplace
Record, Record, Record
Engage with Elanco (Uplook) and other benchmarking tools
Evaluate opportunities for your operation based on the data

7


Athian
Sustainable Livestock Systems
Athian

8

Labor Insight SCALE Control

Dr. David Cook

1

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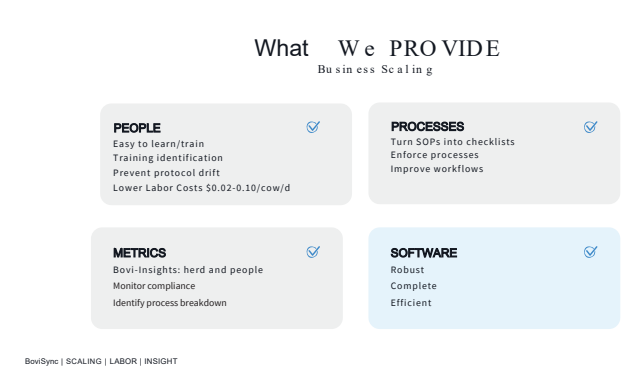

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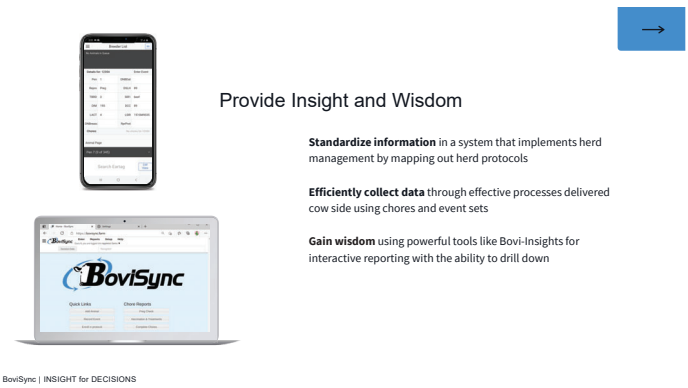

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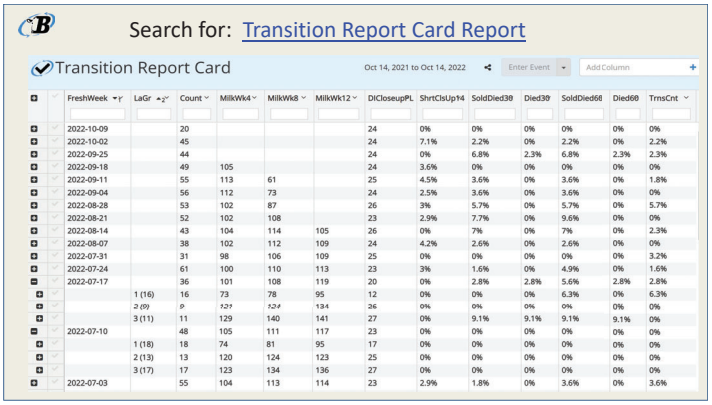

FreshWeek	LaGr	Count	MilkWk4	MilkWk8	MilkWk12	DICloseupPL	ShrtClsUp14	SoldDied30	Died30	SoldDied60	Died60	TrnsCnt
2022-10-09		20				24	0%	0%	0%	0%	0%	0%
2022-10-02		45				24	7.1%	2.2%	0%	2.2%	0%	2.2%
2022-09-25		44				24	0%	6.8%	2.3%	6.8%	2.3%	2.3%
2022-09-18		49	105			24	3.6%	0%	0%	0%	0%	0%
2022-09-11		55	113	61		25	4.5%	3.6%	0%	3.6%	0%	1.8%
2022-09-04		56	112	73		24	2.5%	3.6%	0%	3.6%	0%	0%
2022-08-28		53	102	87		26	3%	5.7%	0%	5.7%	0%	5.7%
2022-08-21		52	102	108		23	2.9%	7.7%	0%	9.6%	0%	0%
2022-08-14		43	104	114	105	26	0%	7%	0%	7%	0%	2.3%
2022-08-07		38	102	112	109	24	4.2%	2.6%	0%	2.6%	0%	0%
2022-07-31		31	98	106	109	25	0%	0%	0%	0%	0%	3.2%
2022-07-24		61	100	110	113	23	3%	1.6%	0%	4.9%	0%	1.6%
2022-07-17		36	101	108	119	20	0%	2.8%	2.8%	5.6%	2.8%	2.8%
	1 (16)	16	73	78	95	12	0%	0%	0%	6.3%	0%	6.3%
	2 (0)	0	129	124	134	26	0%	0%	0%	0%	0%	0%
	3 (11)	11	129	140	141	27	0%	9.1%	9.1%	9.1%	9.1%	0%
2022-07-10		48	105	111	117	23	0%	0%	0%	0%	0%	0%
	1 (18)	18	74	81	95	17	0%	0%	0%	0%	0%	0%
	2 (13)	13	120	124	123	25	0%	0%	0%	0%	0%	0%
	3 (17)	17	123	134	136	27	0%	0%	0%	0%	0%	0%
2022-07-03		55	104	113	114	23	2.9%	1.8%	0%	3.6%	0%	3.6%

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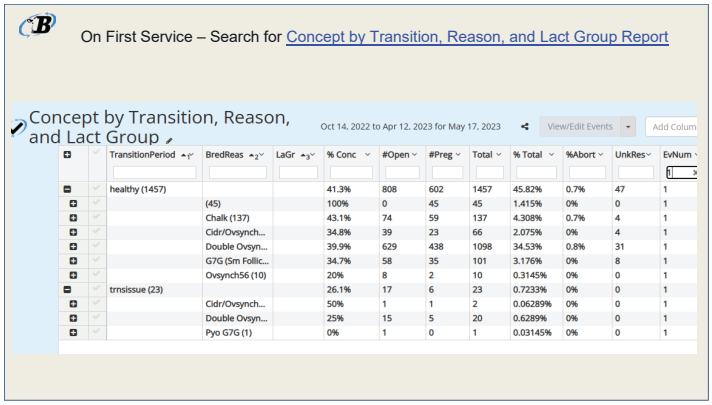


TransitionPeriod	BredReas	LaGr	% Conc	#Open	#Preg	Total	% Total	%Abort	UnkRes	EvNum
healthy (1457)			41.3%	808	602	1457	45.82%	0.7%	47	1
	(45)		100%	0	45	45	1.415%	0%	0	1
	Chalk (137)		43.1%	74	59	137	4.308%	0.7%	4	1
	Cidr/Ovsynch...		34.8%	39	23	66	2.075%	0%	4	1
	Double Ovsyn...		39.9%	629	438	1098	34.53%	0.8%	31	1
	G7G (Sm Follic...		34.7%	58	35	101	3.176%	0%	8	1
	Ovsynch56 (10)		20%	8	2	10	0.3145%	0%	0	1
trnsissue (23)			26.1%	17	6	23	0.7233%	0%	0	1
	Cidr/Ovsynch...		50%	1	1	2	0.06289%	0%	0	1
	Double Ovsyn...		25%	15	5	20	0.6289%	0%	0	1
	Pyo G7G (1)		0%	1	0	1	0.03145%	0%	0	1

6

Feed Intake by Pen Report- BoviSync

Feed Intake by Pen

Week	Pen	Date	Total Count	Average DIM	Average Lactation	PregCount	LMILK	Total Dropped	Avg DMI Per Cow	Feed Efficiency	Feed Cost F
2023-01-08			2277	179	1.87	1222	100.2	1946538	192	0.52	33.26
2023-01-15			2277	179	1.88	1229	100.39	1962181	54	1.86	9.53
2023-01-22			2281	179	1.87	1254	100.73	1938363	53	1.9	9.36
2023-01-29			2288	180	1.87	1283	99.71	1943263	54	1.85	9.44
2023-02-05			2325	183	1.84	1327	98.25	1966819	53	1.85	9.41
2023-02-12			2342	186	1.83	1359	98.39	1993366	53	1.86	9.29
2023-02-19			2893	183	1.81	1647	98.46	2499506	53	1.86	9.13
2023-02-26			3228	179	1.8	1784	98.07	2830739	51	1.92	8.58
2023-03-05			3788	178	1.78	2087	98.09	3117450	48	2.04	8.28
2023-03-12			4094	178	1.77	2234	98.24	3436219	48	2.05	8.11
2023-03-19			4075	180	1.77	2225	98.31	3464845	49	2.01	7.82
2023-03-26			4038	181	1.78	2197	98.46	3519758	52	1.89	7.97
2023-04-02			4012	183	1.78	2183	98.66	3491438	51	1.93	7.64
2023-04-09			4037	185	1.78	2195	98.88	3331109	48	2.06	7.3
2023-04-16			4100	185	1.78	2185	99.23	3433100	49	2.03	7.41
2023-04-23			4114	185	1.78	2195	99.58	3442153	51	1.95	7.74
2023-04-30			4111	189	1.77	2219	99.8	3525954	52	1.92	7.77
2023-05-07			4085	191	1.78	2235	96.32	3435168	52	1.85	7.72
2023-05-14			4067	191	1.79	2226	95.83	3418071	52	1.84	7.76
2023-05-21			4107	190	1.79	2257	95.97	2392874	63	1.52	9.53

7

Allied Industry Solutions

BoviSync Herd Management

8

DataSync as a service

ETL → SASS → Data Endpoints

HMS:
DC 305
PC Dart
DairyPlan
DelPro
Afimilk

Data Client → BoviSync → Bovi-Insights

Reports
Api Access
Data Dumps
Data Lakes
Custom apps

Mobile App
- Data capture
- Guidance

Data sources:
Parlor
Processors
Feed
Sensors

Data owned by farms

Access is based on permissions to team/user accounts.

9

Computer Vision to dairy farms to optimize labor efficiency and eliminate animal abuse

Artem Timanov, Cattle Care

1

Key metrics:

- 44 customers

2

Key metrics:

- 44 customers
- 68 farms

3

Key metrics:

- 44 customers
- 68 farms
- 220k cows are under monitoring

4

Key metrics:

- 44 customers
- 68 farms
- 220k cows are under monitoring
- We've been on the market for 2 years and have only lost 4 customers

5

6

Why a milking parlor is the most important and problematic place on a dairy farm?

- Milking parlor is a harvesting point of a dairy farm

7

Why a milking parlor is the most important and problematic place on a dairy farm?

- Milking parlor is a harvesting point of a dairy farm
- It's the most labor intensive part and it's a tough environment

8

Why a milking parlor is the most important and problematic place on a dairy farm?

- Milking parlor is a harvesting point of a dairy farm
- It's the most labor intensive part and it's a tough environment
- Very hard to measure performance of individuals

9

Why a milking parlor is the most important and problematic place on a dairy farm?

- Milking parlor is a harvesting point of a dairy farm
- It's the most labor intensive part and it's a tough environment
- Very hard to measure performance of individuals
- Majority of interactions between cows and people happens in a parlor

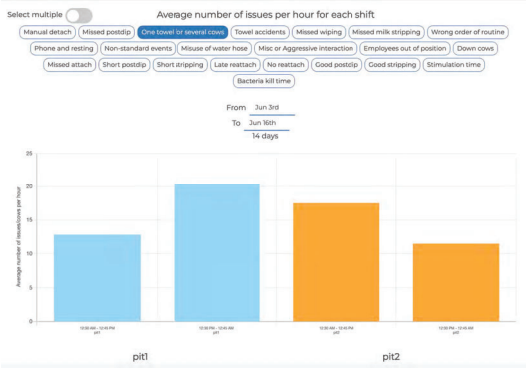
10

11

Total issues: Jun 8th - Jun 14th

	Weekly average during last 2 months	Cows affected this week	% of cows affected previous week	% of cows affected this week	Weekly change
One towel for several cows	1769.0	2210	19.9%	16.7%	-3.2%
Manual detach	750.5	902	6.62%	6.82%	+0.20%

12



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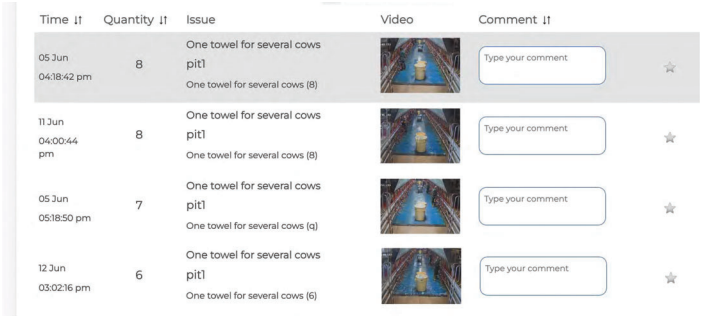


Time	Quantity	Issue	Video	Comment
05 Jun 04:18:42 pm	8	One towel for several cows pit1 One towel for several cows (8)		Type your comment
11 Jun 04:00:44 pm	8	One towel for several cows pit1 One towel for several cows (8)		Type your comment
05 Jun 05:18:50 pm	7	One towel for several cows pit1 One towel for several cows (q)		Type your comment
12 Jun 03:02:16 pm	6	One towel for several cows pit1 One towel for several cows (6)		Type your comment

14

15

All these leads to:

- The first results in the first 3-4 weeks

16

All these leads to:

- The first results in the first 3-4 weeks
- More milk (2-5 lb per cow per day)

17

All these leads to:

- The first results in the first 3-4 weeks
- More milk (2-5 lb per cow per day)
- Better milk quality (drop in SCC, 50k decrease is common)

18

All these leads to:

- The first results in the first 3-4 weeks
- More milk (2-5 lb per cow per day)
- Better milk quality (drop in SCC, 50k decrease is common)
- Less mastitis cases (-25%)

19

All these leads to:

- The first results in the first 3-4 weeks
- More milk (2-5 lb per cow per day)
- Better milk quality (drop in SCC, 50k decrease is common)
- Less mastitis cases (-25%)
- Eliminating animal welfare challenges

20

All these leads to:

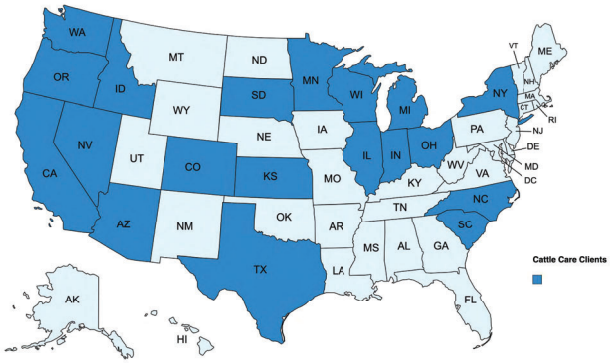
- The first results in the first 3-4 weeks
- More milk (2-5 lb per cow per day)
- Better milk quality (drop in SCC, 50k decrease is common)
- Less mastitis cases (-25%)
- Eliminating animal welfare challenges
- Better team morale

21

All these leads to:

- The first results in the first 3-4 weeks
- More milk (2-5 lb per cow per day)
- Better milk quality (drop in SCC, 50k decrease is common)
- Less mastitis cases (-25%)
- Eliminating animal welfare challenges
- Better team morale
- Lower employees turnover (-20%)

22



23

Core team

Anton Slesarev
Co-founder, Technology

Deep learning experience for 10+ years, content-based image classifiers, the first content-based image search engine

Christian Hoekstra
Co-founder, Sales and Customer Success

Fourth generation dairyman, Cal Poly degree, milking parlor manager at 4,500 cows dairy

Artem Timanov
Co-founder, CEO

Co-founded, headed up and sold Computer Vision based startup for retail

Oleg Akimov
Head of Engineering

Built the largest online cinema in Eastern Europe with 60M MAU

George Serebrennikov
COO

Built globally-distributed remote teams with hundreds of employees, ex CTO, ex CPO

\+

12 Computer Vision and software engineers and Dairy scientists

4 Leading dairy experts in the US as advisors

24

Contact Us

Artem Timanov, CEO
+1 (628) 202-6500
at@cattle-care.com
LinkedIn

25

Terry Canning, Cattle Eye

CATTLE EYE

Precision Dairy Presentation

June 20th

2023

1

The **Problem**

Major problem - poor farm productivity

Inefficient use of feed resource
- Over/under feeding
- Metabolic Disease Potential (£100 per case)

Lameness
- Painful condition; ~30% of cows
- Severe economic impact: £142m UK loss
- Premature culling - Additional GHG emission

Poor welfare standards damage consumer confidence in dairy

CATTLE EYE

Dairy industry inefficiencies

Effective monitoring/management leads to **32% reduction** in GHG emission

2

The **Product**

Video Analytics Platform

CATTLE EYE

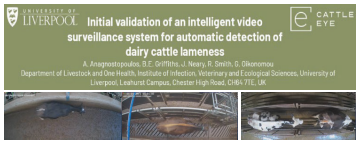
3

Cow	Scorer 1	Scorer 2	CattleEye
5087	1	3	53
5723	0	1	48
5906	0	0	11
1373	2	3	63
5716	1	0	21
5741	0	0	25

4

External
Validation

Lameness



- 12 week blind study of prototype accuracy – 1400 cows
- CattleEye is performing mobility scoring similarly to a trained scorer
- Out performing expert human in lameness lesion detection

UNIVERSITY OF MINNESOTA
Driven to Discover℠

- 12 week study on 3500 cow dairy in South Dakota
- Test group early indication sent to foot trimmer
- 20% improved outcome in 14 days after treatment Test Vs Control

CDCB
COUNCIL ON DAIRY CATTLE BREEDING

- ~500K CE locomotion scores analysed by CDCB geneticists report average 12 pt higher scores for cows with lesions on 100pt CE score

CATTLE EYE

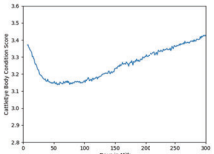
5

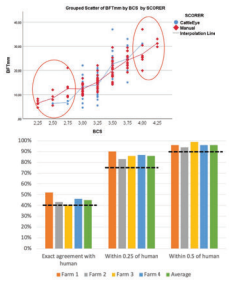
External
Validation

Body Condition Scoring

Results: Higher accuracy levels than any camera vision technology*

- Feb-March 2023
- 12K BCS Scores
- 4 UK Dairies
- 8 whole herd BCS
- 6K cows





UNIVERSITY OF LIVERPOOL

CATTLE EYE

* *Based on data contained in multiple published validation studies*

6

6

Commercial
Traction

Rapid adoption

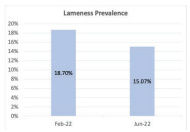
100K cows across UK / US and GCC

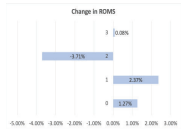
CATTLE EYE

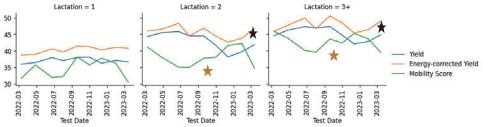
7

Return on
Investment

Highfields farm – Case Study







★ 08/2022 - Farm disengaged - Negative impact on Mobility/Yield
★ 11/2022 - Farm re-engaged - Positive impact on Mobility/Yield

CATTLE EYE

8

8

A clear picture of udder health

Tamara Leigh

A clear picture of udder health

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1

ANIMAL HEALTH FOCUSED

A thriving dairy sector relies on healthy cows.

2

A WORLDWIDE PRODUCTION DISEASE

Mastitis is a persistent & costly dairy health issue.

$248	20%	~10%	>6%
Annual cost per cow, sick or not	Individual production loss	Annual farm production loss	Increase in GHG emissions

© 2023 EIO Diagnostics, Inc.

3

IMPACT OF MANUAL DETECTION

Manual screening costs farmers time & money.

Error-Prone
- Repetitive
- 3-6 secs per cow
- Low accuracy

Expensive
- Salary, benefits, management
- Recruitment & training costs
- High turn-over

Dangerous
- Repetitive strain injuries
- Kicked or stepped on
- *"The worst job on the farm."*

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4

ADVANCED IMAGING & MACHINE LEARNING

EIO automates mastitis detection without touching the cow or milk.

- Sensor installed on pole between cleaning & attachment
- RFID reader at head of cow opposite sensor
- Processes in the barn – limited connectivity requirements
- Marks cows in real-time so workers can follow up
- Integrates with herd management software and sorting gates

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5

- Sensor with air blade

- Camera view of udder

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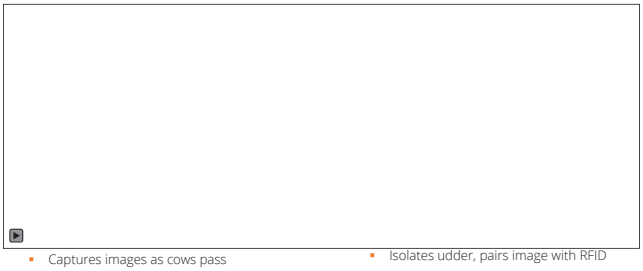
6



- Captures images as cows pass
- Isolates udder, pairs image with RFID
- AI Model determines mastitis status

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7

EXTENSIBLE SOLUTION

Automated Cow Marker:

- Sensor sends ID of sick cow
- Sprays paint when cow passes
- Allows easy sorting and follow-up
- Can pull signal from other software to mark for other issues

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8

FASTER, MORE ACCURATE & CONSISTENT

A better way of detection.

	Manual Screening	EIO Automated Detection
Time to assess	>6 secs	1 sec
Accuracy	65%	80%
Variability	High	Low
Milking Staff Turnover	High	N/A
Early Detection	No	Coming Soon

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9

INNOVATING FOR MORE SUSTAINABLE, PROFITABLE AGRICULTURE

We reimagine the future of livestock health.

Now scheduling installations with early adopters.

- Rotary parlor
- RFID
- Open to a new approach

Interested?
Let's Talk.

© 2023 EIO Diagnostics, Inc.

10

Questions? Get in Touch

Tamara Leigh
CEO & Founder

tamara@eiodiagnostics.com

www.eiodiagnostics.com

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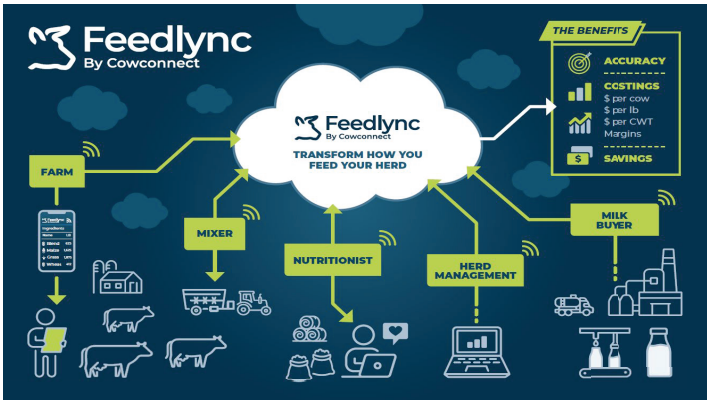
11

Transform How You Feed Your Herd

Sam Vorpahl, FeedLync

Feedlync
By Cowconnect

1



2

ABOUT US

cow CONNECT — Founded in 2017 in Denmark

ab agri — Became part of AB Agri in 2020

WORLD DAIRY EXPO — Launched in USA 2021

Feedlync By Cowconnect — 1500 farmer users to date globally

Feedlync By Cowconnect

3

4

HOW IT WORKS - HARDWARE

- Fits all mixer wagons - any age, any brand
- External weight input from mixer wagon load cells
- Works together wirelessly through the cloud

Feedlync By Cowconnect

5

Key Benefits of Feedlync

Simple Refusal Tracking – Accurate DMIs

Precise Inventory Management – Reduce Running out of Feed

Improved Efficiency and Labor Savings

Feedlync By Cowconnect

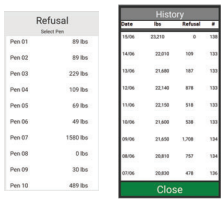
6

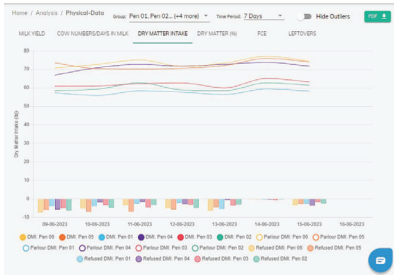
Refusal Recording and Tracking

Refusal

Refusal Entry

Historical Feeding w/ refusal tracking





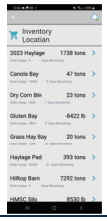
Feedlync By Cowconnect

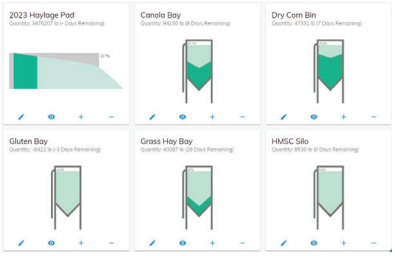
7

Inventory Management

Data can be entered from any device.

Simple management of a tedious task.





Feedlync By Cowconnect

8

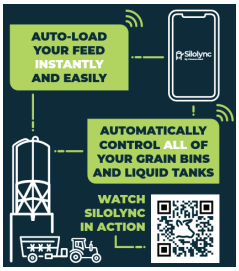
9

Automation Controls

Silolync allows you to Auto-Load your feed

Our simple setup even has intelligence built in to protect against failures

Save time and do other tasks while the mixer is filled automatically



Feedlync By Cowconnect

10

More Information

www.feedlync.com

Feedlync By Cowconnect

11

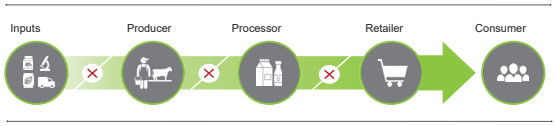
Connecting Data in New Ways to Help Dairy Operations Produce More with Less

Kari Spaan, iYotah Solutions

1

The Challenge

A Disconnected Ecosystem



- Major technology advancements happening within the industry
- Dairy operations today face an overwhelming amount of disconnected, siloed and unused data
- This makes it difficult to recognize what is important and actionable and can lead to inefficiencies and missed opportunities
- On top of that, margin pressures and increased demand for traceability and sustainability are driving an immediate need for change

2

The Solution

At iYOTAH, our mission is to solve these complex challenges by providing cutting -edge software technology that unlocks the potential of data by connecting data, people and business across the value chain

nTELL
iYOTAH SOLUTIONS

- ✓ Built from the ground up with producers
- ✓ Platform provides advanced analytics focused on economic solutions
- ✓ Presents data trends that unleash new opportunities to optimize your operation

3

The Challenge

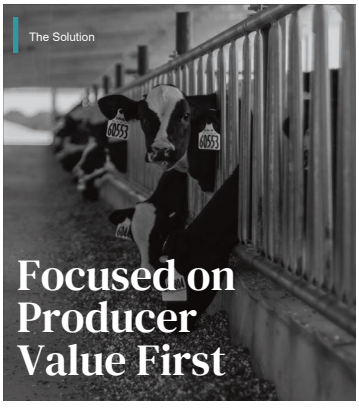
What would it be like if you could access all your data in one place?

nTELL

Enables you to visualize and utilize the data that matters most to you from one location on any device

4

The Solution



nTELL
iYOTAH SOLUTIONS

- Saves time by automating data ingestion and aggregation
- Verifies and validates data by overlaying multiple sources
- Integrates data into decision making
- Generates economic-driven business intelligence
- Automates, permission-based data sharing for enhanced collaboration
- Improves data flow to support your compliance, traceability and sustainability objectives
- Sets your business up for the critical thinking necessary for continuous improvement

5

Innovative user configurable visualizations and tools

10 Key Performance Areas

1. Herd Demographics
2. Feed
3. Animal Health
4. Reproduction
5. Production
6. Labor
7. Geno/Pheno
8. Financial
9. Risk Management
10. Environmental Stewardship

6

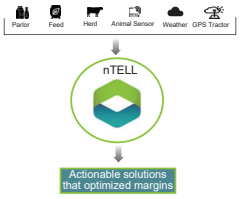
Proven Product Results

Proven Results Driven by Economics

Goal- Feed Optimization

- **Improve Feed Efficiency by 1%**
- 4000 cow dairy with 40 employees

Our Winning Solution



Results - Optimized Margins

- **$800,000** in annual economic value
- **$600K** increased annual production revenue
- **$200K** yearly feed savings

7

Proven Product Results – Driven by Economics

2022 Dairy Producer of the Year
Using nTELL to Improve Performance of Dairy

Dave Zappa, the GM of the dairy, meets weekly with the herd managers and feeders to utilize nTELL to look for ways to improve the performance of the diary.

"By having employees engaged and committed to reducing overfeeding, we are saving **thousands of dollars** over the course of each month using nTELL."

8

Proven Product Results - Driven by Economics

Blumenfeld Holsteins
Hawley, MN

- "iYOTAH has been extremely helpful in identifying which calves we should cull to help us achieve our desired heifer raising rate

" By not raising a calf to a heifer that has less-than-ideal genomics for the farm, we are saving approximately **$2,000 per animal.**"

Blumenfeld Holsteins, Hawley, MN

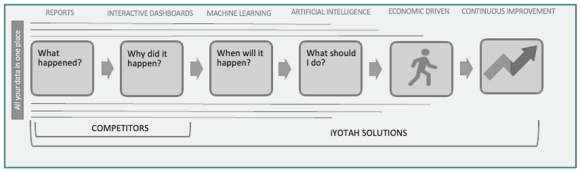
9

iYOTAH's Vision

IYOTAH'S VISION

To Help Our Users Transform Their Operations

Reactive ➡ **Proactive**



We would love the opportunity to work with you. If any of this sounds interesting to you let's talk about how together we can help you unlock a whole new world of possibilities!

10

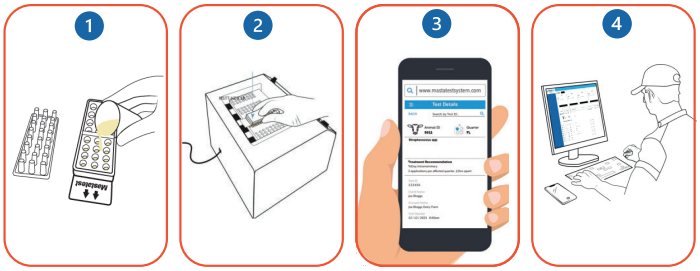
11

Powering Mastitis Decisions

Matias Stangaferro, Mastaplex

1

On-farm culture made easy with Mastatest



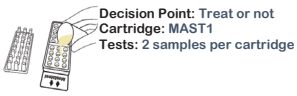
DAIRY HEALTH & Management Services

Mastatest

2

1 Easy-to-use cartridge system

Cartridge options:



Decision Point: Treat or not
Cartridge: MAST1
Tests: 2 samples per cartridge

Decision Point: Treat or not, and how
Cartridge: USP2
Tests: 1 sample per cartridge

DAIRY HEALTH & Management Services

Mastatest

3

2 Lapbox: automated analysis and interpretation

- ☑ Easy-to-use interface
- ☑ Automated data processing
- ☑ Automated interpretation
- ☑ Results by email
- ☑ Syncs with farm software

DAIRY HEALTH & Management Services

Mastatest

4

3 Fully interpreted results: Bacterial ID

- No bacteria identified

OR

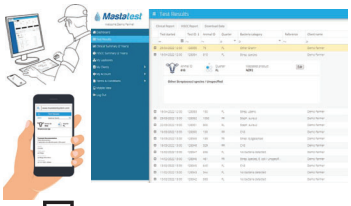
- E.coli / unspecified gram-negative
- Klebsiella / Serratia
- Strep. spp
- Staph. aureus
- Non-aureus Staph.
- Other gram-positive

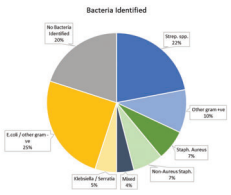
DAIRY HEALTH & Management Services

Mastatest

5

4 Data capture and analysis over time





- ☑ Automated data capture
- ☑ Review cow history
- ☑ Shared access results
- ☑ Review herd trends

DAIRY HEALTH & Management Services

Mastatest

6

What our customers say:

"The Mastatest Lapbox is easy to use, and starting a test is straight forward.

I like this system because I **don't have to do any culture plate interpretation**"

Luis, Dairy manager, US

DAIRY HEALTH & Management Services

Mastatest

7

8

smaXtec

2023 Precision Dairy Conference

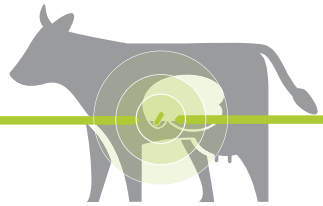
smaXtec animal care GmbH
Belgiergasse 3 • 8020 Graz • Austria
+43 316 46 15 88 • info@smaXtec.com • www.smaXtec.com

1

ONLY THE MOST ACCURATE SYSTEM BRINGS REAL SUCCESS.

Therefore:

MEASUREMENT OF PARAMETERS INSIDE.



- Bolus is administered once and reliably stays in the rumen
- No risk of loss
- No risk of injury
- Most precise data

2

SUCCESSFUL THROUGH HOLISTIC MEASUREMENT.

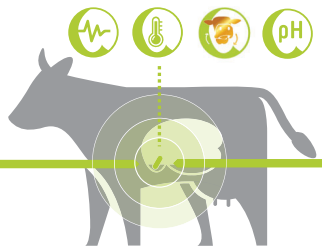
+ OPTIONAL RUMEN pH

INNER BODY TEMPERATURE

+ MOVEMENT ACTIVITY

+ RUMINATION with **smaXtec TruRumi™**

The unrivalled precise*, robust and reliable technology.



*see Performance study Raumberg-Gumpenstein, 2020

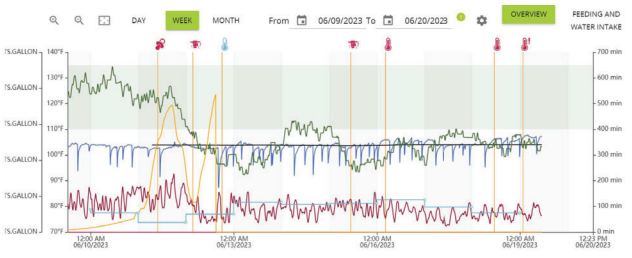
3

SIMPLE ROBUST DEPENDABLE

SAFE.
EASY.
BETTER.

4

WATER INTAKE AFTER CALVING

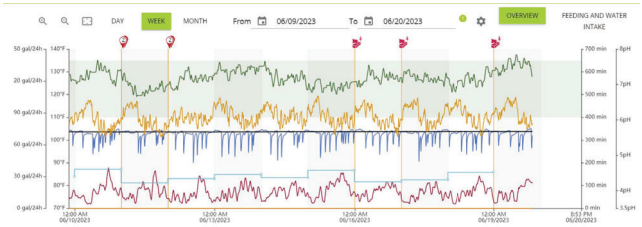


5

MASTITIS

6

SARA Risk


DAY
WEEK
MONTH
From 06/09/2023
To 06/20/2023
OVERVIEW
FEEDING AND WATER INTAKE

7


MESSENGER
smaXtec
DASHBOARD
MESSAGES
ANIMALS
GROUPS
BOLUSES & DEVICES
RATION
Herdsman's action list
1386
1178
137
71
Check health 23 | 0
Suspicious fresh cows 12
Insemination 11
Check for pregnancy 32 | 9
Dry-off 3
Calvings 9/112
Feed management
Weekly rumination time and daily deviation
Weekly rumination time
Fertility status
Fresh cows (DIM < 20) 111
Open 633
Pregnant 753
Suspicious cycle 83
Not in heat 37
Conspicuous reproductive status 36

8

Using Data to Improve Animal Health & Welfare

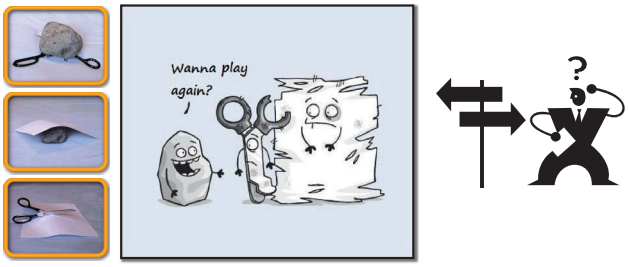
Mark J Thomas, DVM, DABVP

Using Data to Improve Animal Health & Welfare

PRECISION DAIRY CONFERENCE
JUNE 20-21, 2023
MARK J THOMAS, DVM, DABVP

1

Low Quality Evidence: Rock Paper Scissors



2

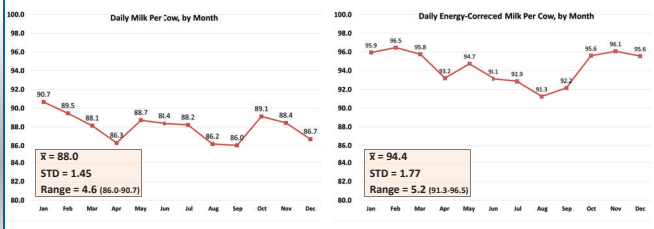
Common problems with on-farm evaluations

- Free product: "put it in and you will see the difference"
- Comparing "before and after"
- Comparing unbalanced groups
- Incorrect implementation: no oversight
- Data issues:
  - Data losses (e.g., software down, missing RFID or tags)
  - Data overwritten (e.g., items vs. events in DC305, lack of track of pen moves)
  - Results evaluated directly in management software (e.g., inclusion vs. exclusion criteria)
- Numerical differences: random chance or significant?
- No sample size

3

Comparing before and after

Usual variation might be greater than the expected response of a product or strategy



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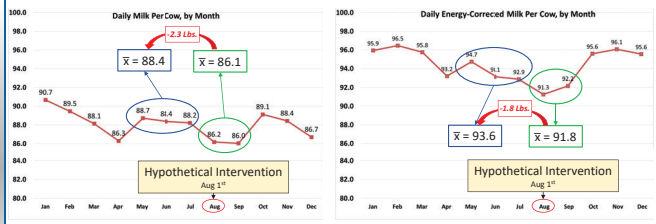
Comparing before and after

Usual variation might be greater than the expected response of a product or strategy



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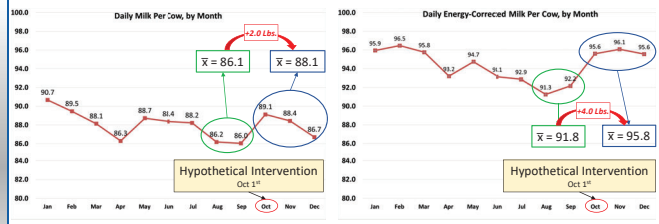
Comparing before and after

Usual variation might be greater than the expected response of a product or strategy



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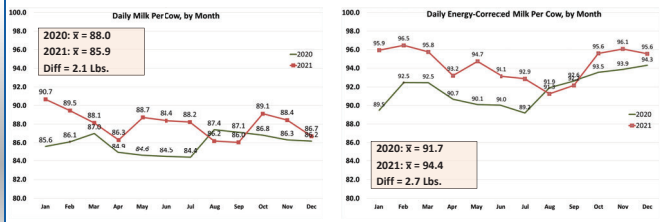
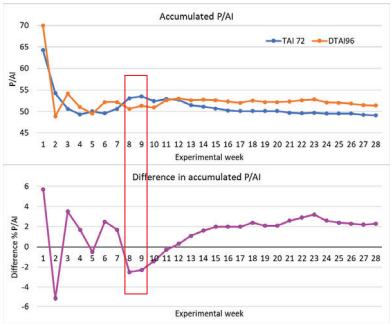
Comparing before and after

Usual variation might be greater than the expected response of a product or strategy



7

No sample size calculation

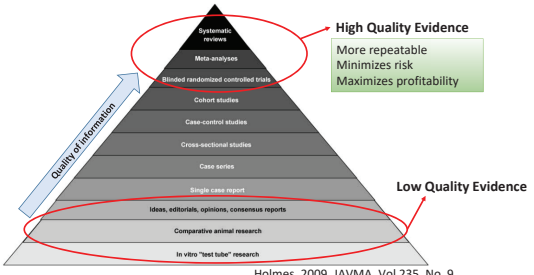


DATE	WEEK	ACCUMULATED CR		DIFF POINTS	n
		TAI 72	DTAI96		
11/15/2021	1	64.3	70.0	5.7	24
11/22/2021	2	54.2	48.9	-5.2	95
11/29/2021	3	50.6	54.1	3.5	166
12/6/2021	4	49.3	51.0	1.7	287
12/13/2021	5	50.0	49.5	-0.5	430
12/20/2021	6	49.6	52.2	2.5	560
12/27/2021	7	50.6	52.2	1.7	720
1/3/2022	8	53.1	50.6	-2.5	856
1/10/2022	9	53.5	51.3	-2.3	952
1/17/2022	10	52.4	50.9	-1.4	1080
1/24/2022	11	52.9	52.6	-0.3	1200
1/31/2022	12	52.7	53.0	0.3	1307
2/7/2022	13	51.5	52.6	1.1	1423
2/14/2022	14	51.1	52.7	1.6	1536
2/21/2022	15	50.7	52.6	2.0	1644
2/28/2022	16	50.2	52.3	2.0	1745
3/7/2022	17	50.1	52.0	2.0	1862
3/14/2022	18	50.1	52.5	2.4	1971
3/21/2022	19	50.1	52.2	2.1	2091
3/28/2022	20	50.1	52.2	2.1	2230
4/4/2022	21	49.7	52.3	2.6	2373
4/11/2022	22	49.6	52.6	2.9	2503
4/18/2022	23	49.7	52.8	3.2	2624
4/25/2022	24	49.5	52.1	2.6	2732
5/2/2022	25	49.5	52.0	2.4	2847
5/9/2022	26	49.5	51.8	2.3	2951
5/16/2022	27	49.2	51.5	2.2	3041
5/23/2022	28	49.1	51.4	2.3	3103

Laplacette et al., 2022. Unpublished

8

Relative strengths of evidence for decision making



Holmes, 2009. JAVMA, Vol 235, No. 9

9

Thank You!

10

Animal Health and Well-being

Tara Bohnert

1

2

FarmControl

Identification

Precision dairy farming simply made possible by the world's most trusted electronic identification solutions.

3

4

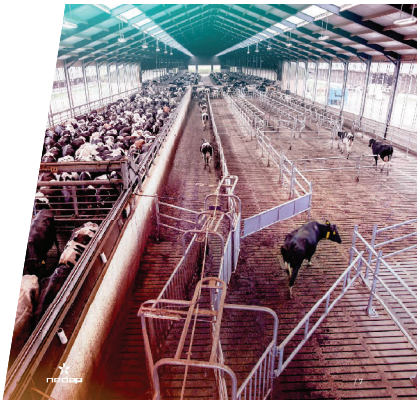
5

6

FarmControl

Traffic

Optimal farm and labor efficiency through fast and smooth cow traffic with the most flawless sorting and routing solutions.



7

CowControl

Health

Proactive health management for early detection of health issues and intensive monitoring of transition cows and post-treatment recovery.

8

Fresh cow recovery monitoring

9

Herd analytics

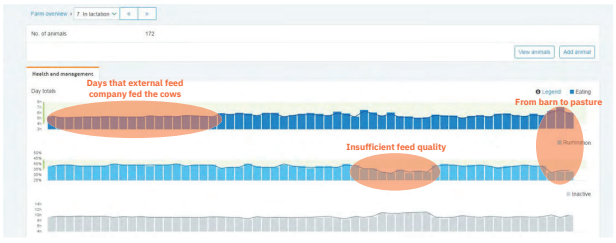
Group Eating Pattern (Tactical)

- Feeding moments
- Frequency of pushing up the feed
- Feeding space availability

10

Herd analytics

Group Behavior Insights (Operational)



11

MilkingControl

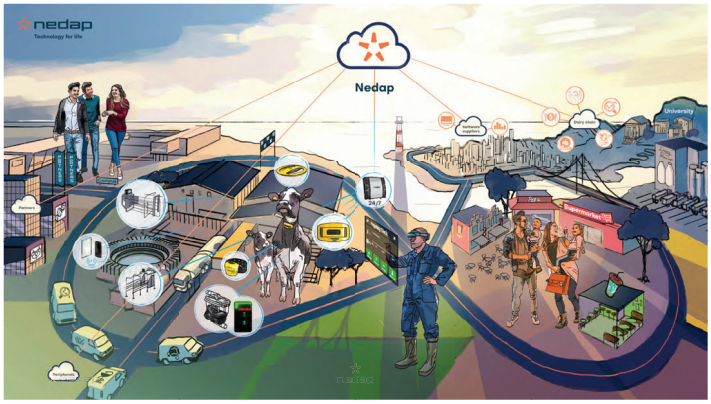
Milk flow monitoring

Groundbreaking care for cow health, milk quality and milking speed with the freeflow and wireless SmartFlow milk meter.

12

13

14



15

16

Using Precision Ag to Improve Efficiency and Productivity

Mark Murray
Murcrest Farms LLC

Using Precision Ag to Improve Efficiency and Productivity

Mark Murray
Murcrest Farms LLC

1

Murcrest Farms LLC

- Located near Watertown, NY
- 1400 adult cows, 1050 youngstock
- 3600 acres crop land
- 4 family owners (adding 2 non-family partners by end of 2023)
- 18 full time employees

2

Technology Utilized

- TMR Tracker
- DC305/Pocket Cowcard
- Auto steer
- Single row section control
- Variable rate seed and fertilizer
- Harvest Lab
- Scio Cup
- Blood/Milk pregnancy testing
- RFID
- SCR and Heatime Pro

3

21 Day Preg Rate

Before SCR

Date	Br Elg	Bred	Pct	Pg Elg	Preg	Pct
1/01/22	173	101	58	168	41	24
1/22/22	183	112	61	181	51	28
2/12/22	179	119	66	178	46	26
3/05/22	184	90	49	183	45	25
3/26/22	192	132	69	191	55	29
4/16/22	221	121	55	218	51	23
5/07/22	207	133	64	205	59	29
5/28/22	210	126	60	207	51	25
6/18/22	235	135	57	232	48	21
7/09/22	241	137	57	235	55	23
7/30/22	222	129	58	220	55	25
Total	2247	1335	59	2218	557	25

After...

Date	Br Elg	Bred	Pct	Pg Elg	Preg	Pct
9/01/22	221	191	86	219	92	42
9/22/22	182	139	76	179	42	23
10/13/22	191	135	71	188	58	31
11/03/22	170	125	74	166	55	33
11/24/22	165	128	78	165	61	37
12/15/22	155	123	79	153	57	37
1/05/23	155	126	81	154	53	34
1/26/23	171	133	78	170	58	34
2/16/23	186	141	76	183	64	35
3/09/23	182	127	70	178	49	28
3/30/23	194	135	70	189	63	33
4/20/23	186	142	76	185	75	41
Total	2158	1645	76	2129	727	34

4

Repro Performance

Before

Breeding Code	95% CI	%Conc	#Preg	#Open	Other	Abort	Total	%Tot	SPC
Undef Code 7	-	50	1	1	0	0	2	0	2.0
Activity	28-56	41	18	26	1	0	45	2	2.4
CIDR	-	91	10	1	0	3	11	1	1.1
Pre-synch	48-55	51	439	414	15	40	868	47	1.9
Re-synch	37-44	40	307	456	21	21	784	43	2.5
STANDING	42-60	51	58	55	0	4	113	6	1.9
1ST SERV SEXED	-	43	6	8	0	0	14	1	2.3
TOTALS	44-49	47	839	961	37	68	1837	100	2.1

After

Breeding Code	95% CI	%Conc	#Preg	#Open	Other	Abort	Total	%Tot	SPC
Undef Code 7	-	100	1	0	0	0	1	0	1.0
Activity	43-48	45	750	912	145	64	1807	80	2.2
CIDR	35-55	45	44	54	12	0	110	5	2.2
Pre-synch	40-53	47	97	111	13	6	221	10	2.1
Re-synch	34-52	42	48	65	5	1	118	5	2.4
STANDING	-	100	6	0	0	0	6	0	1.0
TOTALS	43-47	45	946	1142	175	71	2263	100	2.2

5

Herd Performance

Before

- Cull Rate: 24.6%
- Death Rate: 4.4%
- Avg DIM: 178
- Avg Days Open:117
- SCC: 145,000

After

- Cull Rate: 21.1%
- Death Rate: 3.3%
- Avg DIM: 158
- Avg Days Open: 102
- SCC: 128,000

6

	CORN SILAGE CONV 2022		CORN SILAGE BMR 2022		COW HAYLAGE 2022	
DATE	SCIO CUP	Weighted Average	SCIO CUP	Weighted Average	SCIO CUP	Weighted Average
2/15/2023	35.5		47.4		33.0	
2/16/2023	33.1		41.1		35.2	
3/3/2023	37.6	36.0	38.7	41.5	34.5	34.3
5/15/2023	39.5	37.4	42.4	41.2	35.5	35.7
5/19/2023	40.0	39.1	43.3	42.6	37.8	36.8
5/22/2023	40.7	40.2	43.9	43.4	35.9	36.3
5/26/2023	40.7	40.5	44.0	43.8	46.3	41.6
5/29/2023	37.2	39.0	51.6	47.8	42	41.6
6/8/2023	39.1	39.0	46.9	47.4	41.9	41.8
6/12/2023	36.7	37.4	44.2	46.7	43.9	42.9

Scio Cup

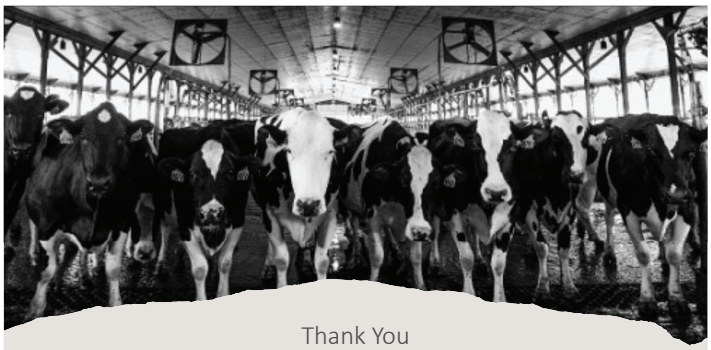
7

IDEXX

Pregnancy testing

Blood/Milk Pregnancy Testing

8

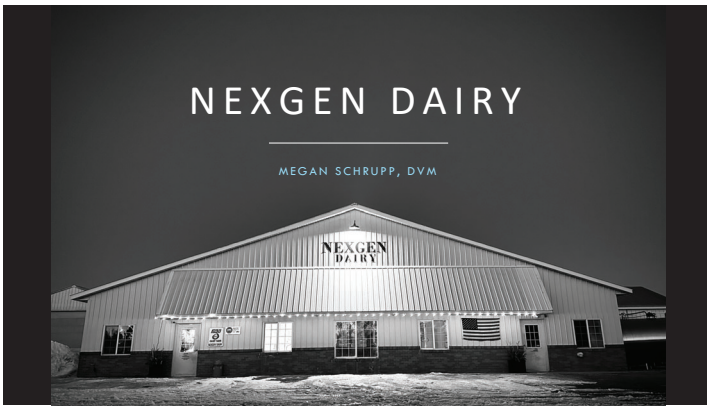


Thank You

9

NEXGEN DAIRY

Megan Schrupp, DVM



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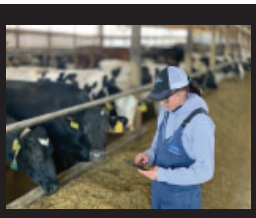
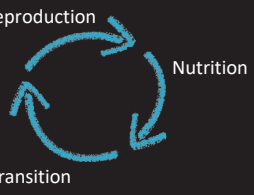


2010: GEA collar: cow ID & conductivity, activity, Dairy Plan
2018: SCR ear tags: added rumination, group breathing
2022: Alta Cow Watch collar: ID, activity, rumination, position;
Software: VAS Platform, NedapNow

4

DAIRY TECHNOLOGY AT NEXGEN

- MILK OLD COWS:
  - GOAL AVERAGE 3 LACTATIONS
- TIGHTEN LACTATION CIRCLE
- CONVERT INVOLUNTARY CULLS TO VOLUNTARY
- REDUCED HEIFER INVENTORIES
- INDIVIDUAL DATA DRIVEN DECISIONS
- LET COWS BE COWS



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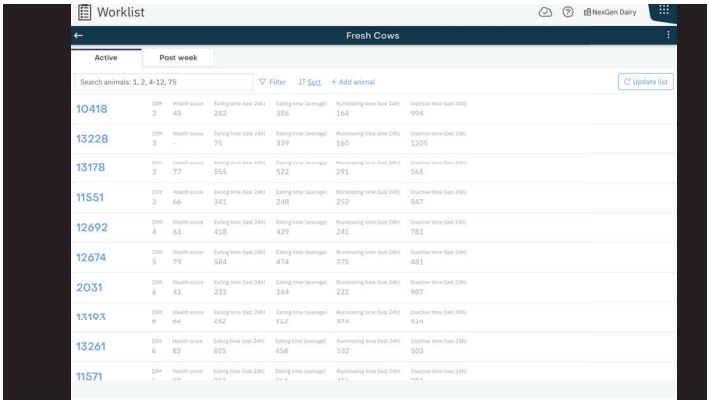
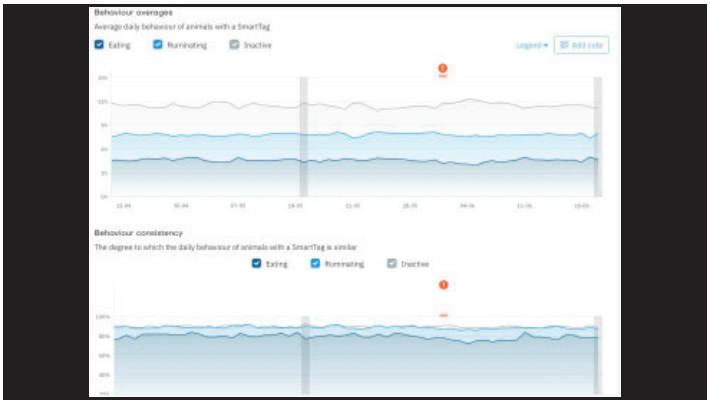


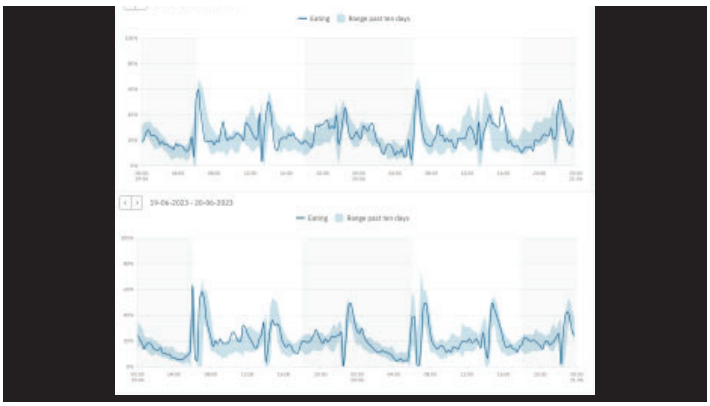
6


Cow
Animal 11333
Health

7


Behaviour averages
Average daily behaviour of animals with a SmartTag
Eating
Ruminating
Inactive
Behaviour consistency
The degree to which the daily behaviour of animals with a SmartTag is similar

8



9

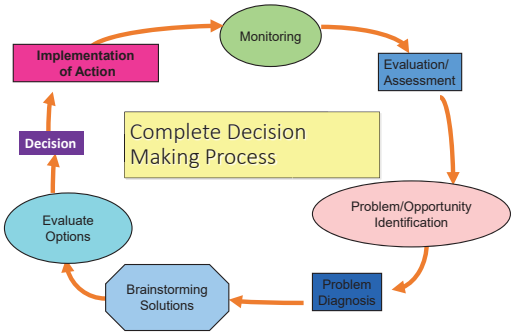
Introduction to Big Data Integration

Dr. Wayne Weiland

Introduction to Big Data Integration

Precision Dairy Conference
June 21, 2023
Dr. Wayne Weiland

1



2

Talk Outline

1. Why should we care?
2. What is being attempted in the dairy space?
3. Why is it so hard?
4. Application examples.
5. What are the benefits of data integration?

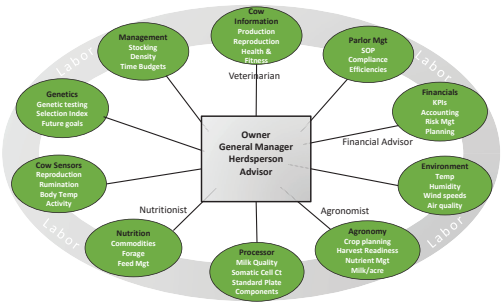
3

Data Paralysis Is A Growing Problem

- A recent Oracle survey of 14,000 business leaders found that large and unconnected data-sets and invalidated data overwhelm users, make decision making harder, and often lead to no decision at all.
  - ✓ Can I trust the data? Is what I see real?
  - ✓ What does all this data mean?
  - ✓ How does it fit together? How do I reconcile conflicting data?
- I know this to be true personally. "At best, the decision making process is *slower* and I have *less confidence*. At worst, it causes paralysis and results in no decision".

4

What is the problem to be solved? Farm Level



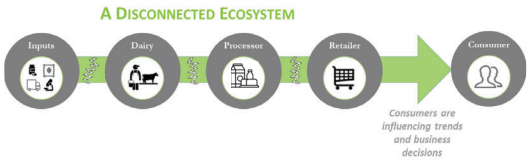
5

Dairy Technology Is Exploding

6

What is the problem to be solved?

Supply Chain



7

What exactly are we trying to do?

Automatically bring data from any and all sources into the "data lake" and scrub it.

⇩

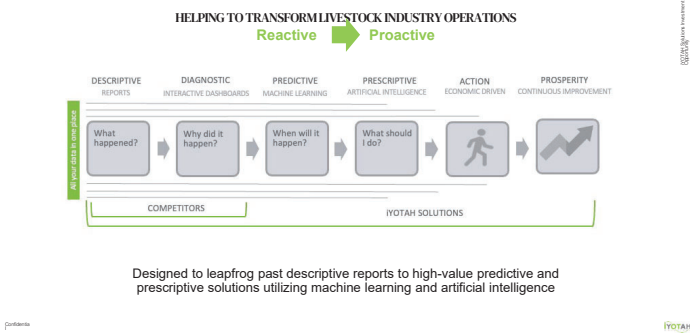
Show data in ways easy to read & interpret for different stakeholders.

⇩

Apply Machine Learning (ML) and Artificial Intelligence (AI)

8

The iYOTAH Difference



Designed to leapfrog past descriptive reports to high-value predictive and prescriptive solutions utilizing machine learning and artificial intelligence

9

Why is it so hard to accomplish?

- The sheer volume of data requires a lot of computing power.
- Data exists in a myriad of forms and must be integrated into a common data lake and form.
- Lack of standardization to terms, definitions, and standards of data entry.
- On-Farm hardware and software is often grossly outdated, making systems unstable and data extraction difficult.
- Internet speed can still be a limiting factor in some areas.
- Every dairy is unique in their needs, how they handle data, and in their decision making process.
- Slow adoption of methods to easily transfer data (API's)
- Last, but certainly not least, a lack of TRUST by data sources to share the data

10

Areas of Potential Application

- ***Suppliers*** could know what inputs are needed and when, providing a proactive and just-in-time approach to inventory tracking and management.
- ***Dairy Management*** uses scrubbed data and easy to interpret KPA's to make faster and better decisions.
- ***Advisors*** (vet, nutritionist, crop consultant, lender, etc.) are all working from the same data. This facilitates working as a team to solve problems.
- ***Processors / Retailers*** have the ability to verify, track, and assure product claims.
- ***Consumers*** get verification and transparency to product claims. Carbon or methane tracking (environmental), antibiotic or hormone use, management practices.

11

Benefits to Large Data Integration

- **Data Accuracy** – via data scrubbing (deal with omissions & errors) and data overlays
- **Time Savings** – by automating data harvest and input
- **Business Insights** – easy to read & interpret data output allows one to identify needs / opportunities and set priorities
- **Perspective** – advisors & employees see the data necessary to support you and your business → increased employee engagement
- **Cooperation** – farm advisors are all working from the same dataset to solve problems / look at opportunities → better teamwork
- **Focus** – allows for role assignments, delegation of tasks, and tracking progress

12

Benefits to Large Data Integration

- **Awareness** – via alert notifications if data falls outside an expected range or tasks are not completed on-time
- **Clarity** – everyone on your team is working toward the same goals / outcomes
- **Measurable Outcomes** – both biological & financial outcomes are measurable and trackable
- **Confidence** – to more quickly make good decisions based on solid data
- **Proactive** – more proactive (vs. reactive) actions
- **Continuous Improvement** – there is always a next opportunity to target

13

Thanks for attending and listening.
I hope YOU are seeing possibilities in
Integrating Big Data!

Questions / Discussion?

14

The Solution - How it works

The platform provides innovative data visualizations and tools that optimize profits

10 Key Performance Areas of Focus

- Feed
- Reproduction
- Labor
- Production
- Financial
- Herd Demographics
- Animal Health
- Genomics
- Risk Management
- Environmental Stewardship

Confidential

15

Cream of the Crop: Cultivating Growth with Clean Data

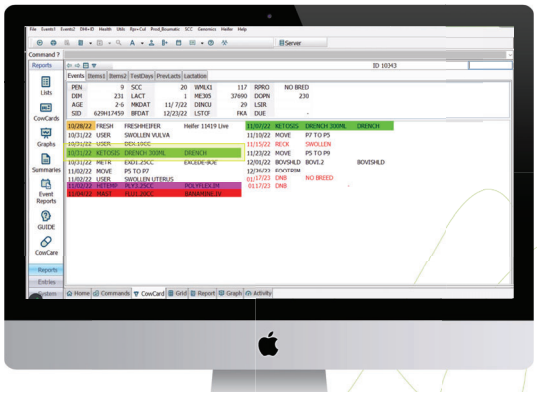
Dale Jefferson – CEO, VAS
Taliah Danzinger – Dairy Intelligence, VAS

1

2

3

4

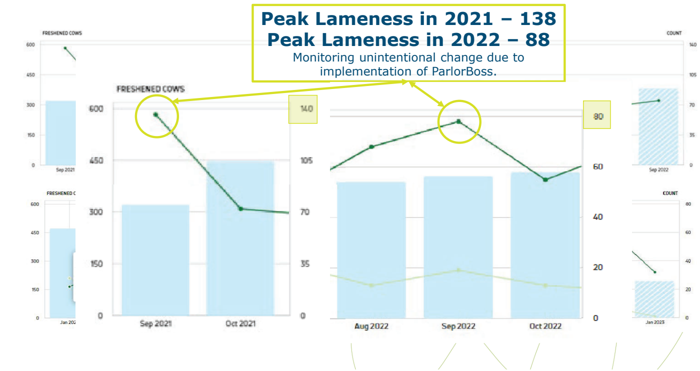


5

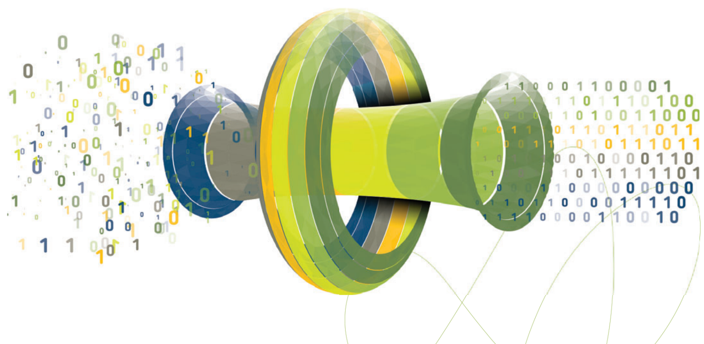
6


HealthVAL
KETOSIS Analysis
Customize Summaries

7


Peak Lameness in 2021 – 138
Peak Lameness in 2022 – 88
Monitoring unintentional change due to
implementation of ParlorBoss.
FRESHENED COWS
Sep 2021
Oct 2021
Aug 2022
Sep 2022
Oct 2022

8



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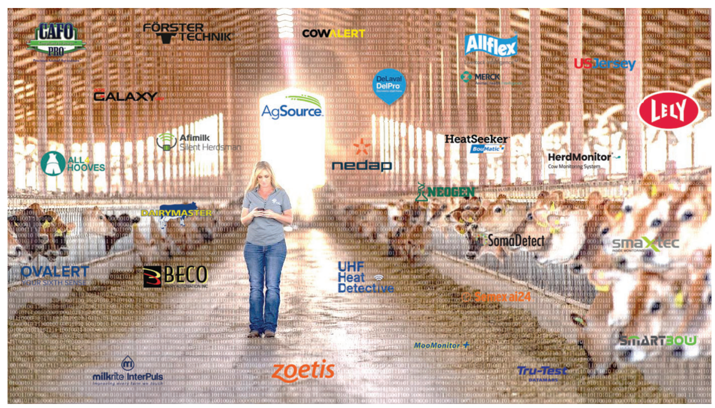

CAFO PRO
FORSTER TECHNIK
COWALERT
Allflex
US Jersey
GALAXY
AgSource
DeLaval DelPro
MERCK
LELY
ALL HOOVES
Afimilk
nedap
HeatSeeker
HerdMonitor
NEOGEN
DAIRYMASTER
SomaDetect
smaXtec
OVALERT
BECO
UHF Heat Detective
SMARTBOW
milkrite InterPuls
zoetis
Tru-Test

10

DATA INTEGRATION PANEL

Mitch Breunig
Mystic Valley Dairy Sauk City Wisconsin

Precision Dairy conference

DATA INTEGRATION PANEL

1

Mystic Valley Dairy

- Milk 450 cows
- 1060 crop acres
- Rolling Herd Average 33251 4.2 1396 3.24 1077
- Preg rate 35
- Cull rate 20
- Sell fresh cows to other farms-last year 150
- Ave 7.5 solids per cow in 2022
- ECM FE of 1.8lbs of milk/DM
- How to remain profitable in a competitive dairy world?

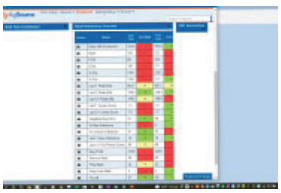
2

Data communication

COMPEER FINANCIAL
GRANDE
intuit quickbooks
vas DAIRYCOMP 305
TMR TRACKER
AgSource
MARGINSMART
SCR
BouMatic

3

How do we get real time data



- Tankers
- Milk quality
- DMI
- Cows in the tank
- Ration cost and formulation
- IOFC

4

Real time verses past verses future

1. How can we take the information to accurately predict profitability at the cow, pen and farm level.
2. We can project pretty good
3. We can see what happened, but already is done cannot change it 60-120 days old.
4. Today is the challenge

5

Real time issues

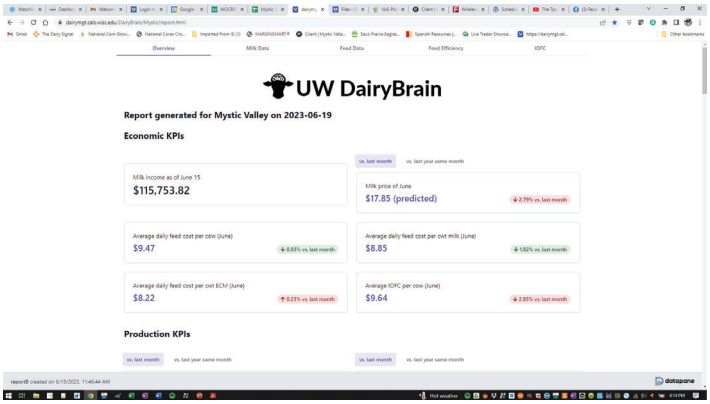
1. Data transfer
2. Intellectual property
3. System upgrades
4. Lack of communication
5. What is important what is noise

6

Need collaboration to make it work.

Benchmarking is great but really needs to be operation dependent

7



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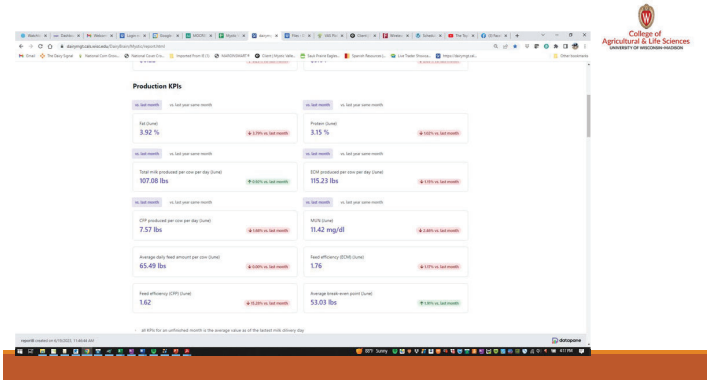


9

Mitch Breunig

Dairy Brain link

Mystic Valley Dairy Sauk City Wisconsin

mysticvalley336@gmail.com

Thank you!

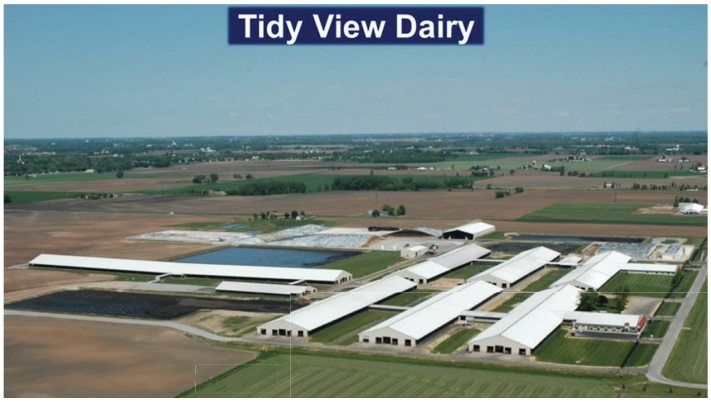
10

DATA INTEGRATION PANEL

John Vosters

1

2



3

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6


LaBelle

7


Calf Source

8


Heifer Source

9


Mosaic Meadows
6/24/2023
SUSTAINABILITY STARTS HERE
Calumet Goat Co

10


Milk Source Genetics
HONDA

11


Our Responsibilities
Farmstead System
Livestock System

12

DATA INTEGRATION

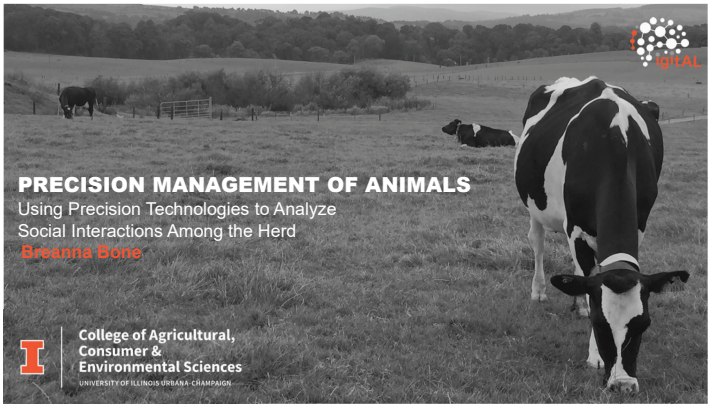
- BoviSync
- Teams
- Power BI
- Dropbox
- Excel/Macros
- Shared Drive/Share Point
- DPN
- Connecterra

13

14

PRECISION MANAGEMENT OF ANIMALS
Using Precision Technologies to Analyze Social Interactions Among the Herd

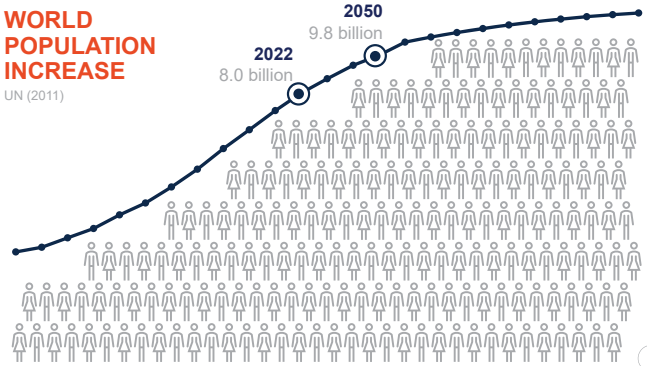
Breanna Bone



1

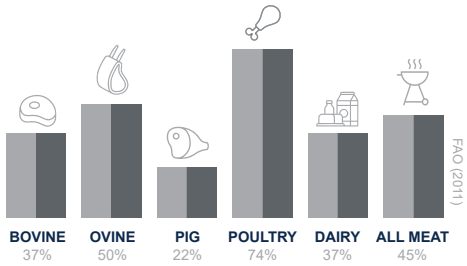
1. THE PROBLEM

2



3

Animal Products Consumption Increase By 2050



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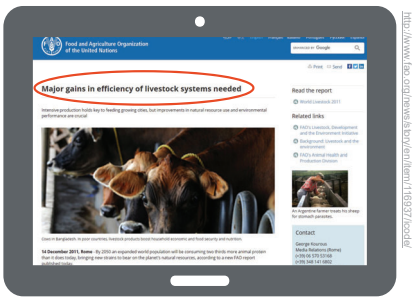
Challenges



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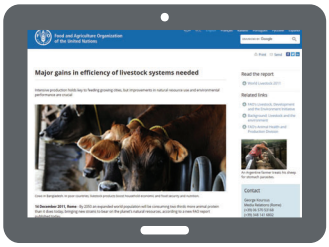
Challenges



- MAINTAIN ANIMAL HEALTH
- IMPROVE ANIMAL WELFARE
- IMPROVE ENVIRONMENTAL SUSTAINABILITY
- HELP FARMERS
- KEEP SYSTEM PROFITABLE
- QUALITY OF PRODUCT

6

2. DEVELOPING TOOLS

7

8

Behavior Observations

ON THE FARM

TRAINED BEHAVIORLIST

TIMED INTERVALS

NOTE TAKING

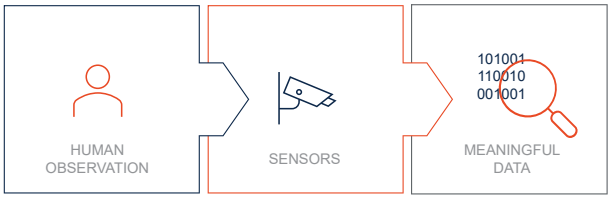
9

The Challenge

To monitor animals' condition in a fast, efficient, continuous, and non-invasive way.

10

Solution



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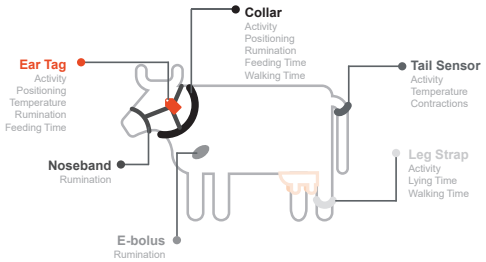
Sensors



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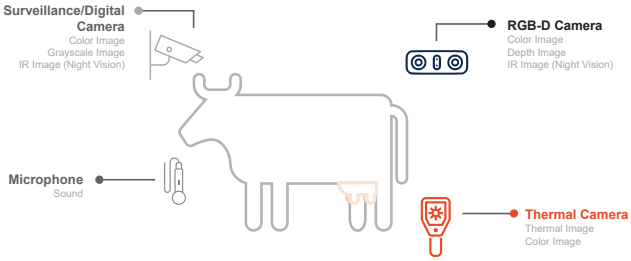
Sensors



13

14

Why care about social behaviors?

- Social Rank
- Health Correlations
- Milk Output
- Profitability

15

3. THE RESEARCH

16

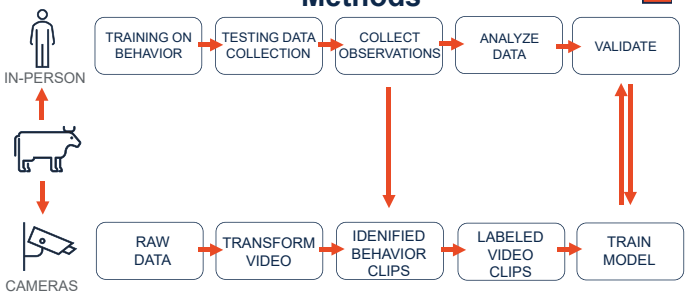
Animal Specifics

15 Holstein Cows | 3 Dry & 12 Lactating | Multiparous | 5 Diets*

*Behavior trial ran in conjunction with nutrition trial

17

Methods



18

Model Specifics

MATLAB

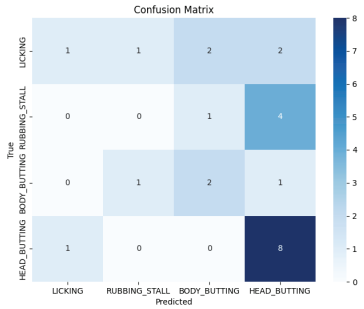
- **Video Labeler**
  - 30 videos per behavior

python

- **Train Model**
  - 80% Train
  - 20% Validation

19

Preliminary Data Results



20

Results

21

Results

22

4. CHALLENGES AND OPPORTUNITIES

23

Equipment

24

Collaboration

25

Future Steps

26

27

Illinois Digital Animal Systems Lab

Breanna Bone

Master's Student
Mentored by
Dr. Isabella Condotta
& Dr. Phil Cardoso

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College of Agricultural, Consumer & Environmental Sciences
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

THE BEST WAY TO PREDICT THE FUTURE IS TO CREATE IT.

-Peter Drucker

28

Dairy Brain
The Next Big Leap in Dairy Farm Management Using Coordinated Data Ecosystems

Yijing Gong

Dairy Brain

The Next Big Leap in Dairy Farm Management Using Coordinated Data Ecosystems

Yijing Gong (gong44@wisc.edu)
Ph.D. student in Victor Cabrera's lab, Department of Animal and Dairy Sciences, University of Wisconsin-Madison

1

Power of Monitoring Key Performance Indicators (KPIs)

- KPIs help **identify gaps** between the current performance and the targeted performance, and monitor the progress towards desired outcome. (Wolfert and Isakhanyan, 2022)
- Continuous monitoring of key performance indicators are critical on **sustainability** of dairy farming. (Atzori et al., 2021)
- Monitoring **FE** and **IOFC** supports better decisions related to **profitability** and **environmental footprint**. (Løvendahl et al., 2018)

2

Feed Efficiency (FE)

- FE is used at the field level as a proxy to measure the relative ability of milking cows to **convert feed** nutrients consumed **into milk**. (Bach et al., 2020)

$$FE = \frac{ECM}{DMI}$$

ECM: $Energy\ corrected\ milk$
DMI: $Dry\ matter\ intake$

3

Income Over Feed Cost (IOFC)

- IOFC is an indirect indicator that ties nutrition to the **profitability** of dairy operations, hence supporting short-term decisions. (Atzori et al., 2021)

$$IOFC = Milk\ revenue\ - Feed\ cost$$

$$Milk\ revenue = Milk\ price \times Milk\ production$$
$$Feed\ cost = Feed\ price \times Feed\ amoint$$

4

Challenges

- FE:
  1) Farm feeding system
  2) Milking parlor system
  3) Milking processor
- IOFC:
  Additionally:
  1) Milk price settlement rules
  2) Milk component prices

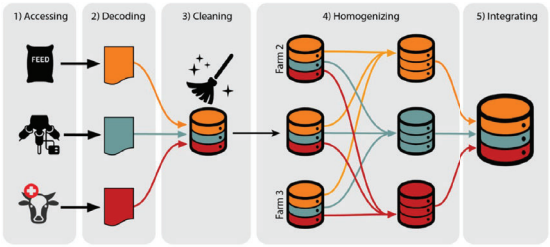
5

Challenges

- Heterogenous data
  - Different sources
  - Different formats
  - Different levels of information
- Continuous access & process of data

6

Continuous Data Integration



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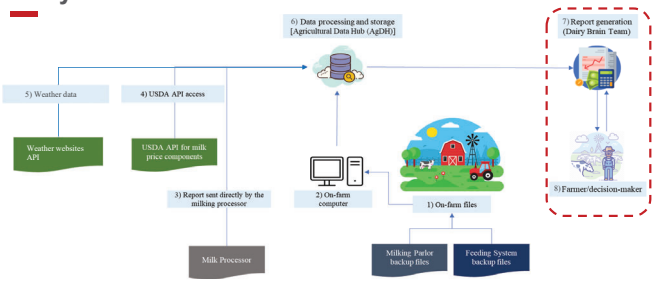
Dairy Brain Framework



8

Report Generation

- Python Jupyter notebook
- Packages: datapane, plotly
- Generalized to different farms

```
def build_datapane():
    dp.Report(
        dp.Page(
            title='Overview',
            blocks=[
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                title_md,
                eco_md,

                comp_md,
                dp.Select(blocks=[
                    dp.Plot(revenue_by_year_graph, label='Revenue'),
                    dp.Plot(production_by_year_graph, label='Production'),
                    dp.Plot(price_by_year_graph, label='Milk Price'),
                    dp.Plot(fat_by_year_graph, label='Fat'),
                    dp.Plot(protein_by_year_graph, label='Protein'),
```

python™ jupyter datapane plotly

9

Video

10

UW DairyBrain

Report generated on 2023-06-15

Daily feed efficiency by pen

11

UW DairyBrain

Report generated on 2023-06-15

Monthly Average Feed Efficiency

12

UW DairyBrain

Report generated on 2023-06-15

13

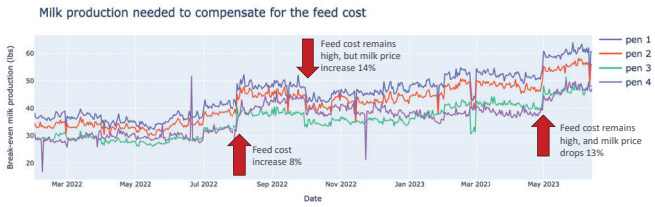
UW DairyBrain

Report generated on 2023-06-15

14

UW DairyBrain

Report generated on 2023-06-15



15

Take-home Messages

- Monitoring **KPI** requires data that normally come from different sources
- It is possible to constantly integrate disparate sources of data and **add value** to data
- Critical to involve the **farmer and the farm team** in the whole process

16

Acknowledgments

- Project supported by Agriculture and Food Research Initiative Competitive Grant No. **2019-68017-29935 (2019-2023)** from the USDA National Institute of Food and Agriculture, **Food and Agriculture Cyberinformatics and Tools Initiative**

USDA NIFA

United States Department of Agriculture
National Institute of Food and Agriculture

17

Leveraging Computer Vision Systems for Monitoring Animal Health and Productivity on Dairy Farms

Ariana Negreiro

1

Outline

Background → Background

Current research

Project 1 → Predicting Feeding Behavior of Dairy Cows

Project 2 → Monitoring Heat Stress Behavior in Dairy Calves

Project 3 → Individual Identification of Holstein Cattle Across Different Physiological Stages

Conclusions → Conclusions

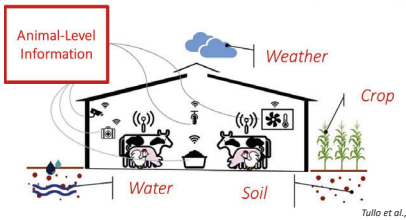
2

Dr. Dorea's Lab

- Research applications of machine learning and computer vision for farm management and genetic selection

Sensors:
Wearable
Cameras
IR Spec.
RFID
Sound
Housing

Animal Identification
Animal Behavior
Body Weight
BCS/Composition
Milk Components
Milk Yield
Estrus Event
Feed Intake
Feed Efficiency
Disease Risks



Tullo et al., 2019

3

Monitoring Behavior in Livestock

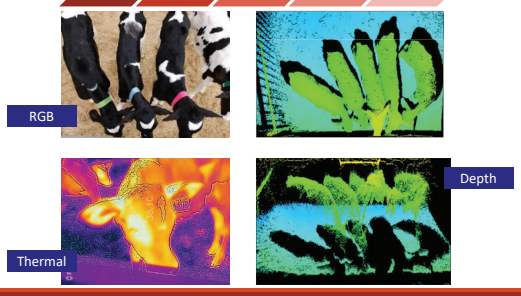
Current methods for monitoring cattle:

- Visual observation
  - Large-scale applications?
  - Subjectivity
- Wearable sensors

* Computer vision

4

Monitoring Behavior in Livestock



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Benefits of Computer Vision

- Cameras are affordable and easy to install
- Ability to monitor multiple animals at a time
- Images provide a great amount of information
  - Animal location/action
  - Social interaction
  - Weather/season
  - Health/mobility

6

Project 1: Cow Mouth Tracking

Background | Project 1 | Project 2 | Project 3 | Conclusions

7

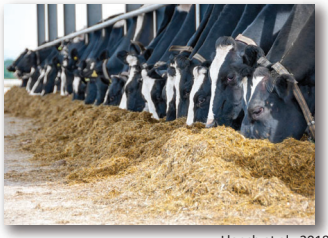
Importance of Feeding Behavior

Background | Project 1 | Project 2 | Project 3 | Conclusions

Feeding Behavior:

- Meal duration
- Meal frequency
- Meal Size
- Feeding time
- DMI
- Sorting

- Feed efficiency
- Rumen health
- Reproductive health
- Milk component production
- Metabolic disease/lameness



Llonch et al., 2018

8

Methods

Background | Project 1 | Project 2 | Project 3 | Conclusions

- 1,662,417 images
  - Cropped for each individual cow 4,008,630 sequential images
  - Mask R-CNN

Training 348 images | Validation 37 images

Inferences made on remaining 4,008,245 images

F1-score: **94.9%**
Precision: **90.7%**
Recall: **99.5%**

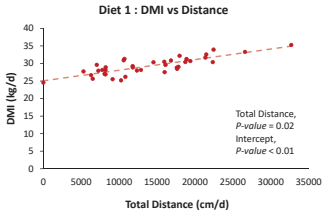
physical measurements
- distance traveled
- acceleration
- velocity

provides insight on feeding behavior, health, and milk production

9

Preliminary Results

Background | Project 1 | Project 2 | Project 3 | Conclusions



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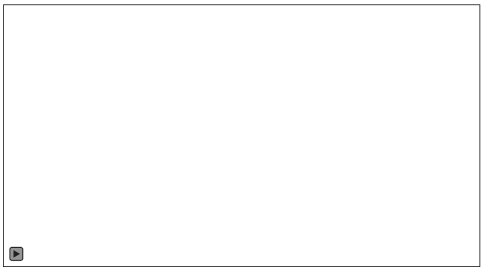
Freestall Application

Background | Project 1 | Project 2 | Project 3 | Conclusions



11

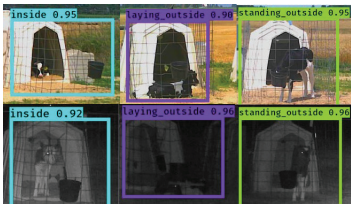
Project 2: Calf Heat Stress Detection

Background | Project 1 | Project 2 | Project 3 | Conclusions

12

Methods

Background | Project 1 | Project 2 | Project 3 | Conclusions



- 27,704 images
- YOLOv3
- tinyYOLOv3

Training 297 images | Validation 128 images

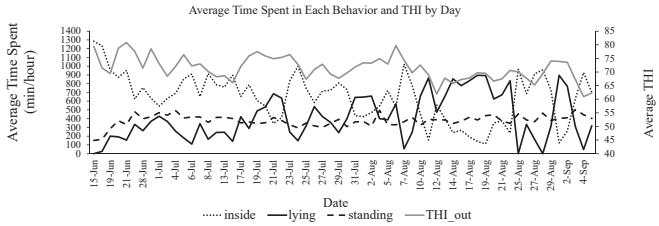
Inferences made on remaining 27,704 images

- **> 90%** precision, accuracy, and recall

13

Calf Detection

Background | Project 1 | Project 2 | Project 3 | Conclusions



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Calf Detection

Background | Project 1 | Project 2 | Project 3 | Conclusions

		Inside	Lying Outside	Standing Outside
	Hour	-0.05	0.05	0.01
	Calf	-0.34 ***	0.05	0.43 ***
	Respiration Rate	0.37 ***	-0.11 *	-0.39 ***
	Rectal Temperature, °C	-0.34 ***	0.04	0.44 ***
	Skin Temperature, Rump	-0.34 ***	0.04	0.44 ***
	Sweating Rate, Rump	-0.13 **	0.11	0.06
Outside	Solar Radiation*	-0.36 ***	0.29 ***	0.03
Outside	Wind Speed, mph*	-0.35 ***	0.31 ***	-0.01
Outside	Rainfall, inch*	0.05	0.11 *	-0.15
Outside	Temperature, °C	-0.02	0.21 ***	-0.25 ***
Outside	Relative Humidity	0.04	-0.25 ***	0.28 ***
Outside	THI	-0.09	0.22 ***	-0.16 **
Inside Hutch	Temperature, °C	-0.28 ***	0.13 **	0.23 ***
Inside Hutch	Relative Humidity	0.34 ***	-0.15 **	-0.3 ***
Inside Hutch	THI	-0.21 ***	0.11 *	0.17 ***

15

Edge Computing

Background | Project 1 | Project 2 | Project 3 | Conclusions

Deploy trained model (trained using CHTC) in edge computing applications to make inferences real-time

16

Project 3 : Calf Identification

Background | Project 1 | Project 2 | Project 3 | Conclusions

17

Individual Identification

Background | Project 1 | Project 2 | Project 3 | Conclusions

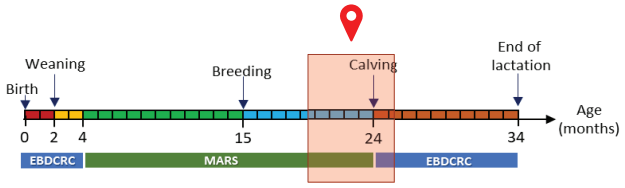
Individual traceability throughout an animal's life

- Mitigate disease outbreak (USDA APHIS, 2022)
- Improve food security and consumer trust (Smith et al., 2005)

18

Project Timeline

Background | Project 1 | Project 2 | Project 3 | Conclusions



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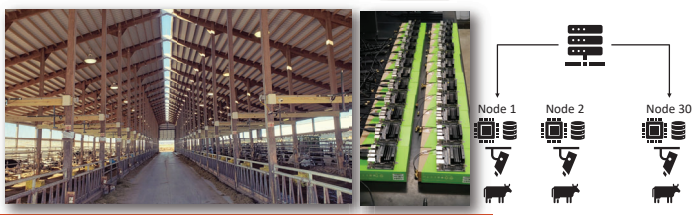
Methods

Background | Project 1 | Project 2 | Project 3 | Conclusions

- Collecting images 24/7 following calves the first 2 years of life
- Tracking growth, health, and behavior

Cloud ➡ 20 TB/mo



20

Methods

Background | Project 1 | Project 2 | Project 3 | Conclusions

- 85 + TB of data
- Current project
- Xception architecture

21

Image Preprocessing

Background | Project 1 | Project 2 | Project 3 | Conclusions


Calf original infrared image


Calf binary mask


Calf body segmented image


Heifer original infrared image


Heifer binary mask


Heifer body segmented image

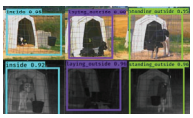
Precision: **78%**
Accuracy: **76%**
Recall: **76%**
F1-score: **77%**

22

Future Steps

Background | Project 1 | Project 2 | Project 3 | Conclusions

- Use edge computing to early detect heat stress in calves
- Develop reliable animal traceability system
- Use developed methods of phenotyping in combination with genomics to predict growth and performance



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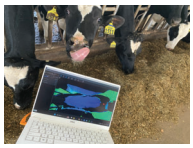
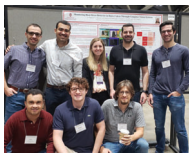
Conclusion

Background | Project 1 | Project 2 | Project 3 | Conclusions

- Computer vision systems are a promising solution to many aspects of dairy management:
  - Heat stress detection in calves based on behavior
  - Cow mouth tracking to predict intake and production metrics
  - Individual animal traceability through periods of growth and physiological changes in dairy cows

24





Thank you!

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Dr. Tiago Bresolin
Dr. Guilherme Rosa
Rafael Ferreira
Alysia Vang

Email: negreiro@wisc.edu

Factors that Influence Milking Visit Patterns in Automatic Milking Systems

Abbi Prins

Factors that influence milking visit patterns in automatic milking systems

Abbi Prins
Advised by: Dr. Marcia Endres
University of Minnesota

1

Background

Why do cows visit the robot?	To be milked and receive concentrate
Importance to increase visits	Optimize visits to maximize daily milk production per robot
How can we increase visits?	Nutritional management and optimize box occupancy time
Changes in visits during lactation	3-4x early lact., 2.5-3x mid-lact., and 2 or less late lact.

2

What impacts visits?

- Social hierarchy
- Lameness

3

What impacts visits?

- Social hierarchy
  - More dominant cows spend less time waiting to enter the robot
  - 1st lactation vs. 2+ lactation
- Lameness
  - Reduced number of visits
  - Other health issues: udder tension and intra-mammary infections

4

Other factors that effect visits in a 24-hour period?

- Parity
- DIM
- Is the pattern specific enough to follow a circadian rhythm?

5

Circadian rhythm background

- Circadian rhythm – physical, mental, and/or behavior changes that follow a 24-hour cycle
- Sleep-wake cycles, hormone production, metabolism, and activity patterns
- Optimize management practices
- Improve welfare
- Enhance milk production

6

Objectives

1. Identify diurnal visit patterns in dairy cows in an automatic milking system (AMS).

2. Investigate if a circadian rhythm exists with regards to robot milking visits, and if it is influenced by factors such as parity and days in milk.

7

Descriptive analysis

10 farms

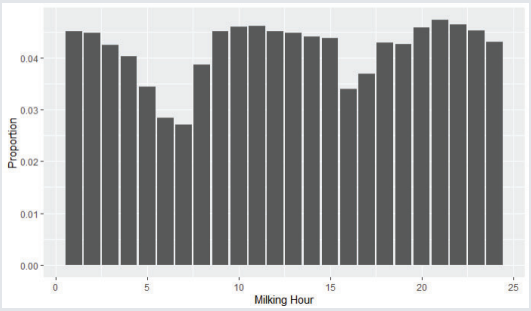
1700 cows

1.5 million observations

Guided Flow System

8

Proportion of cows milked at each milking hour



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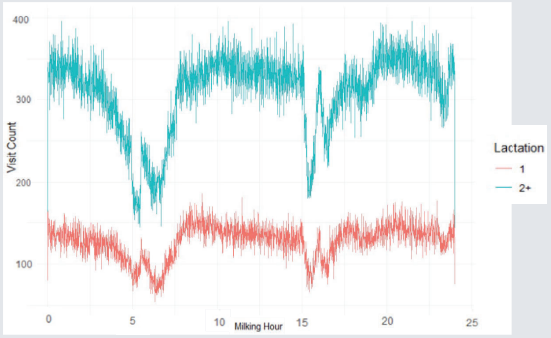
Number of visits per hour by parity



10

Next steps

USE MIXED MODELING IN R

CIRCADIAN RHYTHM ANALYSIS

2ND DATASET WITH 7.5 MILLION OBSERVATIONS

11

Thank you! Questions?

Abbi Prins

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Descriptive Evaluation of Camera-based Dairy Cattle Lameness Detection Technology Paired with Artificial Intelligence

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COI & Supporters

Research Farms
Hoof Trimmers & Veterinarians
Students and Collaborators

2

Lameness

Negative Associations

Profitability

Sustainability

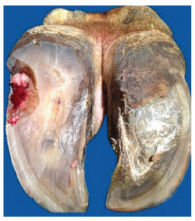
Welfare

3

Three most common types of lesions on dairy farms

Sole Ulcer

Digital Dermatitis



White Line

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Visual lameness detection

- Multiple Scales
- Subjective
- Short Duration

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Video analysis

6

Video analysis

CATTLE EYE

Does it have the ability to detect lesions earlier?

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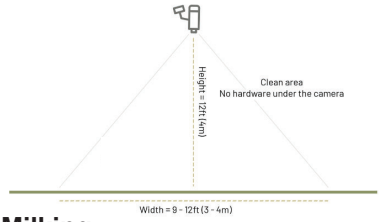
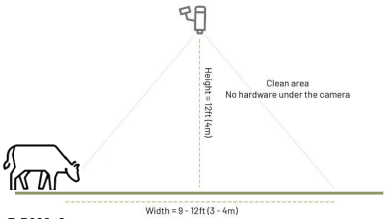
How the technology is set up



Milking Parlor → **Pen**

8

How the technology is set up



Milking Parlor → **Pen**

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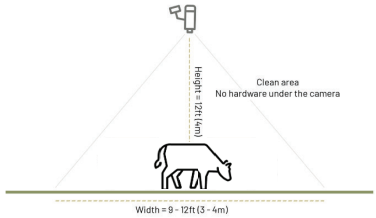
How the technology is set up



Milking Parlor → **Pen**

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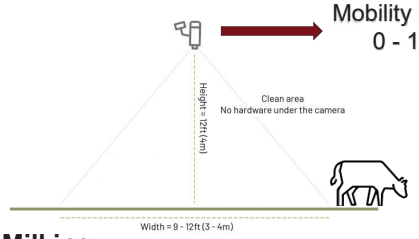
How the technology is set up

Mobility Score
0 - 100



Milking Parlor → **Pen**

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Objective

Describe the associations between weekly scores and data collected during hoof trimming events

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5 years of hoof trimmer data

TRIM

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5 years of hoof trimmer data

TRIM LESION

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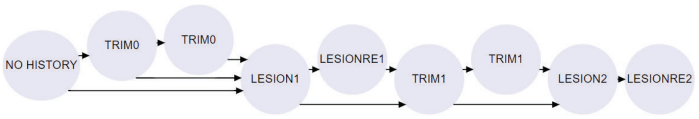
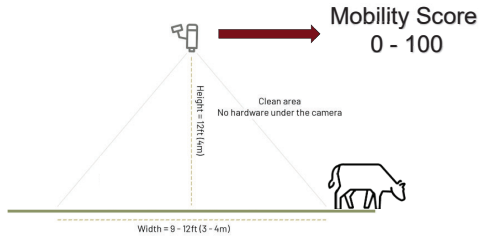
TRIM and LESION can be furthered classified

Purpose: Account for chronicity and past lesions which may alter gait



15

3 Farms in Upper Midwest US with 8 months of scores



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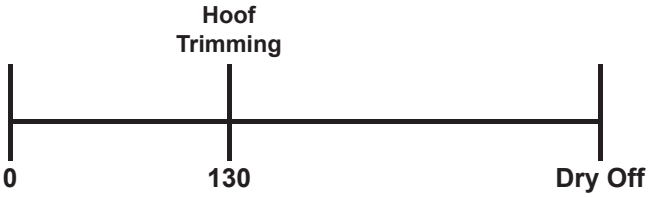
Setting up the data for retrospective scores

Days in Milk

17

Setting up the data for retrospective scores



Days in Milk

18

Setting up the data for retrospective scores

Days From Diagnosis

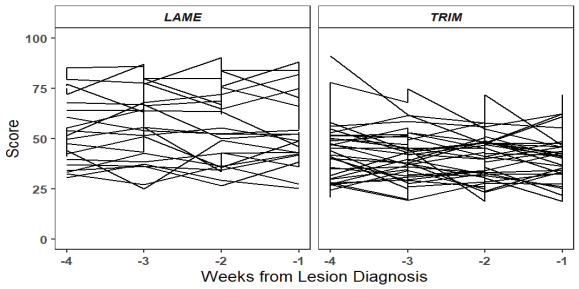
19

Transformed daily scores into weekly scores

Weeks from Diagnosis

20

Weekly scores reduce the daily variation



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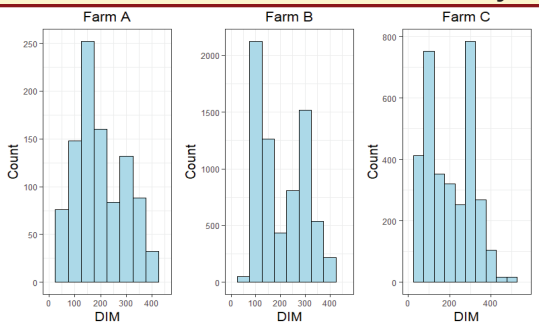
Farms have different trim distributions on days in milk



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Most of the events were TRIM

Event	Farm A	Farm B	Farm C	Total
LESION	90	146	327	563
TRIM	157	1,612	494	2,263

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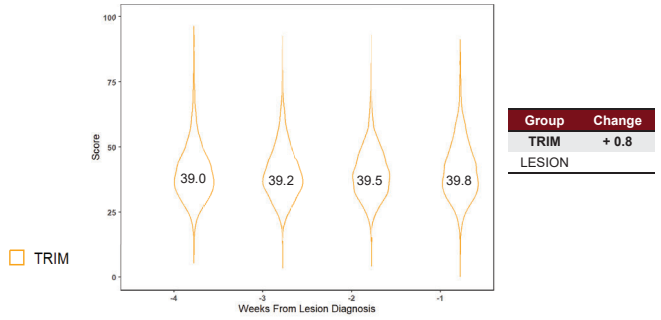
LESION has a higher median score than TRIM



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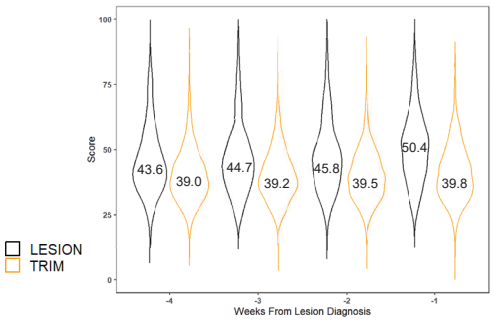
LESION has a higher median score than TRIM



Group	Change
TRIM	+ 0.8
LESION	**+ 6.8**

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Descriptive data of TRIM and LESION

Lesion Type	Farm A	Farm B	Farm C	Total
LESION1	31	22	0	53
LESION2	11	53	92	156
LESIONRE1	17	18	3	38
LESIONRE2	3	7	25	35
TRIM0	96	434	6	536
TRIM1	47	1,144	443	1,634

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Majority of the observations are TRIM events

Lesion Type	Farm A	Farm B	Farm C	Total
LESION1	31	22	0	53
LESION2	11	53	92	156
LESIONRE1	17	18	3	38
LESIONRE2	3	7	25	35
TRIM0	96	434	6	536
TRIM1	47	1,144	443	1,634

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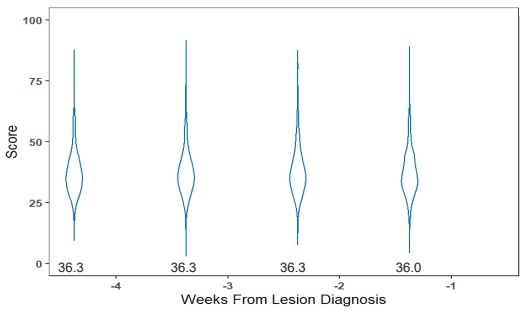
Lameness history increases median scores



Group	Change
TRIM0	**- 0.3**
LESION1	
LESIONRE1	
TRIM1	
LESION2	
LESIONRE2	

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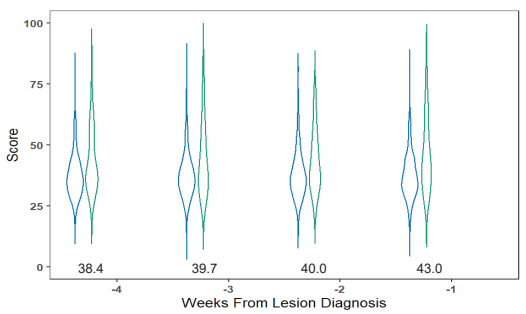
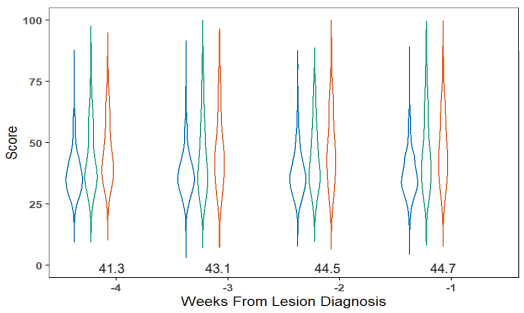
Lameness history increases median scores



Group	Change
TRIM0	- 0.3
LESION1	**+ 4.2**
LESIONRE1	
TRIM1	
LESION2	
LESIONRE2	

29

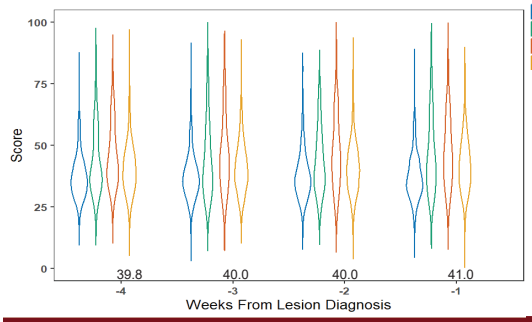
Lameness history increases median scores



Group	Change
TRIM0	- 0.3
LESION1	+ 4.2
LESIONRE1	**+ 3.4**
TRIM1	
LESION2	
LESIONRE2	

30

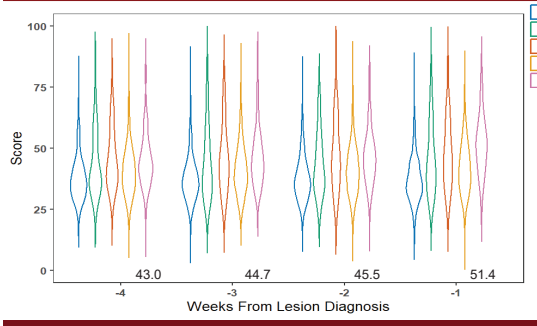
Lameness history increases median scores



Group	Change
TRIM0	- 0.3
LESION1	+ 4.2
LESIONRE1	+ 3.4
TRIM1	**+ 1.2**
LESION2	
LESIONRE2	

31

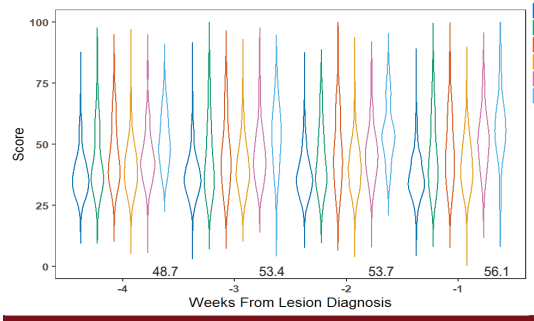
Lameness history increases median scores



Group	Change
TRIM0	- 0.3
LESION1	+ 4.2
LESIONRE1	+ 3.4
TRIM1	+ 1.2
LESION2	**+ 8.5**
LESIONRE2	

32

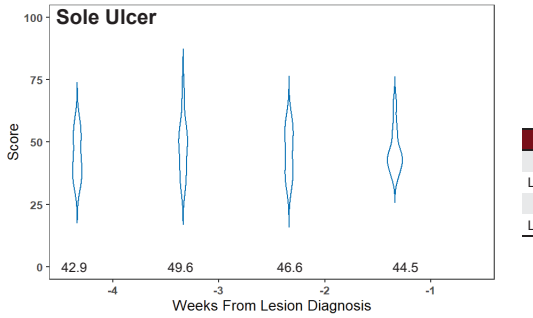
Lameness history increases median scores



Group	Change
TRIM0	- 0.3
LESION1	+ 4.2
LESIONRE1	+ 3.4
TRIM1	+ 1.2
LESION2	+ 8.5
LESIONRE2	**+ 7.5**

33

Different lesions result in different scores



Group	Change
LESION1	**+ 1.6**
LESIONRE1	
LESION2	
LESIONRE2	

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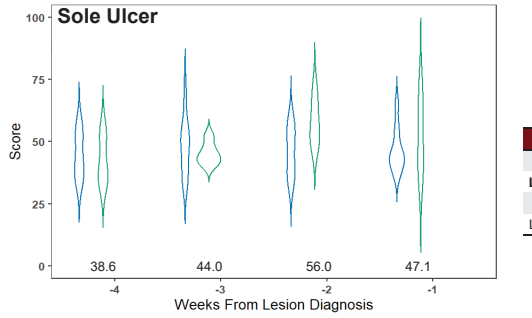
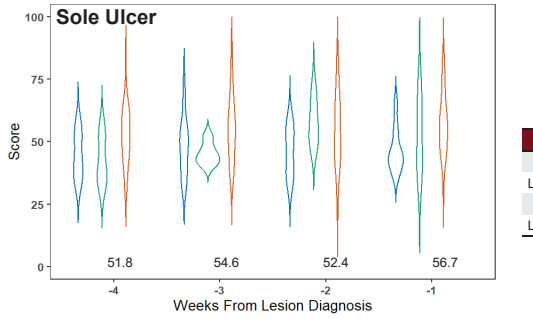
Different lesions result in different scores



Group	Change
LESION1	+ 1.6
LESIONRE1	**+ 8.5**
LESION2	
LESIONRE2	

35

Different lesions result in different scores



Group	Change
LESION1	+ 1.6
LESIONRE1	+ 8.5
LESION2	**+ 4.9**
LESIONRE2	

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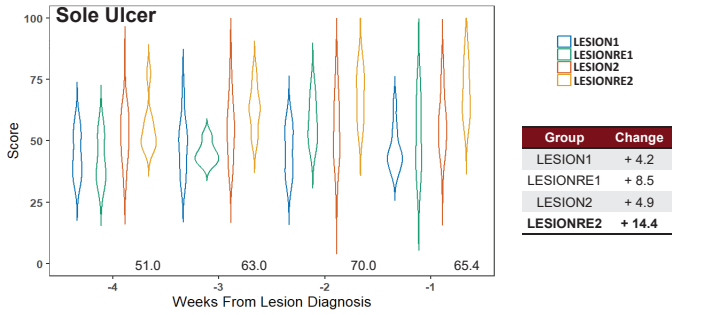
Different lesions result in different scores



Group	Change
LESION1	+ 4.2
LESIONRE1	+ 8.5
LESION2	+ 4.9
LESIONRE2	**+ 14.4**

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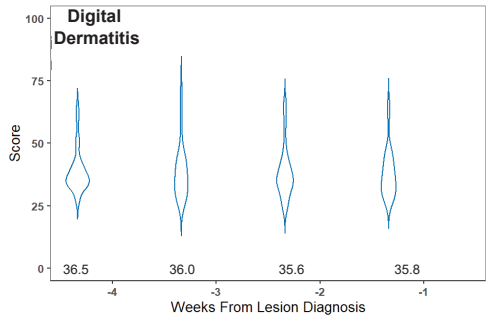
Different lesions result in different scores



Group	Change
LESION1	**- 0.7**
LESIONRE1	
LESION2	
LESIONRE2	

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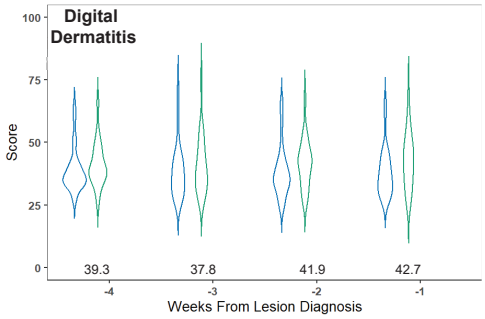
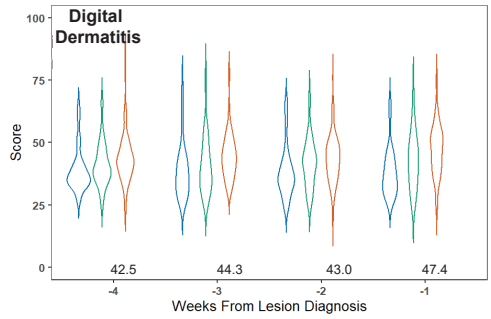
Different lesions result in different scores



Group	Change
LESION1	- 0.7
LESIONRE1	**+ 3.4**
LESION2	
LESIONRE2	

39

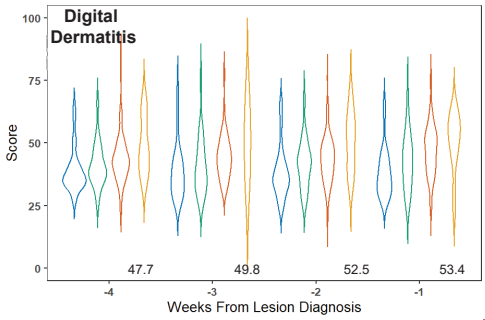
Different lesions result in different scores



Group	Change
LESION1	- 0.7
LESIONRE1	+ 3.4
LESION2	**+ 4.9**
LESIONRE2	

40

Different lesions result in different scores



Group	Change
LESION1	- 0.7
LESIONRE1	+ 3.4
LESION2	+ 4.9
LESIONRE2	**+ 5.7**

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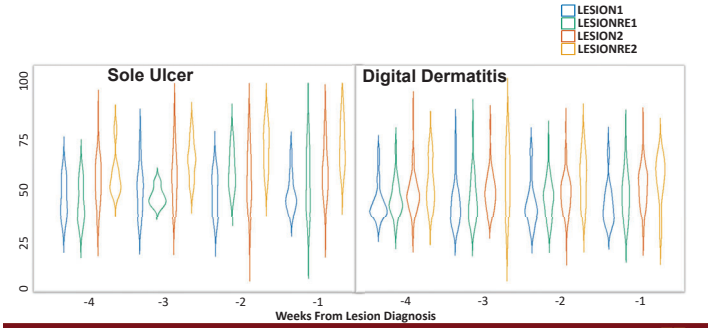
Different lesions result in different scores



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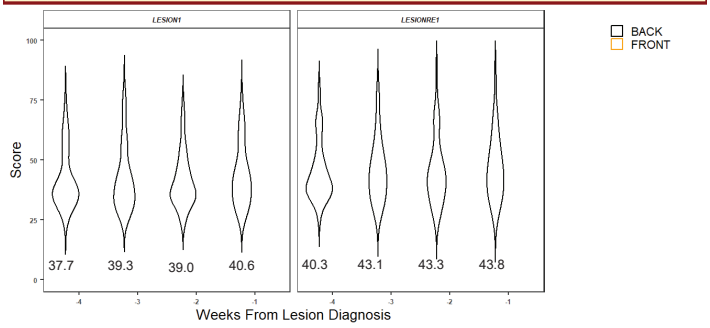
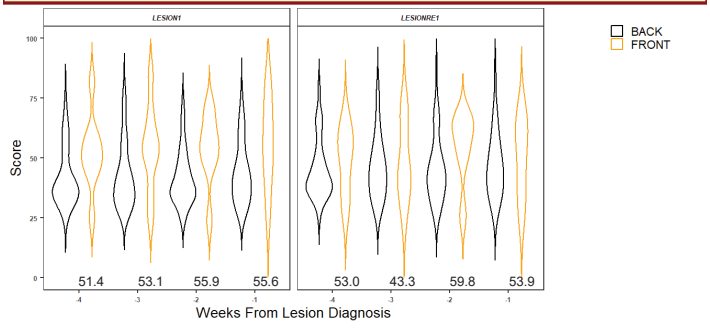
Lesion locations result in different scores



43

Lesion locations result in different scores



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Existing limitations in the current work

- Unknown severity of lesions
- Only 8 months of data
- No measure of trimmer lesion identification accuracy

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The take home message

- The results indicate the score trends from this autonomous lameness scoring technology may have the potential for the earlier detection of some lesions.
- Lesion history, location, and type need to be considered for lesion detecting technology.

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Acknowledgements

Cattle Eye
Council on Dairy Cattle Breeding
USDA National Needs Fellowship
Participating Farms and Trimmers
Signature Program
Cramer Lab

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