EAAP conference, Copenhagen (DK)
28th of August, 2014

Knowing the normal variation in lameness variables in order to build a warning system

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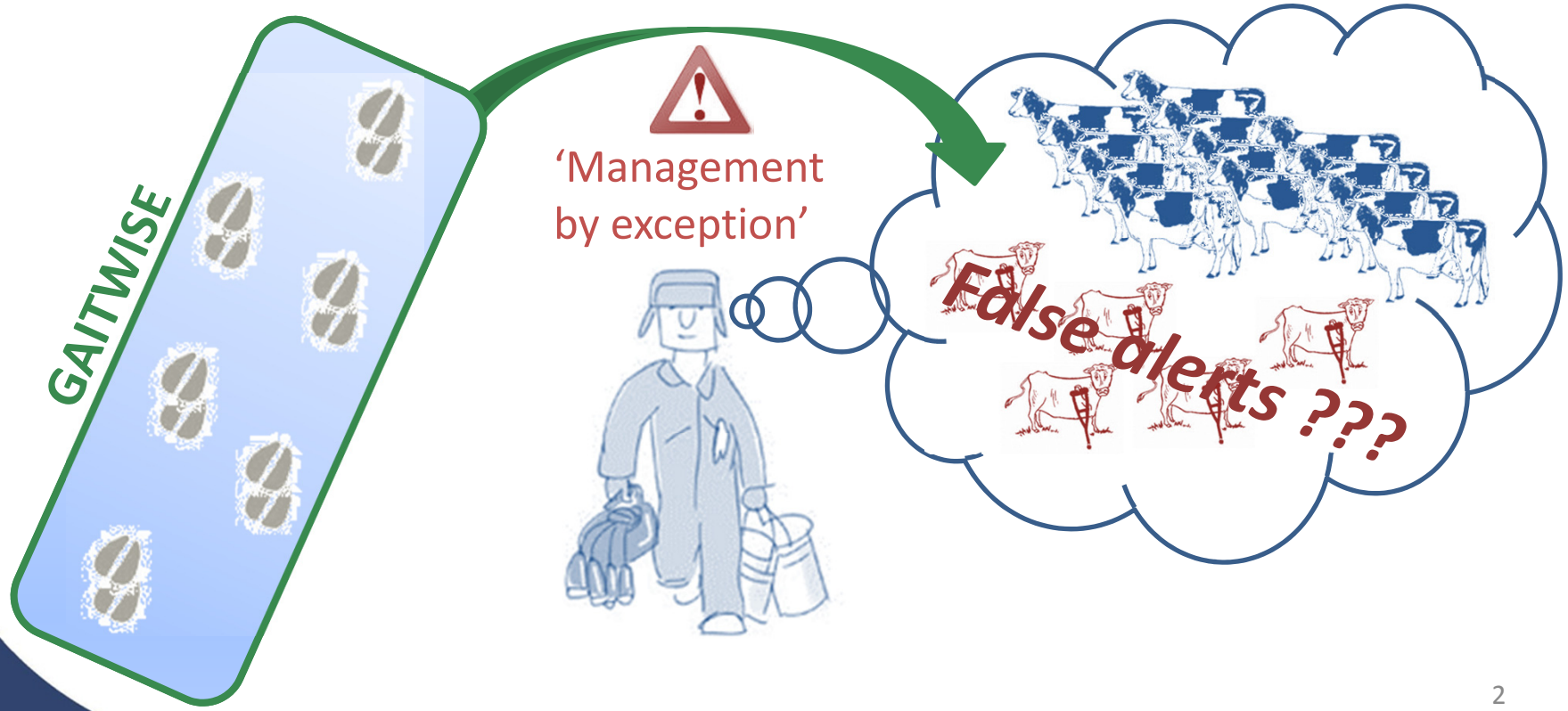
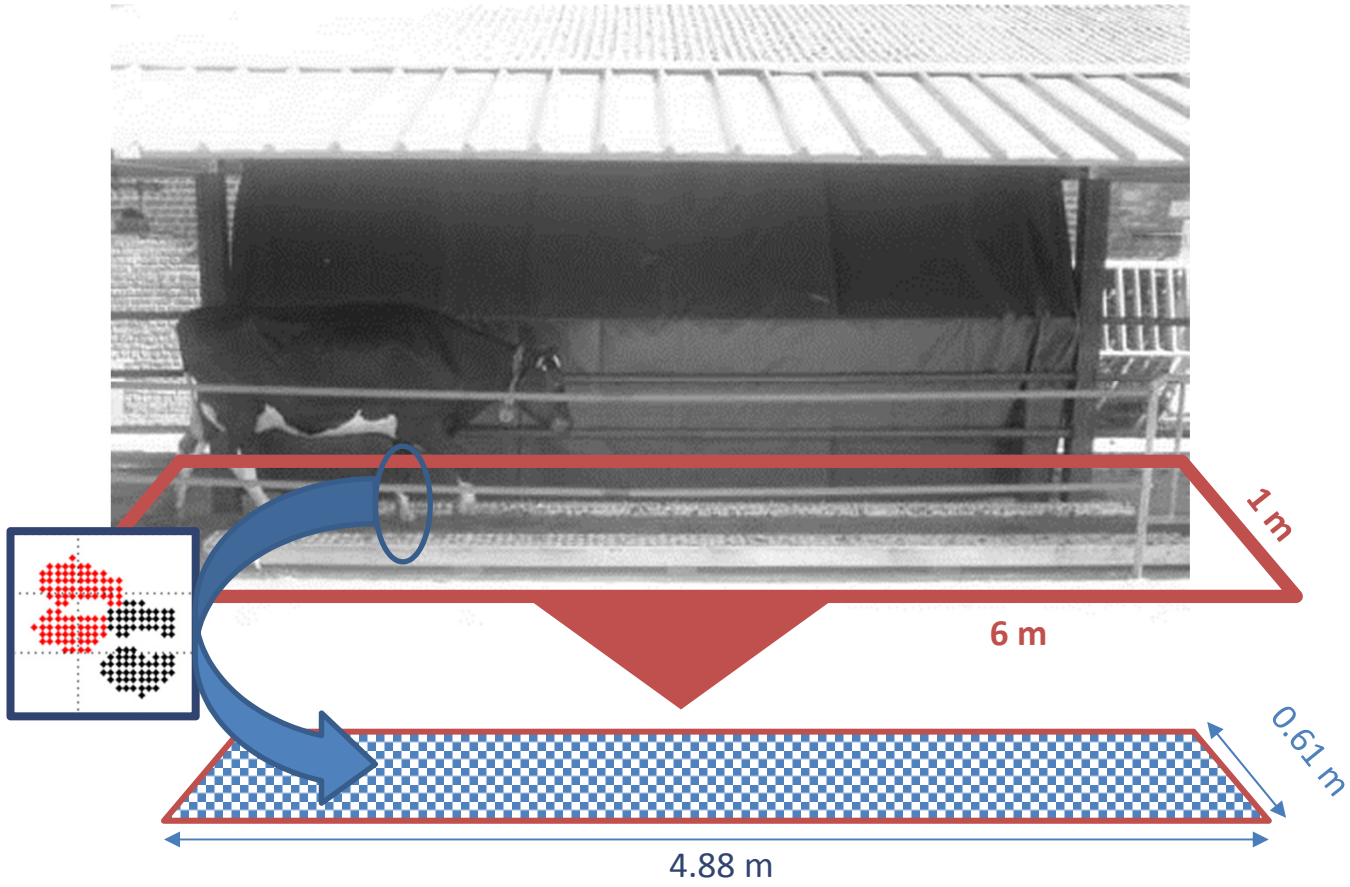
Dairy lameness situation

Negative effect on cow health, welfare, longevity and production
High prevalence hugely underestimated

→ Detect those cows that need extra attention



Gaitwise



TIME – LOCATION – FORCE

Gaitwise

10 Specific variables

- → Stride length
- → Stride time
- → Stance time
- → Step overlap
- → Abduction
- → Asymmetry in Stepwidth
- Steplength
- Steptime
- Stance time
- Force

Cross validation
Leave - one cow - out

Reference	*Model* NON-lame	MILDLY lame	SEVERELY lame	Sensitivity
NON-lame	34	8	0	81
MILDLY lame	10	32	0	76
SEVERELY lame	0	5	37	88
Specificity	88	85	100	81.7 %

Detection algorithm

How to improve the misclassification of mildly lame cows?

- *Look for other variables more suited for detection of mildly lame cows*
  - → *Variables of gait inconsistency*
- *Other 'normal' causes of changes in gait variables*
- *Use a detection algorithm based on individual thresholds compared to group thresholds*

What causes normal variation?

Environmental and cow- specific factors that influence cow gait

Criteria for cow selection:

- No other health problems (mastitis, …)
- Non-lame according to expert
- Received no trimming sessions prior and during experimental period

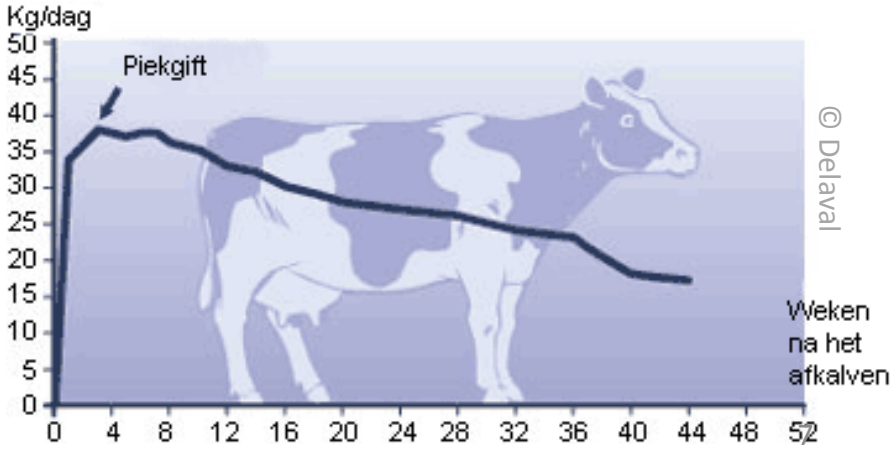
→ 30 cows
→ 5 months

What causes normal variation?

Environmental and cow- specific factors that influence cow gait

Selected factors:

- Light/dark environment
- Wet surface (rain)
- Age
- Production level
- Lactation stage
- Gestation stage



What causes normal variation?

Light or Dark environment

Wet surface

Gaitwise variables	P-value	P-value
Asymm stepwidth ↑		0,004
Asymm steplength ↑	0,028	0,004
Asymm steptime		
Asymm stance time		
Asymm force		
Stride length ↓		0,001
Stride Time		
Stance Time		
Step Overlap ↓	0,044	
Abduction		

Shorter, more asymmetrical strides with less stap overlap

What causes normal variation?

Gaitwise variable	P-value	P-value
Asymm stepwidth ↑	<0,0001	
Asymm steplength		
Asymm steptime ↑	<0,0001	
Asymm stance time		
Asymm force ↑	<0,0001	
Stride length		
Stride Time ↑	<0,0001	
Stance Time ↑	<0,0001	
Step Overlap		
Abduction ↑	<0,0001	

Age

Production

Slower, more asymmetrical strides with more abduction

What causes normal variation?

Lactation stage | Gestation stage

Gaitwise variable	P-value (light)
Asymm stepwidth	
Asymm steplength ↑	0,001
Asymm steptime	
Asymm stance time	
Asymm force	
Stride length ↓	<0,0001
Stride Time	
Stance Time	
Step Overlap ↓	0,002
Abduction	

Shorter strides, more asymmetrical with less step overlap

Detection algorithm

How to improve the misclassification of mildly lame cows?

- *Look for other variables more suited for detection of mildly lame cows*
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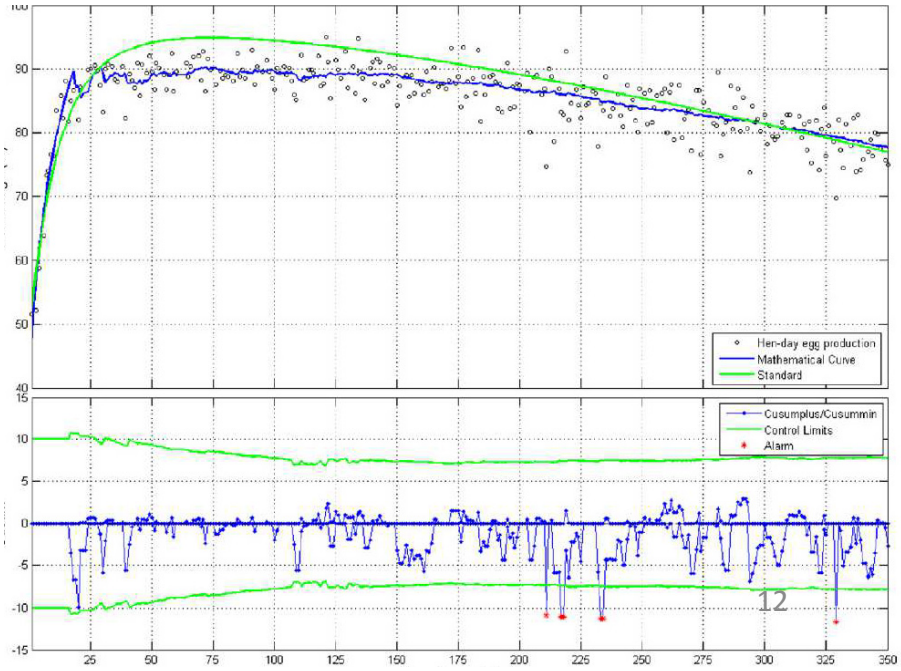
Synergistic Control (SGC)

Statistical Proces Control (SPC):

- Normal variation
- Abnormal variation due to lameness

→ Use of control charts

→ Preprocess data by Engineering Proces Control (EPC)

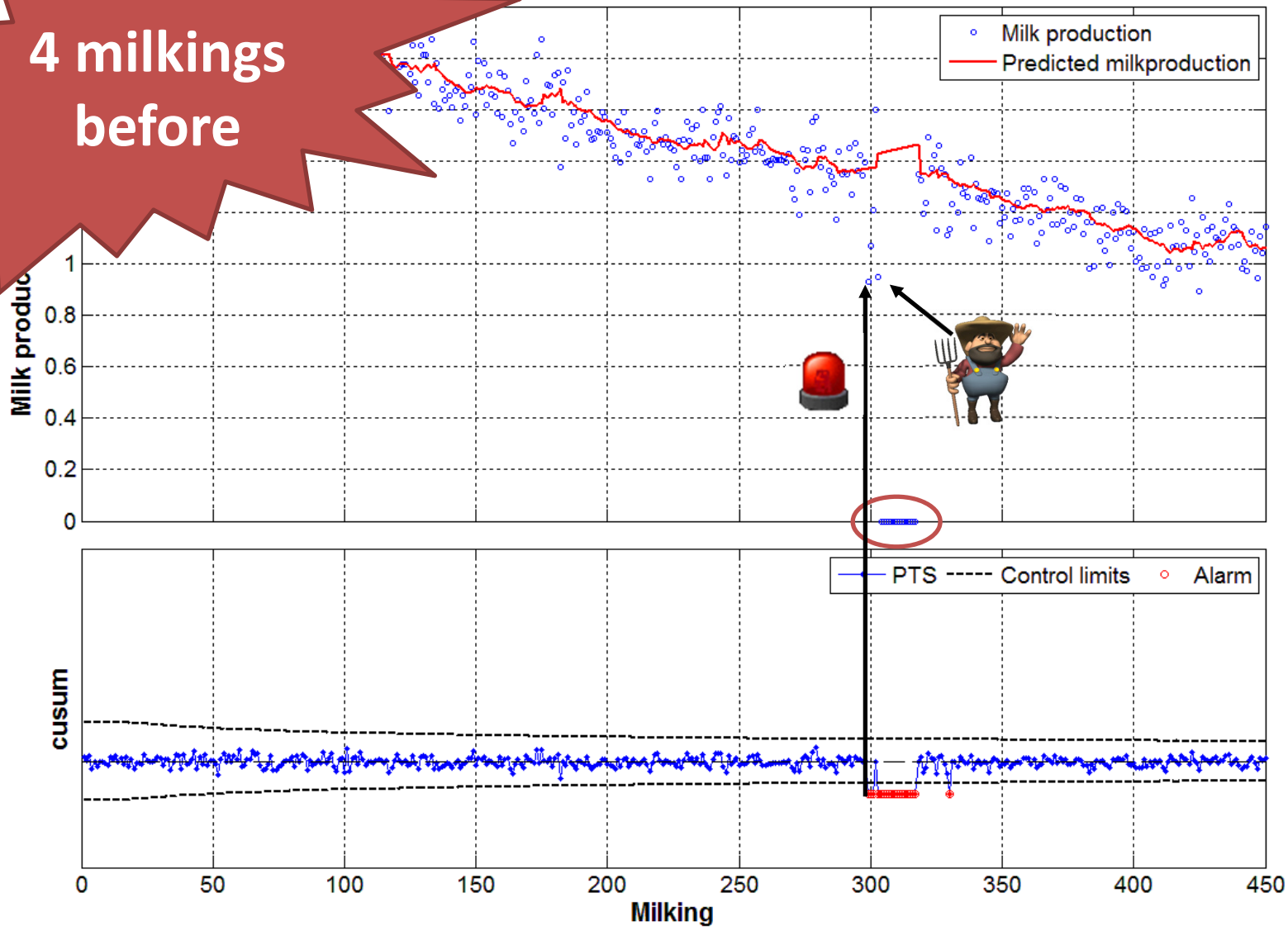


(Mertens et al., 2009)

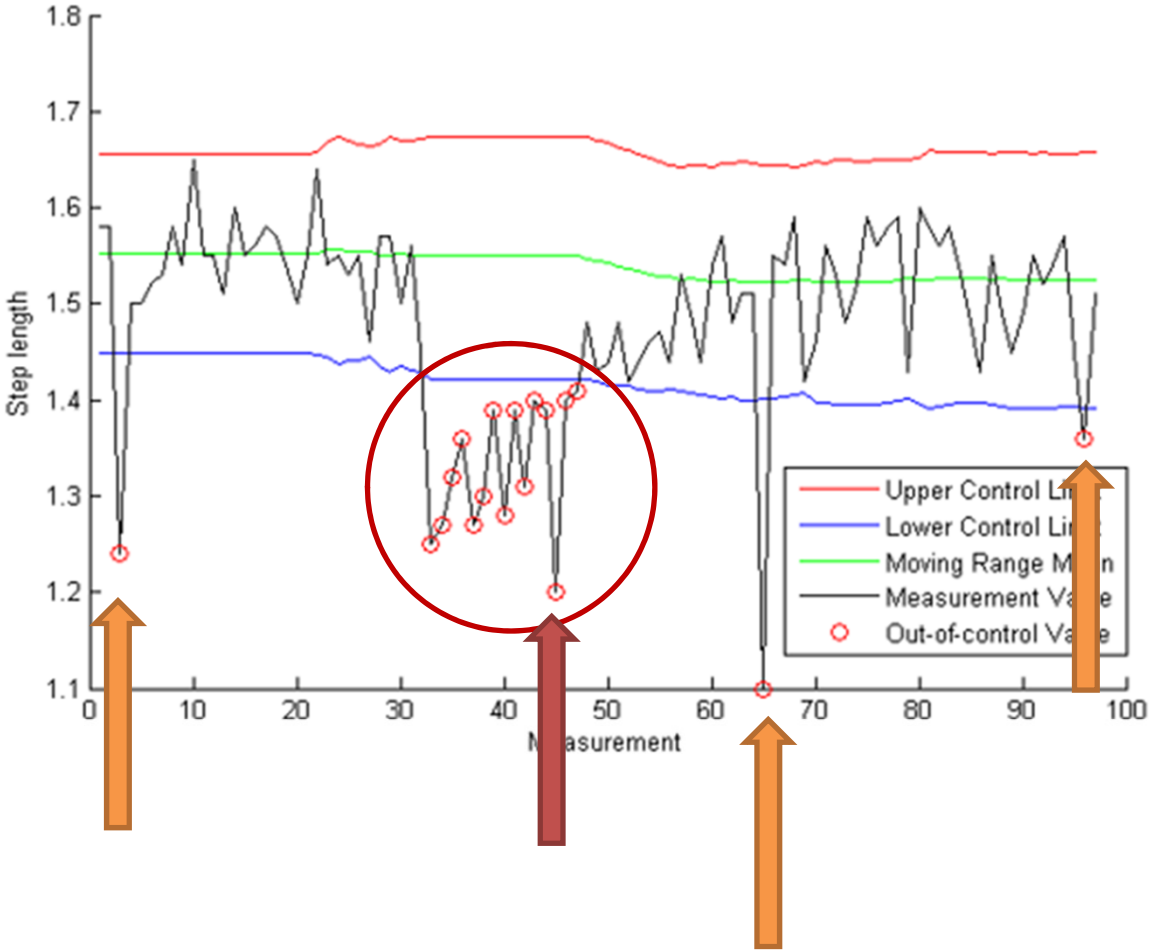
Synergistic Control (SGC)

4 milkings before

Huybrechts et al., 2014



Synergistic Control (SGC)



Challenges for further development of Gaitwise

- Improve lameness detection
  - Combining Gaitwise data with other data
  - Including information on normal variation
  - Improve the detection by using individual thresholds

    → SILF-project

Smart Integrated Livestock Farming

SILF is an ICT AGRI era-net *project (2013-2016) involving:*

[a,f,h] *Institute for Agricultural and Fisheries Research (ILVO), Belgium*

[b] *Department of Engineering - Operations Management, Aarhus University (AU), Denmark*

[c] *Center for Research and Technology (Cereteth), Greece*

[d] *Department of Biosystem Engineering, University College of Dublin (UCD), Ireland*

[e] *Department of Animal Production Research, MTT, Finland*

[g] *Mechatronics, Biostatistics and Sensors Unit (MeBioS) – Catholic University of Leuven, Belgium*

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Smart Integrated Livestock Farming

- Poster during 1st DairyCARE conference
  - → Copenhagen, 22nd -23rd of August 2014
  - → Proceedings on website
    www.dairycareaction.org

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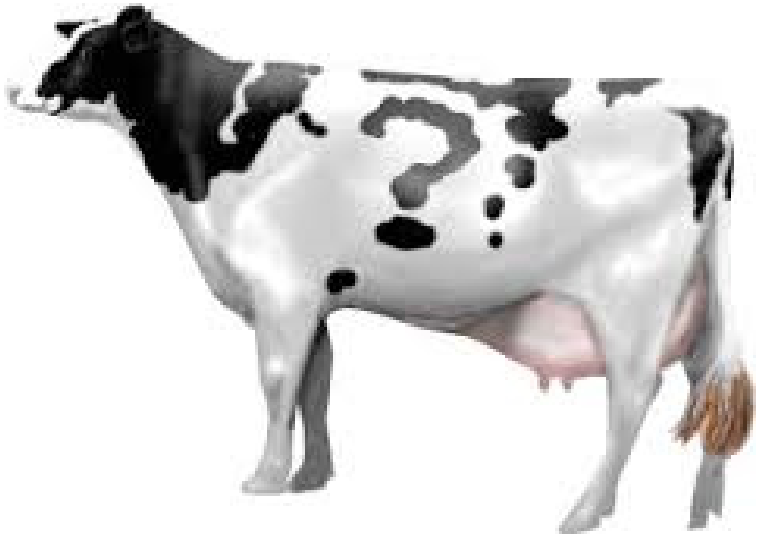

Any questions?

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