EU-PLF PROJECT
Bright Farm
by Precision Livestock Farming

Closing conference
Brussels, 29th September 2016

Conference Proceedings

CONTENT

Daniel Berckmans obtained a Master and a PhD in Bio-Science Engineering from KU Leuven. In 1998 he became a full professor at KU Leuven and the Head of the Division M3-Biores (Measure, Model and Manage Bioresponses).

The main field of Prof Berckmans' research consists of real time signal analysis of humans and animals by using technology like wearables, cameras and microphones. The activities comprise the measurements, modelling and monitoring or management of individual living organisms. His research team is considered as a worldwide leader in Precision Livestock Farming. Half of the team is working on animal applications and half on human applications. Prof Berckmans is the co-author of 273 scientific articles in peer-reviewed journals and 389 papers in conference proceedings.

Since 1982, 15 products have been developed for the world market in co-operation with industrial partners and 18 patents have been submitted. Prof Berckmans is the coordinator of several EU-projects with a total value of over 10M Euro and is the co-founder of 2 spin-off companies: BioR-ICS NV in 2006 and Sound-Talks NV in 2011.

PROF DANIEL BERCKMANS

Erik Vranken started his studies in Agricultural Engineering at KU Leuven, where he obtained his master's degree in 1984, with a specialization in Biosystems Engineering. After his studies he started his research career at the same University, where he specialized in bio-environmental control in livestock buildings. This work resulted in several patents and products in the area of ventilation equipment and livestock production systems, in co-partnership with industry.

In 1999, Prof Vranken obtained his Doctorate in Applied Biological Engineering with a thesis on the analysis and optimization of climate control systems in livestock production units.

In 2002, Prof Vranken was nominated as part-time professor at KU Leuven, where he teaches courses in Biomechatronics, Sustainable Precision Livestock Farming and Biosystems Engineering. Since 2007, he combines his professorship with the position of Research Manager at Fancom BV, a Dutch company and world market leader in the development and sales of Integrated Management Solutions for livestock buildings. The research strategy at Fancom BV is focused on the innovation and developments of Precision Livestock technologies in the pig and poultry sector.

PROF ERIK VRANKEN

Dries Berckmans obtained a degree in Mechanical engineering at KU Leuven, in July 2005.

In April 2010, Dr Berckmans finished his PhD with the noise and vibration research group of KU Leuven on the topic of traffic noise synthesis. In 2011, he became the founder of SoundTalks NV, a spin-off company of KU Leuven and the University of Milan, which focuses on the development of algorithms for automated sound analysis. SoundTalks has commercially launched a respiratory distress monitor for fattening pigs in 2014 and is now developing new PLF products for the poultry, swine and cattle industry.

DR DRIES BERCKMANS

Isabelle Veissier, DVM and PhD, is a research director from INRA (French National Institute for Research in Agriculture). She leads the Joint Research Unit on Herbivores. Dr Veissier's research is focused on animal behaviour and welfare. She studies the different facets of the behaviour of cattle and sheep following the idea that behaviour tells us how animals see the world around them, how they form social bonds, how they learn, and what they feel. Currently Dr Veissier's research is focused on behavioural changes as early signs of health disorders.

Isabelle has worked to spread the idea that the animals were thinking beings, reactive, emotional, etc… and therefore, that their state of welfare can be assessed by specific indicators and should be taken into account in farming.

Dr Veissier's co-leads the French scientific network on animal welfare (1998-2007) and is regularly involved in European projects and networks on animal welfare: a project on the welfare of calves (1997-2000), the COST Network Measuring and monitoring animal welfare (2000-2006), the Welfare Quality® project to develop assessment systems of welfare (2004-

DR ISABELLE VEISSIER

2009) and its following Welfare Quality Network, the Alcasde project to identify alternatives to dehorning (2009), EUWelNet to evaluate the potential to create reference centres in animal welfare in Europe (2013), and currently the EU-PLF project to develop precision farming tools (2012-2016). She also works with policy makers (Ministry for Agriculture, European Union, Council of Europe, dairy industries, etc...) to help them formulate recommendations for the protection of animals.

PROF JÖRG HARTUNG

Jörg Hartung made two round of farm visits during the EU-PLF project (in 2014 and in 2016). The objective of the farm visits was to learn from the opinion and experiences of the farmers after several years working with PLF systems. It was important to hear the full scope of opinions and not only the good and positive ones. Therefore it was of interest to learn from the farmer's opinion speaking directly with him/her.

Prof Hartung is a Professor for Animal Hygiene and Husbandry and Professor for Animal Welfare Science of the University of Veterinary Medicine Hannover, Foundation (TiHo). He is also an Honorary Doctor of the Swedish University of Agricultural Sciences (SLU) – awarded for his scientific merits in research on, animal health and welfare and effects of air pollutants o animal, man and the environment.

Prof Hartung was director of the Institute for Animal Hygiene, Animal Welfare and Farm Animal Behaviour at TiHo, Germany for 20 years (till 1993) and served before as group leader in Silsoe Research Institute, UK.

DR HEINER LEHR

Heiner Lehr holds a PhD in Natural Sciences from the Technical University of Berlin. Dr Lehr is an expert in the fields of precision livestock farming and food and animal traceability. He is actively involved in European research projects. He was the coordinator of BrightAnimal, a direction setting EU project on Precision Livestock Farming. He is the co-editor of a book on the Multidisciplinary Approach to Acceptable and Practical Precision Livestock Farming, available on Amazon. Based on BrightAnimal, the European Commission initiated EU-PLF and ALL-SMART-PIGS, where Dr Lehr is a work package leader. In EU-PLF, he is the leader of the value creation assessment work package and innovation through the high-tech SMEs work package. Due to his interest and expertise in this field, Dr Lehr recently became an entrepreneur in PLF.

DR JEAN-LOUIS PEYRAUD

Jean-Louis Peyraud is Special Adviser to the scientific Director of Agriculture at INRA (National Institute for Agricultural Research) in Paris. After his doctorate at the University of Rennes (1983), he focused his research on dairy production. He gained international fame with his work on grazing and grassland management and has been involved in several European projects as WP leader and has coordinated the FP7-Multisward project whose goal was to improve the competitiveness and sustainability of ruminant production systems based on grassland.

He was the head of the INRA-Agrocampus Joint Research Unit on Dairy Production from 1999 to 2008. He is currently the head of the joint technological research unit "Research and Engineering in dairy farming" led by INRA and the French Livestock Institute, and the president of the GIS "Livestock tomorrow" which brings together all actors (research, formation, extension services) involved in animal production in France. At the European level he is the chair of the public-private platform "Animal Task Force" which promotes sustainable and competitive animal production sector by fostering knowledge development and innovation in Europe.

HIGH-TECH START-UPS IN THE EU-PLF PROJECT

YMAGING

Ymaging is a company focused in R&D of **new technologies and automated system for the interpretation of complex data**. Ymaging holds a strong component of innovation and technology in computer vision, machine learning, data mining, electronics and informatics that flows into breakthrough solutions for synthesizing complex patterns in big data into simple outputs for non-expert users (e.g. artificial intelligence, ultrasound, predictive models, automated interpretations, photonics, Raman, in-vivo imaging). Ymaging is following **three business lines** in the Cloud Services market: (1) an industrial solution of production line for high-speed and high-precision food sorting (up to 4 tonnes/hour), (2) **Fertility:** Cloud Services for automated quantification of medical images for improved management in fertility and (3) PigWei a product for Smart and Precision Farming sector based on Cloud

DR IVAN AMAT-ROLDAN – FOUNDER

Services for precise, feasible and cost-effective pig weighing.

PigWei is a **smart hand-held device** for instantaneous, touchless, precise and cost-effective pig weighing that allows a constant and **continuous monitoring** of the animal growth in a way it ensures a **better management** of resources, **higher quality** of meat and **lower costs** for farmers. Based on a three-fold structure (Software, Hardware and Cloud Services), the device is a breakthrough technology that weighs a pig by capturing an image, which can be taken from a wide range of distances and angles, and sending it to Cloud Services which process the calculation. The elaborated result appears on the device in few seconds and does not require any additional infrastructure, but the Internet.

www.ymaging.com

BAINISHA

Bainisha is a high-tech start-up dedicated to the development of a high precision flexible motion-capturing sensor that can be used to monitor behaviour, motion, and activity. The ultra-thin, multi-layer polymer technology used in the Bainisha products allows to compare very similar moves and identifies extremely small differences The key advantage is that it is worn in a daily life environment without causing any discomfort.

It has a good potential to be used for monitoring locomotion in farm animals and other applications. Bainisha has received several international awards for its ground-breaking technology.

www.bainisha.com
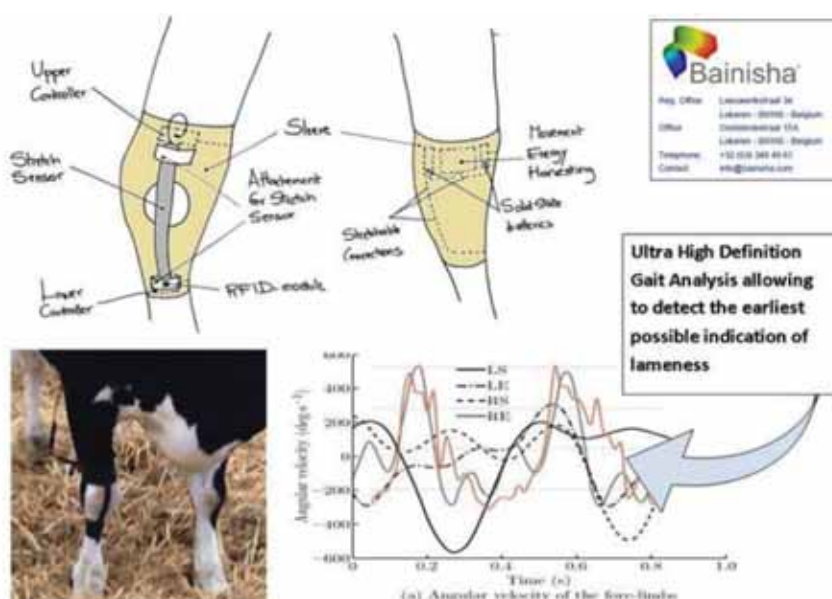
DR PATRICK VAN DE VYVER – FOUNDER

HIGH-TECH START-UPS IN THE EU-PLF PROJECT

CONNECTERRA B.V.

Connecterra is a high-tech start-up, founded in 2014, that aims to change/improve farming through their dairy health service for cows. Connecterra combines the power of sensor technologies and machine learning to provide a complete health monitoring service for the dairy industry. Connectarra's end-to-end solution consists of a wearable device, which monitors the herd in real-time and transmits the data to a cloud platform for analysis and prediction of behavioural patterns. This allows farmers to free up labour time, improve milk production per animal and save a significant amount of money by optimising their breeding cycles.

www.connecterra.io

IR. YASIR KHOKHAR – FOUNDER

COWMATIX SRL

Cowmatix is a high-tech start-up, founded in 2016, with the mission to develop new solutions in the field of Precision Livestock Farming (PLF), that immediately improve the livestock's wellbeing and increase the farmer's profitability. Cowmatix has developed LE.A.D: Leonardo Advanced Diagnostic system. It enables the early detection of hoof disease in bovines, including both infective and bio-mechanical pathologies. LEAD operates continuously to promptly detect and notify the occurrence of the most common pathologies when they first appear

www.cowmatix.com

COWMATIX Leonardo Advanced Diagnostic system

Low-Res IR Camera

Algorithms

Industrial PC

MARZIO MIODINI & LEONARDO SALA – CO-FOUNDERS

David Speller is a poultry grower and consultant from Derbyshire Peak District, UK. He produces more than 20 million chickens a year, mainly for the retail market. He began his broiler chicken farming career in 2004 after having purchased an old 1960's broiler farm due to the owner's retirement. He had no prior experience of poultry farming but it didn't hold him back from establishing a successful broiler business. David was the first British producer to employ underfloor heating. Technology doesn't stop there, he has cameras inside and outside the sheds and he can remotely monitor shed temperature, humidity, lighting and carbon dioxide levels. His system also monitors, in real time, the consumption of water and feed, which allows the early detection of any health problems. His experiences are now helping the sector through his consultancy and contract farming side of the business. Applied Poultry, the company of David, assists clients with any part of their own broiler business through their management services. David will continue to use innovations and technologies to further improve welfare and business margins, to protect the environment and secure a viable food chain that can meet the demands of a growing population.
www.applied-group.co.uk

DAVID SPELLER

John and Truus run a mixed farm in the Netherlands with 1.260 sows, 6.500 fattening pigs and 60.000 broilers. The company has three locations: Beringe, Meijel and Grashoek. Different technologies that are part of the EU-PLF project are installed and utilised on their farm: the eYeNamic system, the eYeScan and the Pig Cough Monitor. "The eYeNamic system monitors the behaviour of our animals. When they are restless, the system warns us that we have to go and see what's going wrong. The Cough Monitor informs us a couple of days in advance that some animals are going to have serious respiratory disorders if nothing is done. We can then treat them before they get really sick and spread their disease to the rest of the animals in the building. With the eYeScan we can assess the weight of our pigs continuously and identify the best moment to sell them. PLF [will] bring our farm to a higher level via better technical results, more profit and more satisfaction in our work."

JOHN & TRUUS VERHOIJSEN-VERSTAPPEN

Tina Dahl is a dairy farmer from Limmared in western Sweden. The farm has an old history from the early 13th century and is situated in a broken countryside with arable land, pastures and large forests. The family also runs a small water power plant and does some contracting for other farmers. In 1978 herd size was 36 cows but now there is a new barn with robot milking, built in 2013 with 200 cows.
"CowView helps us to get an overview of the herd and the individual cow both with their welfare and production. It is very profitable if you can find a sign of any disturbance before it gets too serious. It also helps us to find cows, which are late for milking, with precision and in a fraction of the time it had taken us without the position tags. Technology is progressing fast and we need to learn how to use it. There is a future in technology and if you use it in the right way it will help you a lot."
"Healthy cows give you healthy money."

TINA DAHL

EU-PLF: Bright Farm by Precision Livestock Farming

Animal and farm-centric approach to Precision Livestock Farming in Europe
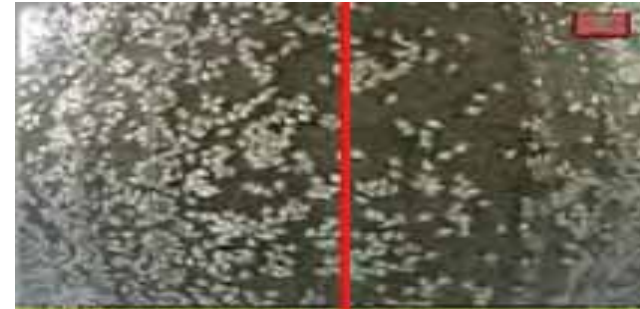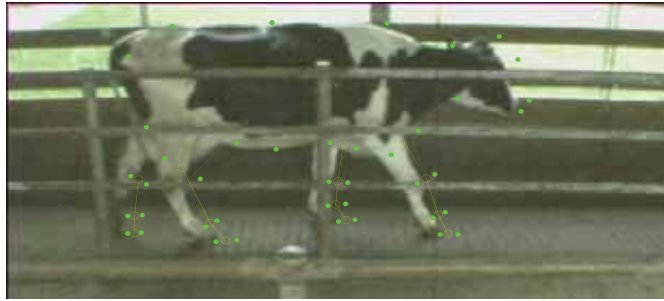
Daniel Berckmans

EU-PLF Closing conference

29 September 2016
Brussels, Belgium

Smart Farming for Europe
Value creation through Precison Livestock Farming

EU - PLF

Precision Livestock Farming

Management of livestock by continuous automated real-time monitoring of production/reproduction, health and welfare of livestock and environmental impact.

Smart Farming for Europe
Value creation through Precison Livestock Farming

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Advantages of PLF technology

- Objective measurements
- Fully automated
- Continuous
- Behavioral responses of animals
- Less visits to the animals

Smart Farming for Europe
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Cow lameness monitor Play

Aggression monitor Play
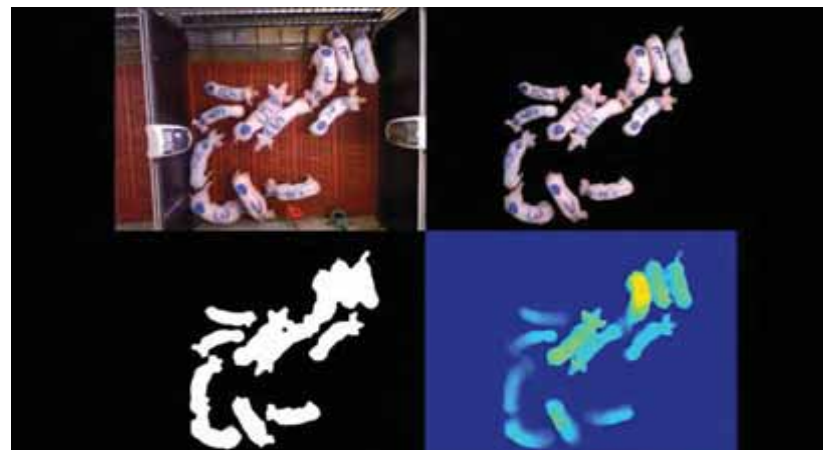
Welfare monitoring Play

Feed intake Play

(c) Laboratory for Agricultural Buildings Research

Image param

Scratching
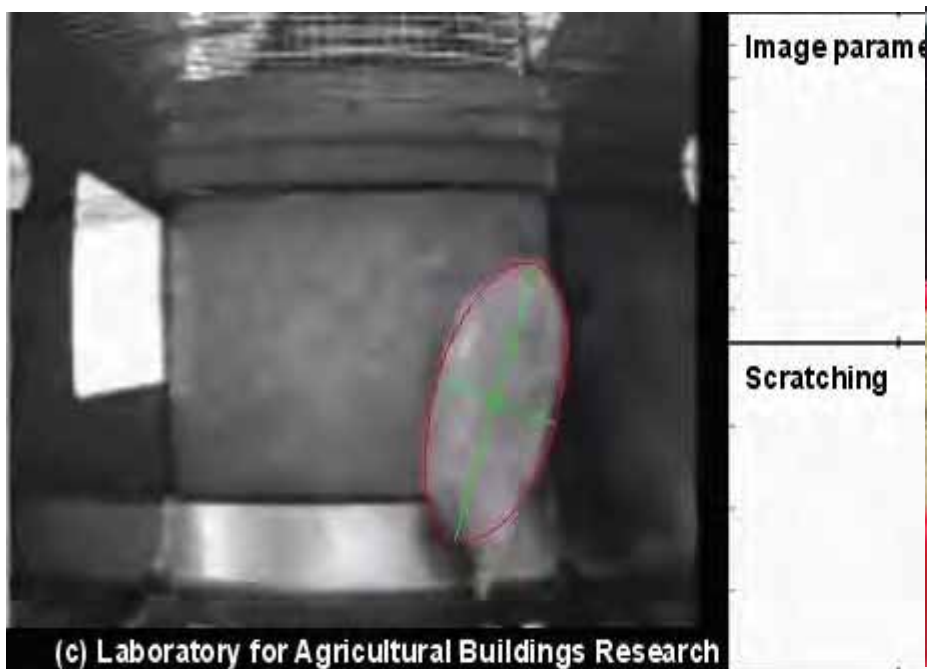
EU-PLF – Bright Farm by Precision Livestock Farming

EU-PLF Partners

EU-PLF Farmers
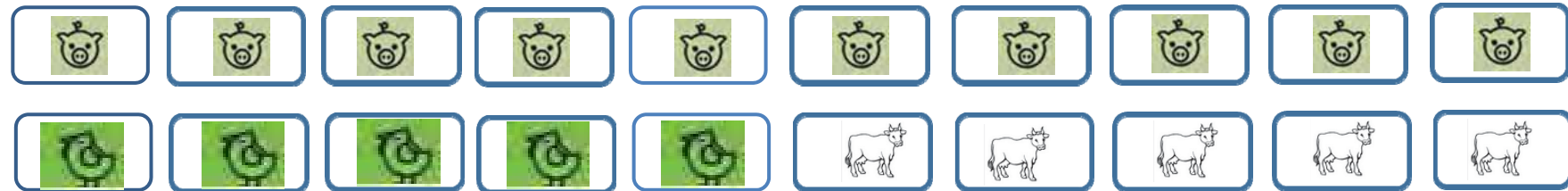
EU-PLF Advisory Board

Prof. Jos Metz   Prof. Noel Devisch   Prof. Leo den Hartog   Dr. Dieter Schillinger   Mr. I. Blanco-Traba

Smart Farming for Europe
Value creation through Precison Livestock Farming

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Objectives

- Installations on 20 European farms
- 60 production cycles for broilers, fattening pigs, dairy
- Where is the value from PLF?
- Start 4 new PLF spin-off companies
- EU-PLF Blueprint

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Value creation through Precison Livestock Farming

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Results and experiences from broiler farms

EU-PLF Closing conference
29 September 2016
Brussels, Belgium

Erik Vranken, Fancom BV

KULeuven (Vasilis Exadaktylos, Alberto Peña Fernández, Lenn Carpentier, Daniel Berckmans)
UMIL (Marcella Guarino, Emanuella Tullo, Matteo Siface, Ilaria Fontana)
Fancom (Erik Vranken, Tom Van Hertem, Luc Rooijakkers)
Soundtalks (Dries Berckmans, Martijn Hemeryck, Jasper Wouters)
SLU (Harry Blokhuis, Per Peetz Nielssen, Anna Silvera)
Bristol (Andy Butterworth, Gemma Richards, Steve Brown)
RVC (Theo Demmers)

Smart Farming for Europe
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EU Grant Agreement no.: 311825

Challenge

Demonstrate how PLF can create added value for poultry farmers and other stakeholders.

Selected poultry farms

Broilers

- Colbers   NL
- Speller   UK
- Cal Xulic   ESP
- The Poultry Side   UK
- Lavarini   IT

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Data collection

Remote observation — Internet — Farm PC — Network — (External Data Storage)

Climate controller — Feed controller

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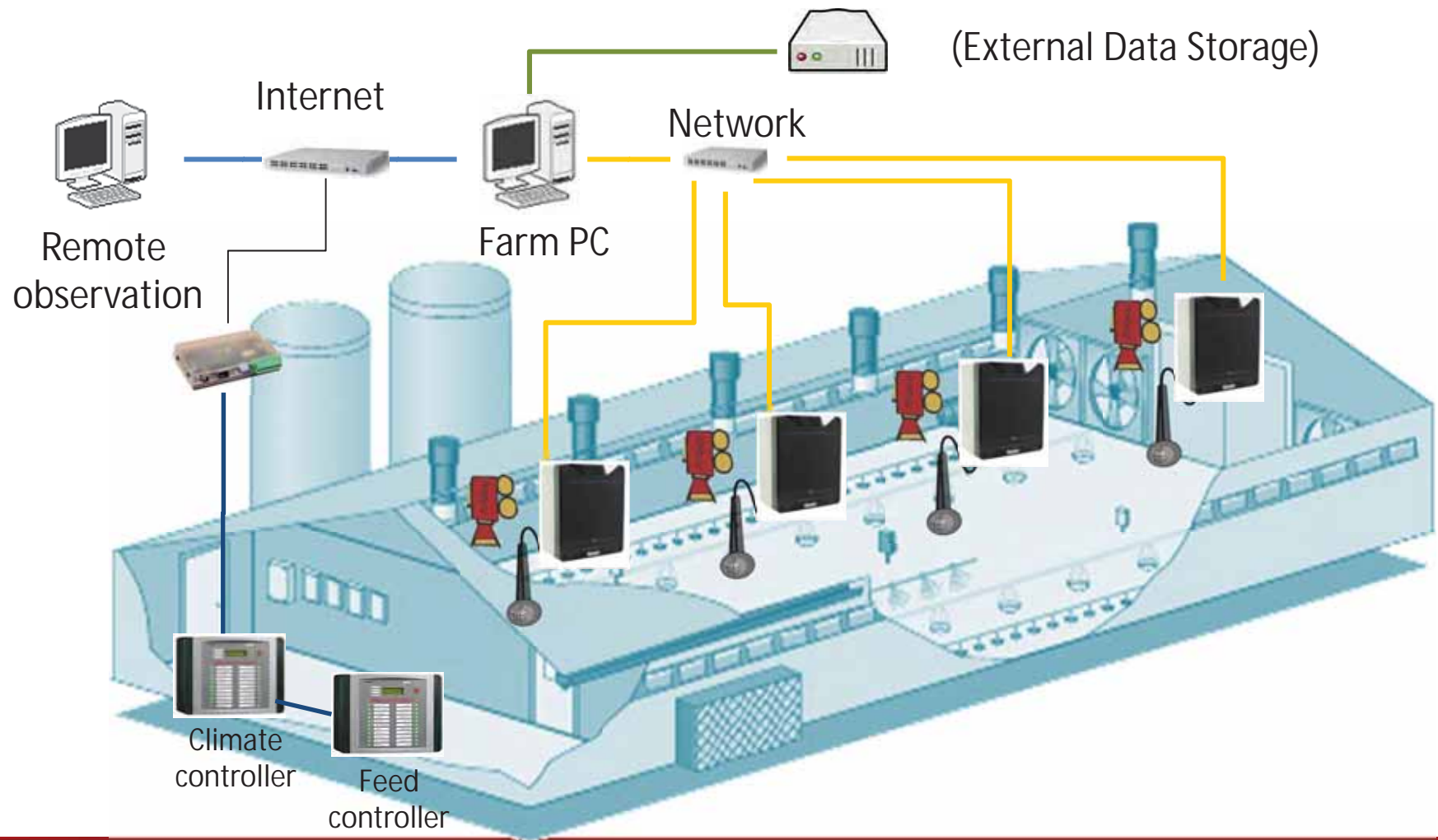
Installation of PLF systems
poultry farms

Problems encountered during installations and data collection

– No (reliable) internet in farms

– Power failures

– Dirt on camera lens

– Hardware failures

– Rodents

– ...

Smart Farming for Europe

*Value creation through **Precison** **Livestock** **Farming***

EU - PLF

Farmer trainings

- Two days @ Fancom
  - Poultry:
    - 4 farmers
    - 2 assessors
    - 7 EU-PLF partners
  - Pigs:
    - 7 farmers/representatives
    - 1 Assessor
    - 9 EU-PLF partners

Smart Farming for Europe
Value creation through **P**recison **L**ivestock **F**arming

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Farmers workshops

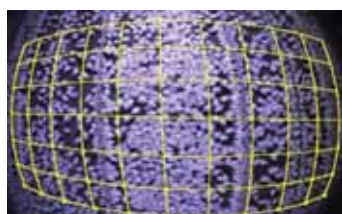**Smart Farming for Europe**
Value creation through Precison Livestock Farming

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Data collection & Assessments

- Number of fattening periods: 90
- Number of measuring days: 5.475
- Image collection: >120 Terabytes
- Sound collection: 4.906.000 files (5min)

- Welfare assessments: 130

Smart Farming for Europe
Value creation through Precison Livestock Farming

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PLF applications

1. Early warnings based on camera observations
2. Risk factor for leg problems
3. Human – Animal relationship
4. Sound monitoring
5. Emission reduction

Smart Farming for Europe
Value creation through Precison Livestock Farming

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1. Early warnings based on camera observations

Objective:

Automatic detection of unexpected broiler behaviour

eYeNamic: Distribution
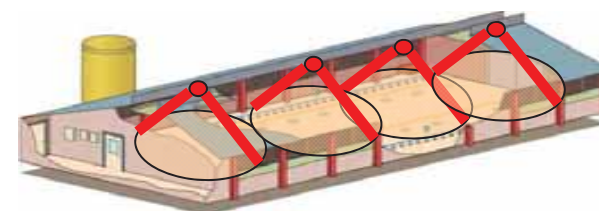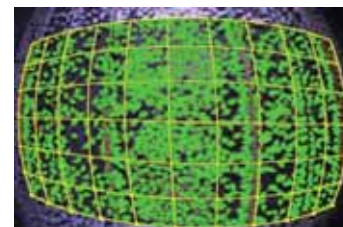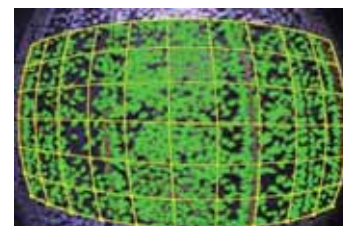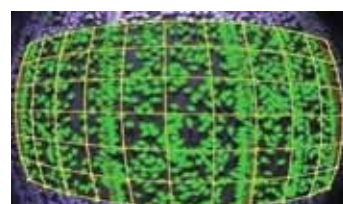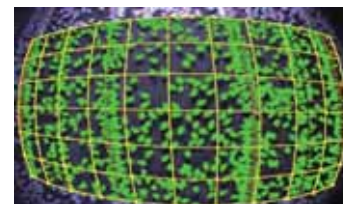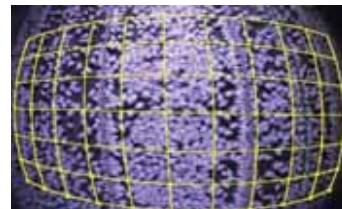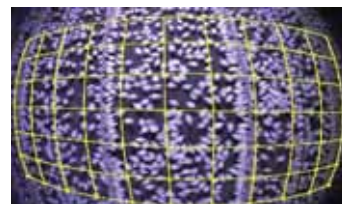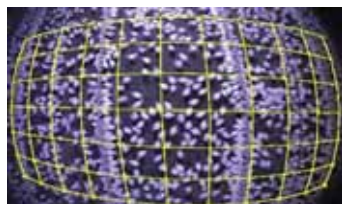
eYeNamic: Activity
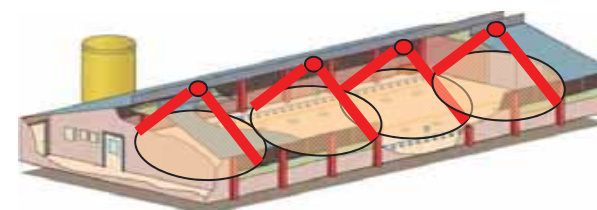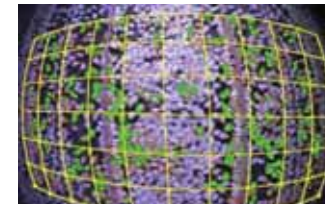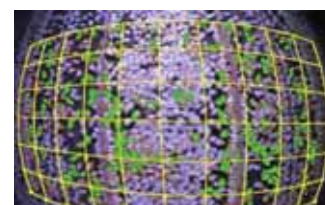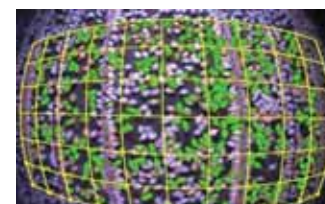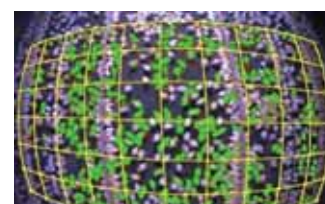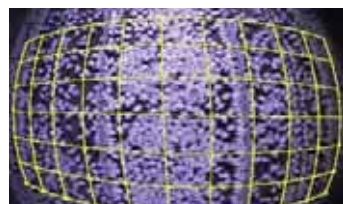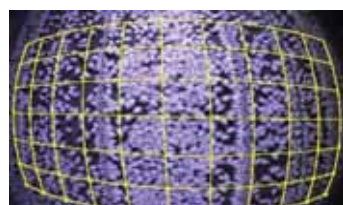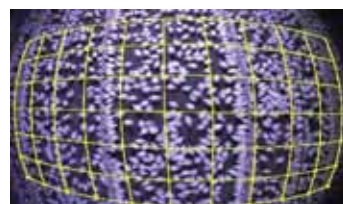
eYeNamic Early warnings

eYeNamic Distribution Index

Feeding line blocked
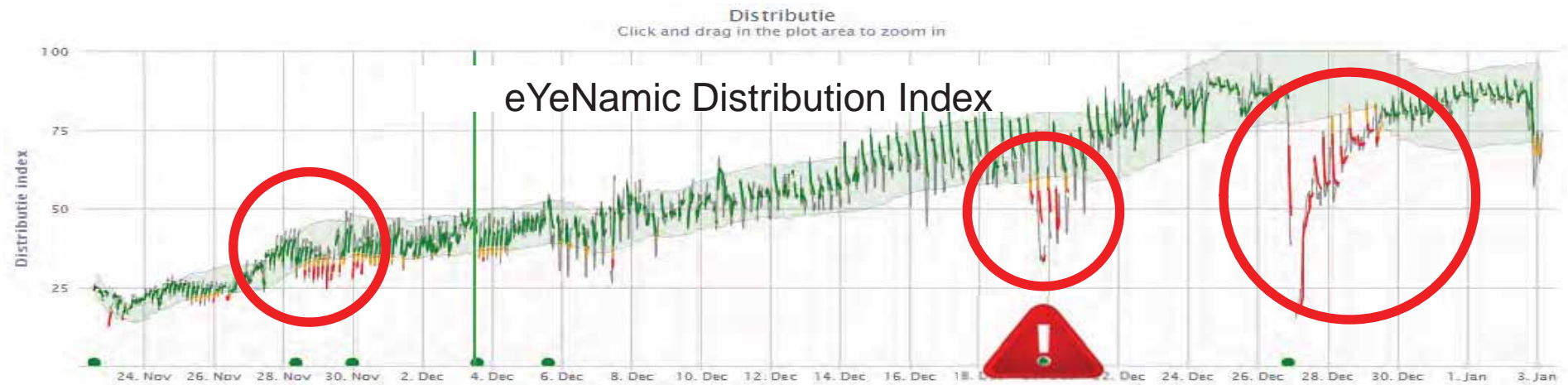
Farmer takes action:
removing feed blockage

Conclusions early warnings from camera observations
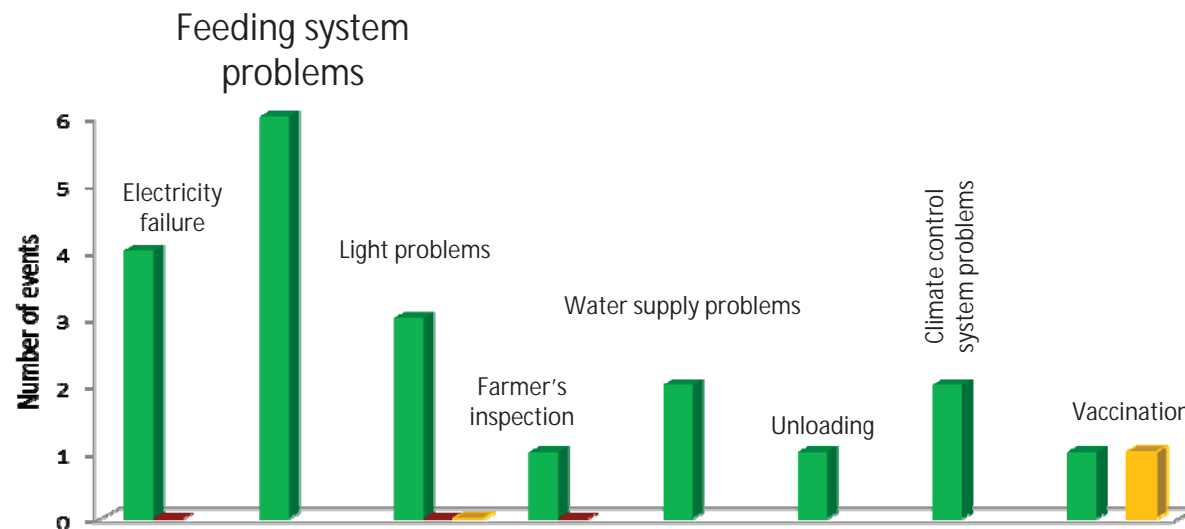
2. Risk factor for leg problems

Objective:

Identify the risk for leg problems with PLF-systems

Relation between environmental variables and leg problems

Time out of comfort zone
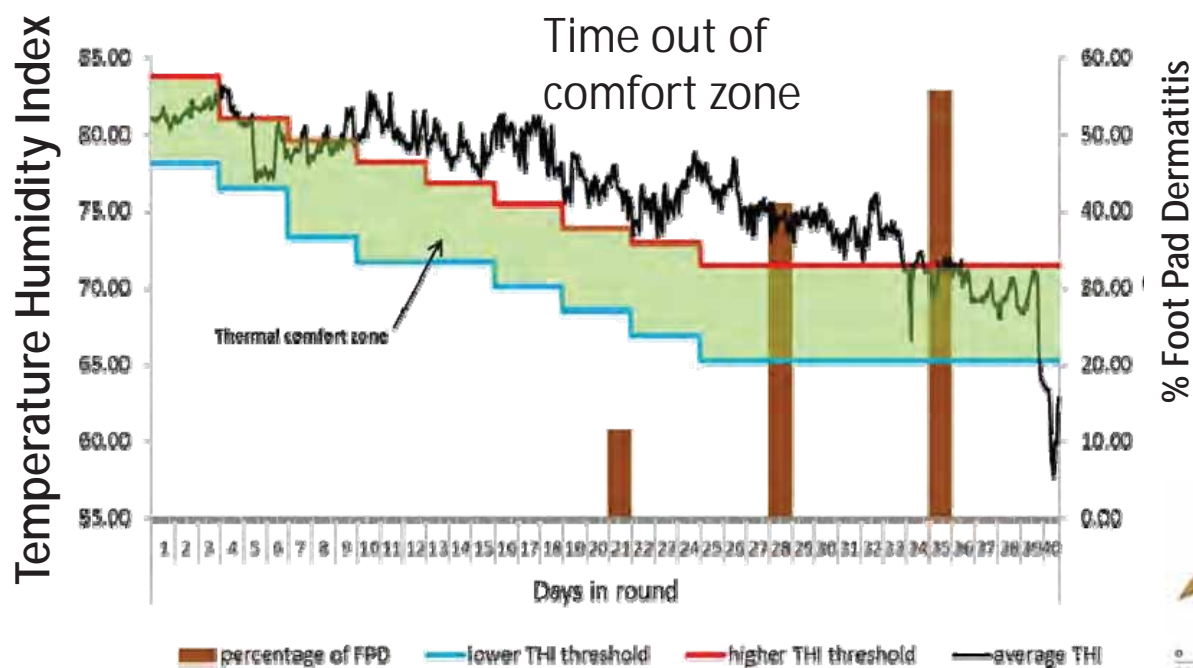
Aim: develop an automated prediction system to detect leg problems (e.g. Foot Pad Dermatitis)
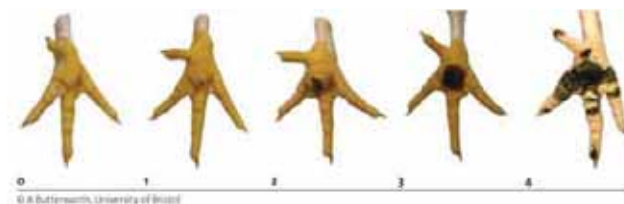
legend: percentage of FPD | lower THI threshold | higher THI threshold | average THI

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Average time out of the comfort zone for the whole round: 71%

55% of birds with severe Foot Pad Dermatitis
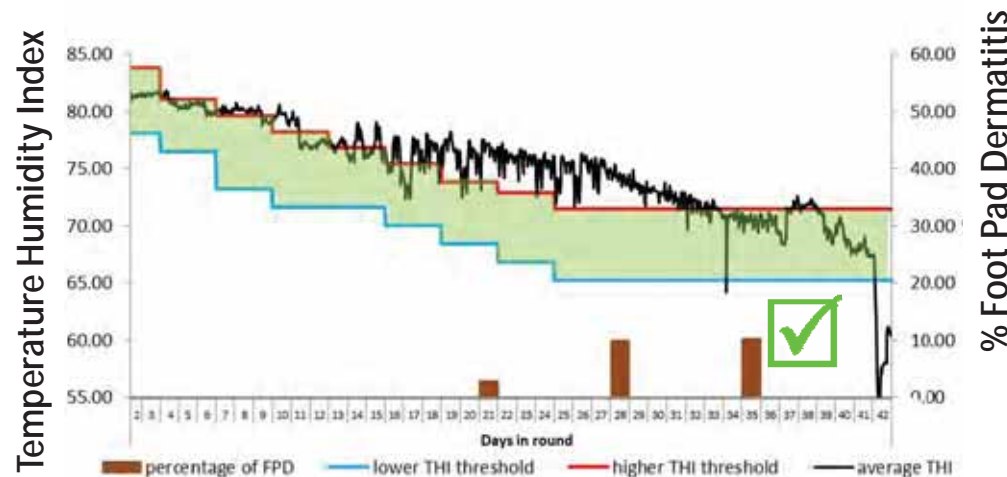
Average time out of the comfort zone for the whole round: 48%

10% of birds with severe Foot Pad Dermatitis

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Analysis of behavioural patterns
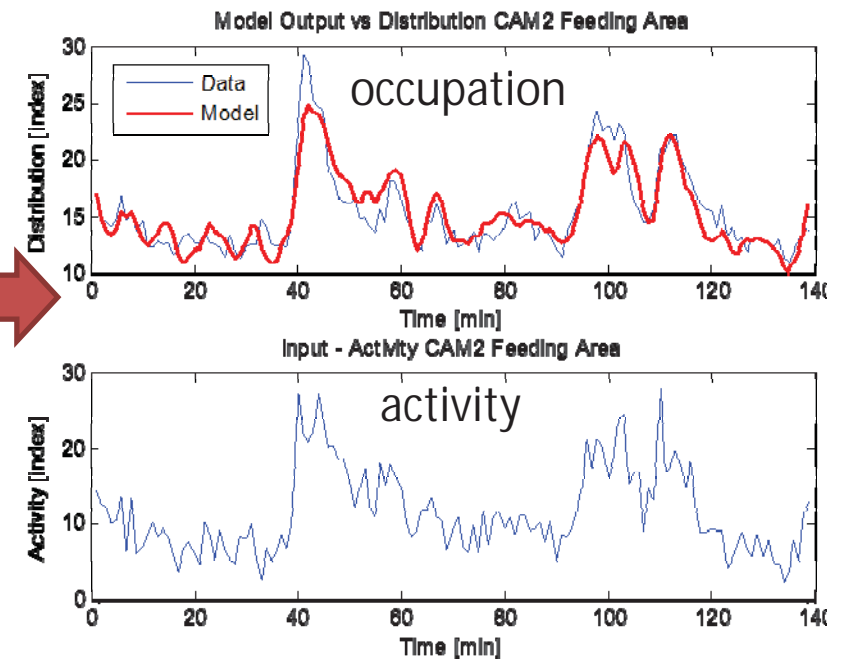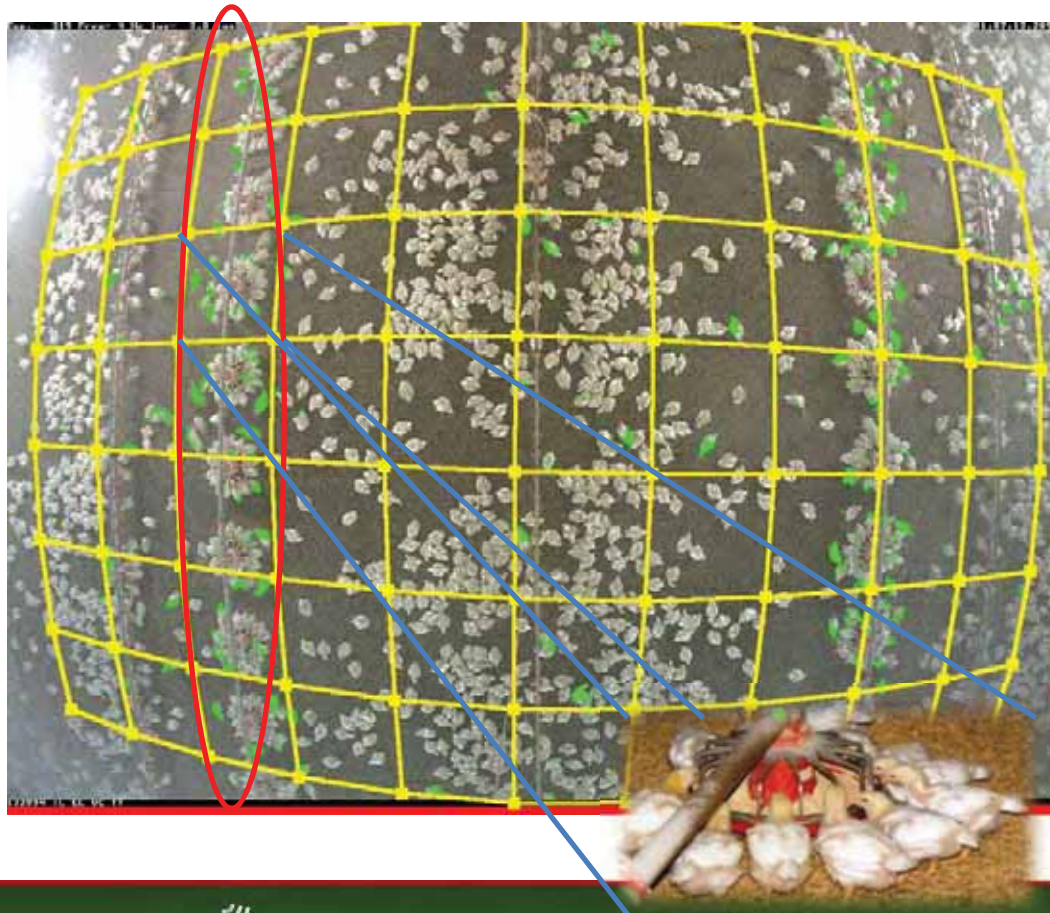
Automated welfare assessment
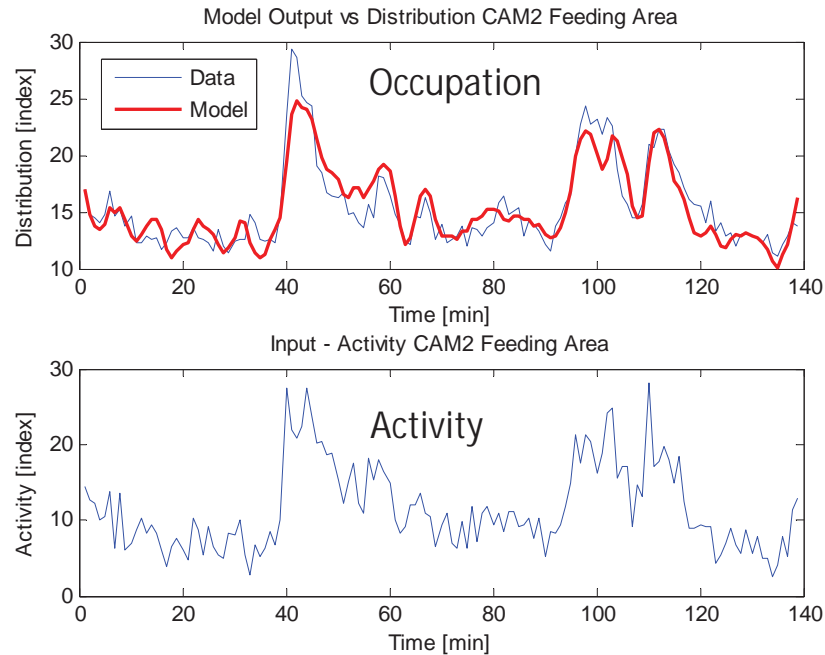
Normal behaviour
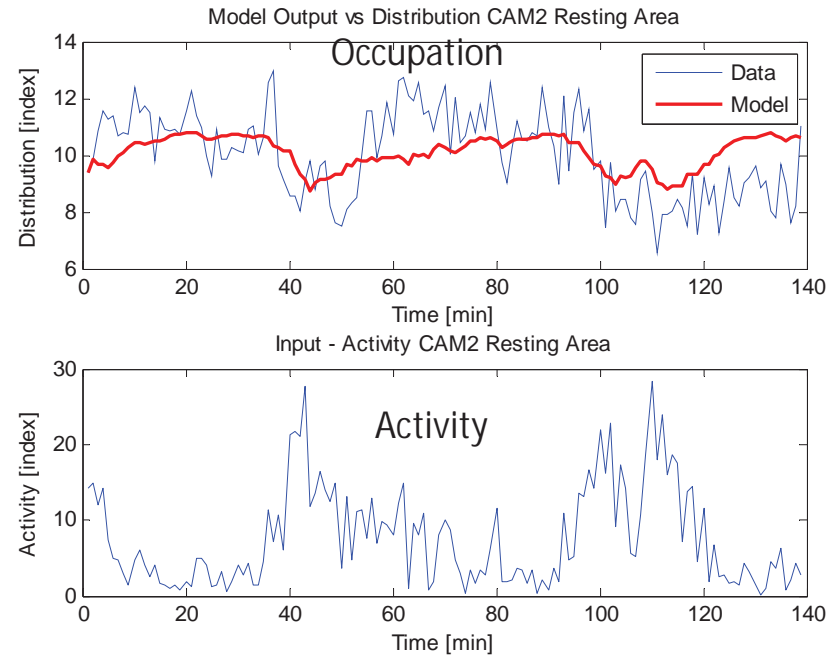
Abnormal behaviour

2. Risk factor for leg problems

Conclusion:

The risk for developing leg problems can be predicted with PLF systems

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3. Human-animal relationship

Objective:

Automated assessment of fear for humans with camera images

Human – Animal relationship

Assessor visits per flock at 3, 4 and 5 weeks of age

1. eYeNamic recording 10 min. before disturbance

2. Walk through procedure

3. eYeNamic recording 15 min.

4. Manual Avoidance Distance + Gait Score assessment

Results

Avoidance distance and gait score could be estimated from activity respons parameters
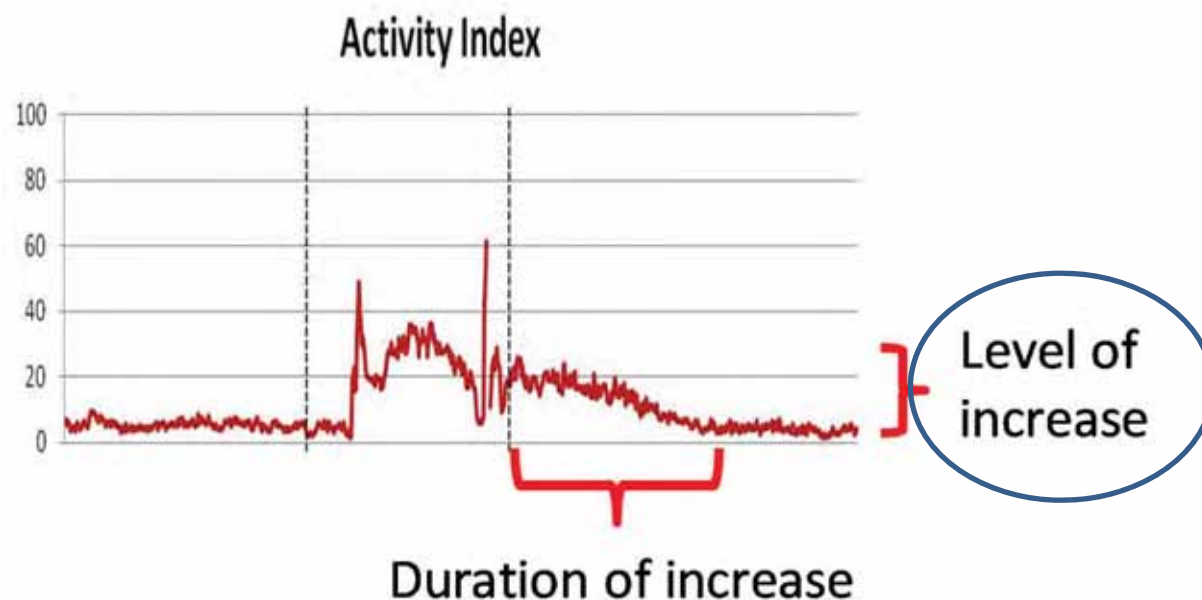
3. Human-animal relationship

Conclusion:

Fear for humans can be measured automatically from an increase of activity

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4. Sound monitor

Objective:

Sound signals to predict production performance of broilers

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Sound monitoring in broiler houses

The figure shows the sound intensity during one complete production cycle in a commercial broiler farm
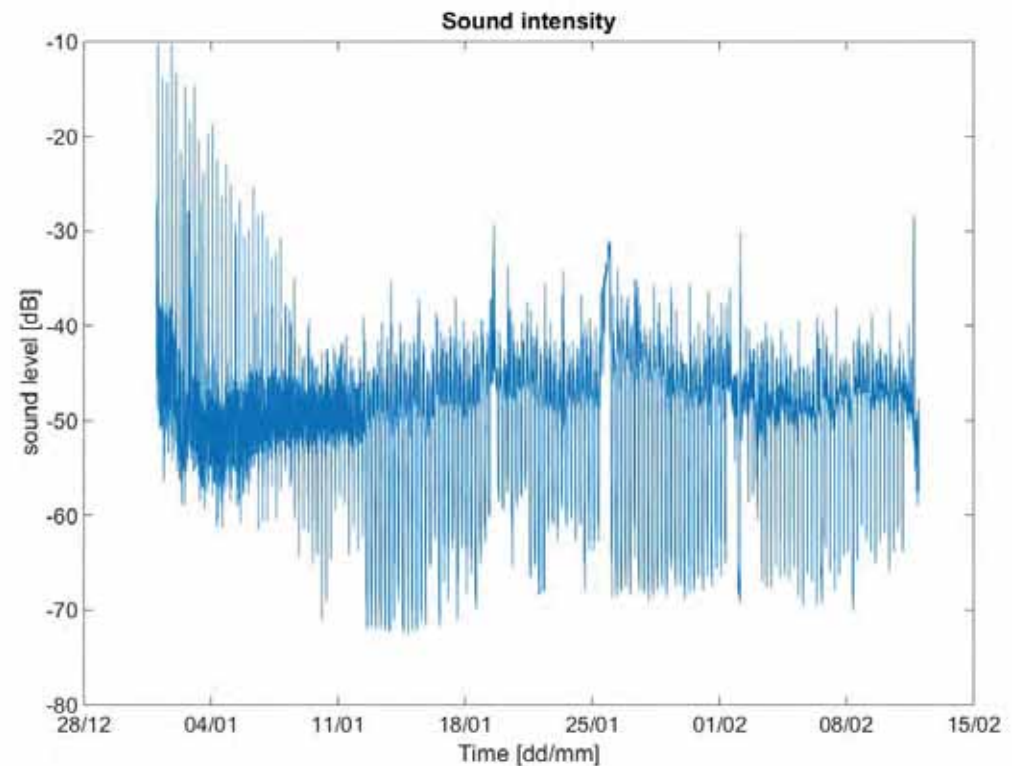
Sound intensity

Sound frequency analysis

Relation between frequency of broiler chicken sounds and production performance

Extracting frequencies of the sounds emitted
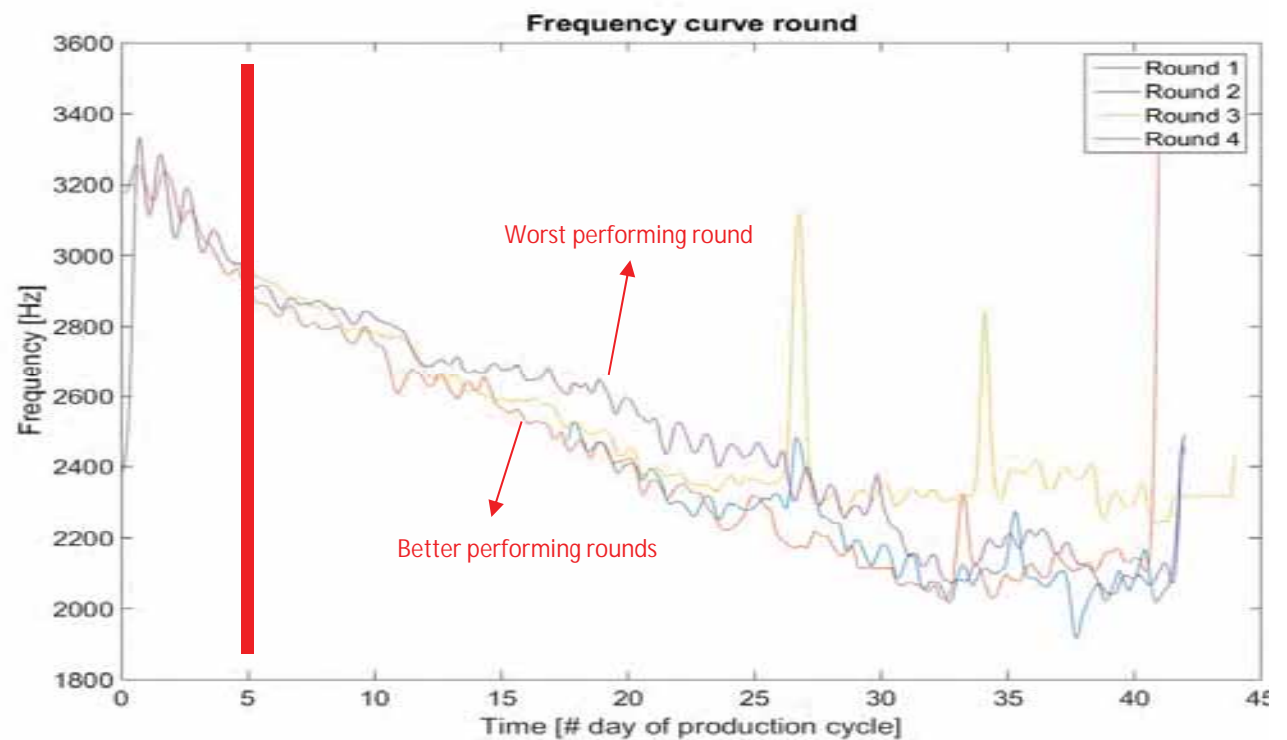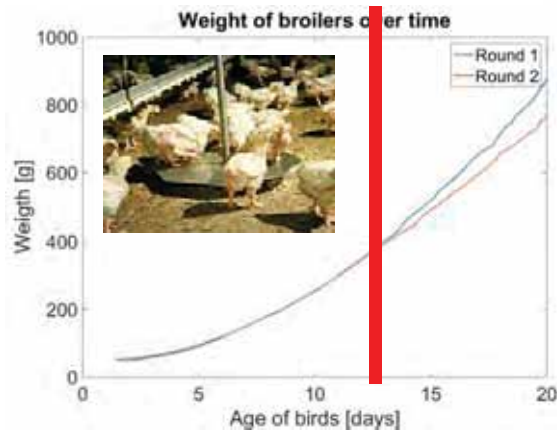
Weight of broilers over time

Frequency curve round

Worst performing round

Better performing rounds

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4. Sound monitor

Conclusion:

Sound frequency analysis has the potential to predict growth retardation 5 days ahead

5. Emission reduction

Objective:

Reduce the emissions by steering the behaviour of the birds

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Emission monitoring (UK)

- Data collection during 6 rounds
- UK farm (The Poultry site)

- Dust and Ammonia sensors installed by RVC

Emission data analysis
PM$_{10}$ and activity
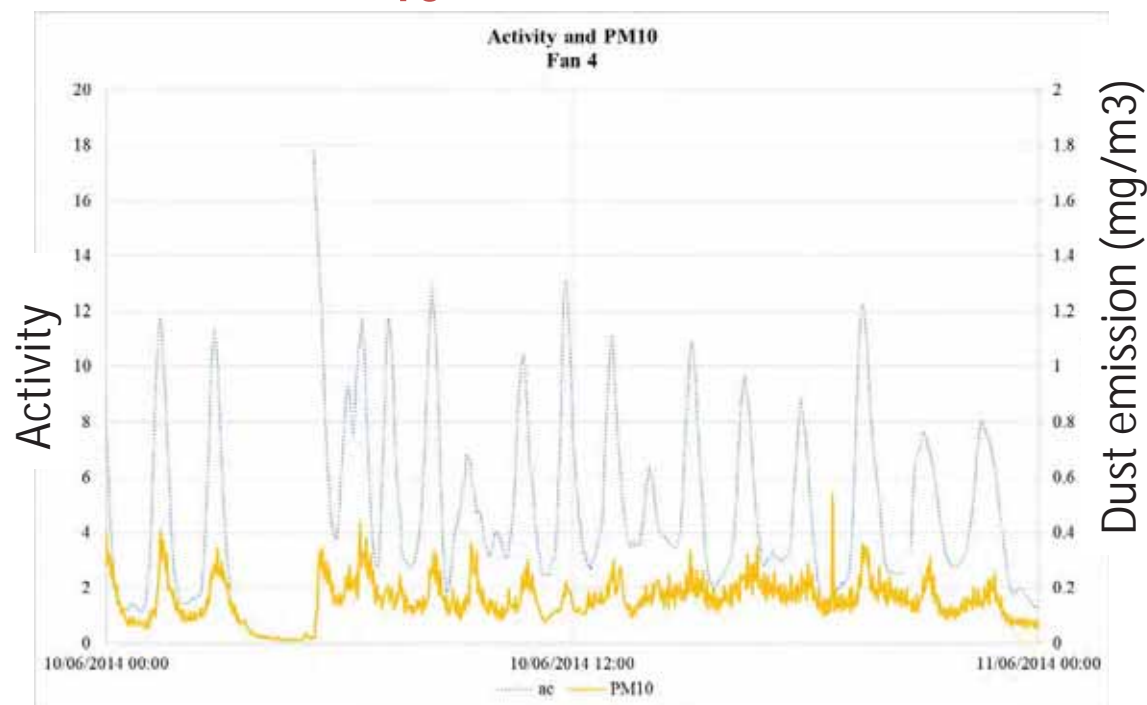
Good relation with activity throughout the day
Concentration lower than previously reported (0.41 – 2.29 mg m^{-3})

Total dust concentration as a function of activity and ventilation rate
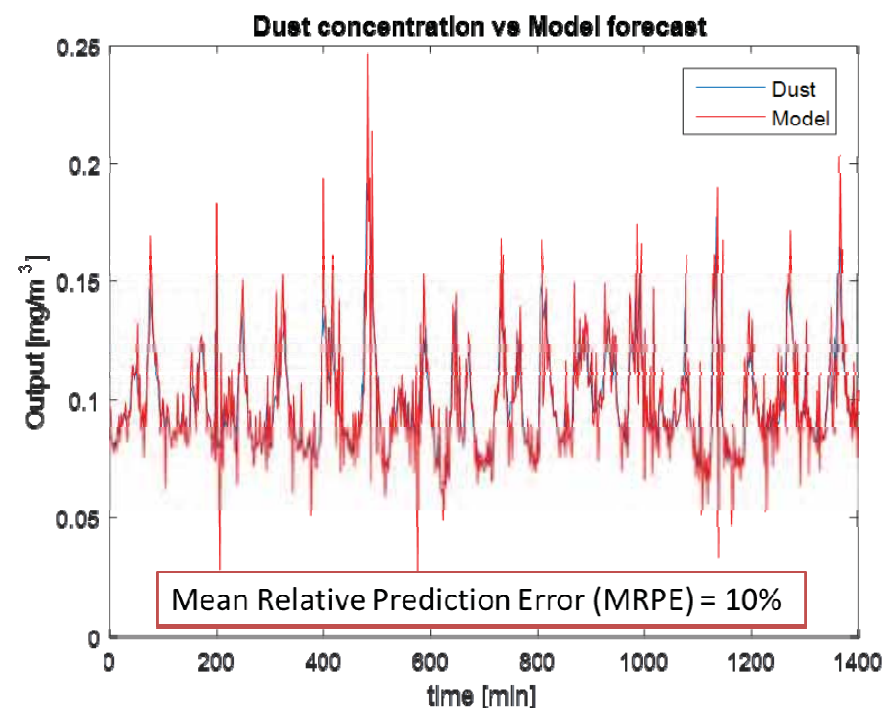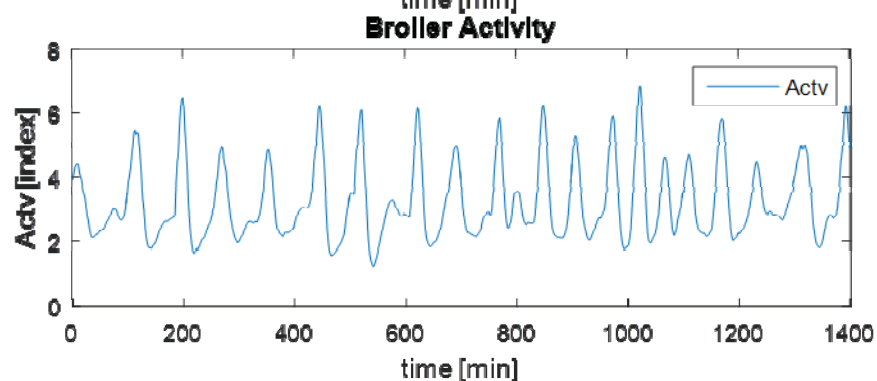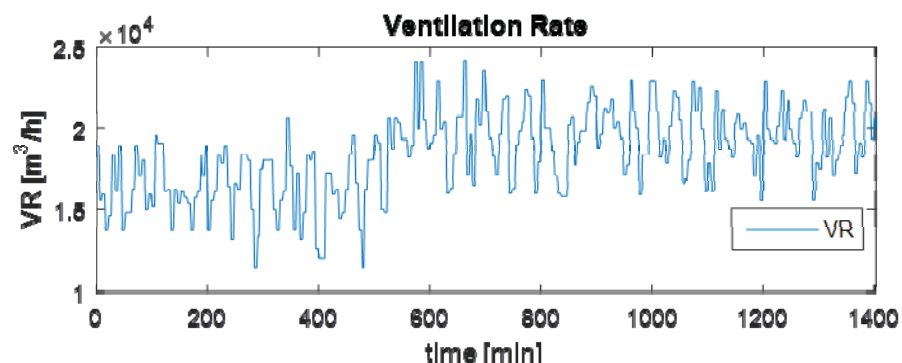
5. Emission reduction

Conclusions:

Strong correlation between emissions and bird activity

Potential to reduce emissions by controlling activity

Further development necessary

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Take Away messages

- PLF systems are ready to collect data, but translation to valuable information is still under development
- PLF systems require training of farmers
- PLF has the potential to automate welfare monitoring

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« *Dairy cows are like F1. They are fragile.*
If you drive a F1 on a ground path, it will break »

Didier, a farmer from Jura, France

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Can PLF help reduce the mismatch and maintain a good welfare?

Animal welfare
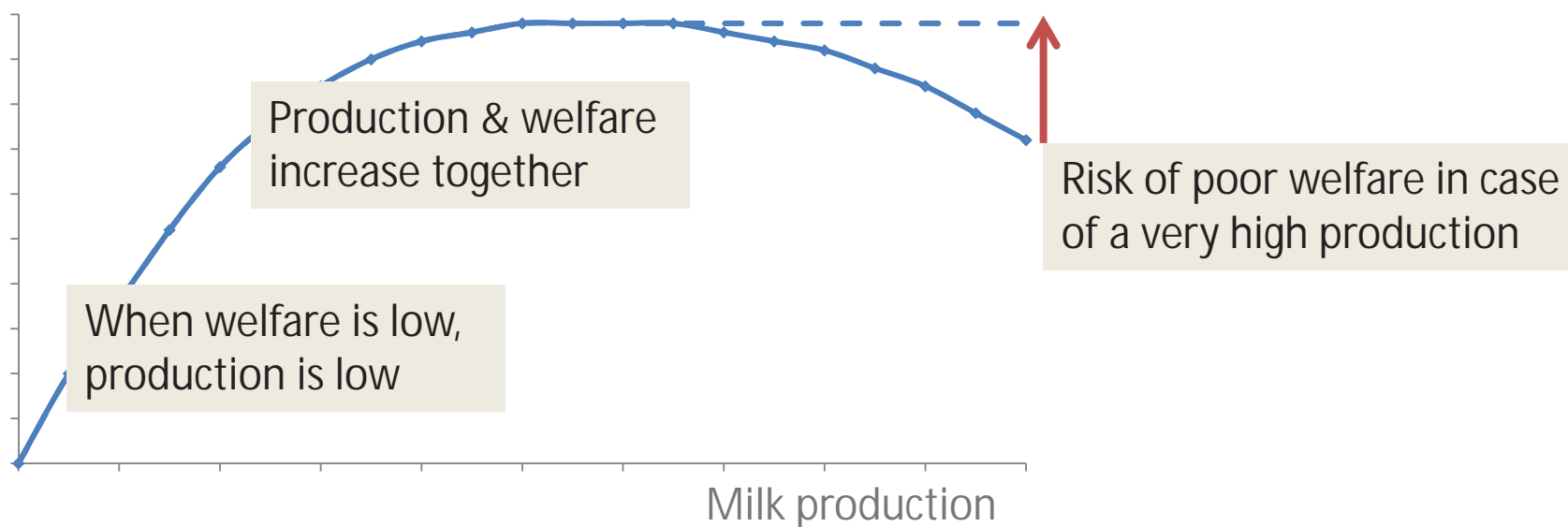
Production & welfare increase together

When welfare is low, production is low

Risk of poor welfare in case of a very high production

Milk production

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Increasing the value of existing PLF systems to assure dairy cows' welfare

Cow Group
KUL (C Bahr then T Norton, A Pena Fernandez) *BE*
GEA (S Klimpel, KH Sloth, C Pathak) *DE-DK*
INRA (B Meunier, MM Mialon, M Silberberg, I Veissier) *FR*
ARO (I Halachmi) *IL*, **SLU** (P Nielsen, H Blokhuis) ,**Teagasc** (B Earley) *IR*

EU-PLF Closing conference
29 September 2016, Brussels, Belgium

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Dairy farms monitored in EU-PLF

8 farms
CowView :
RTLS ➔
Position

SoundTalks:
sound

No. cows x cycles
(total 1300 cows)

488 x 2
205 x 2
429 x 2
238 x 2
122 x 2
595 x 2
160 x 2
160 x 1
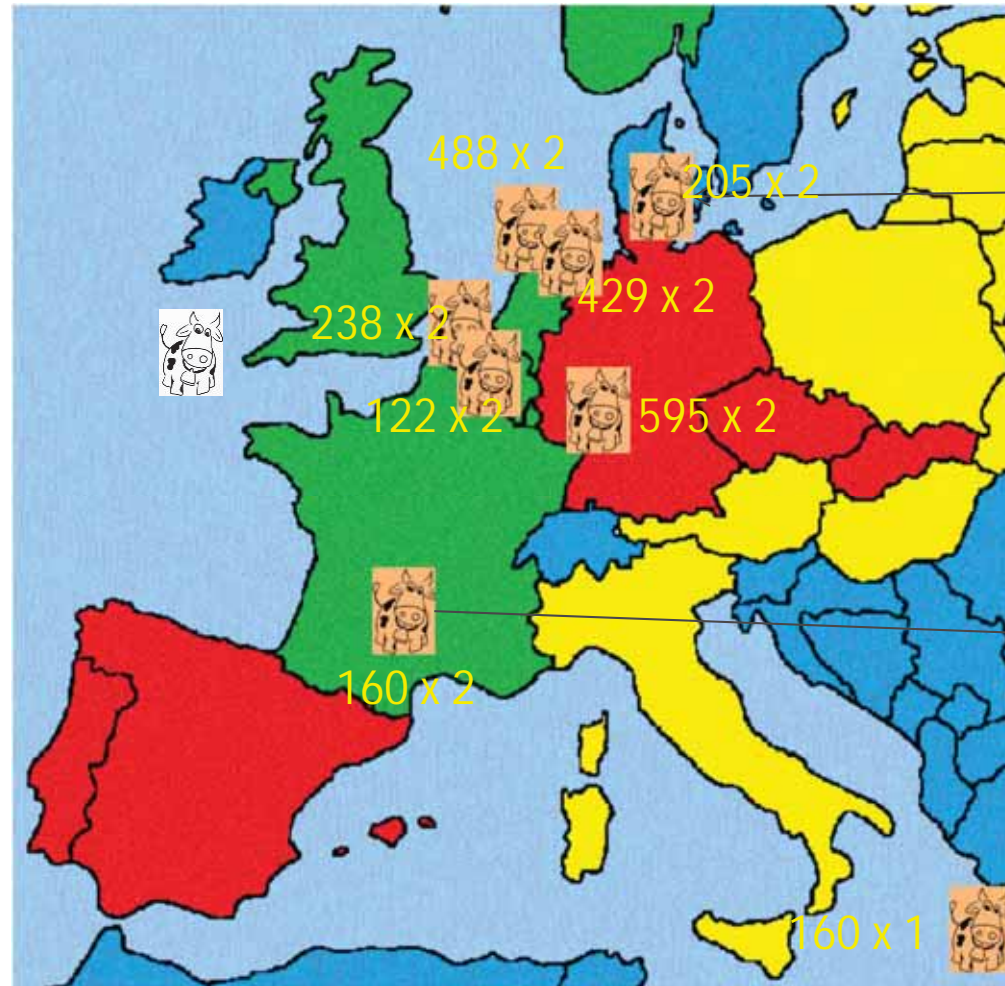
+ *CowScout*
& *IceTag*:
lying, standing

+ Feed intake
Weight
Milk composition
Ruminal pH *eCow*

+ Feed intake
Milk composition
Weight

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Aim: Getting further
with existing sensors and systems

Information
from sensors
- Behaviour
- Sound
-    Ruminal pH

-    ...

Validation
Analysis
Modelling

Specific information
for health, housing,
and nutrition
management
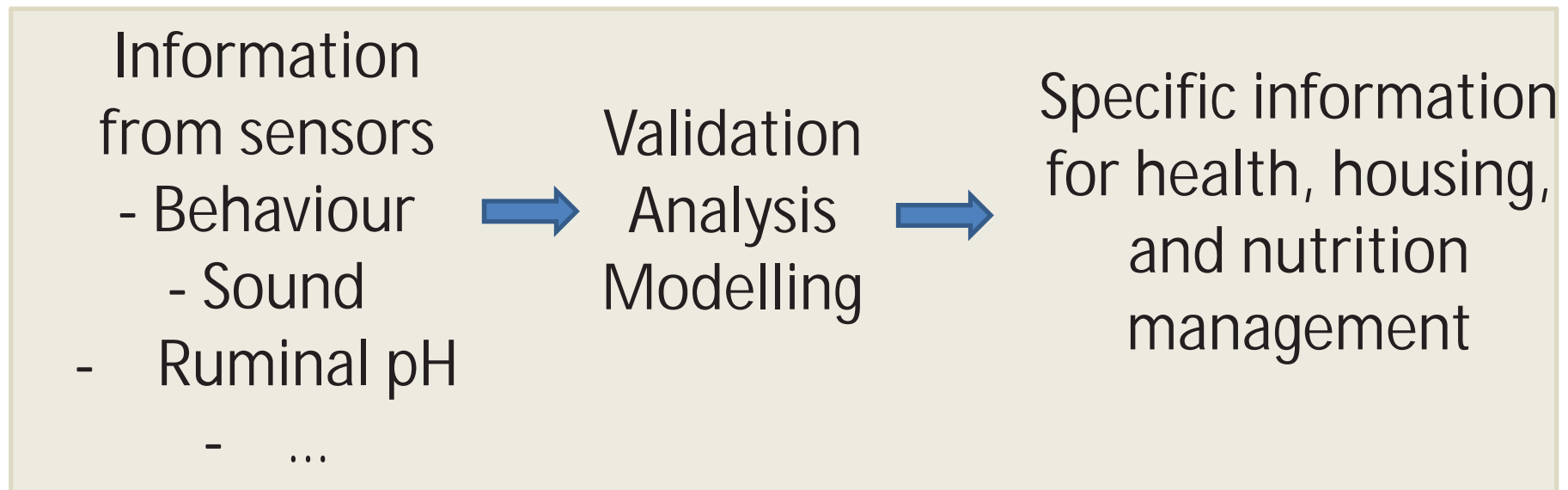
Individual approach: each cow is monitored

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PLF and health management

Use of a RTLS to analyse cow activities

Antennas

tag

CowView

cubicles

alleys

trough

walking

idling
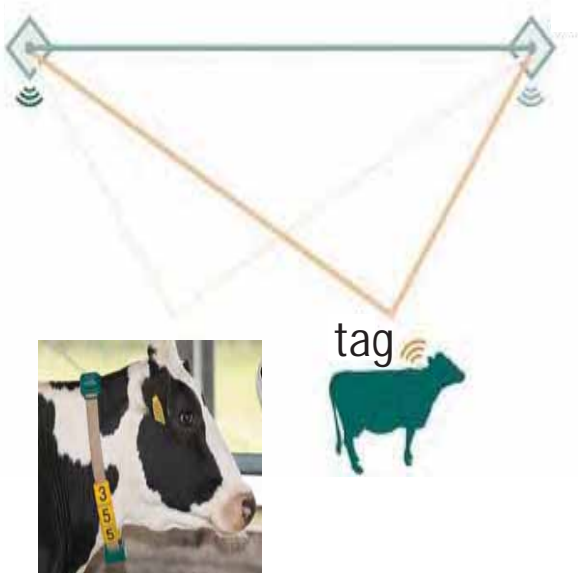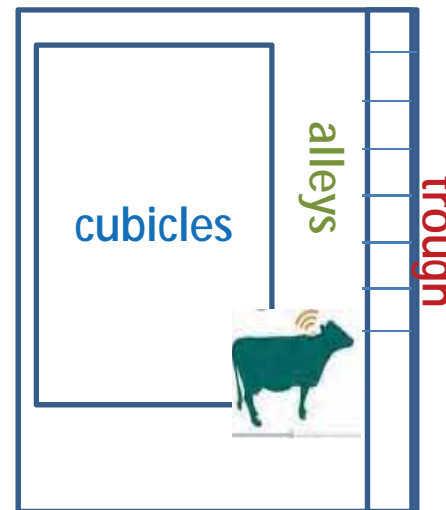
eating

resting

Description of the normal time budget of each cow
Cow more active (e.g. walking) than normal ➔ alarm: oestrus?
Cow less active (e.g. resting) than normal ➔ alarm: disease?

i2

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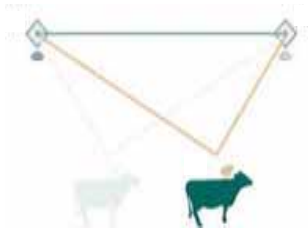
Descriptive approach based on single basic activities
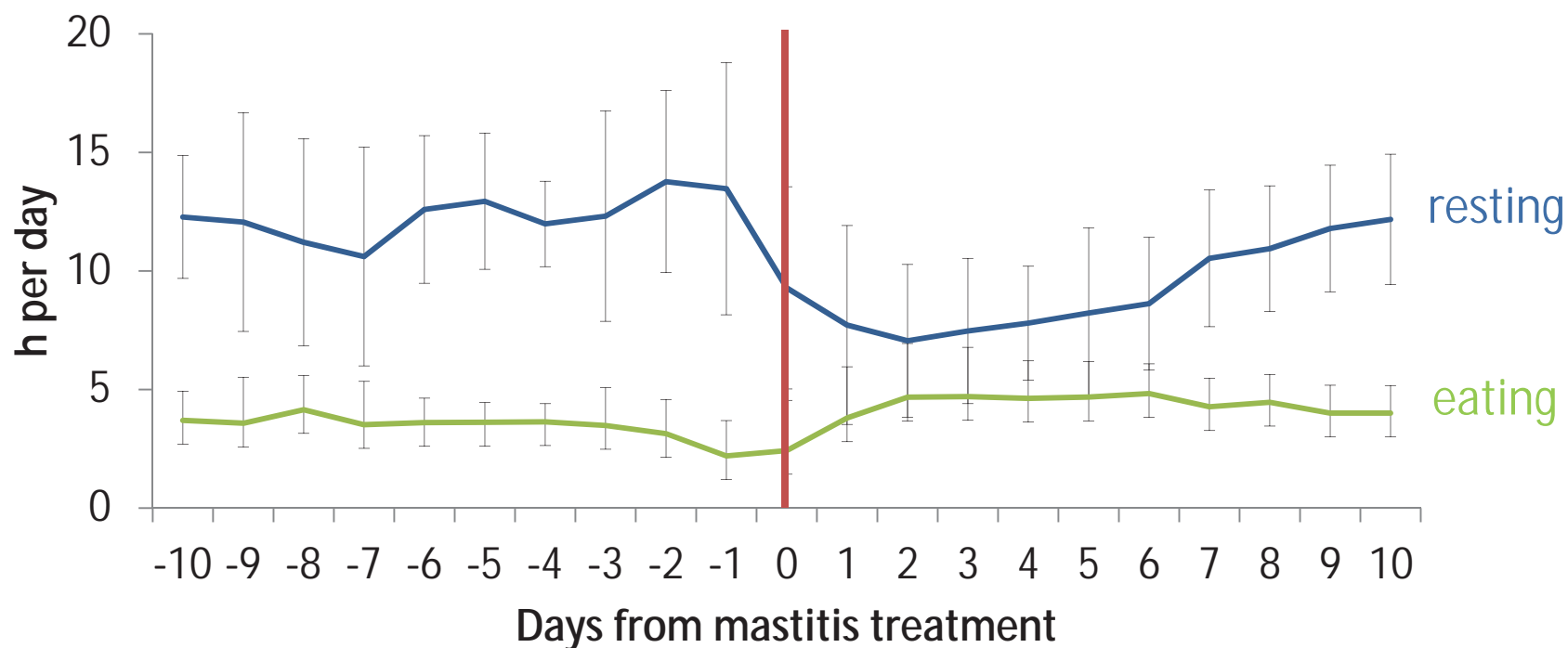
Cows spend less time resting and eating at the onset of mastitis. However, due to large variations the difference is not significant.

Modelling approach based on single activities
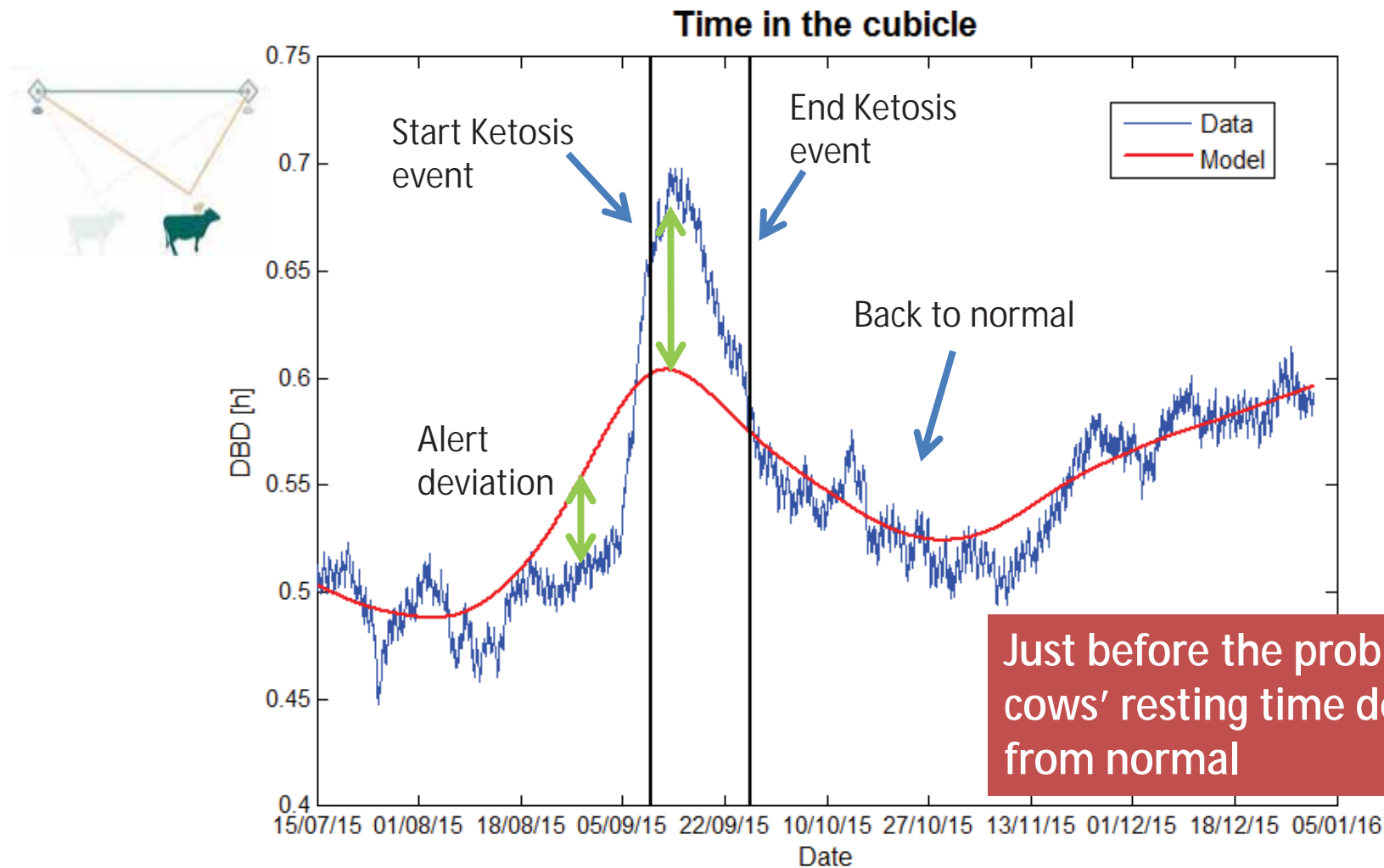
Time in the cubicle

Just before the problem , cows' resting time deviates from normal
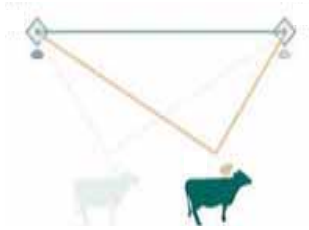
Additional information extracted from RTLS

Activity level = -.15 resting +.12 in alleys + .34 eating
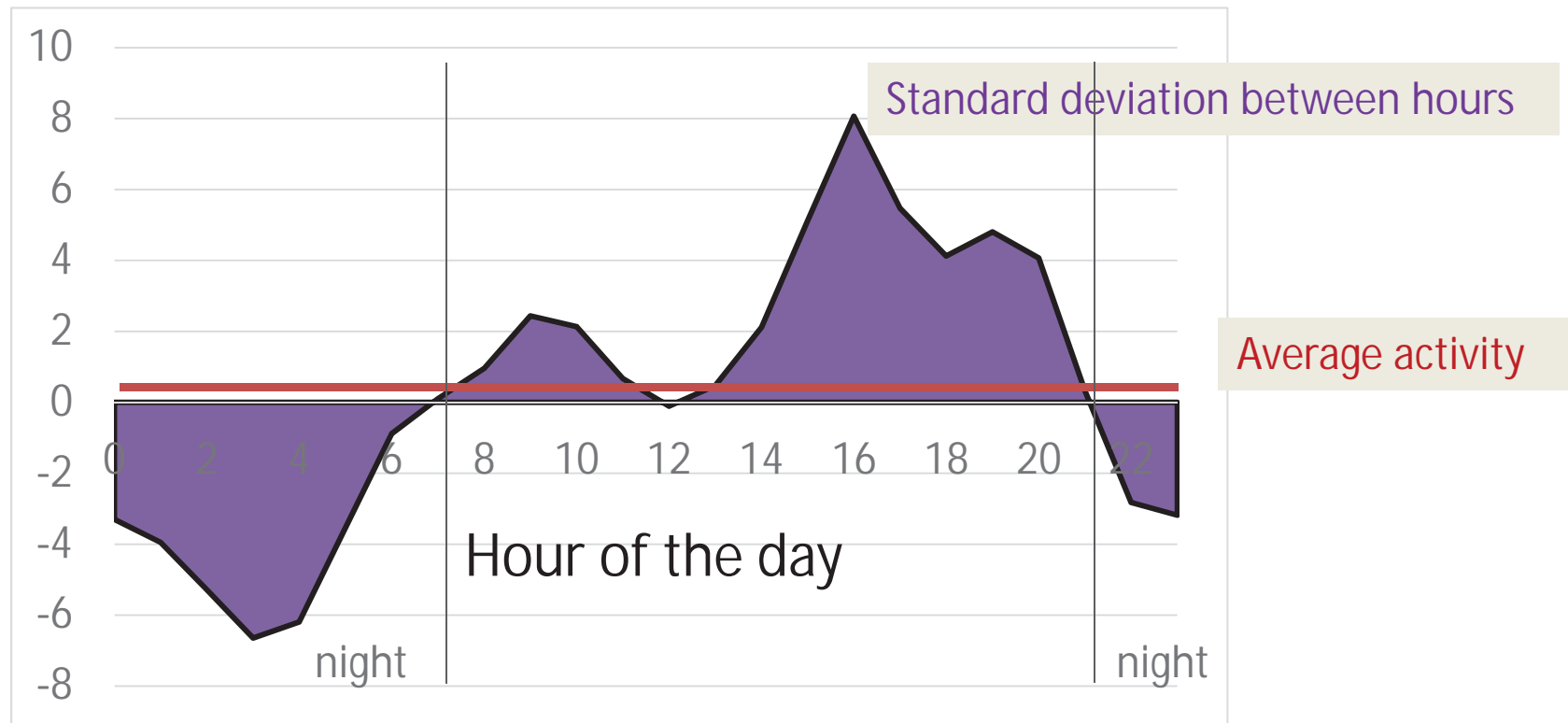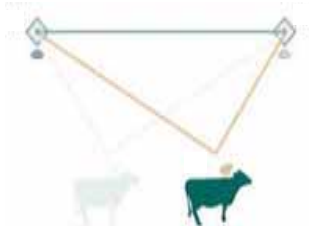
Descriptive approach based on average activity & circadian variations

Data from a commercial farm: 350 cows for 5 mo

Normal day
vs.
Mastitis
Average activity ↗
Circadian variations ↘

P < .001 (1-2 d before)

Activity level

Hour of the day
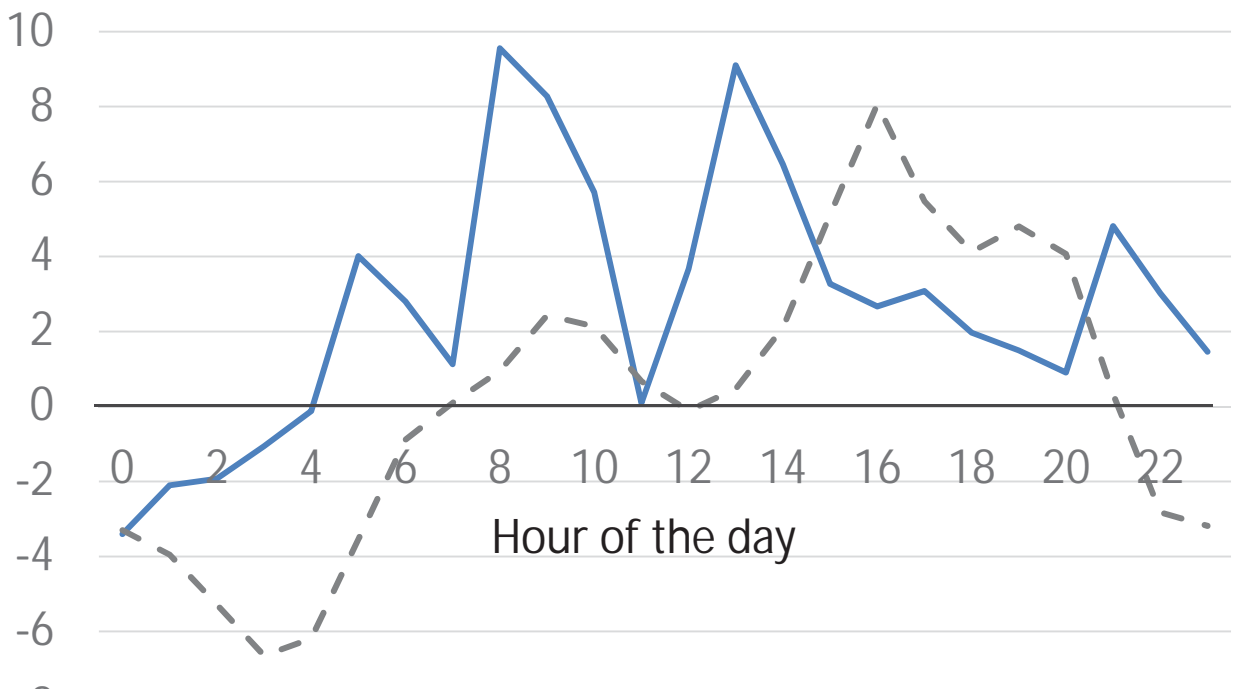
When the cow overall activity and its circadian variations are taken into account, one can predict the onset of a problem 1-2 days in advance.

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Modelling approach based on overall activity
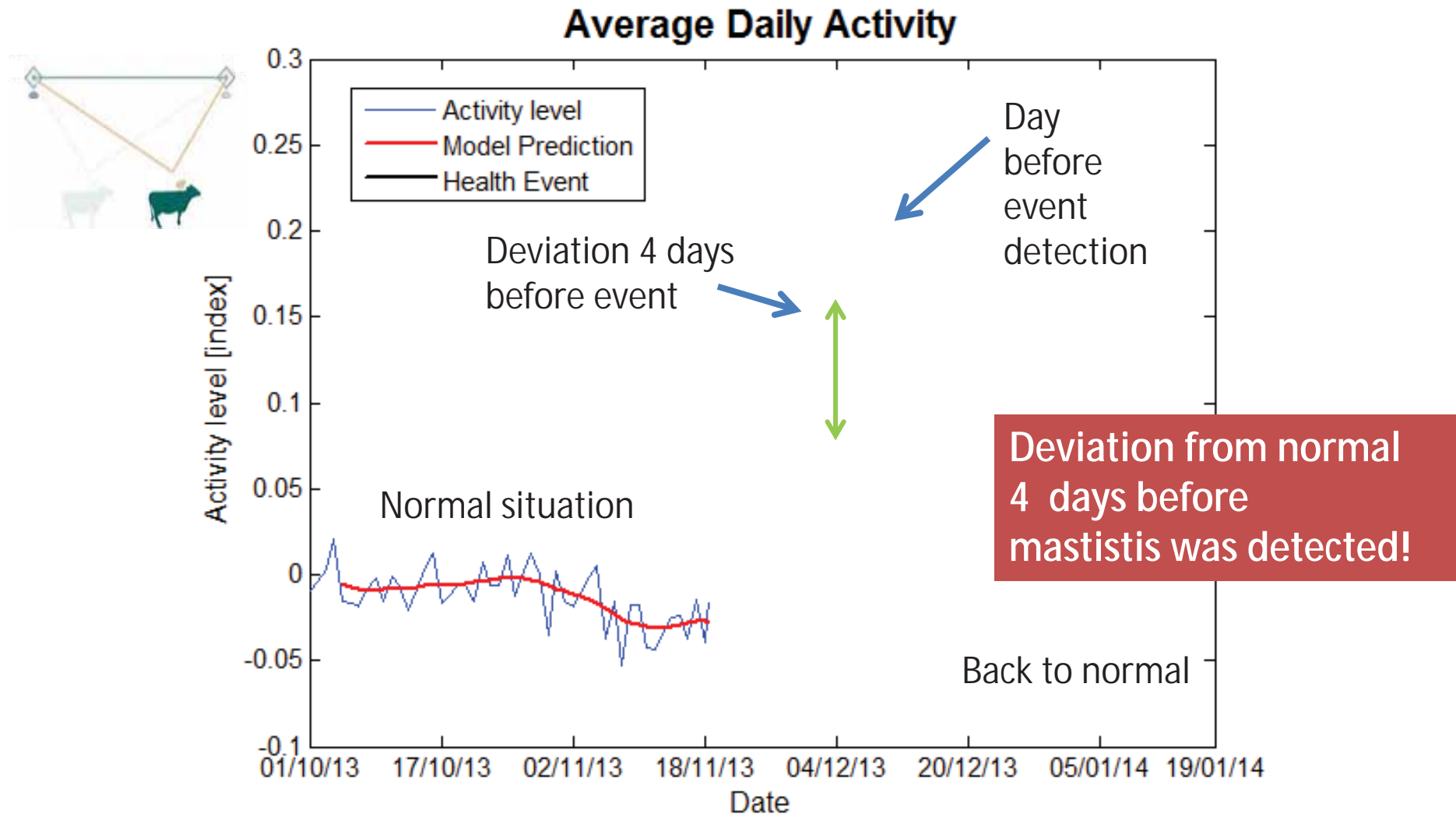
Average Daily Activity

Legend:
- Activity level
- Model Prediction
- Health Event

Day before event detection

Deviation 4 days before event

Normal situation

Deviation from normal 4 days before mastistis was detected!

Back to normal

Y-axis: Activity level [index]
X-axis: Date (01/10/13, 17/10/13, 02/11/13, 18/11/13, 04/12/13, 20/12/13, 05/01/14, 19/01/14)
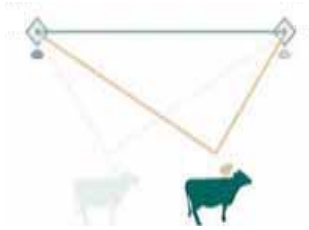
Detection of new points of interest with RTLS and image analyses

brushing its back

brushing its head

licking salt

in cubicle
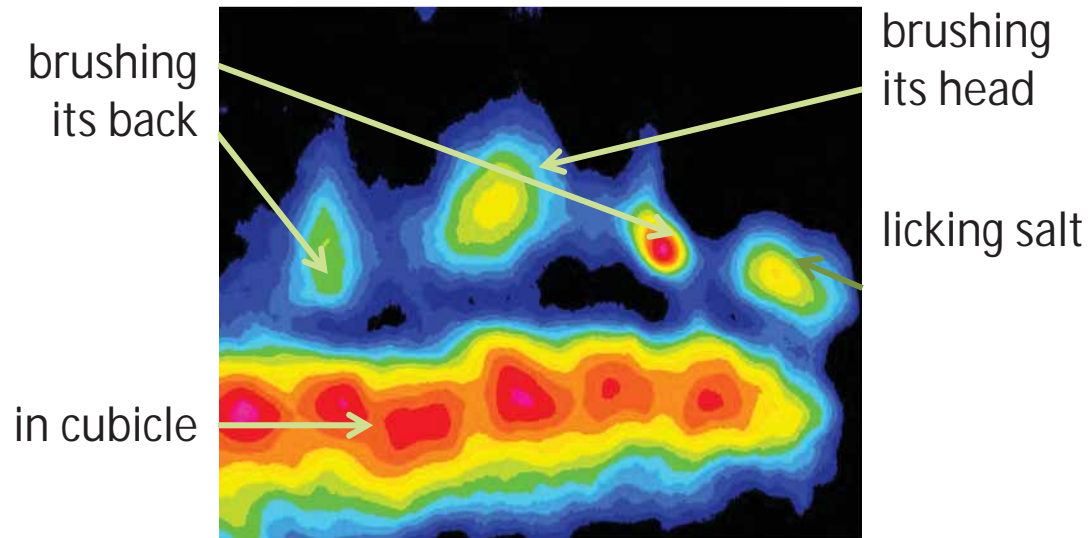
Reduced time spent licking salt could be used as an alarm.

pH bolus
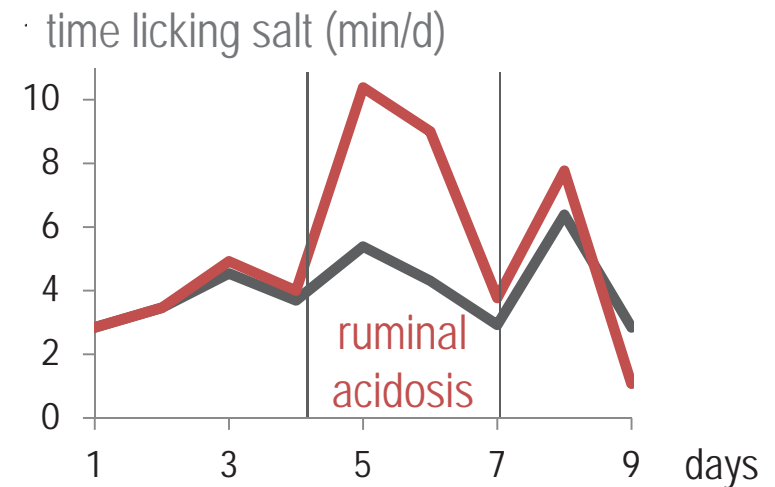
time licking salt (min/d)

ruminal acidosis

days

Detection of cough in calves

SoundTalks

sound
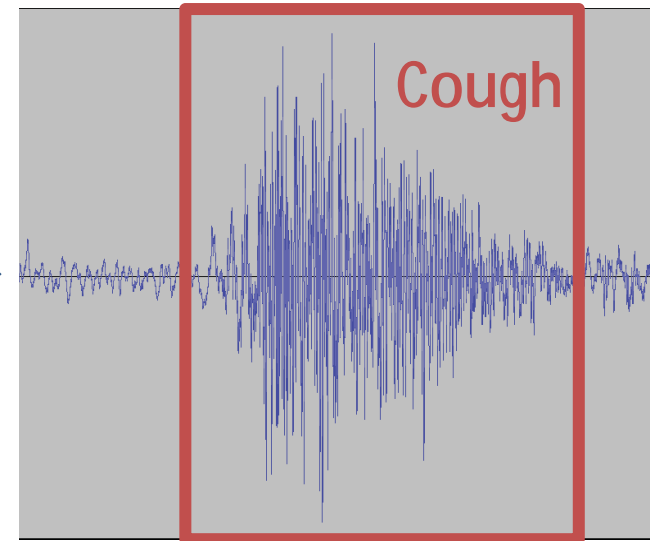
Cough

Increased coughing frequency ➔ early detection of respiratory diseases.

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Animal welfare

<div style="writing-mode: vertical">5 freedoms</div>

1. **Freedom from hunger or thirst** by ready access to fresh water and a diet to maintain full health and vigour
2. **Freedom from discomfort** by providing an appropriate environment including shelter and a comfortable resting area
3. **Freedom from pain, injury or disease** by prevention or rapid diagnosis and treatment
4. **Freedom to express normal behaviour** by providing sufficient space, proper facilities and company of the animal's own kind
5. **Freedom from fear and distress** by ensuring conditions and treatment which avoid mental suffering

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Comfort around resting

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Investigation of resting behaviour

Poor design of cubicles
➔ difficulties in
lying down / getting up
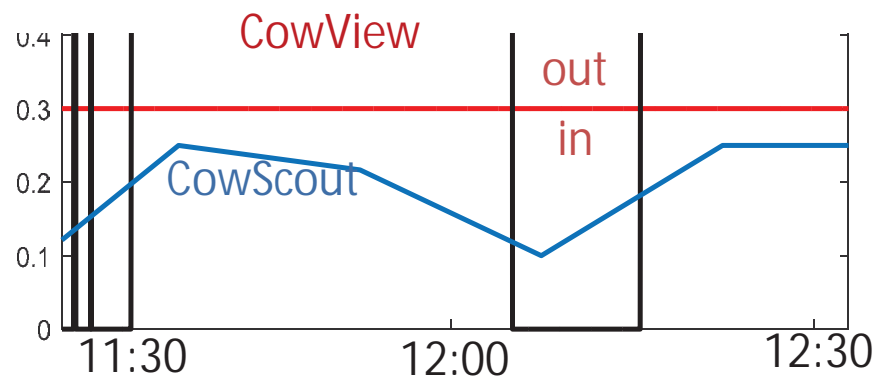
Combining CowScout and CowView allows to know when the cow is lying in a cubicle and the time she takes before she completely lies down.

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Animal welfare

1. **Freedom from hunger or thirst** by ready access to fresh water and a diet to maintain full health and vigour

2. **Freedom from discomfort** by providing an appropriate environment including shelter and a <u>comfortable resting area</u>

3. **Freedom from pain, injury or disease** by prevention or rapid diagnosis and treatment

4. **Freedom to express normal behaviour** by providing sufficient space, proper facilities and company of the animal's own kind

5. **Freedom from fear and distress** by ensuring conditions and treatment which avoid mental suffering

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Use of PFL to manage feeding

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Prediction of cow individual feed intake

Model
Dry Matter Intake = $\beta 0 + \beta 1$ cow location*
+ $\beta 2$ production indicators (milk: kg, fat, protein)
+ $\beta 3$ physiology status (weight...)
+ $\beta 4$ activity measures*...
in real time
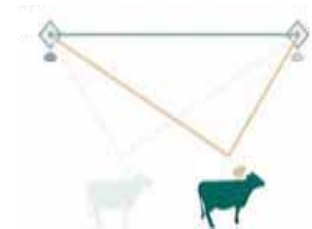
% explained by the model (R^2)	
Without PLF	74 %
With PLF*	93 %

PLF can help to adjust precisely the diet of cows.
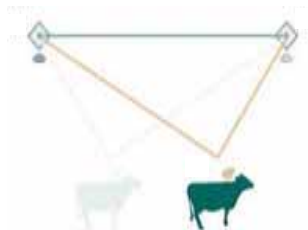
Impacts of changes in meal distribution

Farm 1

Farm 2

Feeding out 6 times/d

resting

eating

walking

Feeding out 12 times/d

Food pushed 3 times/d

Food pushed 10 times/d

Spontaneous rhythm of cows
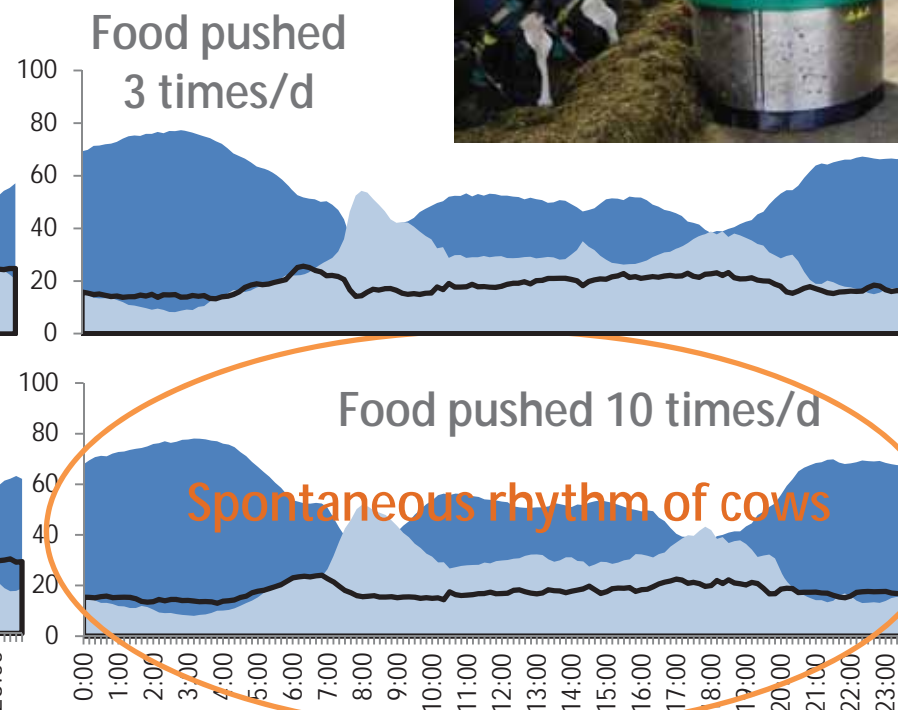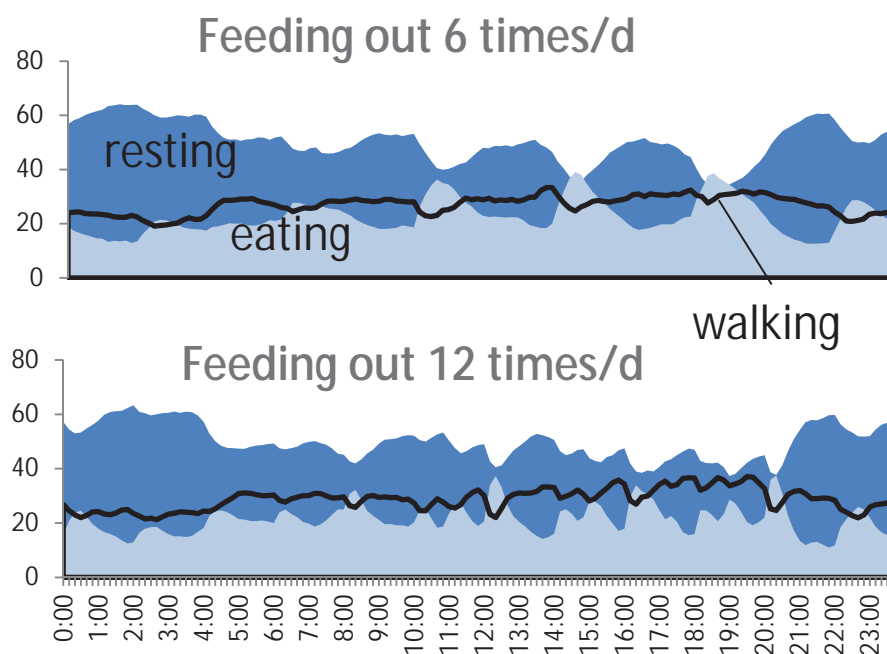
PLF can be used to check the impacts of feeding strategies.

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Animal welfare

1. <u>**Freedom from hunger** **or thirst**</u> by ready access to fresh water and a <u>diet to maintain full health and vigour</u>

2. **Freedom from discomfort** by providing an appropriate environment including shelter and a comfortable resting area

3. **Freedom from pain**, **injury or disease** by prevention or rapid diagnosis and treatment

4. **Freedom to express <u>normal behaviour</u>** by providing sufficient space, proper facilities and company of the animal's own kind

5. **Freedom from fear and distress** by ensuring conditions and treatment which avoid mental suffering

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Take Away messages

- **Simple signals can be used to provide very useful information** when they are processed adequately

- **Collaboration between engineers-natural scientists** and between industry – academics are essential to gain the most from PLF techniques

- In cattle, PLF can be applied at individual level allowing a **fine tune of the management of each cow** and contributing to maintain their welfare

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The Future
NEXT EXIT →

- Modelling of **activity rhythm** during the day to detect anomalies, relate them to cow status (oestrus, mastitis, lameness, ruminal acidosis, stress...)
- Relation between a cow behaviour and its milk yield as an indicator of its **longevity**
- **Comfort activities** (e.g. use of brushes) and disease / stress
- **Networks between animals** to study the spread of diseases
- Use of RTLS to measure **social behaviour** and **responses to humans** ➜ we could address Freedoms 4 & 5
...

... We are open to sponsors!

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Thank you to care for us

and thank you for your attention

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EU-PLF

WP5: SME Drive Workgroup
29-09-2016

Heiner Lehr, Syntesa, Spain
Johan Van den Bossche, Xenon NT, Belgium
Maurice Mergeay, M&M Corporation, Belgium
Daniel Roses, Abrox, Spain

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EU-PLF SME Drive Tasks

1. WP 5.1

    - Creation of awareness on PLF technologies through Smartfarming Innovation days.

2. WP 5.2

    - Selection/coaching of teams & prototypes.

3. WP 5.3

    - Intensive coaching of teams.

    - Valorisation of promising EU-PLF technologies through creation of **4 spin-off companies**.

    - Contribution to EU-PLF-Blueprint.

Task 5.1	Create awareness of promising PLF technologies		
Task 5.2		Develop prototypes to demonstrate new PLF applications	
Task 5.3			Create and valorise spin-off companies

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EU-PLF SME Drive Summary

WP 5.1. **Awareness**	Selected/invited emails: more than 10.000
	6 SmartFarming Innovation Days 97 Participants

WP 5.2. **Coaching**	...
	...

WP 5.3. **Spin-Off Creation**	...

...

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SmartFarming Innovation day
Barcelona 07/03/2013

Barcelona 27/11/2015

Wageningen 29/05/2013

Leuven 09/09/2013

EU-PLF SME Drive Summary

| WP 5.1. Awareness | Selected/invited emails: more than 10.000 |
| | 6 SmartFarming Innovation Days
97 Participants |

| WP 5.2. Coaching | 30 teams |
| | 6 prototypes to JURY – 1 under investigation |

| WP 5.3. Spin-Off Creation | ... |

...

WP 5.3. Selection/Coaching

✓ Projects related to: new sensor applications, illness detection, robotics and automation solutions.

✓ 6 projects entered competition for prototype development

1. PiggyBodywarmer   > JURY rejected
2. Ymaging   > JURY accepted
3. Bainisha   > JURY accepted
4. Connecterra   > JURY rejected
5. CowMatrix   > JURY accepted
6. NDA (Milan) recently entered >
   under investigation by JURY

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EU-PLF SME Drive Summary

| WP 5.1. Awareness | Selected/invited emails: more than 10.000 |
| | 6 SmartFarming Innovation Days 97 Participants |

| WP 5.2. Coaching | 30 teams |
| | 6 prototypes to JURY – 1 under investigation |

| WP 5.3. Spin-Off Creation | 5 Spin-Off's started - 6th coming soon |

...

WP 5.3. Spin-off's

Lead connecting the sensor & box..

Connector plug.

Braided lead.

Active Stretch Sensor Section

1) Infra-red Camera
2) Atom-class PC
3) Algorithms
4) Graphical User Interface

EU-PLF SME Drive Summary

WP 5.1. Awareness
- Selected/invited emails: more than 10.000
- 6 SmartFarming Innovation Days
  97 Participants

WP 5.2. Coaching
- 30 teams
- 6 prototypes to JURY – 1 under investigation

WP 5.3. Spin-Off Creation
- 5 Spin-Off's started - 6th coming soon

- EU-PLF-Blueprint
  Book 'How to setup a high-tech company in PLF'

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EU-PLF SME Drive Recommendation 1

✓ The SME-Drive has gathered very much data/information on the potential transfer of technology to EU-PLF
and the potential creation of new businesses the EU-PLF area.
(30 teams entered the coaching process ...)

✓ A follow-up project would a very wise investment.

✓ EU-PLF SME Drive thus looks for further funding.

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EU-PLF SME Drive Recommendation 2

✓ The concept of adding a WorkPackage, similar to the WP 5: EU-PLF SME-Drive **to every EU project** is highly promoted.

✓ The goal should be that every EU project results in the creation of a number of high-tech companies.

✓ This is a very important way to valorise EU projects in a sustainable way.

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Spin-Off presentations

1. Ymaging,
   Dr Ivan Amat-Roldan

2. Bainisha
   Dr Patrick Van De Vyver

3. Connecterra,
   Ir Yasir S Khokhar

4. CowMatix,
   Dr Marzio Miodini & Leonardo Sala

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PigWei: handheld device for precise and fast weighing of livestock pigs

Ymaging - Dr Ivan Amat-Roldan

Established: 01/12/2012

EU-PLF Final conference

29 September 2016
Brussels, Belgium

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PigWei: A Portable pig weighing system on pigs based on image analysis and cloud services

PigWei

PigWei IBÉRICO

PigWei MADRE

PigWei LECHÓN

APPLICATION: **Growth management**
- Appropriate growth is the best **key indicator** of a healthy animal

Ninche market: Iberico pigs
- Iberico pigs need to be weighted by law before sacrifice

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PigWei DEVICE (I)

PigWei DEVICE (II)

PigWei Models

Work in Progress

White indoor basic

White indoor precision

- Iberico outdoor basic

- Iberico outdoor precision

DONE Iberico indoor basic

DONE Iberico indoor precision

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PigWei DEVICE (III)
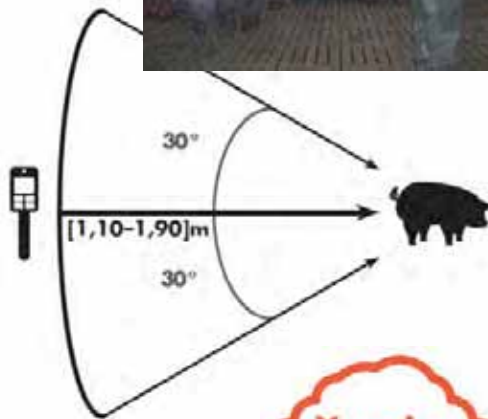
Weighing Pigs (I)

Weighing Pigs (II)

Cloud computing

Computer Vision

Machine Learning

Artifical Inteligence

8-10 seconds

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Weighing Pigs (III)

Current results

Statistics

96% error <5Kg
100% error <10Kg
median absolute deviation = 1.6Kg
(MAD)
root mean squared error =
2.5Kg (RMSE)
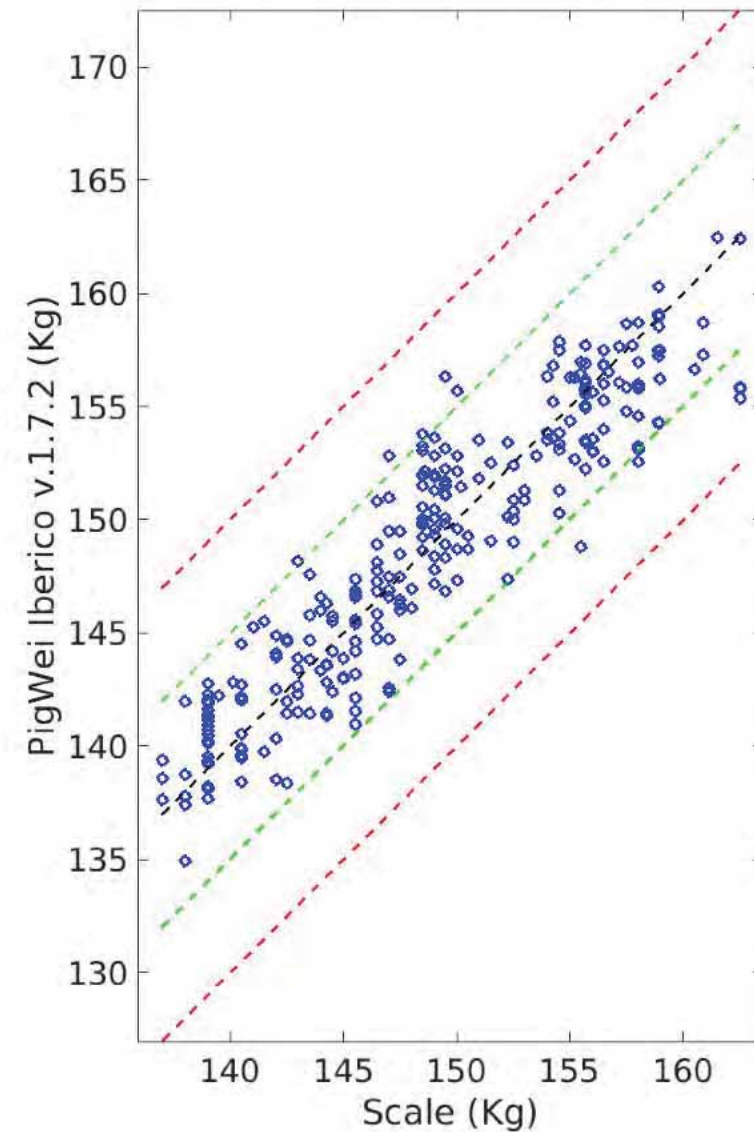
------- 5 Kg
------- 10 Kg

Other pig-related technologies

- Objective measurement for boar taint

- Laser-based technology

- In-line integration

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Acknowledgements

- EU-PLF consortium.

- Daniel Rosés, ABROX.

- Maurice Mergeay, M&M corporation

- Johan Van den Bossche, Xenon NT.

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Thank you

ivan@ymaging.com

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Early Detection of Lameness

Patrick Van De Vyver

EU-PLF Final conference

29 September 2016
Brussels, Belgium

Team Bainisha

Founder/CEO

Applied Physics & Systems Engineer

Mechatronic & Embedded System Engineer

Public Affairs Manager

Business Advisor

Business Developer

Established

25th June 2014

IDTechEx Wearable EUROPE

Winner

Best New Wearable

Technology Device 2015

Bainisha®

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Objective

Detection of lameness
in the earliest phase

Hinges on the ultra-high resolution un-interrupted & continuous tele-monitoring of the animal's gait

Bainisha®

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Obstacles – IMU limits
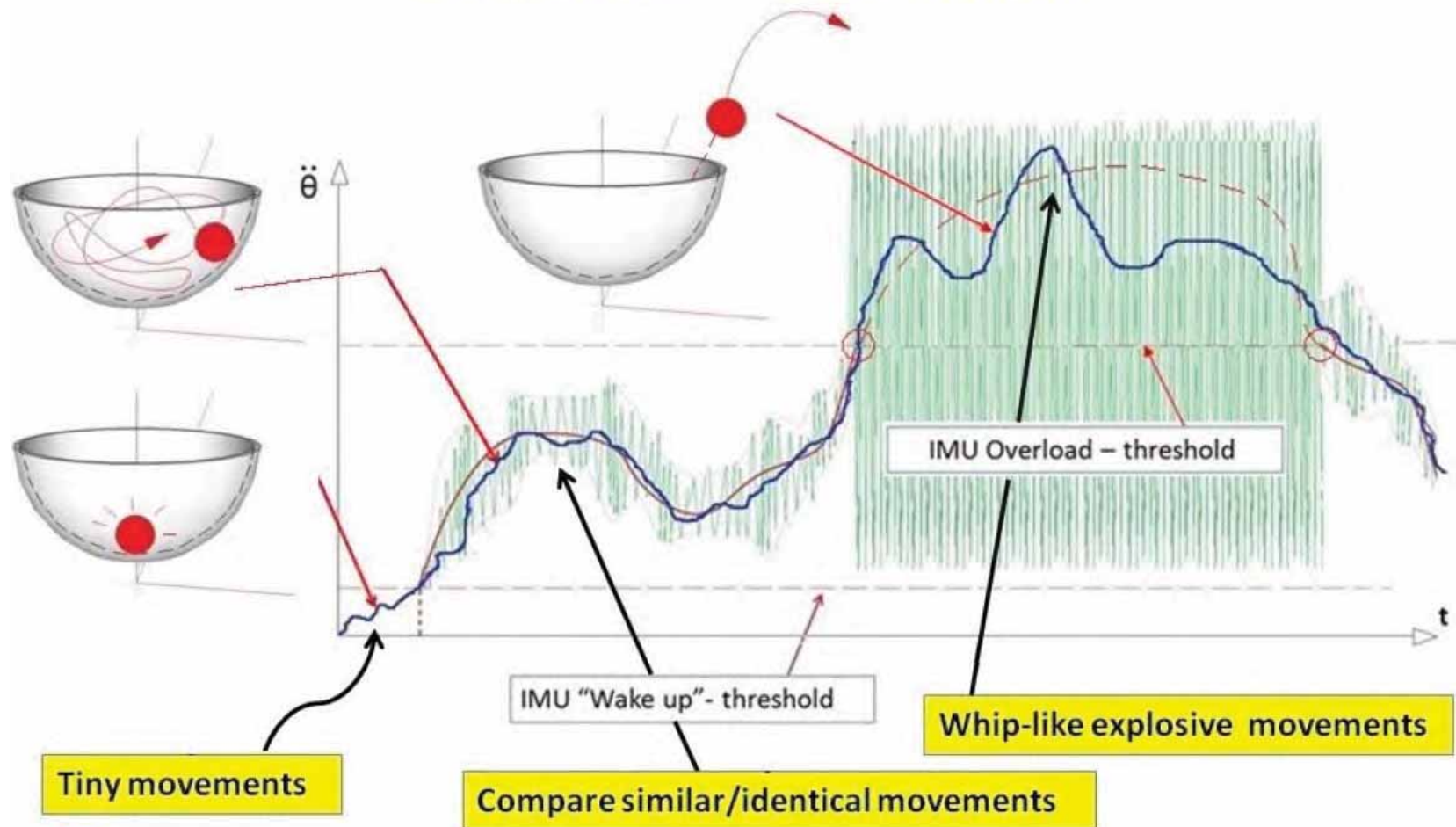
IMU Overload – threshold

IMU "Wake up"- threshold

Tiny movements

Compare similar/identical movements

Whip-like explosive movements

Bainisha®

Skin Anomaly

The mass of the units are sitting on a multiple degree of freedom spring = uncontrollable

3D Scatter Chart (1)
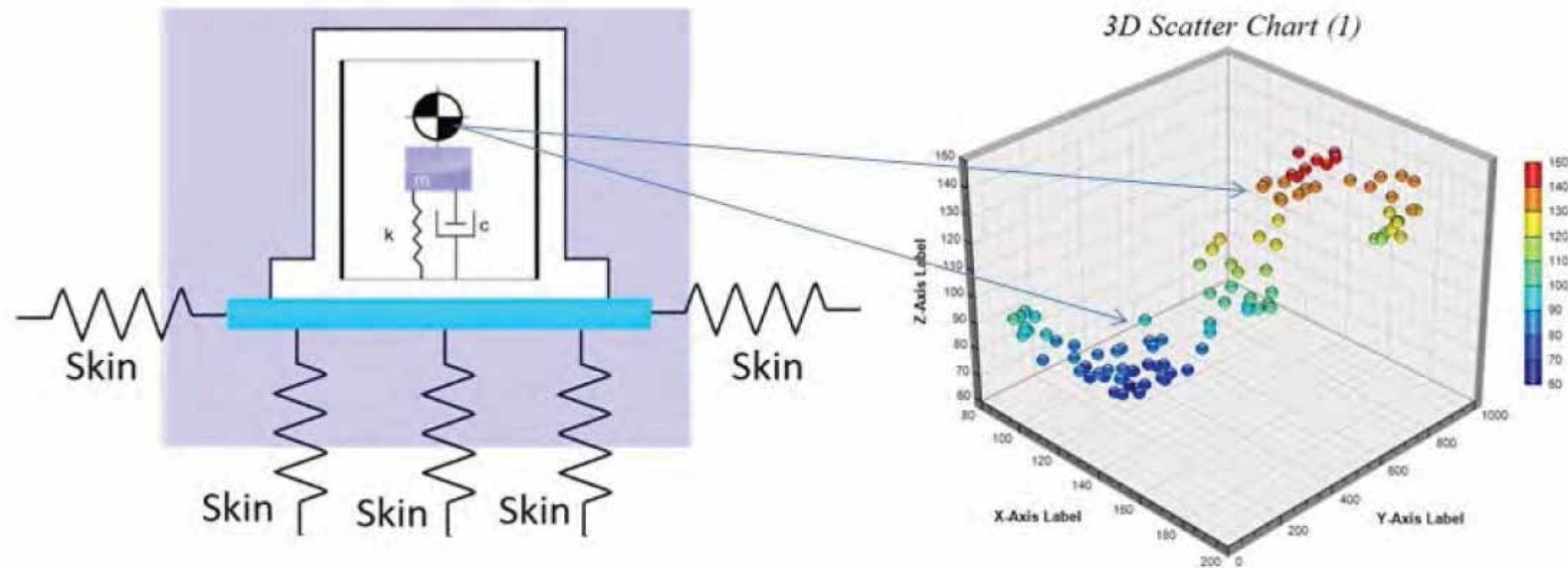
Versus the "virtual mass-less" polymer sensors integrated in/on the skin

Bainisha

Solution - Stretch Sensor Tech

Standard length 145 mm

Screened layer of adhesive = projected area of bare sensor

Overall adhesive layer covering the top surface of the substrate

Moulded-in connection of electrodes with shielded wire (COAX).

Peel-off protection film

Flexible strip - not stretchable
Anti-rupture zone tab connection

Stiff protection backing

Hyper stretchable thin film substrate
E.g. Wacker ELASTOSIL 20 μm

Shielded COAX wi...
RAYCHEM CLFH-...
RG178, 30 AWG, ...

No silicone protection (encapsulation) layer at face-down side

Thinnest possible silicone protection layer (encapsulation) on top

compliant electrode

elastomer

0 V

1000 V

Bainisha

Solution - Stretch Sensor Tech

Upper Controller
Stretch Sensor
Lower controller
Sleeve
Attachement
Wireless Data Transfer
RFID
Batteries

Ultra High Resolution

(a) Angular velocity of the fore-limbs

LS
LE
RS
RE

Angular velocity (degs⁻¹)
Time (s)

Bainisha

Complete System

Low energy local transmission

Receivers/transmitters

Mathematical Models

De-localized hubs.

App & Local review.

Bainisha®

Lifestock Management System

Medical/ veterinarian
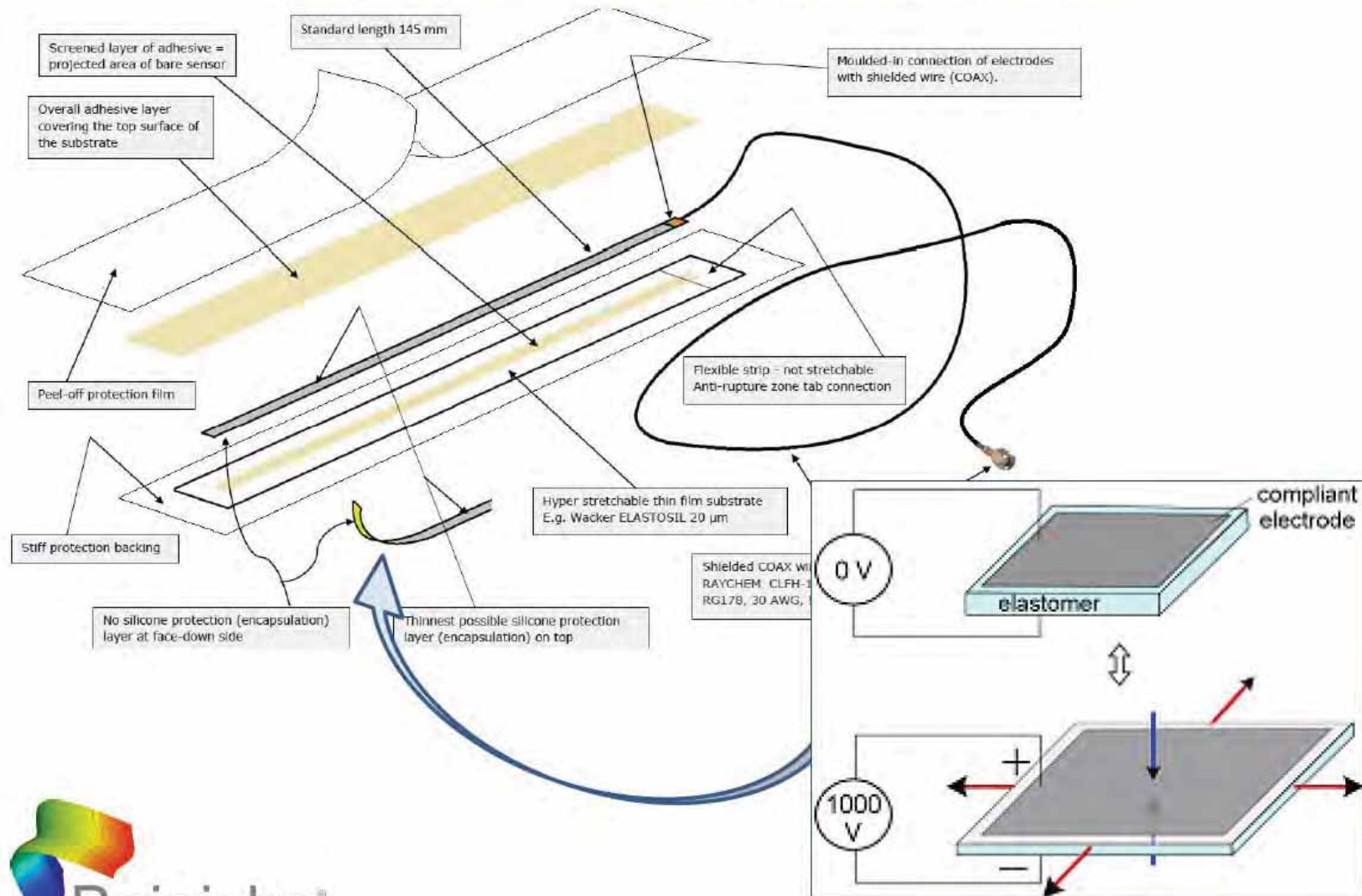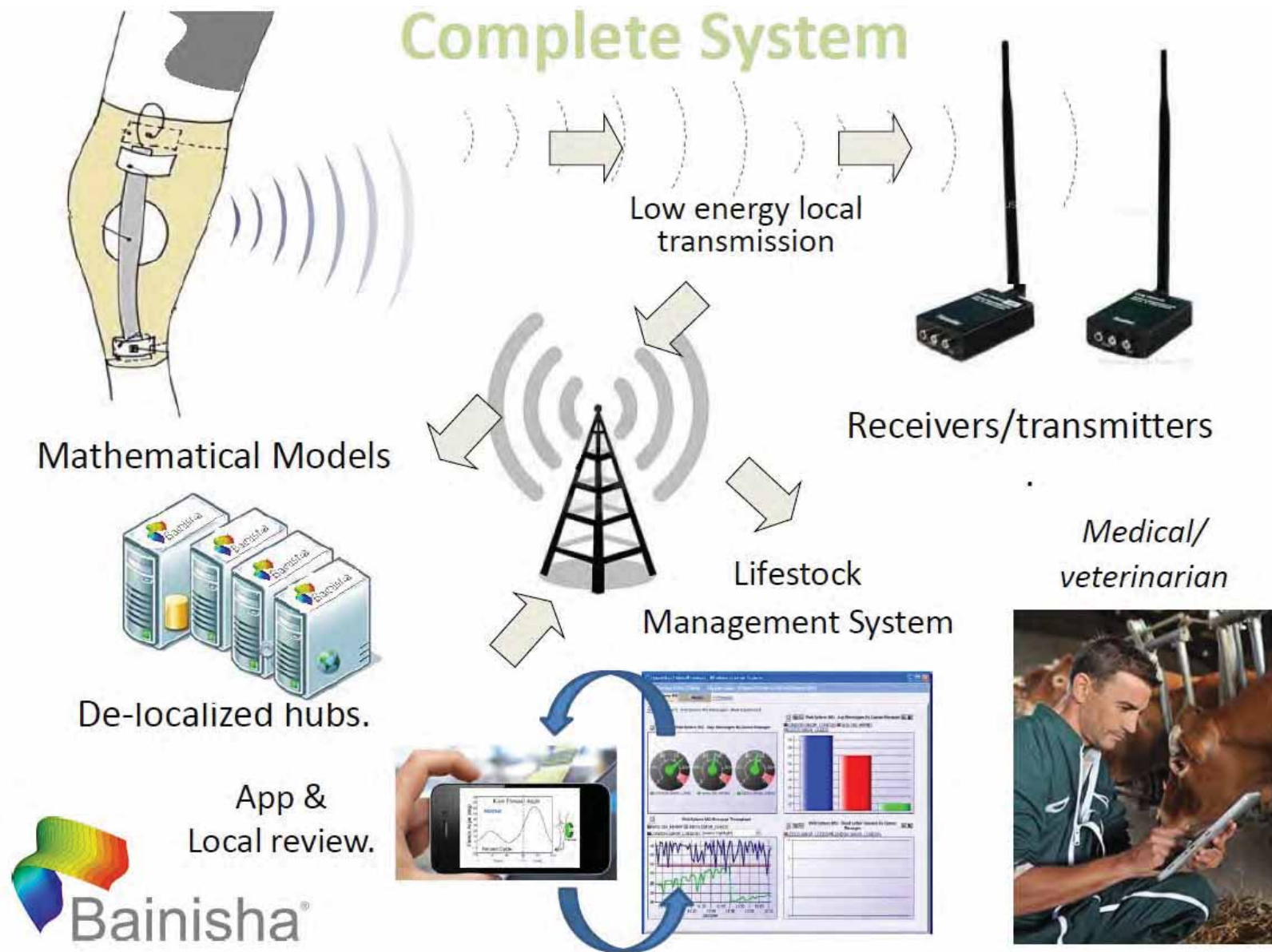
Thank You

Patrick Van De Vyver
CEO

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www.bainisha

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Other Developments

Substrate composed of a hyper - elastic film and a proprietary "sticky gel layer."

Alternatively, this layer may be "doped" with a disinfectant to prevent infections from small shaving cuts.

Shaved and degreased area for application of the self adhesive stretch sensor and module.

Wire connection with micro-connector

Very thin self-adhesive stretch sensor =
DISPOSABLE COMPONENT
Minimum occupancy for disposable part:
- 3 stretch sensors
- Microprocessor for pre-processing.

Procedure:

1. Apply patch and module & connect.
2. Cell Phone Module - CPM - calls all clients for activation.
3. Unique serial number of the patch is assigned to the horse and its location is logged.
4. Pre-determined hierarchy (roll/function) of the clients is transmitted for confirmation.
5. Monitoring system sends self diagnostics and reports any malfunctioning.
6. "Eminent foaling warning" is sent when contraction profile is recognized.

MC

Data processing & transmission module =
REUSABLE COMPONENT
Occupancy at the recycling module:
- Microprocessor for post-processing
- Cell Phone Module - CPM
- GPS module
- Rechargeable battery.
The module switches on when a patch is attached.

Information about the pregnancy (and alternatively the communication between the system and the clients) will be collected on a de-localized hub which serves as a "secure data centre".

MC
CPM
Battery
GPS

Bainisha

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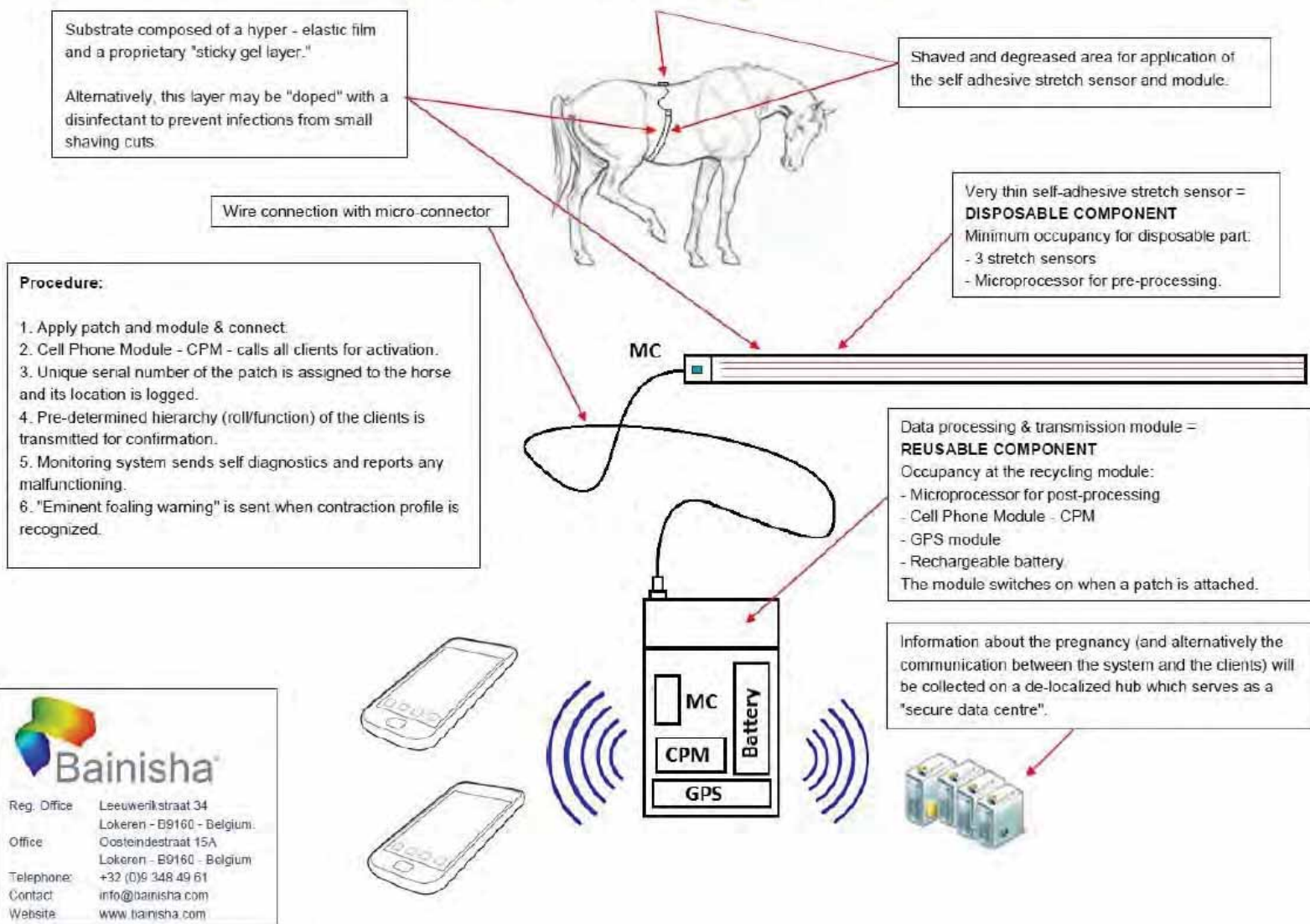
Other Developments

First phase -> **Dev Kit**

Second phase -> **Knee Patch**

Third phase -> **Back Sensor**

Wired - Batteries &
Electronics separate

Wireless - Batteries &
Electronics on board

Wireless - Batteries &
Electronics on board 3D

Educating the market

Follow-up Arthroplasty

Multi Purpose 3D Spine

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9 **Billion** People
By 2050

4.2 **Billion** People

Will enter the mainstream consumer class by 2025 (up from 2.5Bn in 2010)

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3000 Liters in 2014

The average water footprint of a typical consumer

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Sustainable?

Making Sense from Sensor Data

Yasir S Khokhar

CEO

Connecterra

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Agenda

Trends driving innovation in technology

The paradox of data

A case study in making sense from sensor data

Why this matters

Emerging trends in technology today

Sensors:

Smaller, powerful, autonomous, long range and battery life.
The average iPhone has 14 sensors in it.

Data Technologies:

Zettabyte scale, processing billions of records per second (NSA/Google)

Cloud Computing:

Dropping cost of cloud based resources as economies of scale make their effects felt. Near Infinite storage and near infinite compute resources.

3 node compute cluster: $100K in 2000 -> Down to $45 / month in 2016

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We don't really need more data

The advertising industry is well and kicking with over $1Tr of market cap

We need more insights

And insights need data; quality and volume

The Paradox of data analysis

Chart: Y-axis "Analytical Ability", X-axis "Volume of Data", with a downward sloping line labeled "Human's Capability".

The Paradox of data analysis

(Chart: Analytical Ability vs. Volume of Data, showing "Machine Capability" line increasing and "Human's Capability" line decreasing)

The Paradox of data analysis

The Paradox of data analysis

The Paradox of data analysis

Analytical Ability (y-axis)

Machine Learning

Machine Capability

Human's Capability

Shift the productivity Point with machine cognitive ability

Volume of Data (x-axis)

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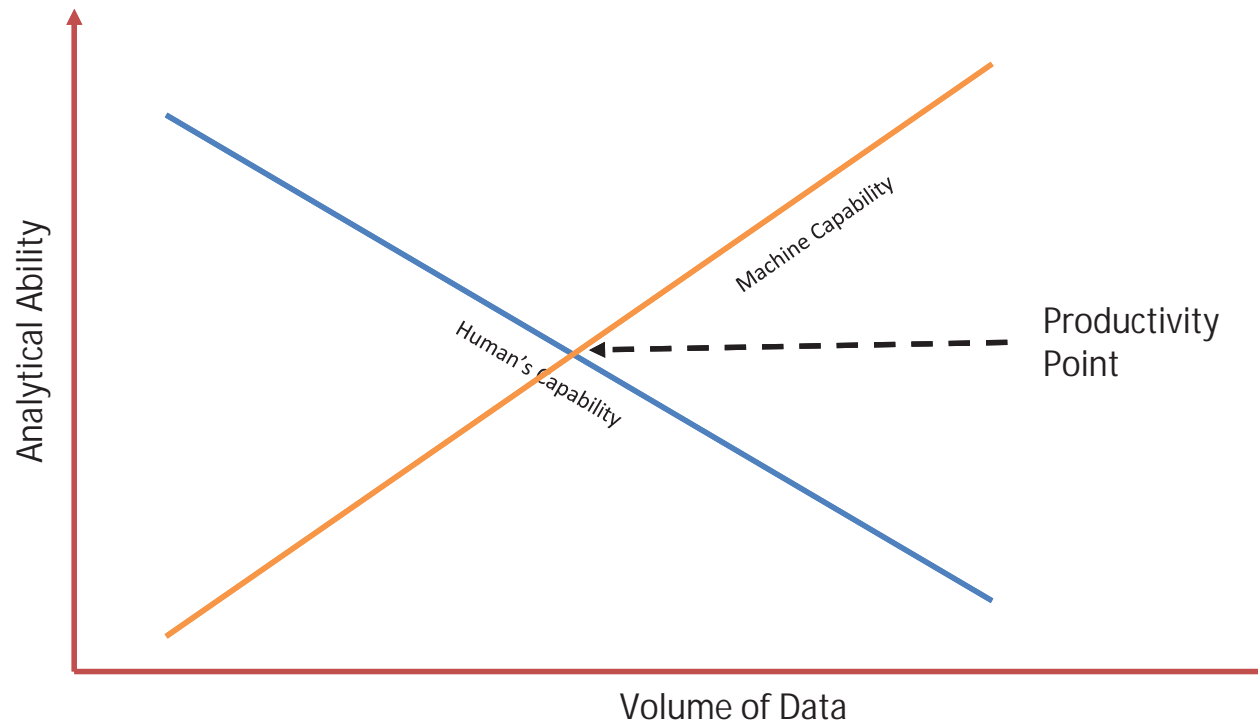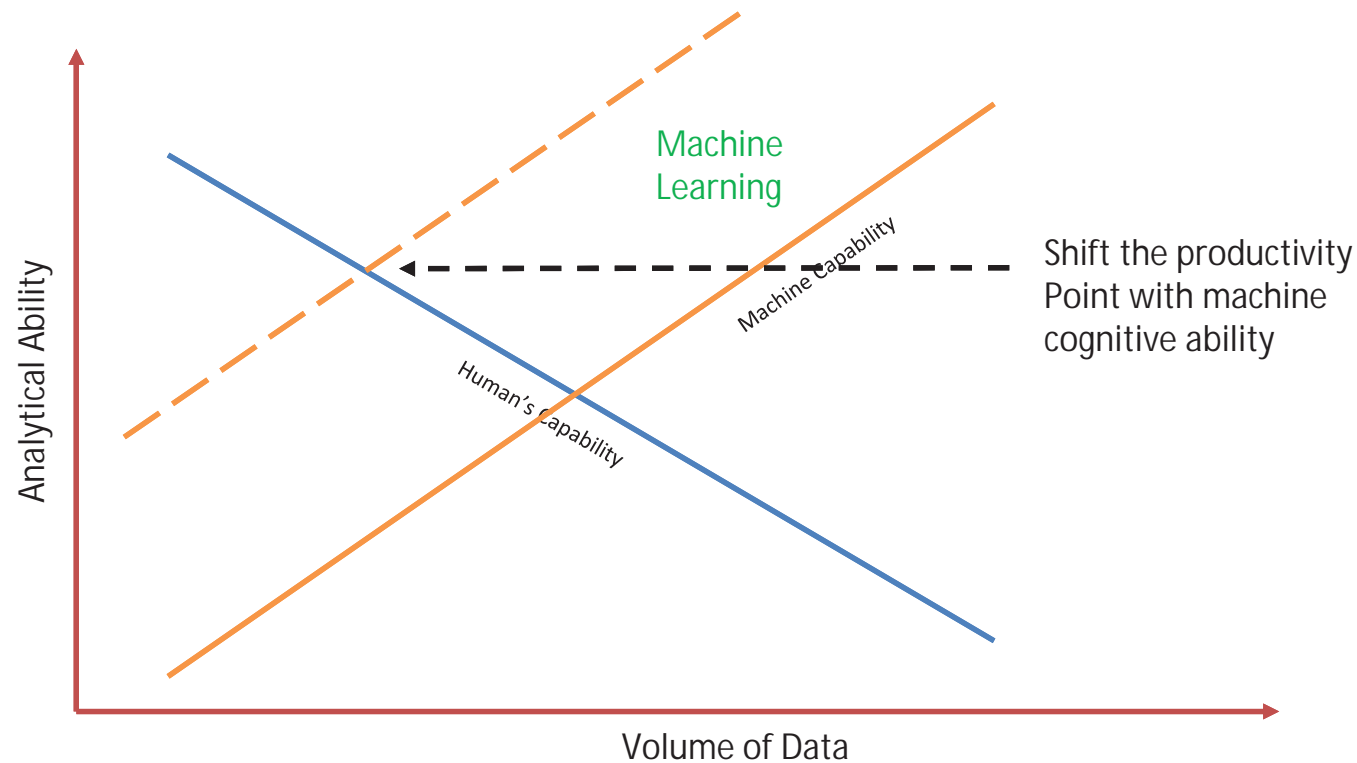
But the trick is in asking the right question!
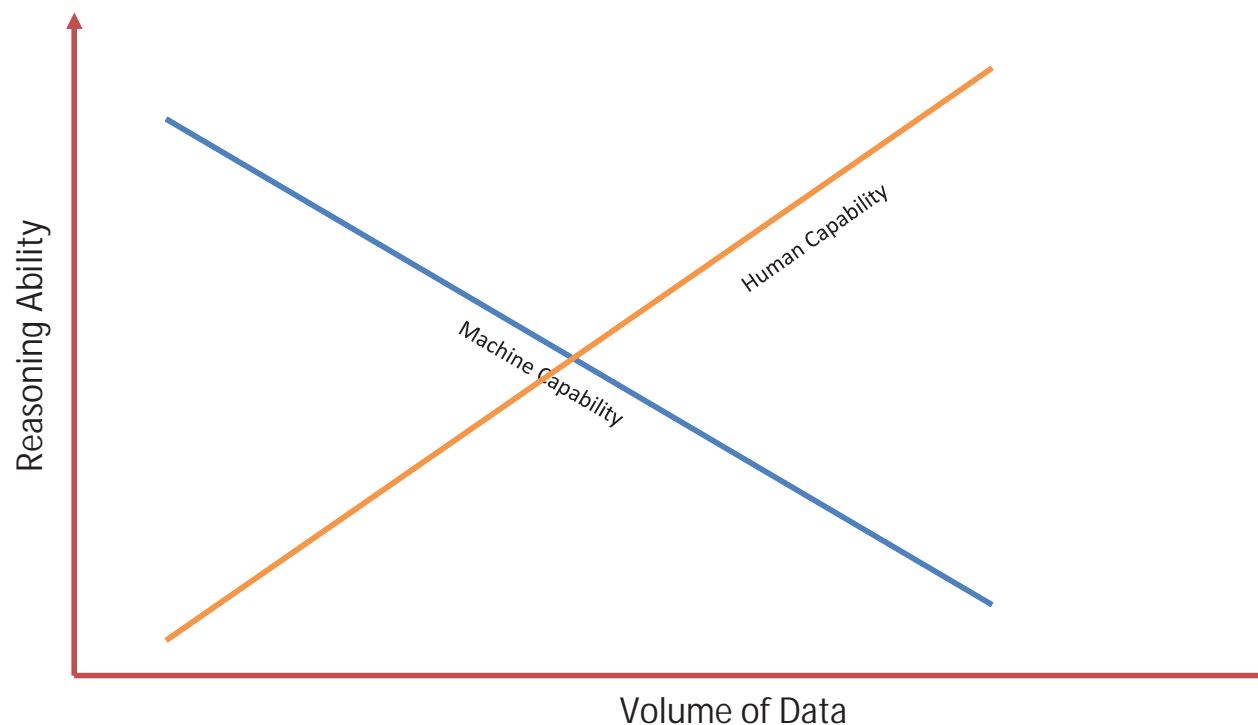
Process large amounts of data with reasoning
ability = Insights

.....the year so far in the machine learning world

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Connecterra:

Learn the behavior of dairy cows by observing their behavior:
Eating, Ruminating, Drinking, Walking, Idle (and more)

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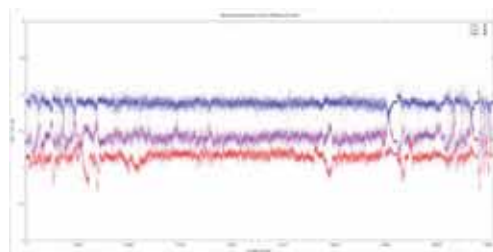
Sensor Data

Insights

Cow shows an unusual eating behaviour.
#9998 Oh Well

An example of what we found
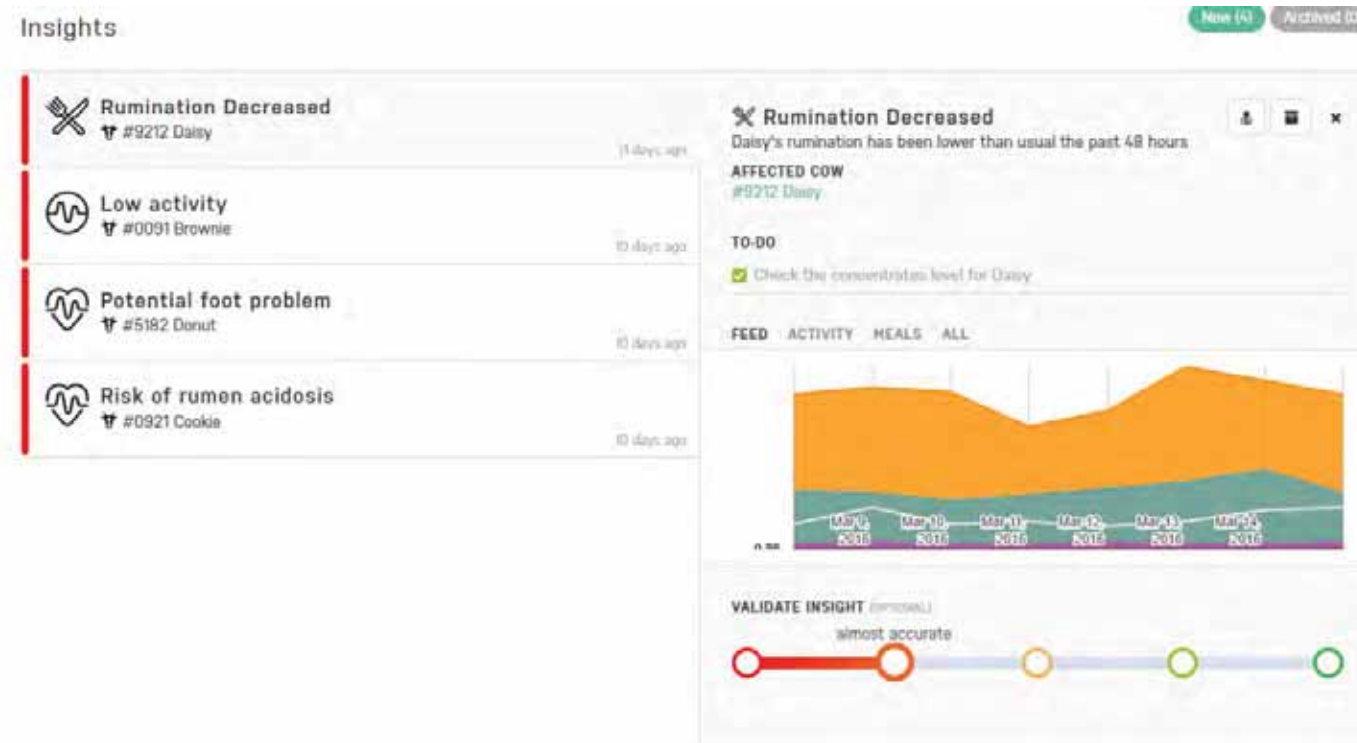
Farmer gives fresh food on 10:00 every day.
Pushes food back to gates in afternoon, 18:00 and 23:00.

Typical patterns for Daisy

112

0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00
23-3-2016

■ Eating   ■ Ruminating   ■ Idle   ■ Walking   ■ Drinking
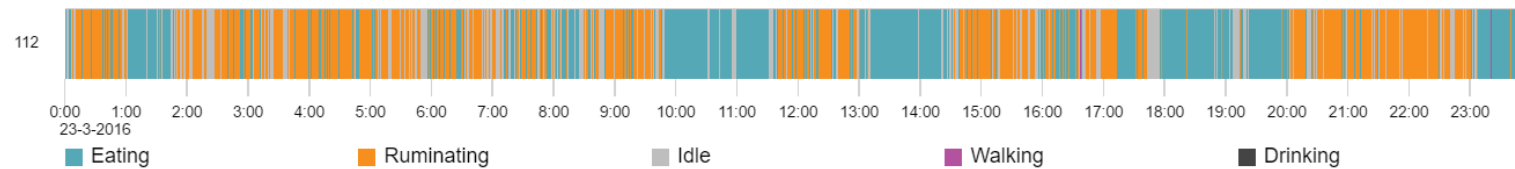
After a change in feed input
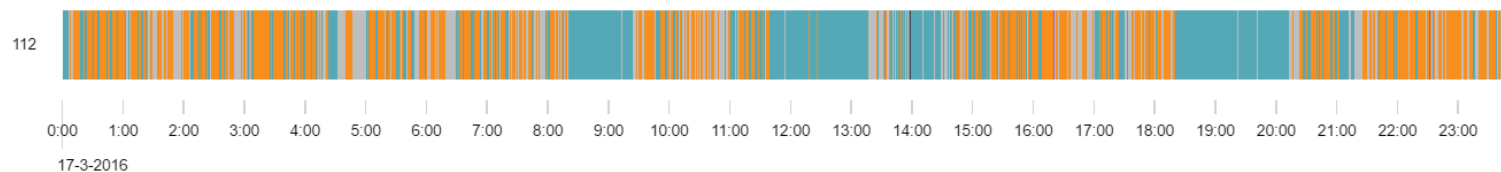
112

0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00
17-3-2016

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Including the farmer in the feedback loop creates cognitive ability of the system

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A system that has cognitive awareness also has predictive capabilities

Upcoming Inseminations ③

#361 Marge   #101 Betty   #213 Moolly

6 AM 7 8 9 10 11 12 PM 1 2 3 4 5 6 7 8 9 10 11 12 AM 1 2

Predicting estrus cycles and optimal insemination time is based on the learning from past experiences

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A system that has predictive abilities and massive scale gets better with multiple forms of data

Additional sensors
Financial Data
Partner Data

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Help us feed the world by 2050,
Spread the word

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Thank you.

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What farm practices do I employ that have the biggest impact on productivity?

How do I compare to other farmers in my region?

Are my suppliers products as good as they say they are?

How do I operate my business in a more sustainable manner for a better planet?

Projected Dairy Cash Flow Analysis

Input information from your dairy operation in the yellow boxes. The worksheet will calculate income and expenses. Information is not saved in this form so use the Print Button to capture the results.

		Update	Default	Values Used in model			
1	Price Per CWT	12.00	14.20	12.00			
2	CWT Per Cow	263.00	263.00	263.00			
3	Herd Size	150.00	6,000.00	150.00			

Dairy Sample Data

	INCOME	AMOUNT	PER CWT	PER COW	PERCENT			
4	Milk	$473,400	$12.00	$3,156	100.00			
5	Total Income	$473,400	$12.00	$3,156	100.00			

EXPENSES

Feed

						Update	Default Values Per cow
6	Hay	19,500	0.48	130	4.12		$130
7	Silage	58,800	1.49	392	12.42		$392
8	DDG - Gluten	14,700	0.37	98	3.11		$98
9	SBM - Soybean	21,300	0.54	142	4.50		$142
10	Grain	21,450	0.54	143	4.53		$143
11	Other Feed - Supplements	36,300	0.97	242	7.67		$242
12	Total Feed Expenses	$172,050	$4.34	$1,147	36.34		

Herd Replacement Cost

13	Depreciation - Dairy Cows	34,950	0.89	233	7.38		$233
14	Other Costs	16,200	0.41	108	3.42		$108
15	Total Herd Replacement Cost	$51,150	$1.30	$341	10.80		

Other Operating Expenses

						Update	
16	Interest and Rent	31,200	0.79	208	6.59		$208
17	Labor plus Benefits	48,125	1.22	321	10.17		$321
18	Depreciation – Other	22,950	0.58	153	4.85		$153
19	Milk Hauling	10,050	0.25	67	2.12		$67
20	Industry Assessments	6,300	0.16	42	1.33		$42
21	Supplies	25,050	0.63	167	5.79		$167
22	Repair and Maintenance	21,750	0.55	145	4.59		$145
23	Utilities	8,700	0.22	58	1.84		$58
24	Taxes and Licenses	6,600	0.17	44	1.39		$44
25	Insurance	6,450	0.16	43	1.36		$43
26	Fuel and Oil	7,688	0.19	51	1.60		$51
27	Legal and Accounting	3,600	0.09	24	0.76		$24
28	Veterinary and Breeding	12,900	0.33	86	2.72		$86
29	Testing and Trimming	3,900	0.10	26	0.82		$26
30	Hauling Livestock	900	0.02	6	0.19		$6
31	Miscellaneous	4,000	0.05	11	0.10		$11

Help a farmer manage the top and bottom line by using the power of predictive analytics

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Cow shows an unusual eating behaviour.
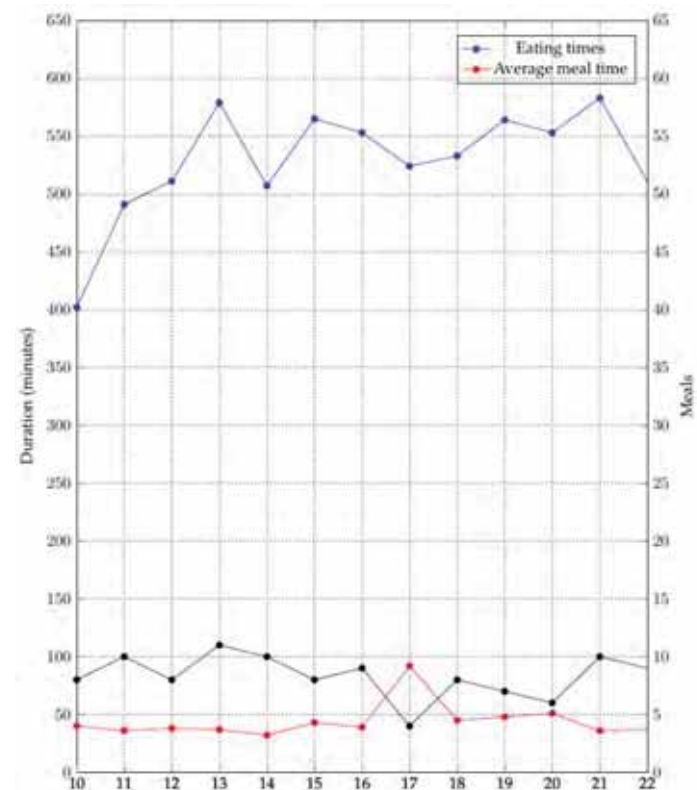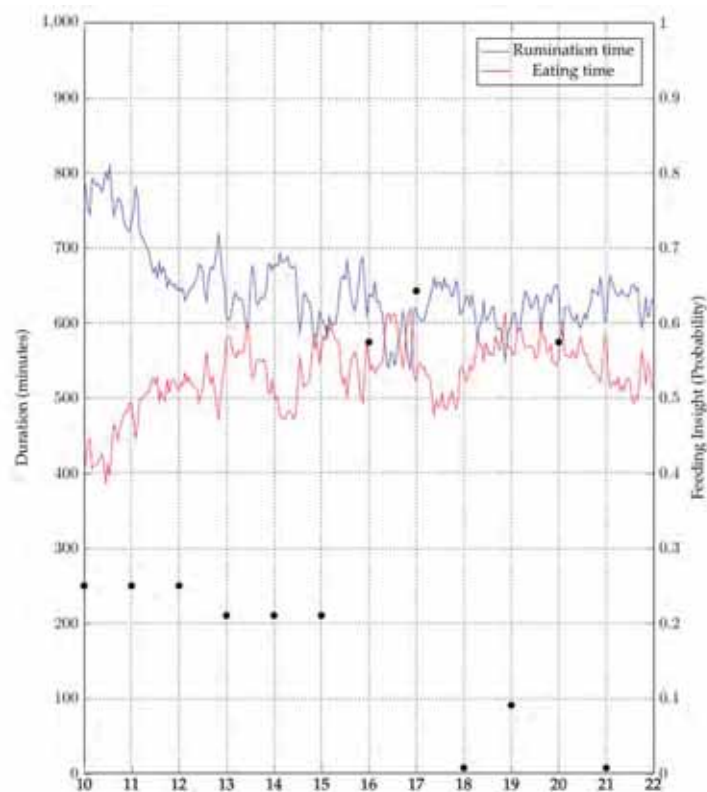
Ruminationtion ratio is relatively low. Increasing eating times.
Decreasing rumination ratio over last week. Sudden drop in meals.

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An automatic 24/7 diagnostic system for hoof diseases in bovine

COWMATIX - Marzio Miodini

EU-PLF Final conference

29 September 2016
Brussels, Belgium

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Who we are

Young Start-Up incorporated on May 9th 2016

Marzio Miodini - CEO

Degree in Animal Science; Ph.D. in Zoo Economy

15+ barn design experience – Cow Signals Master Certified
Trainer - Owner of *Segnali dalla Vacca* training school

Leonardo Sala - CTO

Degree in Microelectronics

inventor, programmer, algorithms and systems expert.

Assignee of 20+ patents.

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COWMATIX Mission

To develop new solutions in the field of Precision Livestock Farming (PLF), that immediately improve the livestock's welfare and increase the farmer's profitability

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COWMATIX LE.A.D

- COWMATIX has developed LE.A.D: Leonardo Advanced Diagnostic system.

- It enables the early detection of hoof diseases in bovines, including both infective and bio-mechanical pathologies.

- LEAD operates continuously to promptly detect and notify the occurrence of the most common pathologies when they first appear.

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COWMATIX LE.A.D advantages

1. Early diagnosis
2. Continuous automatic 24/7 monitoring
3. Increased reform index
4. Increased milk / cow index
5. Increased deliveries / cow index
6. **15.000 to 60000 € / year / 100 cows recovery**

LEONARDO
italian genius

COWMATIX

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COWMATIX LE.A.D architecture
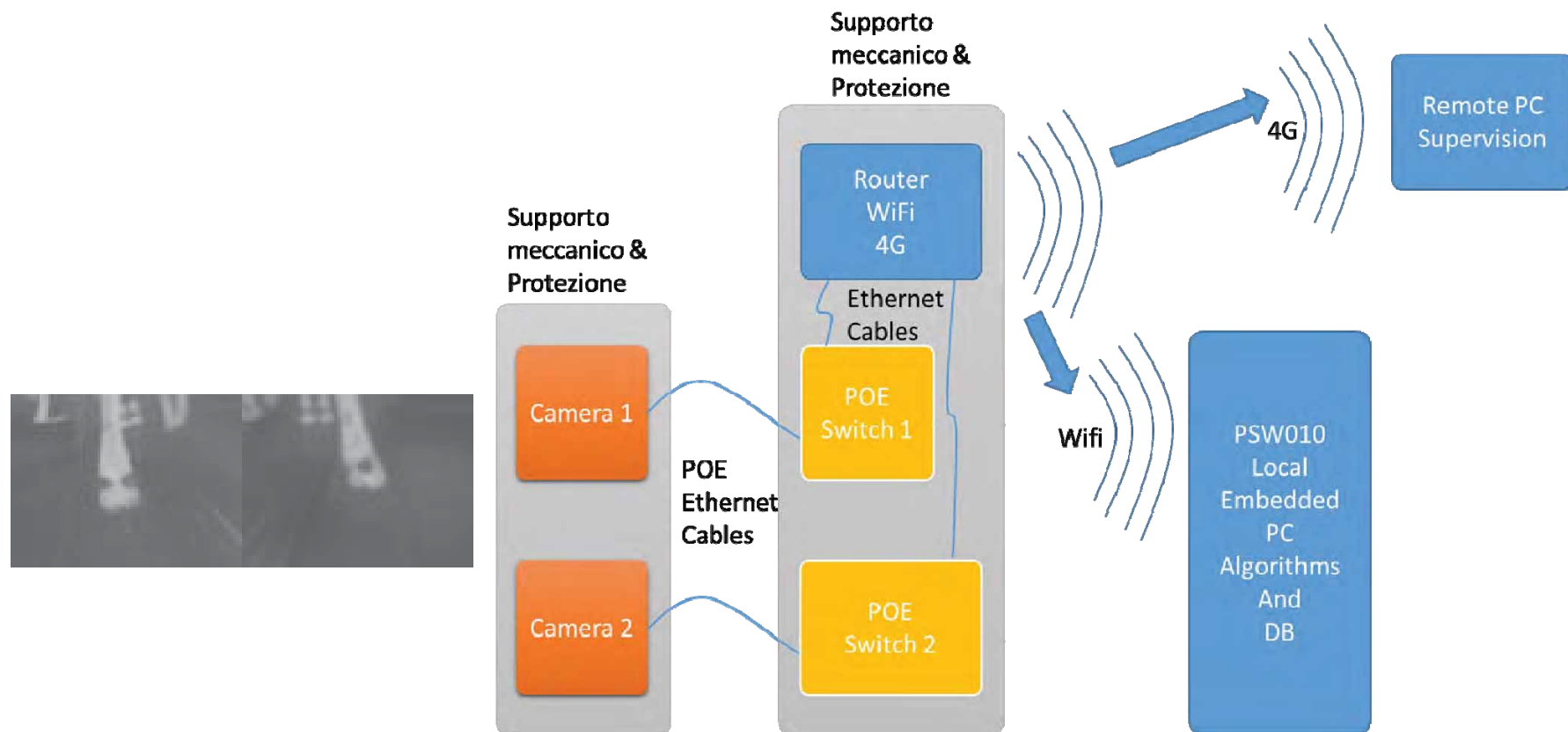
COWMATIX

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COWMATIX LE.A.D User Interface
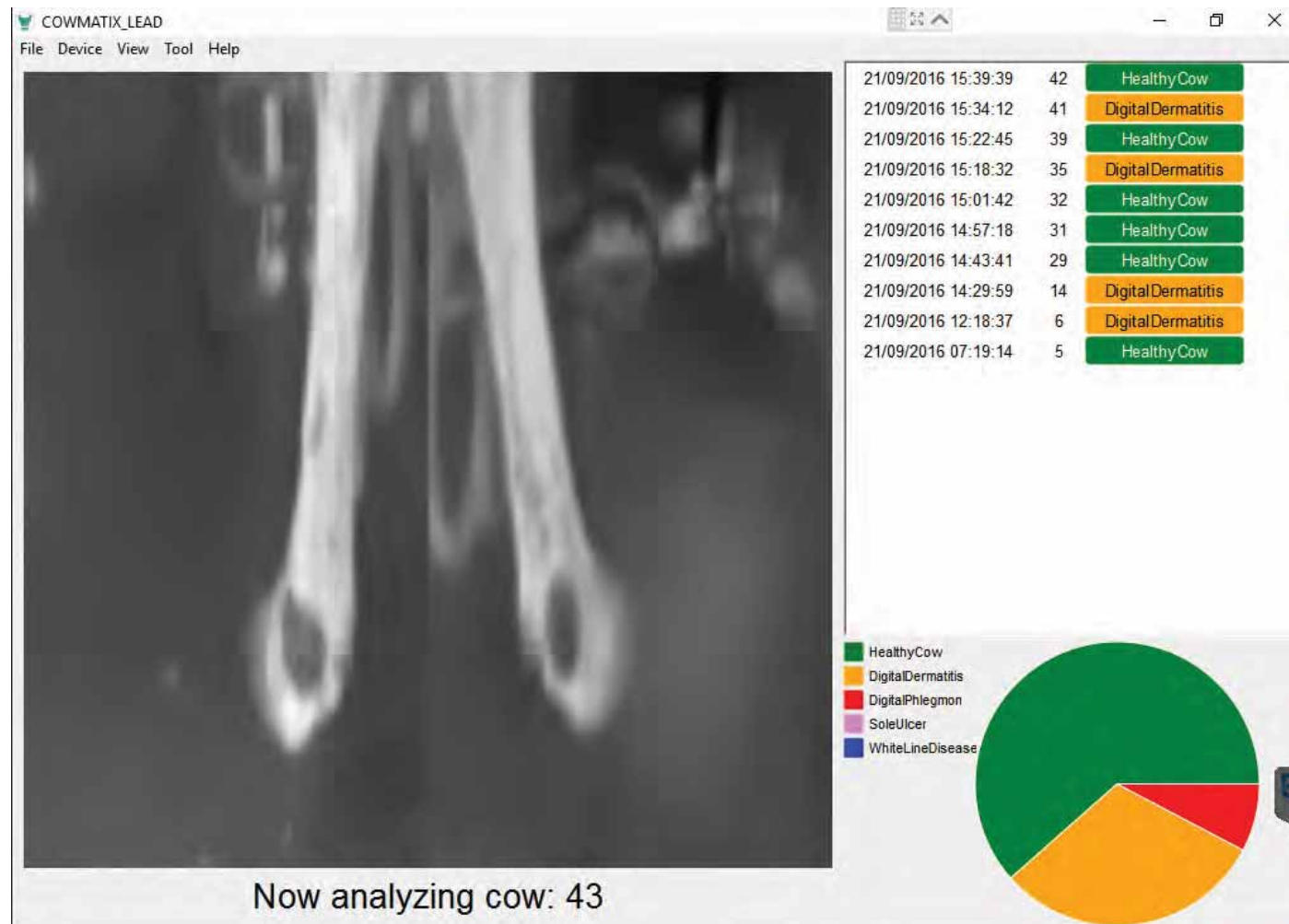
COWMATIX

COWMATIX LE.A.D Status

- First complete installation completed
- Uses low-cost cameras
- Uses low-cost processing unit
- Running since September 5th
- 4000+ diagnoses saved
- Algorithm development keeps going to increase accuracy above 90%
- Algorithm finalization target date is: late November 2016

COWMATIX

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Thanks

www.cowmatix.com

info@cowmatix.com

COWMATIX

Farmers' engagement in using PLF technology

Report of the EU-PLF farm visits
- the farmers' perspective

Jörg Hartung

EU-PLF Closing conference

29 September 2016
Brussels, Belgium

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Content

1. Challenges of Livestock Production

2. Introduction to the questionnaire

3. What do farmers know about PLF?

4. How did farmers react in interviews on farm?

5. Conclusions

6. Recommendations

7. Messages

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World livestock population
(estimated)

Chicken	19 billion
Cattle	1.4 billion
Sheep	1.0 billion
Pig	1.0 billion

The distribution varies extremely.

(The Economist online 27.07.2011, access. 10.04.2015)

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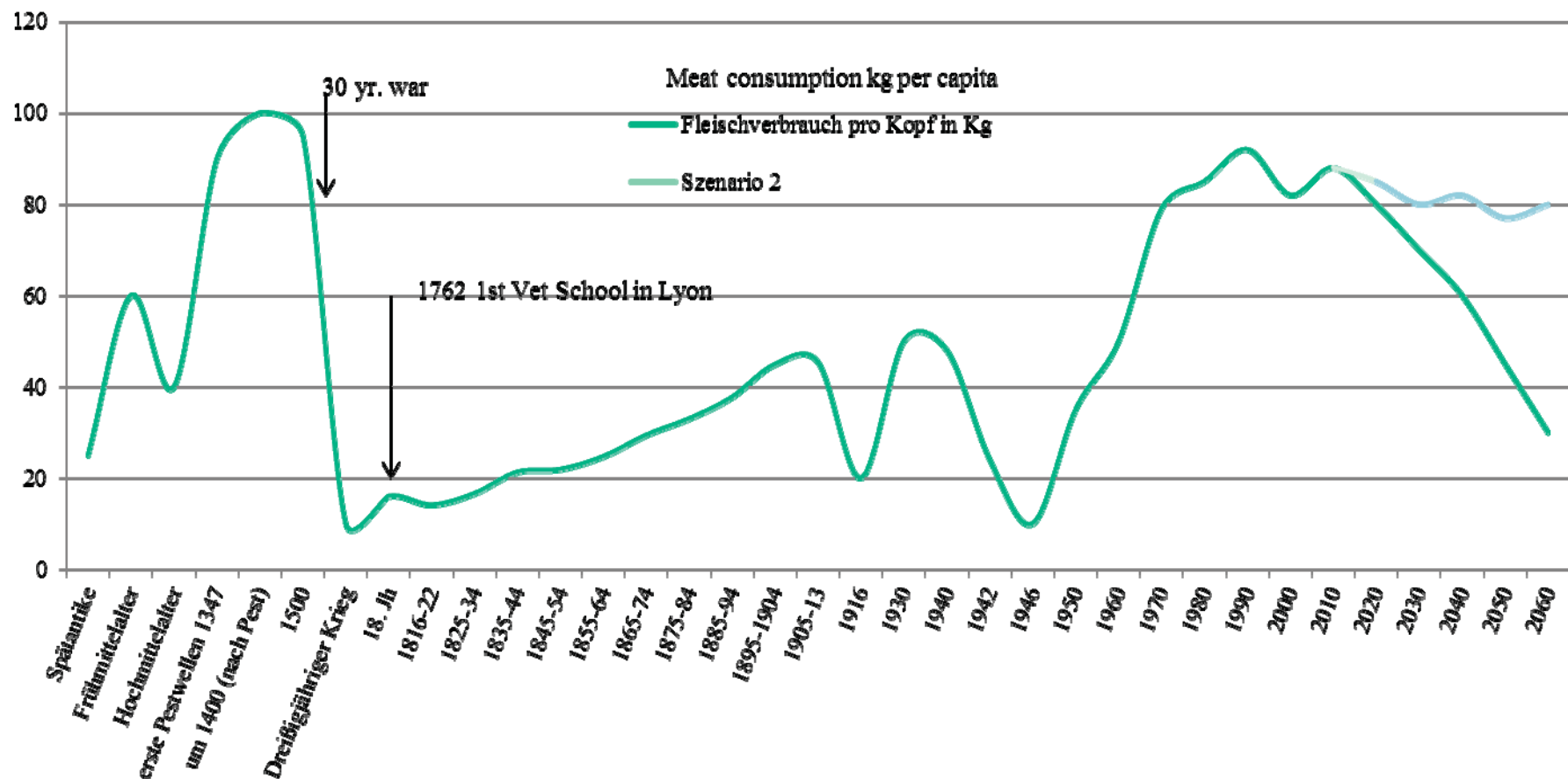
Development of meat consumption in kg per capita in Central Europe from Late Antiquity to today and beyond

(Hirschberger 2014)

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Meat Consumption (mio t) worldwide 1995 – 2030 estimated in developed (green) and developing countries (blue) (from FAO, 2015)
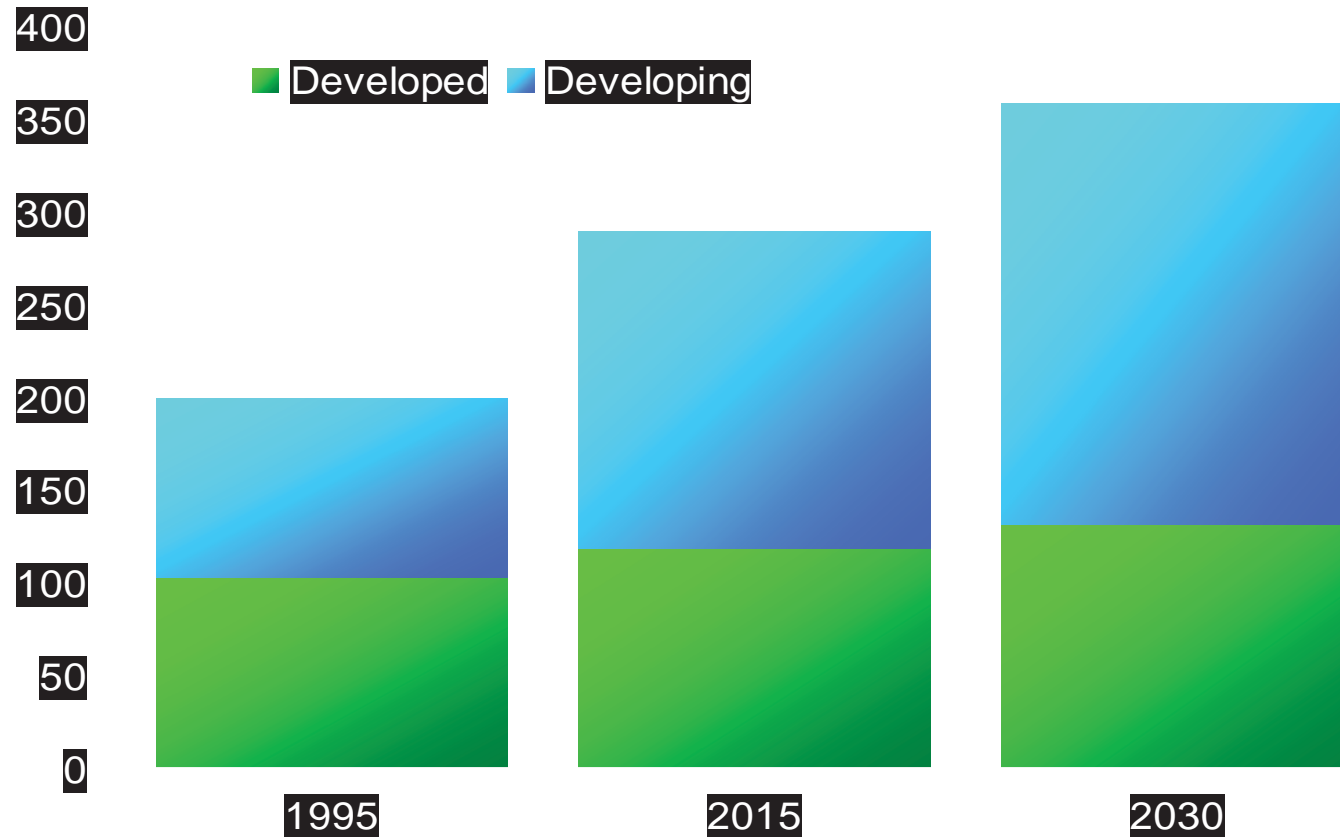
Challenges of animal Production today

Animal Production today is driven by <u>Economic Pressures</u> and <u>Expectations and Demands</u> of the society (citizen) and the consumer:
.

1. Food Security. (9.6 billion people in 2050. Food supply gap is closing. FAO, 2014)
Of increasing importance are the demands for:

2. Food safety, quality and diversity (consumer).

3. Affordable food, low prices (consumer).

4. Protection of environment and residents (public).

5. Animal Health and Welfare (public, consumer acceptance).

ethical, social, sustainable

The voice of the farmer is not much heard in this debate.

Introduction to the interviews

21 farmers/managers in 10 EU member states were interviewed about PLF technology installed in their farms. The farmers were asked by personal free format interviews face to face on their farms. (WP4, Task 4.1).

Aim:

The interviews and farm visits should give some insight in the attitude and opinion of the farmers on PLF technologies, advantages and problems of PLF in practice and should be used to inform strategy development for market entry of PLF technology. In spite of the limited number of nine pig, five broiler and seven dairy farms the answers can be helpful to identify chances, gaps and deficiency.

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COUNTRIES	No of VISITS	ANIMAL TYPE	PLF EQUIPMENT
The Netherlands (NL)	2 visits	2 piggery = 4 1 broiler barn = 2	sound, eYeN sound, eYeN
UK - N-Ireland	1 visit	1 piggery = 1	sound, eYeN
Hungary (Fadd)	2 visits	1 piggery = 2	Sound, eYeN, PLFagritec (NH3, dust, weight)
UK – England	2 visits	1 Broiler = 2	sound, eYeN, RVC dust, NH3
UK - England	2 visits	1 Broiler = 2	sound, eYeN (No access limited)
UK - England	1 visit	1 piggery = 1	sound, eYeN
FRANCE (Brest)	2 visits	1 piggery = 2	sound, eYeN
ITALY	2 visits	1 piggery = 2 1 broiler = 2	sound, eYeN sound, eYeN
SPAIN	2 visits	2 piggeries = 4 1 broiler = 2	sound, eYeN, PLFagritec, weight, dust, NH3

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COUNTRIES	No of VISITS	ANIMAL TYPE	PLF EQUIPMENT
The Netherlands (NL)	1 visit	2 dairy farms = 2	Cow view
Germany (D)	1 visit	3 dairy farms = 3	Cow view
Sweden (S)	1 visit	1 dairy farm = 1	Cow view
Denmark (DK)	1 visit	1 dairy farm = 1	Cow view

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Examples of Questions

1: How familiar are you with the term PLF? (2014 and 2016)

2: Why did you decide for this technology?

3: What are the positives associated with this technology?

4: What are the negatives, risks and uncertainties associated with PLF technology?

5: Do you expect to have more time for social life?

6: What market conditions impact on your livestock production the most?

7: In your experience, where do you see most advantages for your animals using PLF?

8: What is stressing you most, time pressure or your financial situation?

9: How would you rank your farm production?

10: Is animal welfare relevant for you and why?

11: Can PLF technologies improve consumer acceptance/satisfaction of current livestock practices?

13: Can PLF replace the farmer in the barn?

14: How do you see the future of animal Production in Europe?

15: What do you would like to improve on your farm in the future?

16: Would you employ a paid service to run your PLF system?

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Conclusions

1. Most important production factors are feed price (60-70%), energy, labor, environmental restrictions.
2. Decision for PLF because of novelty, offer and new opportunities.
3. However, farmers are cautious to buy PLF technology unless benefits are proven and convincing. In the project most farmers got instruments for free or little costs. Does the investment pays back? Not only price also maintenance is important.
4. Farmers are open for change but need objective help (training on site, qualified services!) to be able to run new systems.
5. In 2014 only a few farmers were familiar with the term PLF.
   In 2016 only one said he is not or only little familiar with PLF.
6. Those who had already positive experience with PLF technologies are more in favour of it than others.
7. All of the interviewed farmers saw PLF now as a promising Evolution. "Since I monitor I understand my animals much better".

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Conclusions

8. Negative associations with PLF were high prices, too complicated operation and slow maintenance service. Unsure about benefits.

9. Nearly all farmers (except one) said that it is very important to see the animals directly and not only by video. They are concerned to pay not sufficient attention to the animals, loose contact. This applies more for pig and dairy cows than for poultry farmers.

10. The attitude towards animal welfare was always positive. The farmers understand welfare and health as important factors of their production. These factors determine very much productivity and income. However, they made clear that welfare measures without regard of economy are unrealistic.

11. Farmers opinion on the future of animal farming in EU varied considerably. They all hope for better conditions but are afraid of welfare movements and environmental concerns in the society.

Conclusions

12 All farms called their financial situation "sound" or normal. Nearly all farms produced above their country average level. They are prepared to invest but many farmers are afraid that the market does not pay their investments back.

13. A strong drawback and disappointment was that many farmers had no access to the data, "all is with the company". They did not see the results as their own figures. They must be able to interpret their data – or use a qualified service.

14. Most farmers want to understand and interpret their data. Decision is taken by the farmer not the computer.

15. Several farmers strongly recommend Demonstration Farms! In such farms farmers and public can learn how PLF works. Training courses are required.

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Conclusions

16. Some PLF systems delivered unrealistic figures. Such instruments are not only useless they damage also the trust in PLF systems. It is important that the industry delivers fully functional and durable systems.
17. Farmers are afraid that the market does not pay their investment back.

18. Farmers want to get early warnings on their mobile phones plus computer.
19. Service system: Farmers were interested in the service system (basic, standard, plus) which was offered. However, basic is in most farms already. Standard is partly offered by consultants of feed companies. For the Standard and Plus offer they are prepared to pay up to about 10% of the profits (some broiler farms) for data processing service – when it is really working.

Remark: We have to keep in mind that a selection of interested and advanced farmers was interviewed which may not be the "average farmer" in the respective country and the answers cannot be generalized based on this small number without care.

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Recommendations

1. It must be better demonstrated that PLF benefits the animals, the farmer, the consumer, the environment and saves resources.

2. Demonstration farms can serve as "lighthouses" to promote PLF.

3. Reliability of instrumentation is crucial.

4. Training on site, farmer must be able to run and repair the systems in case of default and / or qualified services must be provided.

5. PLF is a support system for the farmer. He takes the decision.

6. Ownership of data. Farmers should own his data. That improves his identification with the technology and his data.

7. PLF is for most farmers the way to a new and animal friendly New Age in animal farming.

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EU-PLF: Smart Farming for Europe

Main messages from farmers:
1.Talk to the farmers
2. Listen to the farmers
3. Support the farmers

Keep in mind:
"The truth is in the pitch"
This is not only true for football.
That is even more true for animal farming.

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EU-PLF: Smart Farming for Europe

Acknowledgement

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Finally: PLF has a bright future:

Thank you for your attention

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How PLF Technologies Have Created a New Business Model

David Speller

EU-PLF Closing conference

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So Who Are We?

- Initially a Broiler Farming Business (2014 -)
- Owner Farmer but contract manage 10 other sites as well
- Daily monitoring / Consultancy on further farms
- Covering 3,000,000 birds/ cycle producing around 20 million birds per annum to market
- Current plans manage beyond 3.5m birds in 2017
- Offer a range of contracting services as required
- Currently employing 50+ people, increasing at about 1 person/ month

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The Team

PLF Technologies Installed

- Eyenamics – behaviour monitoring
- Auto scales – bird weights
- Feed & Water registration
- CCTV
- Microphones
- Environmental monitoring, CO_2, RH%, Temp, etc

Smart Farming for Europe
Value creation through Precison Livestock Farming
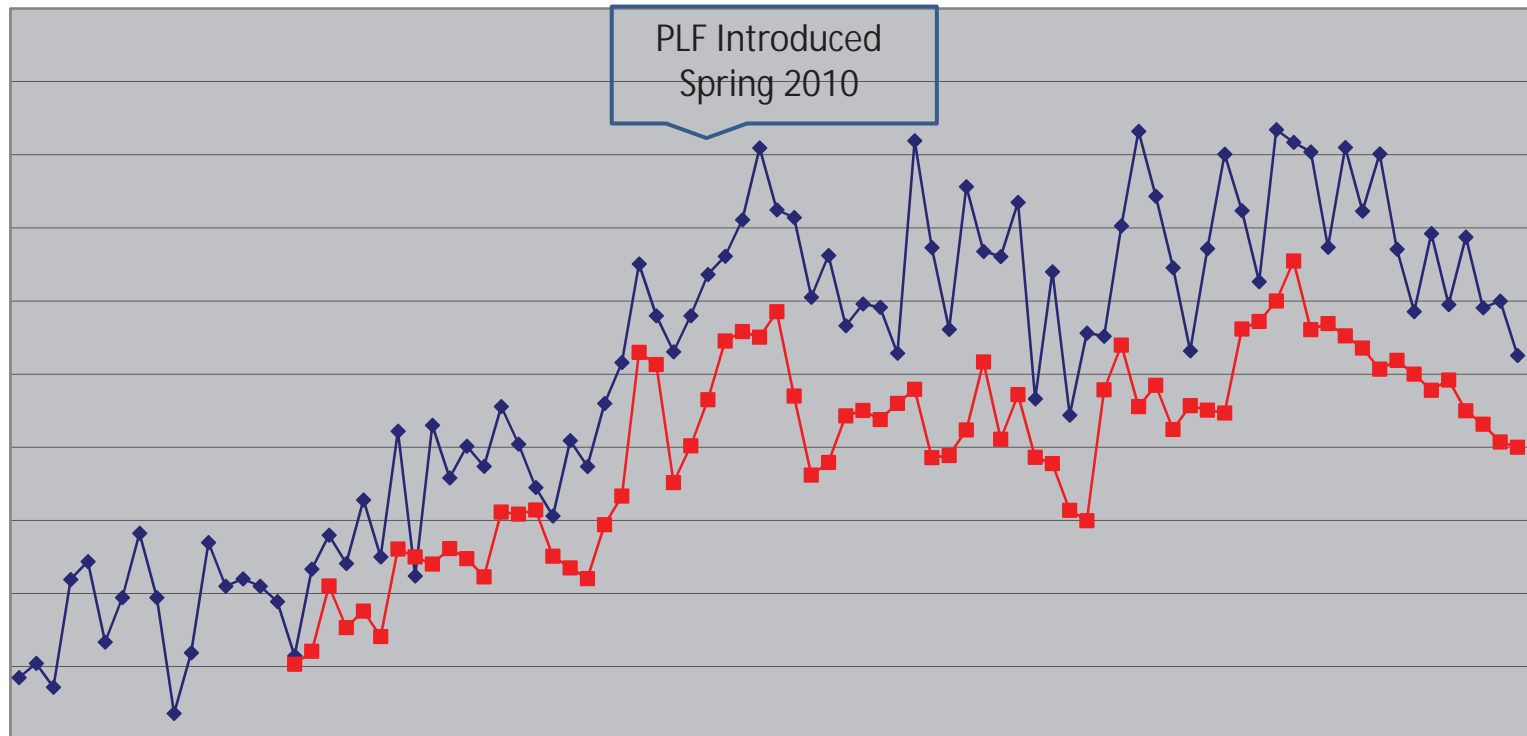
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Experiences

- The more innovative the technology the more teething problems you will have
- Expect more questions than answers from the data
- We still have to get the regular farming methods right as well
- Agriculture can be slow to accept new ideas

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Has it Paid For Itself?

PLF Introduced
Spring 2010

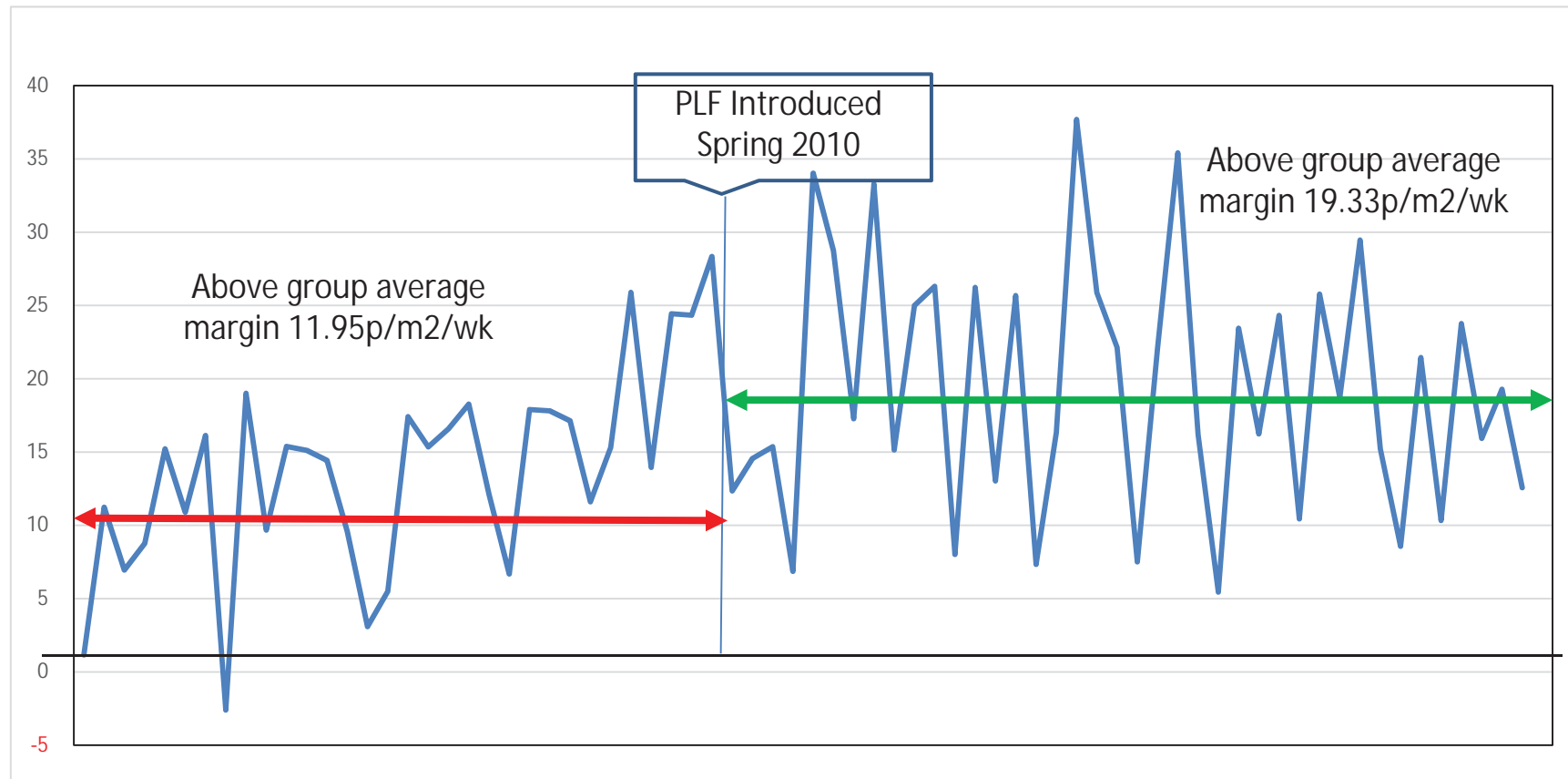**Smart Farming for Europe**

Value creation through **P**recison **L**ivestock **F**arming

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Increased Margin (Over 6 years +240,000 Euros)

PLF Introduced Spring 2010

Above group average margin 11.95p/m2/wk

Above group average margin 19.33p/m2/wk

Smart Farming for Europe
*Value creation through **P**recison **L**ivestock **F**arming*

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Applications & Improvements

- Look to integrate with whole supply chain not just on farm (hatcheries, mills, factories).

- Consider developments in other sectors that can be moved into agriculture rather than looking to develop bespoke technologies

- Start to use PLF for human monitoring and biosecurity as well as bird monitoring

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Tips for Others

- Initially only spend on sensors to give you the data you want

- Ensure you look at the data and make decisions based on it

- Don't be put off by the potential to spend significant funds initially – you don't have to

- Expect your investment to continue as more sensors are developed

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Creating Value From PLF

- Predictive modelling of birds performance
- Driving forward performance and welfare
- True on farm in house trials
- Centralised monitoring of multiple sites
- Allowing for alternative staff recruitment

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Value creation through Precison Livestock Farming

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Creating Value - New Service Developed

OPTIFarm

- Remote site monitoring and optimisation.
- An initial service allows monitoring of farm parameters and environmental optimisation
- Second level introduces bird optimisation, water, feed, bird weight management, light management, etc.
- Third level introduces bird behavioural management, Eyenamic, etc
- A 4th service introduces future innovation into a business

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Sites Managed/ Monitored

In Discussions With Australia & Peru

Smart Farming for Europe
*Value creation through **Precison** **Livestock** **Farming***

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A Farmer's Testimony
(Pig farmer)

Mr John Verhoijsen

Table of content

- Who am I?
- EU PLF sensors on my farm
- My experiences with PLF
- Tips for new adaptors
- Improvements to current systems
- Application field of PLF
- Added value of PLF

Smart Farming for Europe
Value creation through Precison Livestock Farming

EU - PLF

EU Grant Agreement no.: 311825

Introduction

- Family farm Verhoijsen
- Mixed Pig and Poultry farm
  - Semi closed farm
  - 3 locations
  - 1300 Sows
  - 7000 Fattening pigs (building in progress 3800 pigs)
  - 63000 Broilers chickens

Home location
Sows + broilers

2nd location
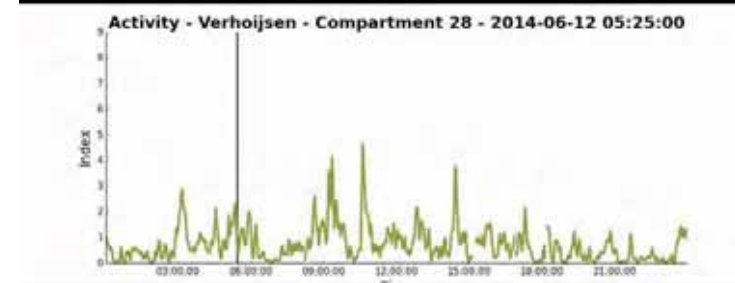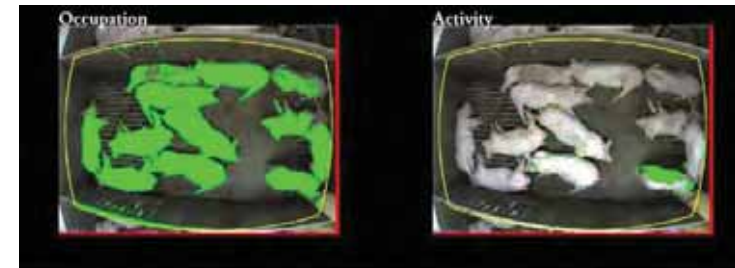Fattening pigs

Smart Farming for Europe
Value creation through Precison Livestock Farming

EU - PLF

EU Grant Agreement no.: 311825

Introduction

- PLF sensors on farm
  - eYeNamic (Behaviour)
  - PCM   (Health)
  - eYeScan   (Weight)
  - Feed
  - Water
  - Climate

Benefits

- PLF are tools to develop insight in:
  - **Daily growth performance**
  - Animal behaviour
  - Animal health
- Automation and PLF give me a peace of mind
  - **24/7 alertness on farm**
- Control external factors
  - Limit the effect of the daily temperature changes
    - Climate Management per compartment → drill-down
    - Confidence in equipment
- Data logging → simple to look back

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PLF gained more interest in community

FINISHERS

Accurate data gives confidence to pig farmers

Precision agriculture is moving ahead very rapidly. Automatic data acquisition on an individual level...

Special editions published by PIG PROGRESS

FUTURIS 4 months ago

Big farmer is watching! Surveillance technology monitors animal wellbeing

last updated: 09/05/2016

Humans have long been under CCTV surveillance, but now chickens and pigs are being watched too

Pluimveeweb.nl

Vleeskuikens | Leghennen | Symposium | Thema-avond

Pluimveeweb.nl / Pluimvee columns / Marcel Kuijpers / Big data, zegening of gevaar?

Big data analyse, zegening of gevaar?

dinsdag 26 juli 2016
aangepast: woensdag 27 juli 2016

Big data zijn hot! Het aantal publicaties, gesprekken en bijeenkomsten over dit onderwerp dat ik in de afgelopen periode heb bijgewoond is bijna niet te tellen.

Pigs | Broilers | Layers | Mushrooms

How we use data to make better decisions

Smart Farming for Europe

Value creation through Precison Livestock Farming

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Current disadvantages

- Not always plug-and-play
    - I don't trust the new systems yet
    - Not ready for the big market
- Not accurate enough (for 100% trust)
    - Don't need to be 100% accurate, but 100% reliable!
- It is hard to get a complete overview
    - Need for one integrated system
- No feeling for data, but for animals

Farm extension: new pig house

- Will there be PLF-technology? **No**(t yet)
  - Water, feed and climate control are a must
  - EUPLF sensors have not provided me added value; we did not experience problems that these sensors could pick up (e.g. coughs)
  - Financial break-even point not visible for PLF technology
  - I am not an early adaptor: new technologies first have to prove their value!
  - Not enough trust in the current systems
  - PLF sensors → only detection; not a solution
    - Staff member can do both detection and provide solution
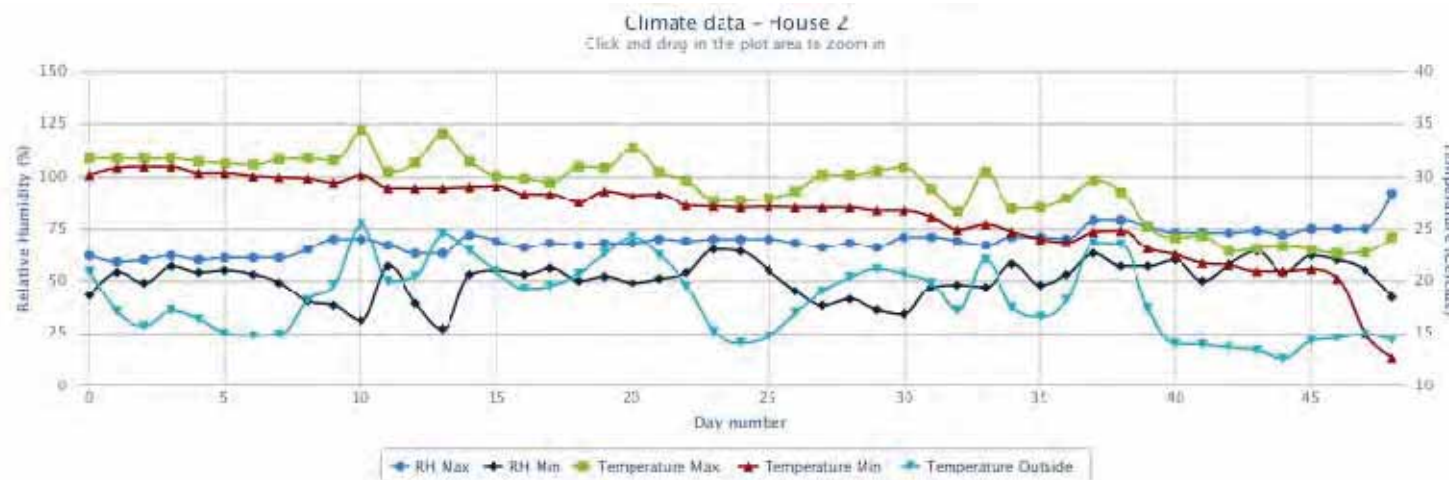
Smart Farming for Europe
Value creation through **P***recison* **L***ivestock* **F***arming*

EU - PLF

Points for improvement

- Simplicity of PLF-systems
- Reliability of the systems
- Standardization of the output
  - Data → information

Climate data – House 2
Click and drag in the plot area to zoom in

Tips

- Invest time to learn the PLF-systems

- Staff needs the correct competences
  - Animal caretaker
  - Data scientist
  - Electrician
  - Engineer
  - Business Intelligence

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Value creation through Precison Livestock Farming

EU - PLF

EU Grant Agreement no.: 311825

Application of PLF

- Better monitoring of animal health
  - Improve climate control and reduce effects of unexpected events
  - Optimise feed supply, feed composition and feed quality
  - Optimise growth performance
- Visualisation of pig quality
  - Monitoring of farm staff

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Value creation through Precison Livestock Farming

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Added value of PLF

- Look back and improve
- Optimise farm strategy and vision at operational level
- Being more conscious about
  - Feed
  - Climate
  - Growth performance
  - Pig weight distributions
  - ➔ Finding answers to many unresolved questions

Smart Farming for Europe
Value creation through Precison Livestock Farming

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Added value of PLF

- Need for individual attention
  - "You don't grow 1000 pigs, but a thousand times 1 pig"
- The continuity of the farm is top priority
  - Being competitive → scaling up
  - PLF is the next step

Smart Farming for Europe
Value creation through *Precison Livestock Farming*

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Added value of PLF

- More attractive for social life
  - Other way of time management
  - More time for others (or more animals)
  - Fixed working times (9 to 17) possible
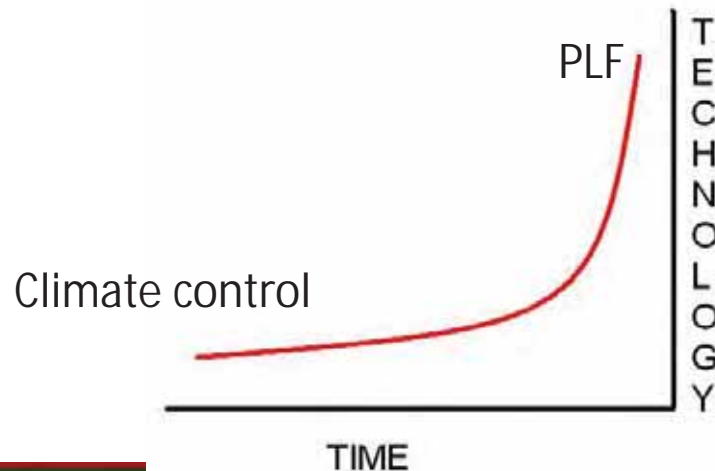   - More attractive for staff

Smart Farming for Europe
Value creation through **P**recison **L**ivestock **F**arming

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Conclusion

- The EUPLF project made me more conscious about the processes on my farm
- I am not ready for PLF / PLF is not ready for me
- But I am convinced of the potential of PLF

Smart Farming for Europe

Value creation through Precison Livestock Farming

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A Farmer's Testimony (Dairy Farming)
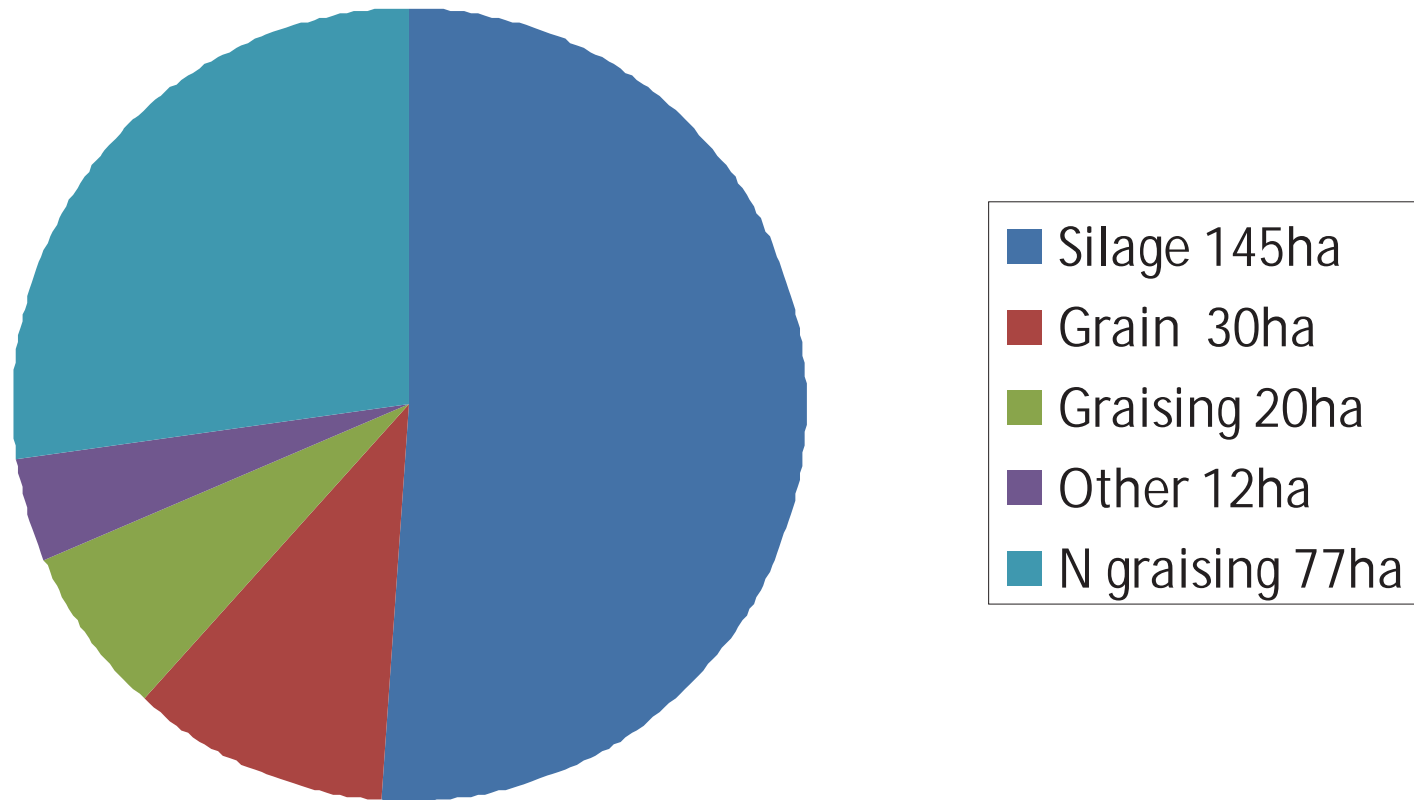
Mrs. Tina Dahl

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Value creation through Precison Livestock Farming

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Acreage 284 ha

- Silage 145ha
- Grain 30ha
- Graising 20ha
- Other 12ha
- N graising 77ha

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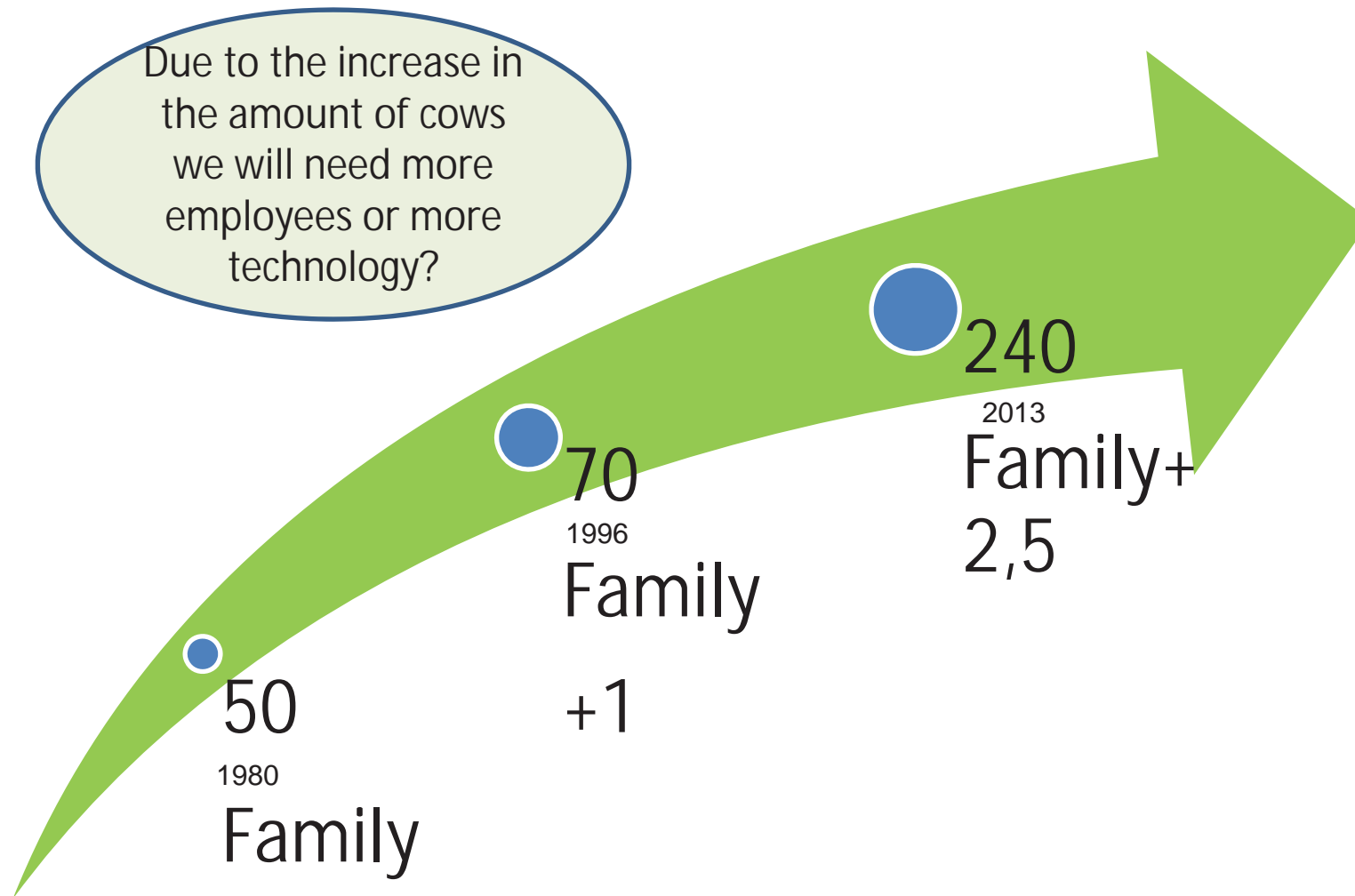**Smart Farming for Europe**

Value creation through **P**recison **L**ivestock **F**arming

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Smart Farming for Europe

*Value creation through **P**recison **L**ivestock **F**arming*

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Risk multiplot: 966

Before and after Cowview
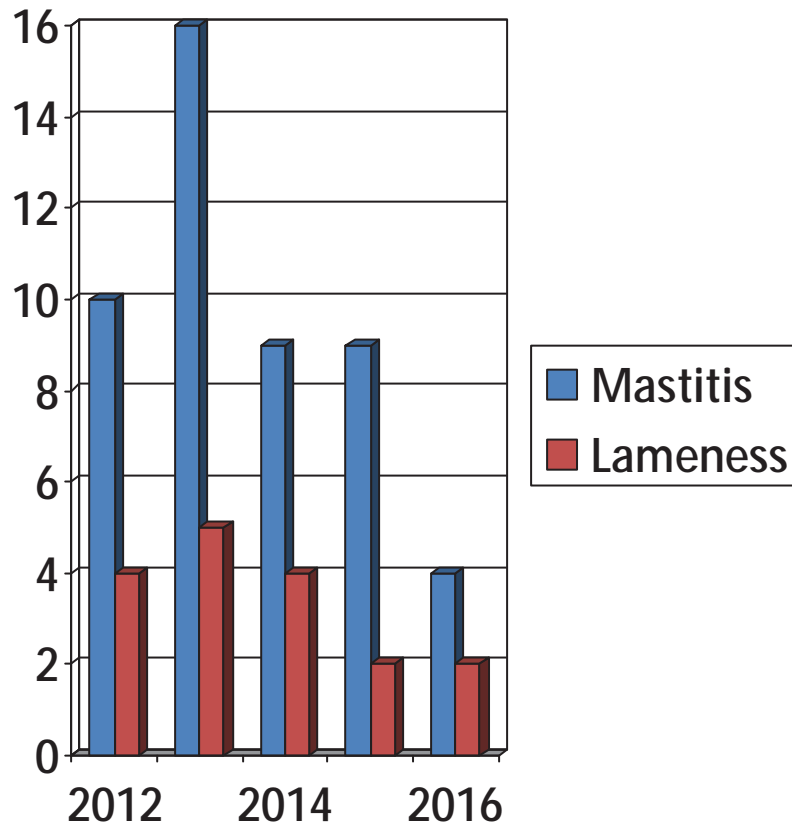
- The amount of actions per 100 cows

- Early detection means less antibiotics, lower costs and better animal welfare

TODAY
The Use of Cowview

- To find cows late for milking

- To detect cows in heat

- To find cows with low activity

- To supervise behavior that are different from normal

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Dreams and Wishes

- Faster updating and continuously
- More integration with Farm-Management
- More direct information from the Robot
- Updating with Farm-Management continuously
- Integration with the whole Feeding System

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How to implement Precision livestock Farming into Practice ?

Jean-Louis Peyraud

President of Animal Task Force

Precision Livestock Farming...   promises ?

- More efficient use of resources

- Reduction of harmful emissions per unit of product

- Reduction of drugs use through early detection of pathology

- Reduction of workload and work painful through automation

- Management of animal welfare

- Automatic control of product quality (sanitary, nutritive, technology)

- Complete traceability of livestock through the food chain

What is PLF ?
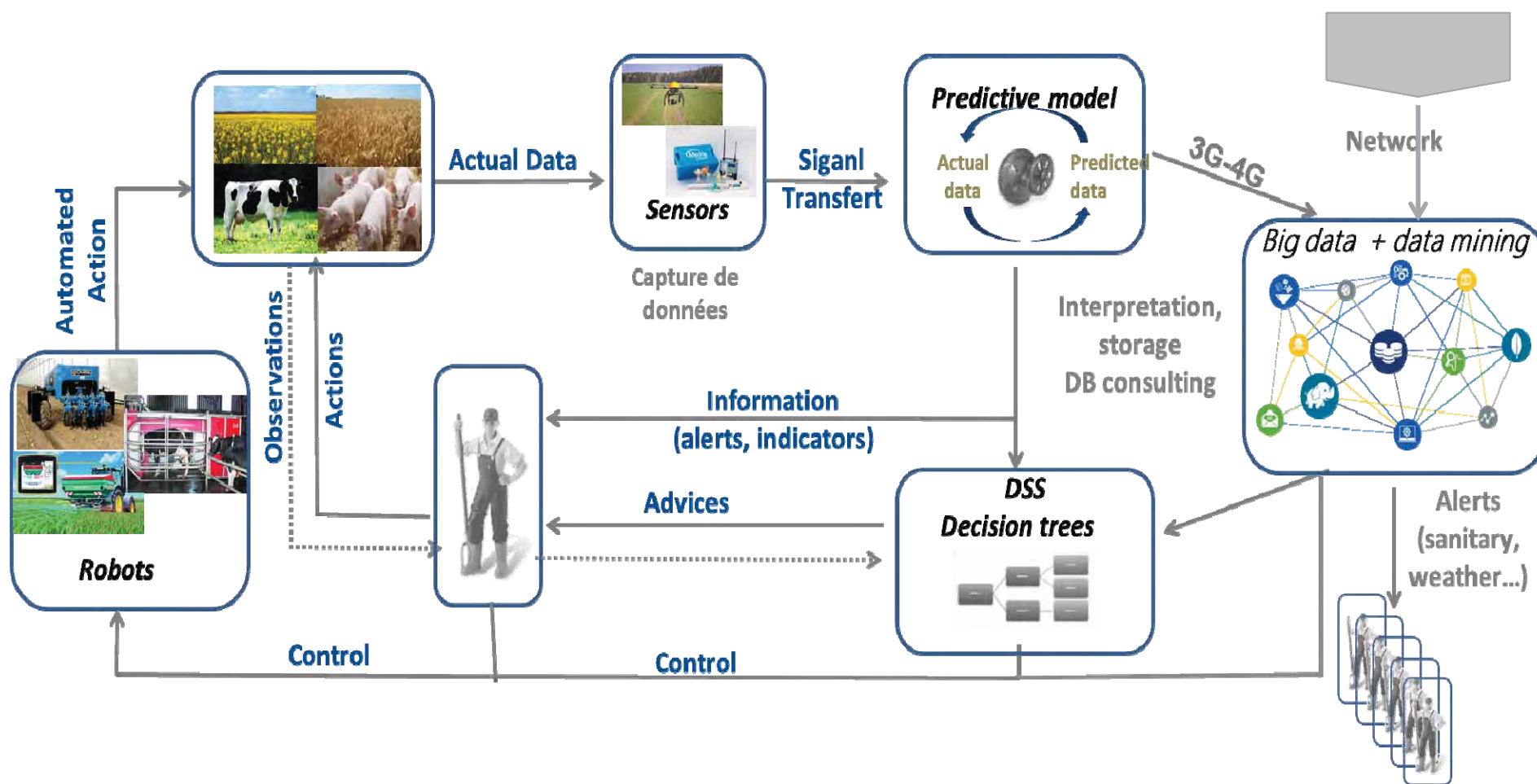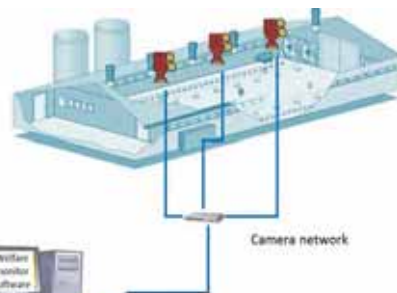
What is Precision Livestock Farming?

atf

a n i m a l
t a s k
f o r c e

A European Public-Private Platform

Some examples from EU-PLF projects

EU - PLF

Farm manager dashboard

Camera network

Autograssmilk

ATF vision

ATF Seminars: How to implement PLF in practice

ATF-EAAP special session, Aug. 31th 2015, Warsaw

ATF Seminar, Nov. 17th 2015, Brussels

- How could supply and demand influence the development of PLF, how could research contribute?

- Where are the gaps of innovation (High tech, big data, Farm and food chain management)?

highlighted most important topics on which ATF can work further

EIP Focus group: Mainstreaming precision farming

EIP-AGRI Focus Group
Precision Farming
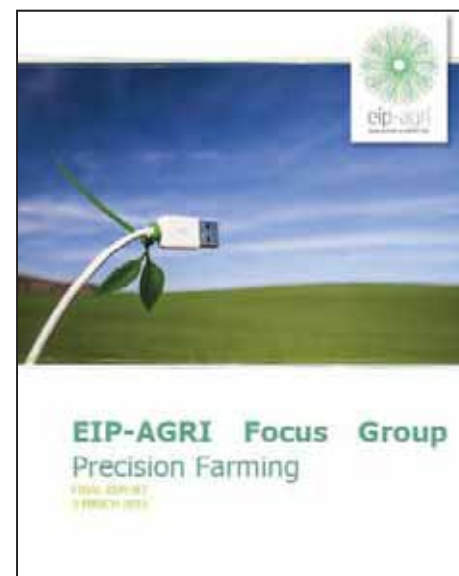
- How to organise the data capture and processing to mainstream the application of precision farming for an optimisation of inputs and yield?
- Identify the main reasons behind the current lack of adoption, and identify the key barriers to the implementation of Precision Farming on European farms

PLF: a key element for smarter farming, competitive breeding and value chain

Telemetrics

Metabolics

Robotics

Genomics

Biometrics

Phenotypics

ICT
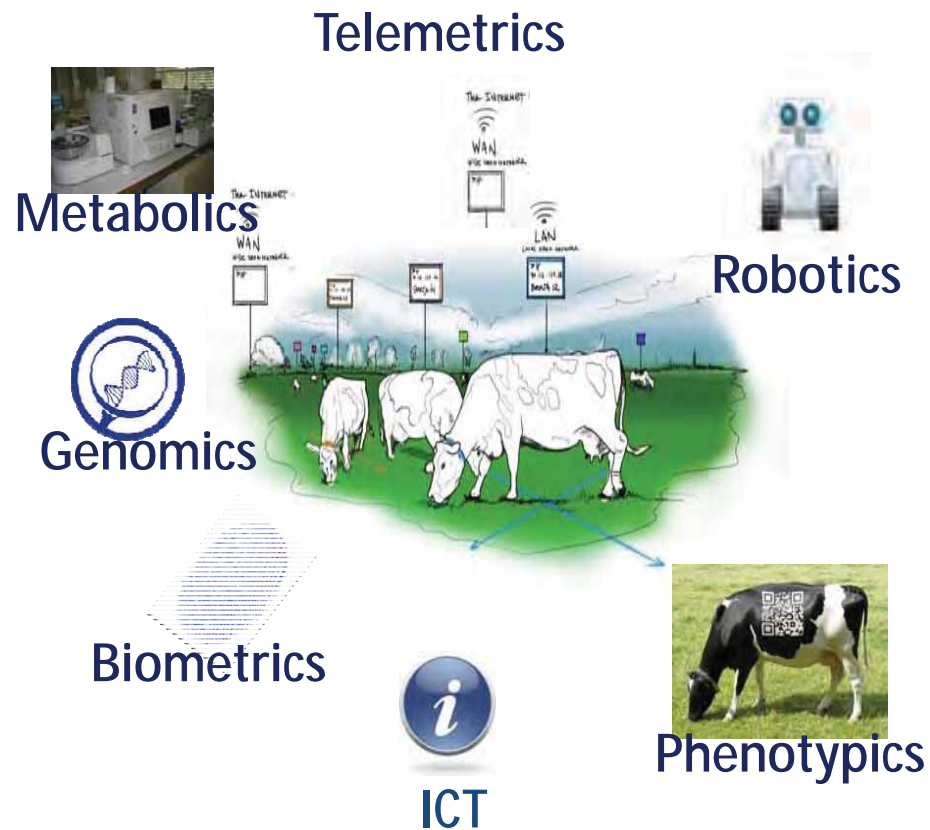
- **Numerous domains**
  - Feeding
  - Health & welfare
  - Housing systems
  - Breeding
  - Agri technology
  - Traceability

- **Big Data management**
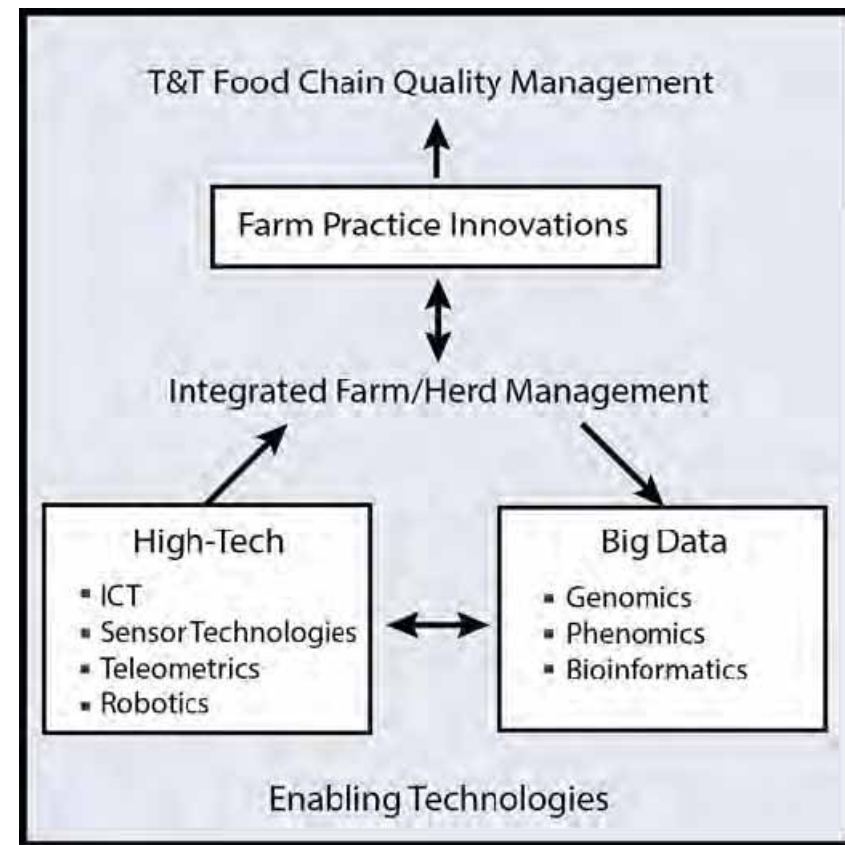
...TO CREATE VALUE FOR FARMERS

How to implement PLF

- A platform to link Big Data, High Tech, Farm practices innovations and T&T food chain quality management

  > Multi-users, Multi-disciplinarity International, Multi-sectoral

- At the moment PLF is restricted to Engineering. The goal is to connect this part with the 2 others.

  > Operational Groups, Living Labs, H2020 Projects...

Home messages (1)

- Conditions of success : how to create value for farmers
  - The added value for farmers (advisory services, food chain) should be tested, validated and demonstrated in practice
    - Field assessment experiments, Modelling, learn from others
    - Appropriate tools for cost-benefits analysis
  - Solutions need to be integrated into farm management systems
    - Multi inputs – multi outputs systems, inter operability
  - Involvement of farmers in development of tools & training farmers are essential to ensure clear benefits
  - New business models for open data management and use

Home messages (2)

- **Some technical problems to be solved**
  - **Sensors and data acquisition:**
    Bio/smart sensors, IoT to facilitate machine-processor communication (context-aware approaches for sensors…), interoperability
  - **Information systems** (sensors, IoT, crowd sourcing, web): make data retrievable, accessible, interoperable and re-usable (computer science), innovative management tools for big data
- **Consider geographic, socio-economic and farming systems variability across Europe**
  - **Increase efficiency vs collaborative digital tools**
  - **Digital inequalities** (access to internet, 3/4G networks…)

Home messages (3)

- **Questions cannot be reduced to technological developments**
  - **Digital tools must be adapted to the actors' needs** (co-construction):
    - LPF innovation renews the research process
    - Collaboration between researchers, advisory bodies, farmers & stakeholders
  - **Deep change in farmers' working conditions**
    - Managerial innovation, new relation with digital providers
    - Interaction with animals
  - **Legal issue related to intellectual ownership**: collection, analysis, sharing of data and related information
  - **Technology development will stimulate interactive innovation**
  - **Societal acceptance of new technologies**

What's next? ATF White paper

- **A topic: Precise management of animals**
  - Innovative sensors and intelligent models to monitor efficiency, health and welfare
  - Adaptation of PLF to nature based systems
  - Evaluation of social consequences of the implementation of PLF

- **A cross cutting issue: PLF**
  - Development of automated data sampling and analysis
  - Development of ICT/infrastucture to promote data exchange
  - Data driven research
  - Development of predictive biology approaches in PLF
  - New business models

For latest news and upcoming activities:
www.animaltaskforce.eu

- **ATF Scoping paper** *Aug. 2015*

- **ATF Blog on PLF**

- **ATF Position Paper 2016**

Thanks!

@AnimalTaskFrc

info@animaltaskforce.eu

EU-PLF: Bright Farm by Precision Livestock Farming

General conclusions

Daniel Berckmans

EU-PLF Closing conference

29 September 2016
Brussels, Belgium

Smart Farming for Europe

Value creation through Precison Livestock Farming

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Dissemination - Internationalization

4 Smart Sensors Workshops

2000: Silsoe
2002: Bremen
2004: Leuven
2006:
Gargnano

First Brazilian PLF conference in 2016

2003 European Committee of PLF

7 European PLF Conferences

First Asian PLF conference in 2016

APO workshop 2016 – Tokyo

Asian PLF conference organised by IRCAEW every 2 year

First PLF conference in 2017 in USA

Smart Farming for Europe
Value creation through Precison Livestock Farming

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Dissemination: EU-PLF project

- Published journal publications: 6
- Submitted journal publications: 9
- Submitted to internal review: 13
- Conference papers: 35
- Submitted conference papers: 5
- 48 invited keynotes in 16 countries
- 6 workshops/trainings with farmers: Copenhagen, Milan, Belfast, Brussel, Panningen 2x
- 50 news items on website and newsletters
- 2 TV news videos: Euronews, Arte
- 1 Video for World Expo
- 3 Videos for farmers
- 8 General publications
- EU-PLF Blueprint (farmers) and e-course (for scientists and others)

Smart Farming for Europe
Value creation through Precison Livestock Farming

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Dissemination material
EU-PLF Project

Conclusions (1)

- PLF Systems work in real farms, PLF technology will go

- PLF creates Big Data, they cannot all be stored

- Data are difficult to interpret, PLF = Tool

- Automated alarms need farmers' actions to create value!

5

Smart Farming for Europe
Value creation through Precison Livestock Farming

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Conclusions (2)

- Farmers need information and training

- Business models must be tested in the market

- Important role for farmers'organisations

- Real collaborations between research disiciplines are needed, + farmers and + industry!

THANK YOU TO EU-PLF FARMERS!

Thank you to all the EU-PLF farmers for allowing us to install the PLF technology in your farms during the project.

Thank you

- *for your contributions and discussions*
- *for your feedback on the PLF technology*
- *for your testimonies during the EU-PLF workshops*
- *for welcoming us to your farms*

EU-PLF FARMERS DURING THE WORKSHOP IN COPENHAGEN AUGUST 2014

EU-PLF FARMERS WHO GAVE TESTIMONIES DURING THE WORKSHOP IN MILAN SEPTEMBER 2015