

Big data in the livestock sector: Challenges and opportunities

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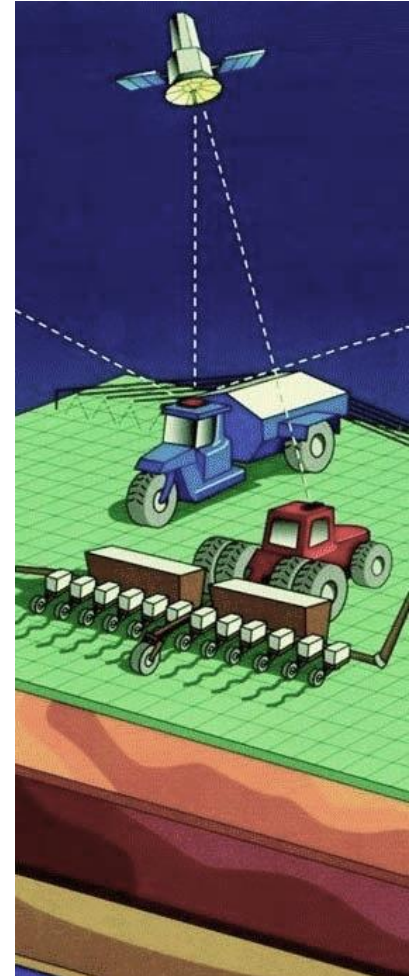


Outline

- Precision farming – from arable to livestock
- Precision dairy technologies
- On farm – from data to decisions
- Data beyond the farm
- Using sensor data in farm assurance and to engage the consumer
- Summary

Precision farming

- Precision farming:
 - Gathering and processing **information** to improve the **precision** of resource management
- Biggest impact so far has been in the **arable** sector
 - Rather than apply e.g. fertiliser at a standard rate
 - ... we map soil fertility levels and apply it only where it is needed



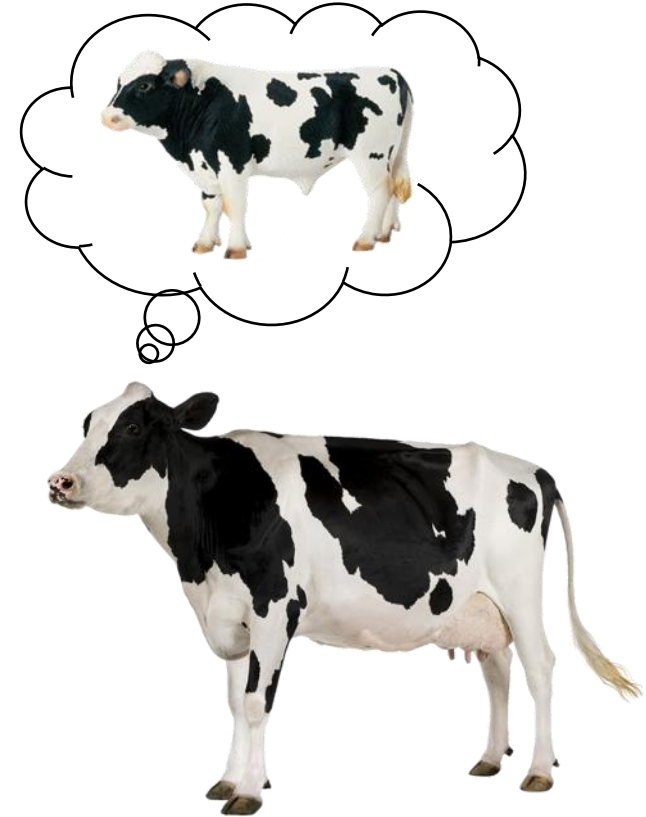
Precision Livestock Farming



- Livestock production has been **intensified** to help us control production (at the **group** level)
- **Precision livestock farming** (PLF) is changing this:
 - Gather data from **individual animals** so we can then manage them as individuals
 - Much closer monitoring and control
 - Aim is to improve the **efficiency** of resource use by only using them when and where needed
 - Greatest adoption is in intensive **dairy** production

Dairy at the PLF frontier

- The predominant use of artificial insemination (AI) in dairy systems requires reliable oestrus detection (a **'killer app'** for dairy)
- The lifetime production value of a dairy cow means there can be a **return on investment** in a reasonable time
- Dairy technology is arguably at the forefront of precision agriculture as it manages the biological unit i.e. the **individual animal**



EID and accelerometers

- Electronic identification (**EID**) is the core technology in PLF (also known as RFID)
- Allows identification of individual animals
- Passive tags are energised by the reader causing them to transmit their ID code



- Cheap triple-axis accelerometers have been developed for consumer electronics e.g. in smart phones and smart watches
- These are also revolutionizing the capture of animal behaviour data

Accelerometer-based sensors

Ear-mounted:

- Rumination
- Activity
- Calving?

e.g. SmartBow

In rumen bolus:

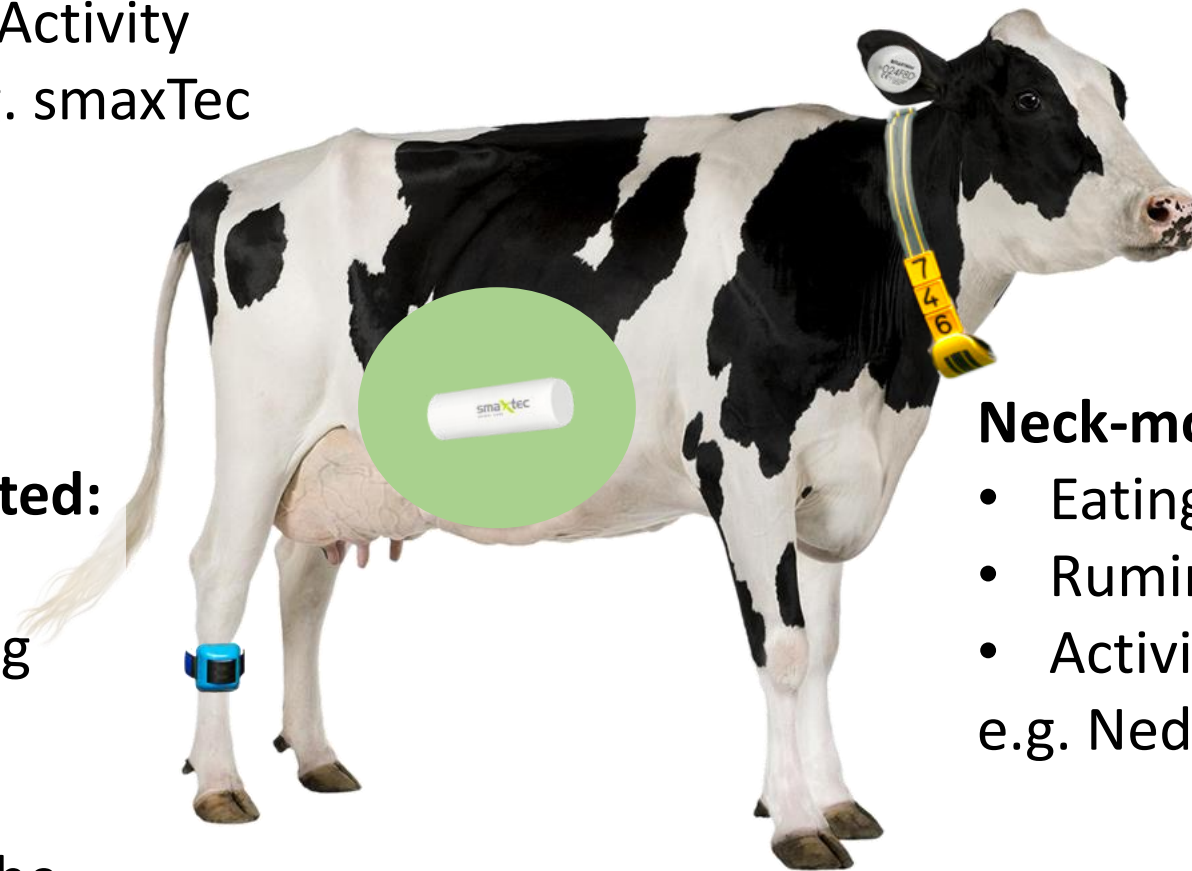
- Activity

e.g. smaxTec

Leg-mounted:

- Lying
- Standing
- Steps
- Activity

e.g. IceQube



Neck-mounted:

- Eating
- Rumination
- Activity

e.g. Nedap Neck

Sensors not to scale!

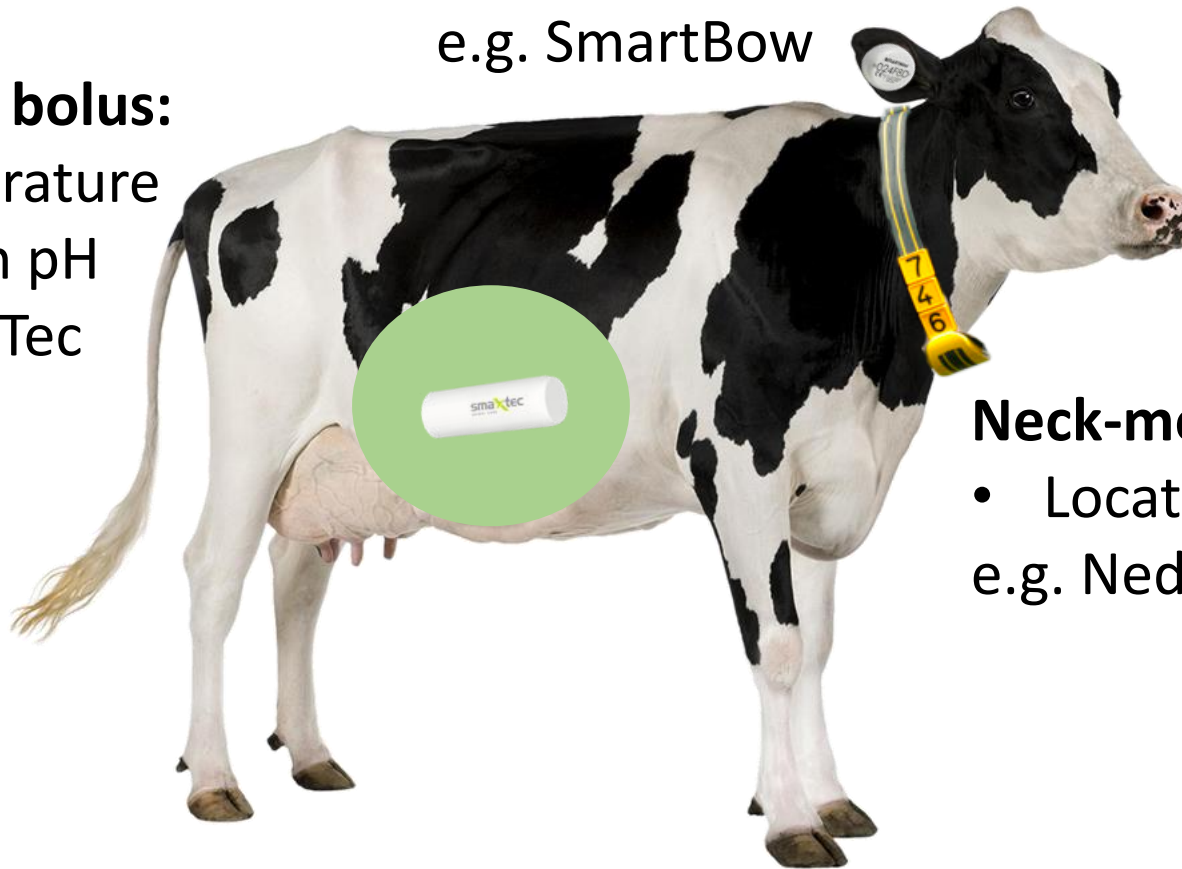
Other animal-mounted sensors

Ear-mounted:

- Location
 - Temperature
- e.g. SmartBow

In rumen bolus:

- Temperature
 - Rumen pH
- e.g. smaxTec



Neck-mounted:

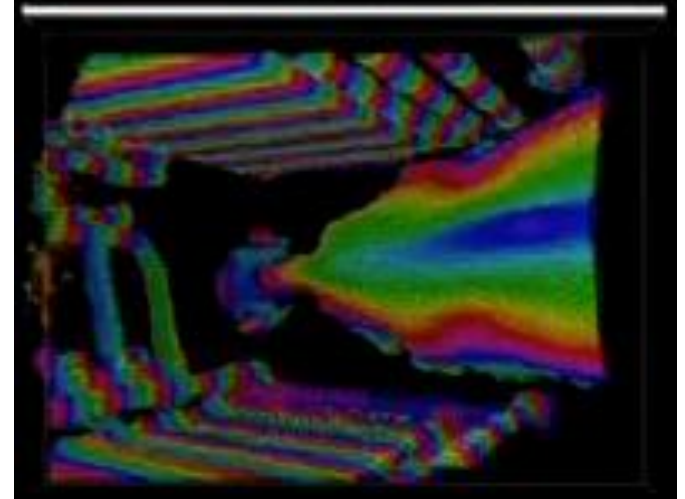
- Location
- e.g. Nedap Neck

Sensors not to scale!

'Static' sensors

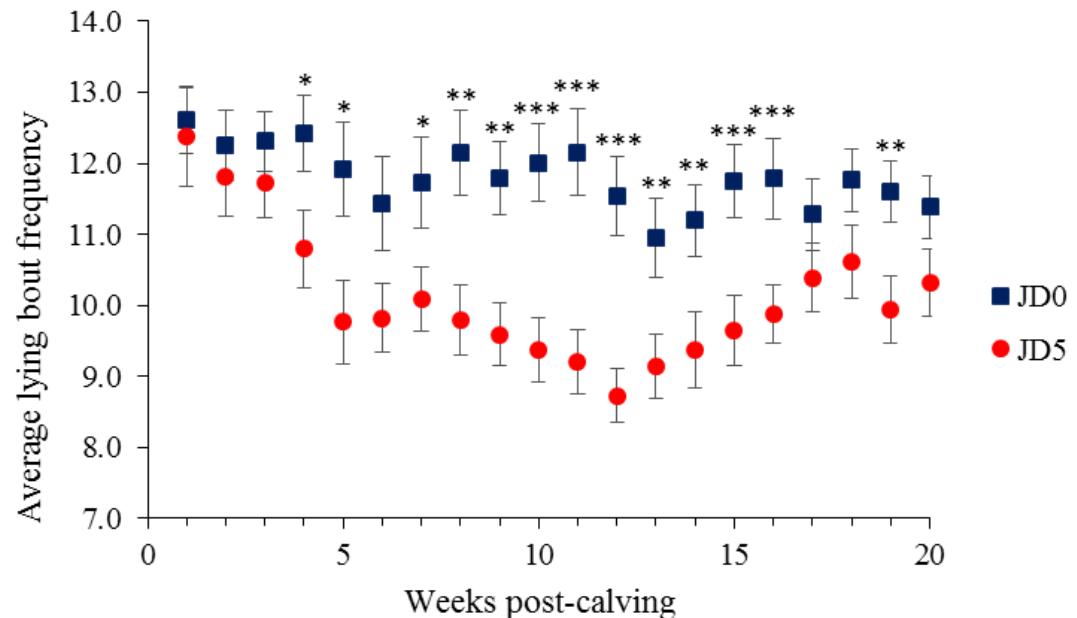


- EID and cameras can be used to automatically monitor animals that pass near them
- e.g. DeLaval uses a 3D camera to body condition score cows
- Can also combine EID with a weigh platform to automatically record animal liveweight

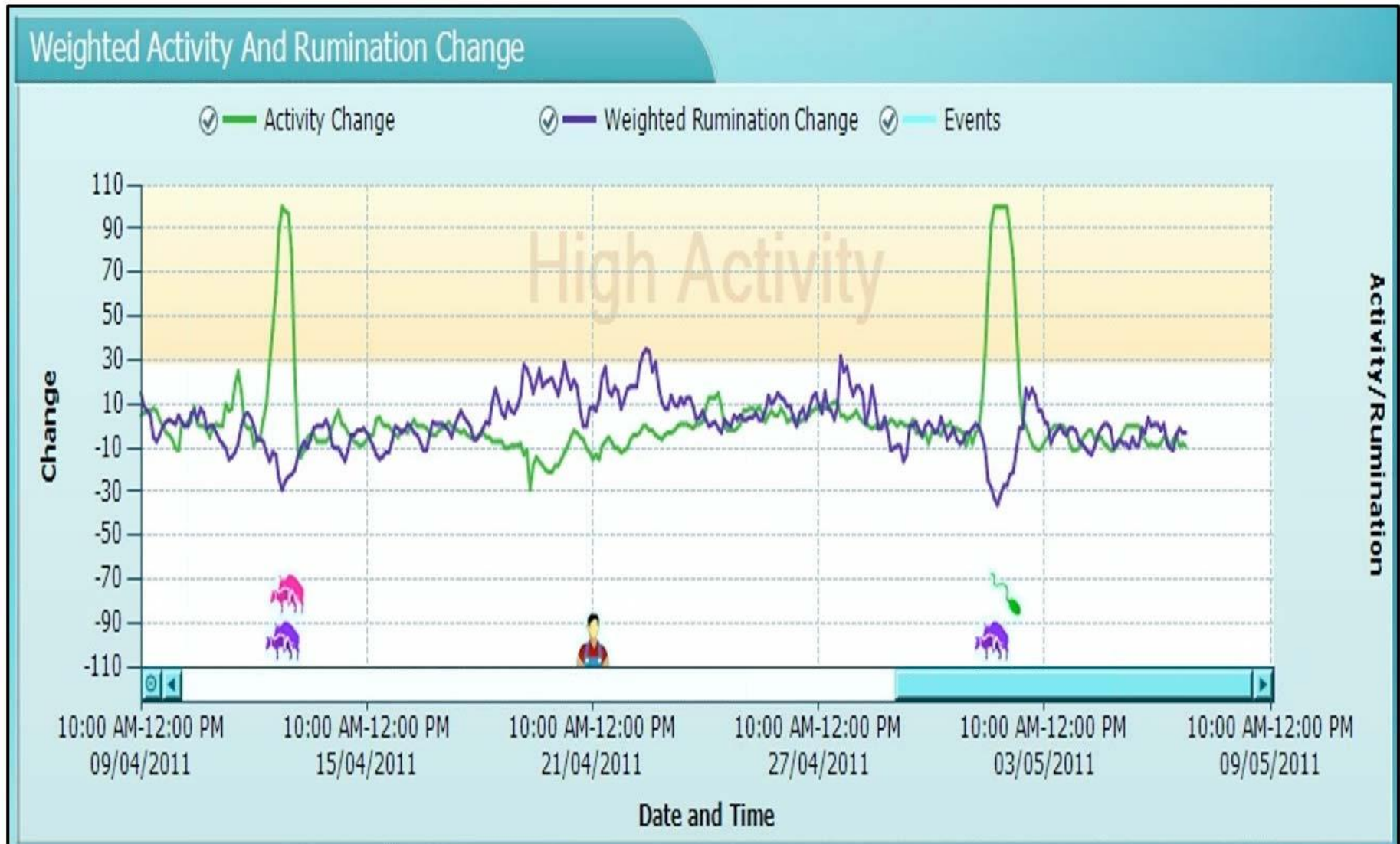


Health monitoring

- Just as animal behaviour changes during oestrus, it also changes when the animal is sick or injured
- Leg-mounted accelerometers (e.g. IceRobotics CowAlert) can detect the gait changes indicative of the early stages of lameness in cows
- Cows with Johne's disease spend less time and have fewer bouts of lying in peak lactation

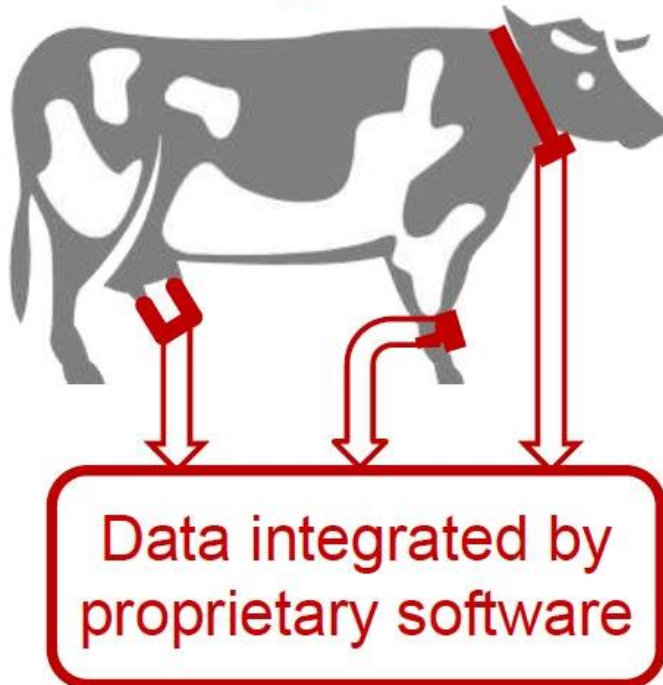


Data integration

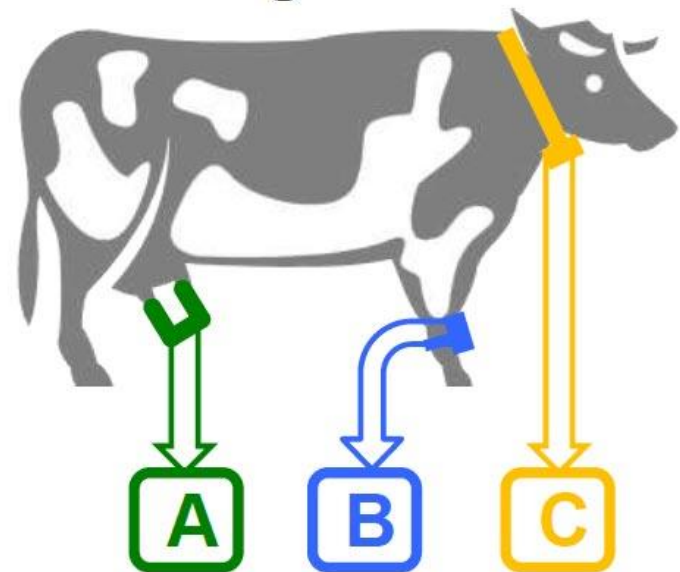


Data integration - now

Single manufacturer integration



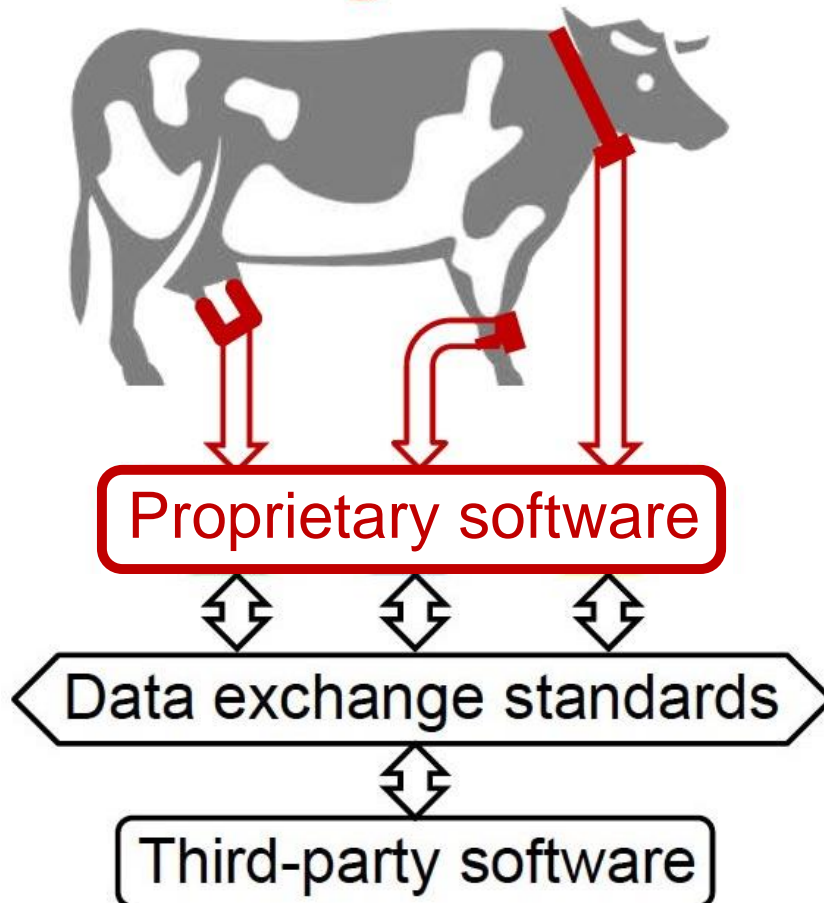
Multiple manufacturer integration?



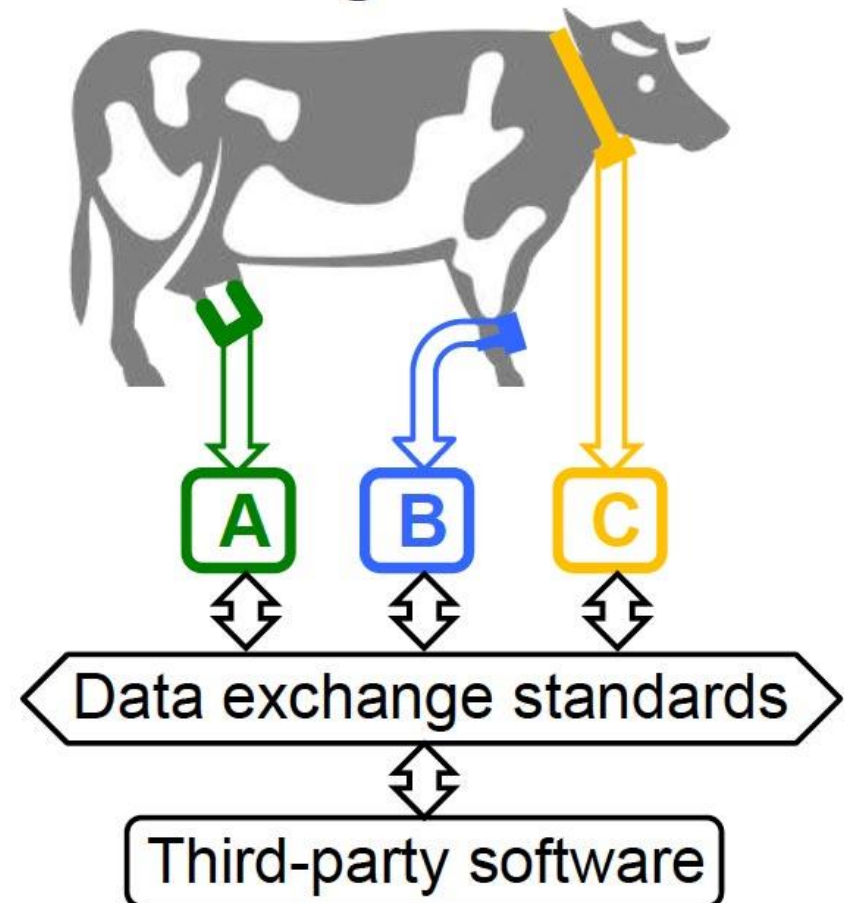
Stand alone systems that do not talk to each other!

Data integration – future?

Single manufacturer integration



Multiple manufacturer integration



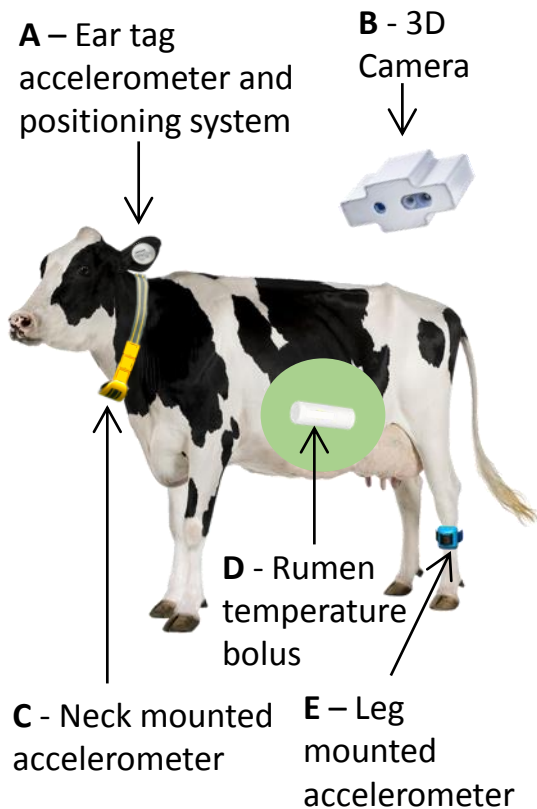
Data beyond the farm

- As well as improving on-farm resource use efficiency, data can be shared through the supply chain



- One key area where data could be used is in farm assurance schemes, especially around animal welfare
- Welfare assurance is currently based on infrequent, costly farm audits that are largely resource-based
- E.g. 'absence of prolonged thirst' – we currently record how many animals share each water trough

Sensor-derived welfare



Sensors not to scale!

	Sensor-derived data	Welfare Quality® Criteria	Welfare Quality® measure <i>Sensor-based measures</i>
A	Position and movement	Expression of social behaviours	Agonistic behaviour (infrequently recorded i.e. at time of audit) <i>Continuous record of social interactions</i>
	Rumination time	Absence of prolonged hunger	BCS (infrequently recorded) <i>BCS (frequently recorded)</i> <i>Fibre intake estimates (based on time spent ruminating)</i>
B	Body condition score (BCS)		
C	Eating time		<i>Eating patterns</i>
D	Drinking bouts	Absence of prolonged thirst	Attributes of drinkers (resource-based) <i>Frequency of drinking (animal-based)</i>
	Core body temperature	Absence of disease	Obvious signs of disease (infrequently recorded) <i>Automated, continuous monitoring for subtle signs of injury or disease</i>
E	Lameness probability		
E	Step count		Ease of movement
	Lying time	Comfort around resting	Cow cleanliness, time to lie etc. <i>Continuous monitoring of lying</i>

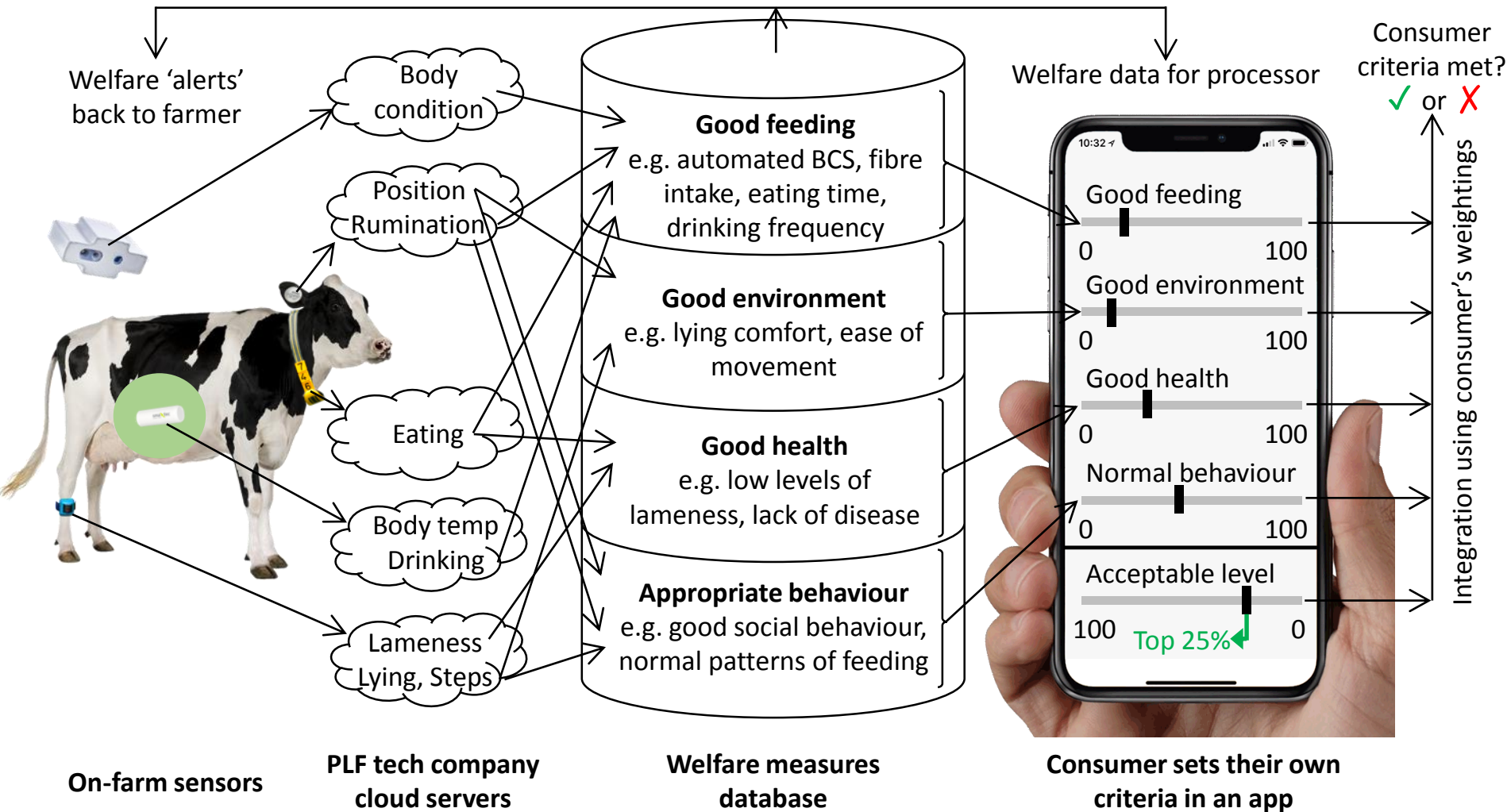
Sharing product data with consumers



Welfare assurance

- There are other issues with current farm animal welfare assurance schemes:
 - The weightings of the different factors (health, behaviour etc) are agreed by 'experts' and are fixed
 - No incentives to improve welfare beyond the 'acceptable' threshold
- A more dynamic approach could use e.g. an 'app' to let consumers set their own weightings and set a relative acceptable level e.g. from farms with above average welfare; top quartile...

From 'farm to phone'





✓
This product
meets your
welfare standard

Wider use of livestock data

- The Livestock Information Programme (LIP) is an industry-government partnership to deliver a new multi-species livestock information, identification and tracking service
- This will help make the UK more resilient and responsive to animal disease
- Sensor and other data from commercial farms could also be used in future livestock research

 **LIVESTOCK**
INFORMATION

Summary

- Lots of data being collected on many dairy farms
- Sensor data is already improving production efficiency, but we can do a lot more
- Need to do a better job converting data into management 'alerts'
- Need to develop data exchange standards to allow better data integration
- Scope to add value and enhance consumer confidence by sharing data through the supply chain

Any questions?

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