Best practice guide on Activity & Behaviour

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This guide aims to assist dairy farmers who want to include new sensor technologies. It outlines the different technologies available for monitoring activity and behaviour, their importance and how to use it on farm

Introduction

Need for effective monitoring

In the last few decades the dairy industry has increased significantly in size and productivity. As a result on large modern automated farms, it is difficult to monitor (or supervise) all the cows, and also the direct interaction with them is decreasing. This creates a greater need and opportunity to equip large farms with sensors to monitor the animals and reduce costs and labour inputs while increasing farm productivity. To minimize loss of milk yield and prevent other health costs, it is essential to identify behavioural changes or activity abnormalities as early as possible. It has been seen that changes in cows' behaviour are valid indicators of their health and welfare problems and thus they can be used as input to an early warning system. Activity levels of cows increase significantly when heat; but when cows are sick (e.g. fever, milk fever, lameness), their activity will clearly reduce, or their feeding behaviour will change (e.g. displaced abomasum, pneumonia in heifers).

Profitable animal welfare monitoring

Knowledge about animal behaviour is needed to optimise animal welfare in the farms. This knowledge allows more effective identification and treatment of ill animals, as well as making precise decisions which can lead to animals that are more suitable for breeding purposes. Additionally this knowledge gives an impression of the basic principles of animal housing systems. For example, lameness indicates lack of welfare, and lying behaviour can indicate animal comfort in different housing conditions and physiological status.

The location of cows is also an important parameter. It is needed to estimate behavioural patterns and activity, for health inspection, for an estimation of missed operations (for example milking) and for automatic isolation of individual animals at risk. The use of sensor technology to collect key physiological parameters like cow activity rate, becomes a key tool to prevent cow disease, accurately determine the cow oestrus, achieve fine breeding for improving milk yield, and to promote the quality of raw milk. For that reason behavioural monitoring systems in herds are useful tools to collect data about cow's individual and social behaviour, which can later be used to evaluate cow health, welfare and determine the reproductive status. It can also be used to validate a new housing design.

Constantly monitoring activity and behaviour

Our objective of monitoring cows is to get information all throughout the day, so that sensors can be our "eyes" 24 hours a day – 7 days a week. This is especially important in cows housed in large groups or on pasture, because it is more difficult for the farmer to visually evaluate them, and also during the transition period, where it is very valuable to predict which cows are at risk for transition health disorders (and monitor the overall transition management). The most reliable way to achieve this is to attach sensors on individual cows. The most commonly used sensors are accelerometers, pedometers and global positioning (GPS) trackers.

Advantages of using these technologies:

- Labour saving through real time location information;
- flexible workflow management;
- establish a normal behavioural pattern where management and housing can be assessed at farm level;
- an optimized reproduction cycle through reliable heat detection;
- an early warning system for health risks;
- monitor losses due to reproduction or diseases that can affect production;
- flexible data access and
- Increased economic efficiency of the farm.

Where are my cows? Commercial tools to find them

There are currently some systems to find exactly where are all the cows in a free-stall barn, so you don't feel like finding a needle in a haystack trying to localize them. Some of them combine position and activity monitoring.

Available commercial technologies (click on the name to get more information):

- Nedap Cow Positioning®. This tool locates individual cows in the barn quickly and accurately. This specialized neck tag provides information on cow's activity and health, but also provides their location. It is always combined with Nedap Heat Detection, Health Monitoring (Eating monitoring) and ISO identification for feeding, separating and milk measurement. Beacons are placed in the barn at permanent locations (at a maximum distance between beacons of 25 metres). This tool lets you see where individual animals are in the barn on the screen of your PC, tablet or smartphone.

Photo 1. *Nedap Cow Positioning neck tag*

- GEA CowView®. This neck collar localizes each cow in real time, provides information about oestrous activity, gives early warning about diseases, helps with outstanding tasks and ensures reliable communication. It provides clever conclusions using the animal-specific movement profile, normal behaviour patterns and also the behaviour of animal groups: If lying, eating or daily habits change, it will generate the correct warnings for your smartphone, tablet or PC.

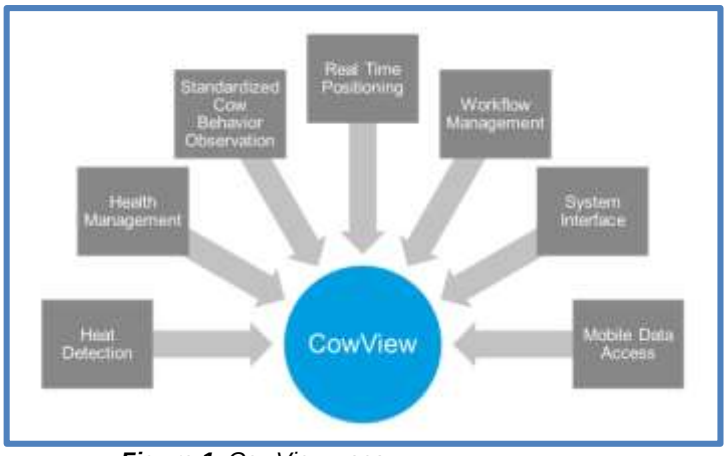

Figure 1*. CowView uses*

- Faire: iBO® Real Time Positioning and Monitoring. This neck collar not only focuses on cow activity, but continually tracks and monitors, in real-time, the precise 3D orientation and movement of an individual dairy cow. It uses an integrated animal identification, positioning and sensor data capture platform, in real time. The company is planning the roll-out of the iBO technology platform in 2017.

- Noldus: TrackLab®. Software that combined with a neck collar provides recognition and analysis of spatial behaviour in farm animals. The real-time data collected can be visualized (computer), processed and analysed. It can monitor

indoors or outdoors with GPS system. Generates location information, graphs, and heat maps, and also the speed of the cow at that moment. It is able to exchange its data in real-time with other software.

Photo 3. *Visualization of a single GPS track of a cow in TrackLab from one day.*

- SmartBow: Eartag LIFE. It is an eartag system for cattle that can also be used for official animal identification, real-time location (RTLS) and health monitoring purposes. It can be used for heat detection, ruminating and health monitoring.

Other tools: activity sensors

There are a lot of other sensors, mainly activity sensors that are commercially available to monitor **activity, rumination and behaviour**. The most important activities to monitor are: **feeding and rumination behaviour** (*for more information you can read the Best Practice Guide for Nutrition on 4D4F website*), **water intake** (essential for good milk yield, also correlates closely with feeding intake) and **sleeping behaviour** (more information in the next section). For example, monitoring rumination behaviour may aid in the early identification of cows at higher risk for developing subclinical Ketosis post-calving. Usually activity sensors are already used for oestrus detection (*for more information you can read the Best Practice Guide for Reproduction*), but they can also provide reliable information about health and behaviour. Generally the neck collars give us more information about eating behaviour, while leg tags help to monitor walking, standing and lying time more accurately. Anyway it will also depend on the software used to interpret the data coming from sensors. Other sensors that are very useful to monitor behavioural patterns are **calving sensors**, used to predict when calving will occur. They help to save time, create a better environment and improve safety. See the document ***Warehouse of technologies on A&B*** for more detailed information about activity sensors already used in oestrus detection, calving prediction or other applications.

The importance of time budget

As you probably know, certain components in a cow's life are fixed and non-negotiable. Cows spend a significant part of the day eating, lying, socially interacting, ruminating and drinking, but they also have to handle the management activities: milking, veterinary procedures… *(Figure 2).* Especially for high yielding cows there is a competition for the time spent in the different activities. If one activity is taking up more time (e.g. long-time milking), time spent in another activity will be reduced (e.g. less time spent on feeding and resting).

Lying time is perhaps the most important parameter in the cow's daily budget. Cows produce more milk when they are lying down, as blood flow through the external pudendal artery increases by around 24 – 28 % when lying compared to standing up, and all metabolic processes conduct much faster lying down. Failure to achieve adequate resting periods suggests a significant stress response. There is also a linear relationship between time lying and milk production: for each additional hour of resting, milk production increases with 1.5 L. This behaviour is so important that cows would voluntarily reduce eating time if adequate lying time is not met.

The target is to achieve around 10-12 hours of lying time per day (herd mean). A lot of management factors can impact the time available for resting on a daily basis, including:

1) Prolonged milking time,

2) Competition for stalls due to overstocking,

3) Inadequate heat abatement, and
4) Excessive time spent in lock-ups and away for milking.

What else affects the time budget?

- Clearly facility-based factors affect daily lying time, i.e. stall stocking density and rubber flooring.
- When heat stress occurs, mean lying time decreases, and time spent standing in the alley increases.
- Dairy cows milked in robotic milking systems may have slightly different time budgets.
- Cows in the later stages of their lactation have greater lying times, which is thought to be driven by decreased feeding time (associated with the lower energy demands of decreasing milk production), leaving more time available for resting.
- There is also a relationship between lameness and long lying bouts, where lame cows tend to lie longer. Also the feeding time in lame cows is slightly reduced.

It is for all these reasons that monitoring lying time is important. If you know the time budget of your own cows, you will be able to identify deviations and respond quickly to any alteration.

Figure 2. *Ideal daily budget.*

How to improve my farm

Nowadays many large farms are already using pedometers or other devices to monitor oestrus and reproduction. This is a great advantage, because the technology and information are already on the farm. The correct use and interpretation of the data allow the farmer to have a complete overview of the farm. The best way to improve is being proactive and not just to wait for something to happen, but to look out for it. If you can rank the activity, rumination or resting times of your cows, you can look for the extremes every day and react to the problems.

How to decide through all the available sensors?

You have to take into account the specific situation of your herd. Are the cows on pasture? Are the facilities old or new? Is the floor slippery? Is there a high risk of heat stress? How does the data transfer work? Which attachment location (on the cow) is more useful for the farm situation? Which other technologies are being used on the farm? Which other information do you want to collect?

What to look into?

Low rumination times, low feeding times, low (or increased) resting times… all the information you can catch. Learn how to manipulate information, find what suits your herd.

If you use all the technologies and data at your fingertips, maybe you will be able to detect and monitor all that you are not capable of seeing directly on the farm and can act accordingly.

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