UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

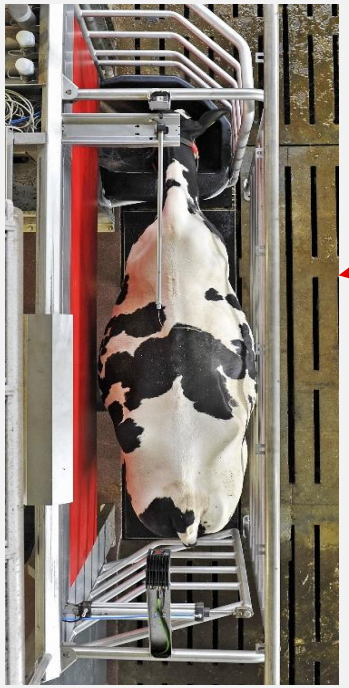
Dipartimento Medicina Veterinaria Produzioni Animali

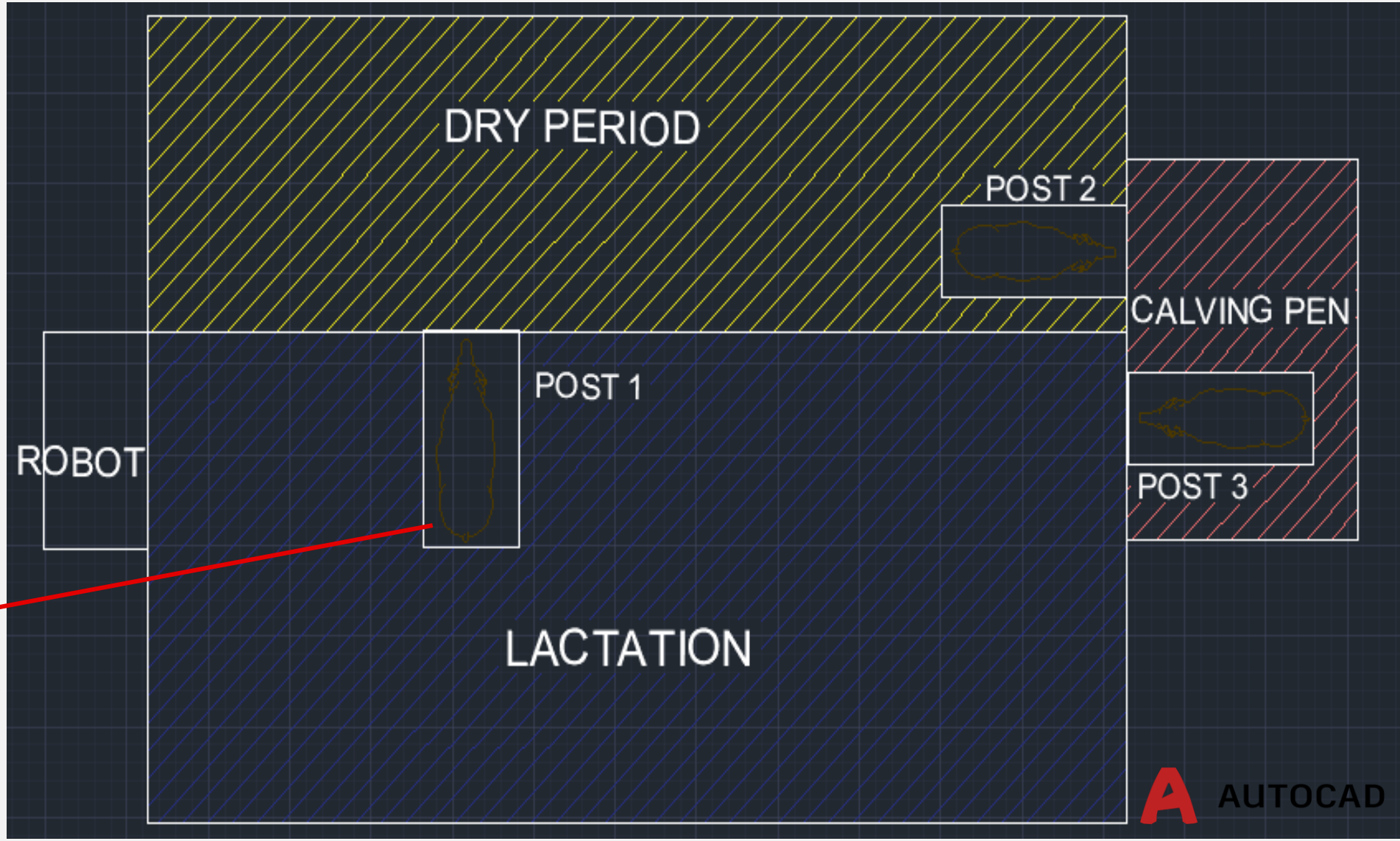
PLF MEETING
21 September 2023

Smart Management for Smart Herd

Prototype for intelligent and automated herd management

The aim of this project is to make smart the management of a buffalo or dairy cattle farms. Technologies are integrated mainly for an automated switch between lactation, dry group and calving pen, but also for other functions.





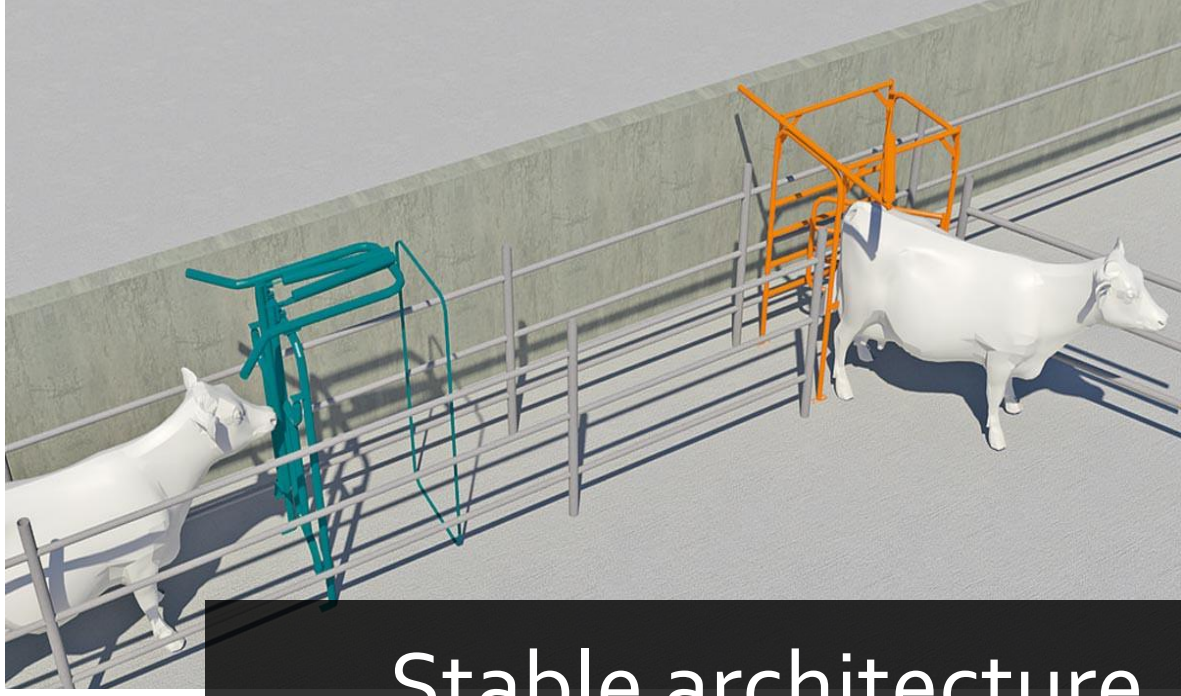
- The idea stems from the analysis of the main critical issues present in today's farms. In particular, thought was given to automating the movement of animals in the different production groups, which is generally entrusted to an operator.

- Because carried out by physical operators this practice is not always error-free. As a matter of fact, there is often a risk that animals are moved from their groups late or early, or even confused.

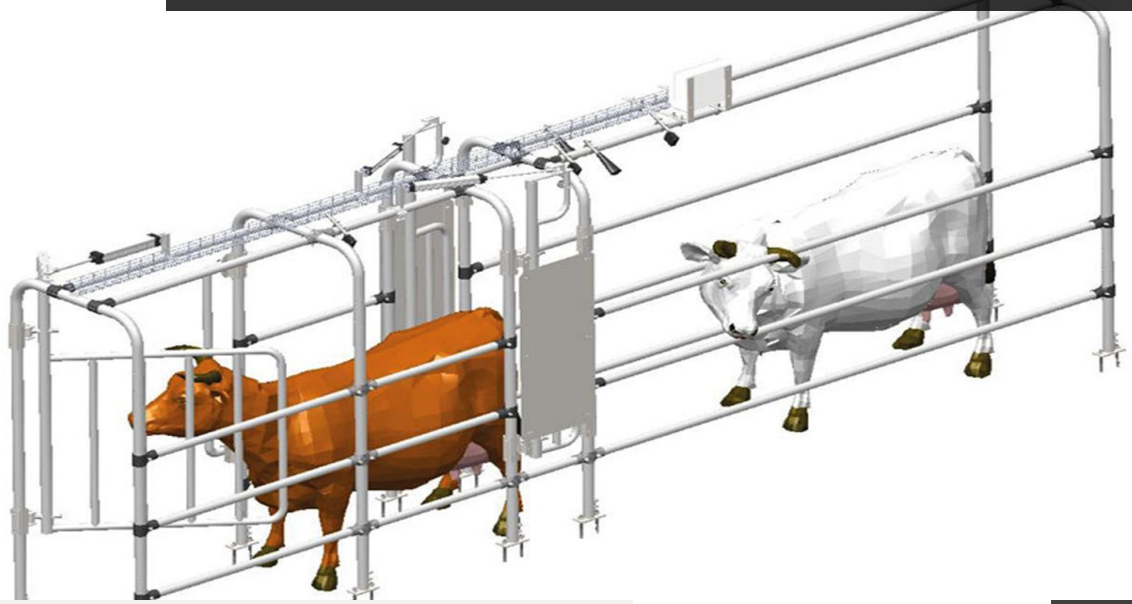
- We assumed that milking in the farm, is also automated using a robot milking machine.

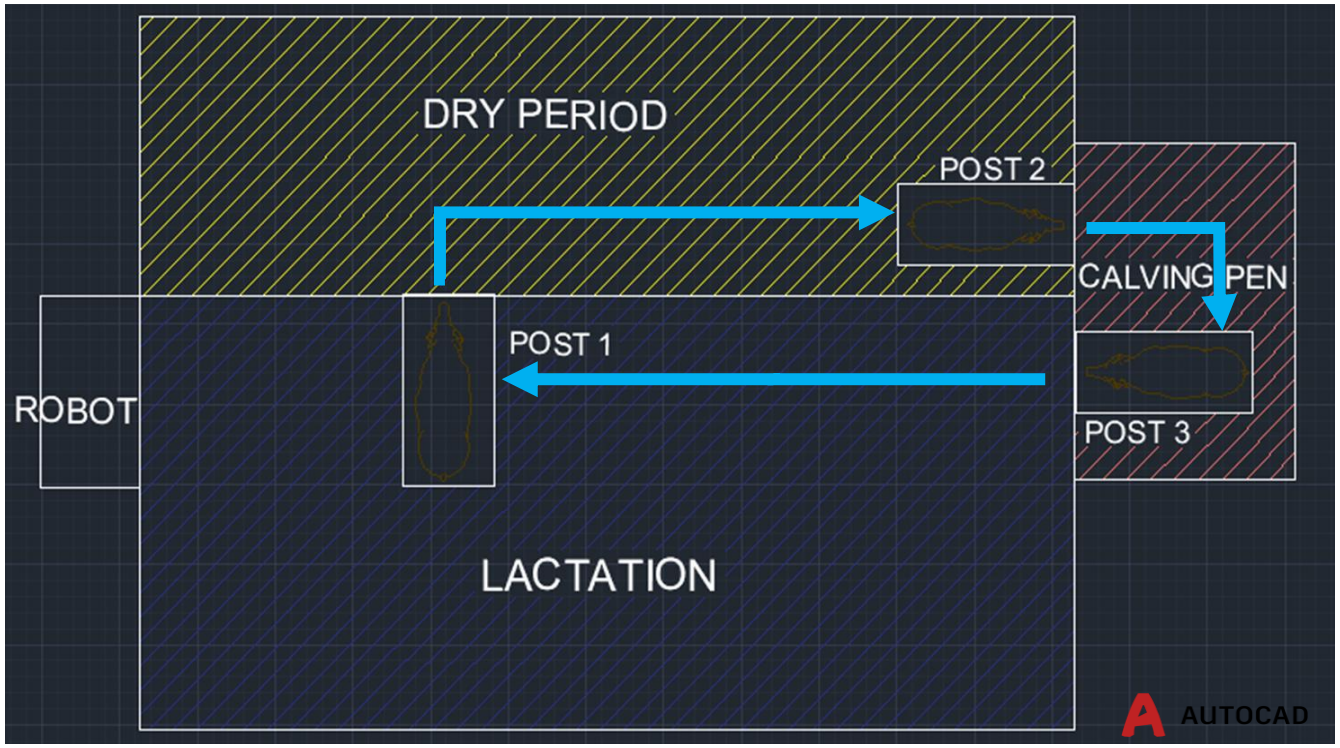
"Smart management for Smart Herd" involves the use of technologies for:

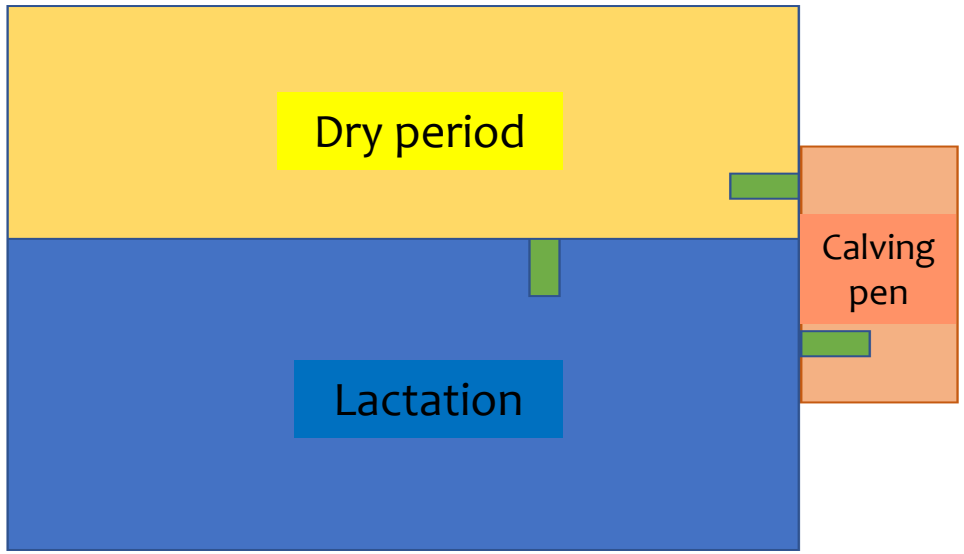
- -Smart switching between production groups using posts equipped with sensors that interface with the farm management program.
- -Intelligent distribution of head-by-head weighed feed via automatic feeder equipped with load cells.



Stable architecture







Project description

The project involves the installation of three posts with gates allowing unidirectional passages:

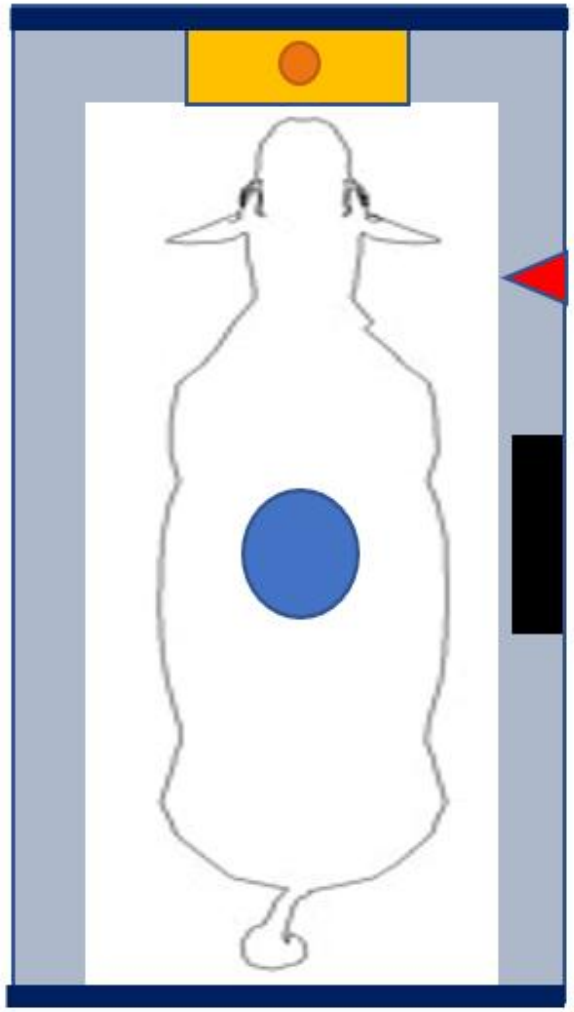
1) Lactation → Dry group

2) Dry group → Calving pen

3) Calving pen → Lactation

The post is sized for single animal access, and specifically rectangular in shape with dimensions 2.5x0.9 m.

It is assumed that the herd consists of three production groups (Lactation, Dry period, Calving pen) positioned near to each other, and that the animals are identified with electronic identification, (in addition to the eartag) through ruminal trasponder.



The post is equipped with:

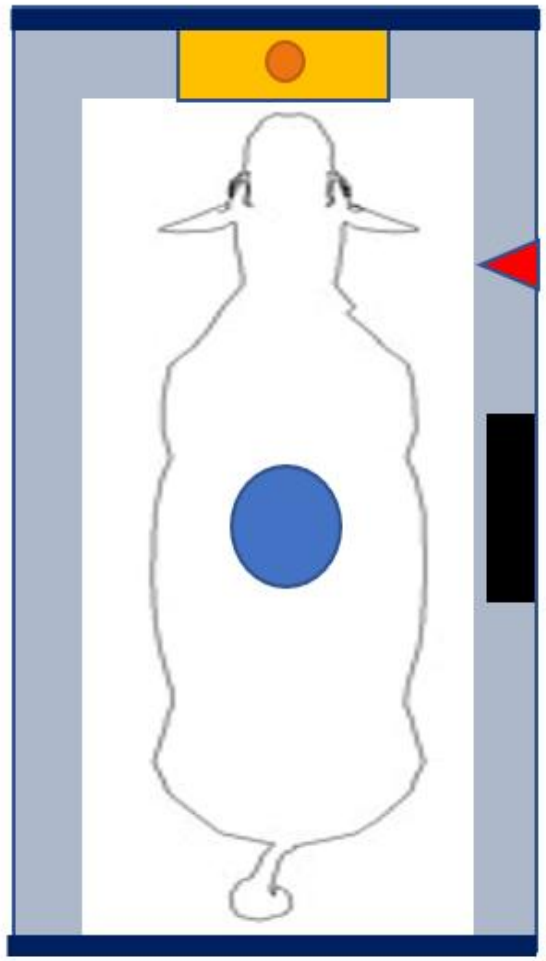
-a **rear gate** (2), generally open to allow the animal to enter and which will close as soon as the animal is fully entered and identified;

-**a front gate** (1) generally closed, which will open for moving the animal to the next group once permission is obtained from the management program;

-an **automatic feeder** for feed distribution, equipped with a **loading cell** for dosing and a flap to prevent the animal from interfering with the cell during weighing. Through piping, the feeder is connected to the farm silo from which the pelleted feed comes;

-actuators for the automatic distribution of feed into the manger and servomotors for the automatic opening of the two gates.

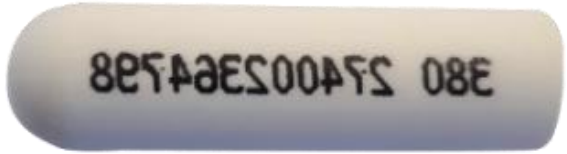
Sensors



-a **load cell** at the base of the post to reliably detect the presence of an animal. It will be confirmed if a weight of at least 300 kg is identified. It will also make it possible to monitor the body weight of animals and thus more accurately estimate the amount of feed to be distributed;

-a **photocell** to detect the presence or absence of an animal inside the post. Specifically, it is installed toward the front (about 2.2 m from the rear gate) so that it detects the animal only when it has fully entered;

-a **RFID tag sensor**, a sensor typically used in animal husbandry for animal identification by ruminal bolus; it communicates the animal's identification code to the farm management program.



How technology works …

Management database

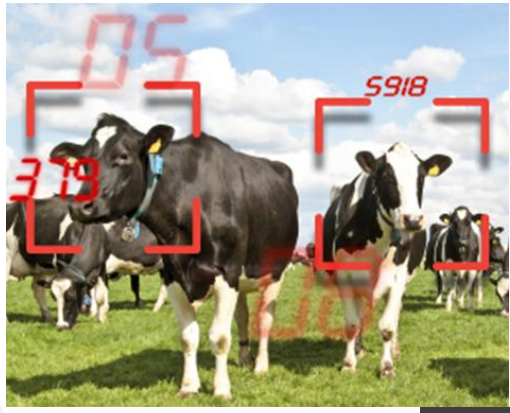
PHOTOCELL → Is the animal present ?

LOAD CELL → Is there a weight of at least 300kg ?

RFID TAG → Has an animal been identified ?

YES → Back gate closed → Animal's identification code → Management database

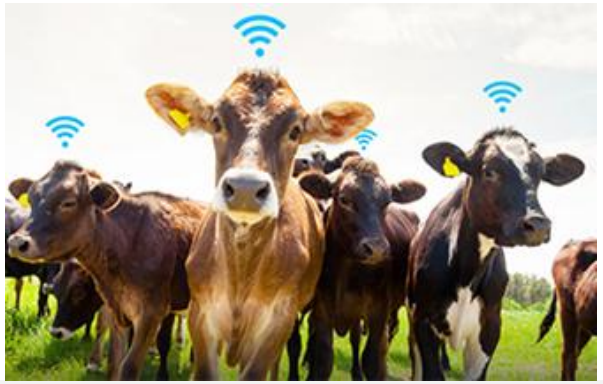
NO → Back gate open



How technology works…

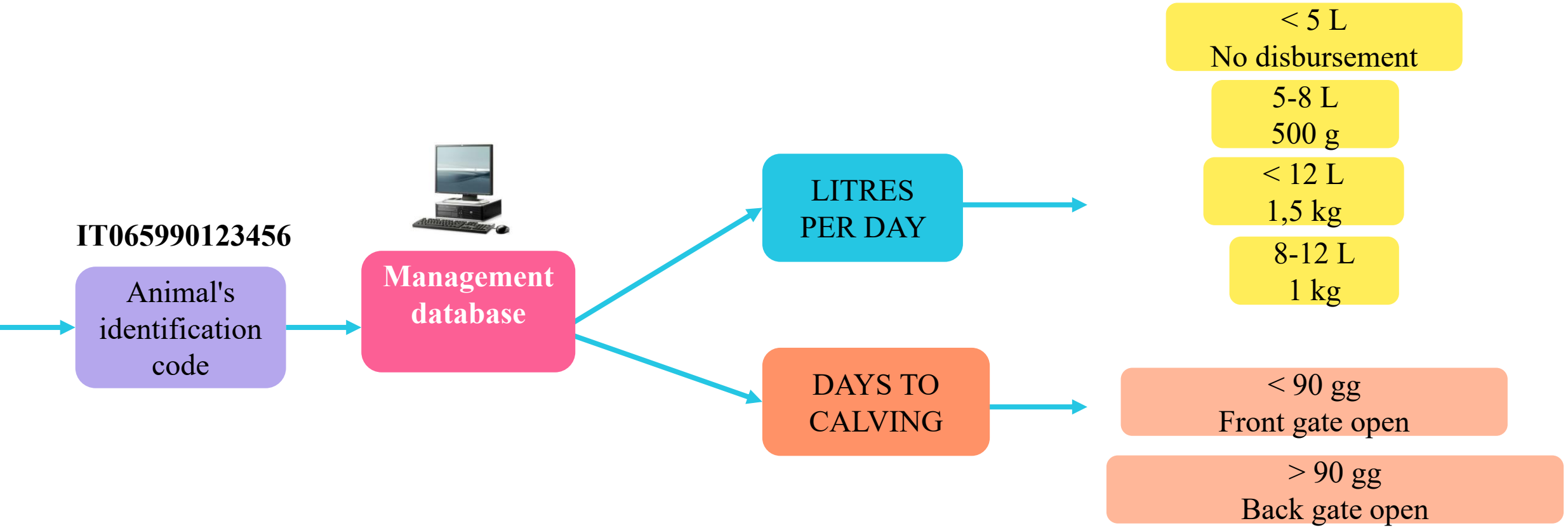
- As a communication protocol between the two entities we assume the use of WiFi (isa short-range protocol that allow wireless communications ranging from tens of meters up to hundreds of meters). In particular we chose WiFi Lora Net System.

- It is assumed that there is a graphical interface that allows viewing the status of the gate, and can be consulted at any time by the farmer or 'operator via computer or smartphone



Lactation → Dry period

Specific case of buffalo species
(for bovine species it will be sufficient to reset the parameters)



Dry period → Calving pen

IT065990123456

Animal's identification code

Management database

DAYS TO CALVING

> 20 gg
No disbursement

10-20 gg
500 g

DAYS TO CALVING

< 10 gg
Front gate open

> 10 gg
Back gate open

Calving pen → Lactation

IT065990123456

Animal's identification code

Management database

DAYS AFTER CALVING

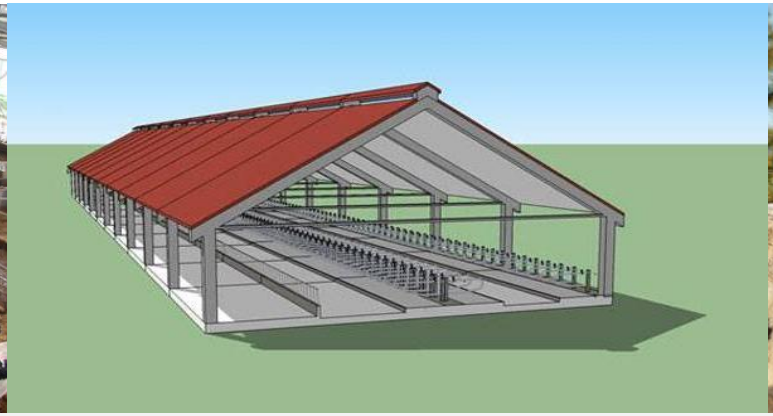
- 0-5 gg
  500 g
- 5-10 gg
  1 kg

DAYS AFTER CALVING

- > 10 gg
  Front gate open
- < 10 gg
  Back gate open

Limitations

- Unique electronic identification for the whole herd
- Use and continuous updating of a management program
- Structural arrangement Period of adaptation for animals
- Presence of an operator who intervenes in case of need in the management of the animals and manages the software
- Adjustment of parameters for different species and different farms



Implementation

Implementations can be made to make the farm smarter, such as:

- Camera to assess the BCS of animals: It assesses changes in the subcutaneous tissue reserve of animals during lactation. Assessing and managing the rate of change in the BCS of animals and achieving optimal BCS at different stages of lactation are key factors in maintaining or improving animal performance and welfare.
- Vulvar sensor: it allows us to monitor calving at any time of the day and intervene if it is necessary.
- Solar panel : the use of renewable energy, especially solar energy would make the stall energy self-sufficient and more sustainable. We can consider putting collars on the animals on which mini solar panels are installed.

Benefits of using smart gates and feeders

Why adopt Smart Management for Smart Herd: a viable solution to major management problems in stables.

CORRECT AND TIMELY ADVANCEMENT OF ANIMALS IN GROUPS:

Ensuring a proper dry period

Ensuring a proper steaming-up phase

Ensuring a correct calving preparation phase

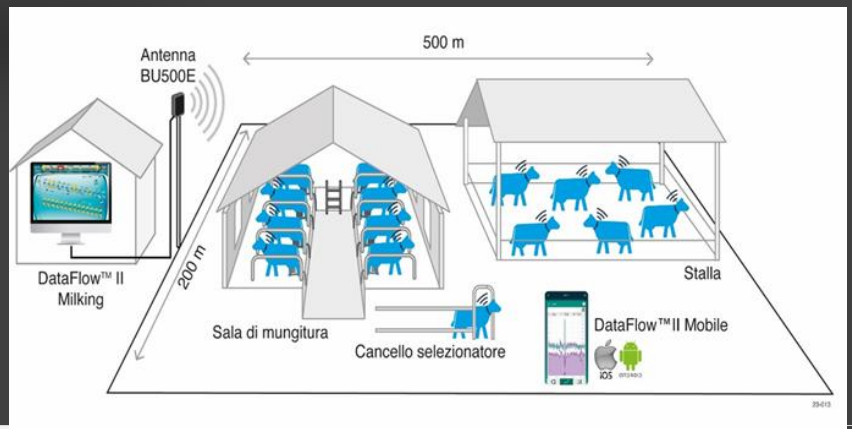
In summary, the effects for animal husbandry in terms of economic and environmental sustainability, and animal welfare are:

- 1. Reduced labor use: reduced management costs and increased farm efficiency.
- 2. Avoiding drops in milk production: avoiding economic losses
- 3. Safeguarding animal health status: reducing drug use
- 4. Timely and personalized nutritional supplies: improved animal welfare

Benessere Animale certificato in allevamento

Moreover, the adoption of PLF techniques on farms allows, not only for farms to upgrade and become more efficient, but also to be in line with European goals in terms of Farm to Fork (Green Deal) sustainability. Technological advancement in agricultural and food production practices is supported by the Rural Development Plans promoted by the European Community, (e.g. "Agriculture 4.0"), one of the goals is precisely the digitization of farms.

Indeed, digital tools are able to record and collect a large amount of data, which can be used to assess the sustainability of the farm from social, economic and environmental perspectives.



Thanks for the attention

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Pierro Federica