A management principle from the industry used in dairy farming

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Evolutionary Operations (EVOP) is a manufacturing process-optimisation technique where small systematic improvements are introduced, and the response is continuously evaluated. With EVOP the manager is seeking for the most optimal production at the exact production site. EVOP's intention is that a certain solution regarding the production can have a positive effect for some production sites but a negative effect for others. With EVOP the manager of a production site makes systematic experiments during the normal production flow to optimise the production.

Dairy herds are not identical and with EVOP the manager exploits the local truth on the exact production site. This means that the response is expected to differ between herds and production sites.

In a dairy farm EVOP might consist of small systematic changes in the feeding, milking strategy, health management, reproduction or other management elements in the production. The change is called an intervention and typically an EVOP consents by several small interventions in the same area.

An EVOP normally includes four steps:

1. The production condition that needs to be improved should be identified, and the current value must be determined.
2. The interventions should be appointed and implemented. Alternatively, small changes in the process variables that occur during a normal production flow on dairy farms can also be monitored and used to gain knowledge.
3. Evaluation of the response to the intervention. Response parameters must be monitored, and errors on the response must be evaluated.
4. Decisions on implementing the new production condition.

Using tests to determine if a production change is profitable is not an unknown concept. In generations, farmers have picked up and tried out new initiatives. If the response were as expected, the farmers proceeded with the initiative. If not, the farmer stopped with the initiative. With EVOP the process is controlled and often completed in small steps.

One of the biggest issues with EVOP in dairy production is to distinguish the responses from a change made consciously from those changes that occurred accidentally. One example is to compare the yield in two periods. The herd has developed with cows calving in, cows been dried off, cows changing lactation status, and a lot of others changes. At the same time, we are looking at a small response on a factor with large day-to-day variations. Thus, it may be difficult to determine a connection between management change and response.

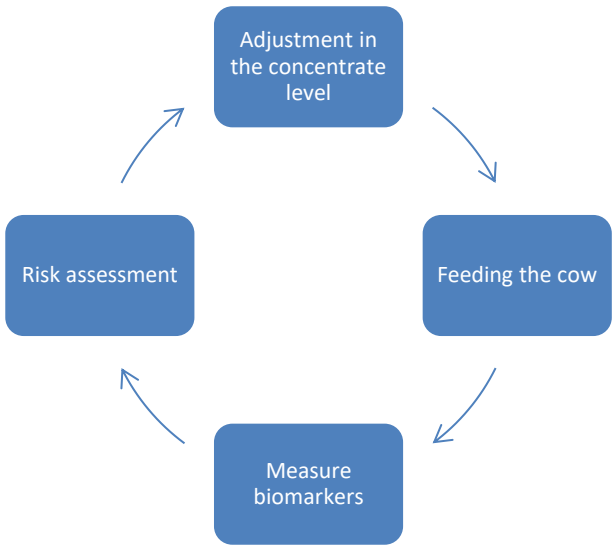
Finding biomarkers in the cow

In relation to the project GplusE, scientists from Europe, China and USA are looking for biomarkers that can measure the physiological status of the cow. Biomarkers are molecules in blood and milk that are used as indicators of the physiological state of the animal. In GplusE, the researchers are looking for biomarkers

with a good correlation to production, reproduction, health, metabolic status and methane emission. To obtain an adequate correlation, the biomarkers are combined in clusters to give an indication of the cow's condition.

By using biomarkers from GplusE as a response in an EVOP farmers might optimize their production not only to milk yield but also to the physiological state of the cow. The idea is that a cluster of biomarkers can serve as a clear response to a change in management. With the use of a cluster, the metabolic response of a change in the feed ration can be used to evaluate the feeding change. The specific goal is to optimise the individual feed ration to the metabolic response. If the adjustments in the feed ration has a positive response on milk yield and none or a positive effect on the metabolic status, the farmer can continue to adjust. In case of a negative effect on the metabolic status, the farmer should fall back on the previous ration.

In practice, the model could be used in the early lactation to find the optimal level of concentrates on the individual cow. First, the concentrate level is adjusted. Then, the responses to the adjustments are measured on biomarkers, and the risk of being in physiological imbalance is assessed. Lastly, based on the risk assessment, the concentrate level is adjusted.



To use this model to combine EVOP and biomarkers it is important that the biomarkers have a strong relationship to the risk of getting an imbalance. The example includes biomarkers on a metabolic status, however the principle could also be used on measurements concerning the excretion of nutrients in manure or methane in the expired air to lower the environmental footprint of producing milk.