Align Your Precision Dairy Robot System with Your Goals

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Take Home Messages

- The value of precision technology increases if all sensors are used in a single information system using the aggregated information. It is not about management by exception anymore, but about valuating fitness scores of the healthy cows.
- Implement precision information in each step of your management circle: 1) vision, 2) design, 3) goal, 4) observe, 5) analyze, 6) adjust, 7) evaluate … and back to step 3), to make the management circle go round based on the best possible information.
- Include precision information in short term and long term management sessions with your dairy advisory team. Require from your advisors a scenario (based on precision settings), rather than a single step advice, to be able to steer the process in between the consultancy visits.
- Free cow traffic in robot systems give about 1 kg of milk/cow/day more, or 76 kg milk/robot/day more than guided/forced cow traffic. Cow pens with 1 milk robot per pen give 60 kg milk/robot/day less than in pens with more than 1 robot.

Introduction

Many studies, publications and practical testimonials are available that show the merit and values of precision dairy sensor technologies. Usually these publications deal with 1 sensor at the time only and mostly show the value on the optimistic side, so that companies can get them sold.

Great work is done by Jeffrey Bewley, UKY to summarize the value of these individual monitoring tools available. He concludes that there is a gap between the impact of precision dairy farming technologies in research versus commercial settings. Additional effort needs to be directed toward

implementation of management practices to fully use information provided by these technologies. Factors that have the most influence on the profitability are those related to what happens with the technology after it is purchased (Bewley, 2013).

In addition, multiple sensors in combination with the visual observation of naturally behaving cows in the robot barn enable the herdsman to see the abnormal individual in a much earlier stage. It is about being pro-active instead of reactive and about making better decisions to prevent cows drifting off (instead of making culling decisions after the problem got too severe). All of this improves constant health and therefore constant production, fertility and longevity results of the herd (Smink, 2012).

Precision dairy does not change cows or people, but it will change how they work together. The path to success using precision tools on farm is to maintain realistic expectations, support the farmer in using the information, never lose sight of the cow and educate, communicate and collaborate (Bewley, 2015).

In this paper I would like to make the next step and show:

- how dairy producers can utilize precision technology wisely in daily practice;
- how dairy producers can get trained to get value out of the sensors;
- how dairy consultants can use sensors to provide complete up to date advice.

Circle of Efficiency and Management

To structure the practical use of precision technologies, I will use an adjusted circle of efficiency and management (Figure 1) and will go over each step of this process and conclude how this circle can go round with precision information in the collaboration between cow, herdsman and consultant.

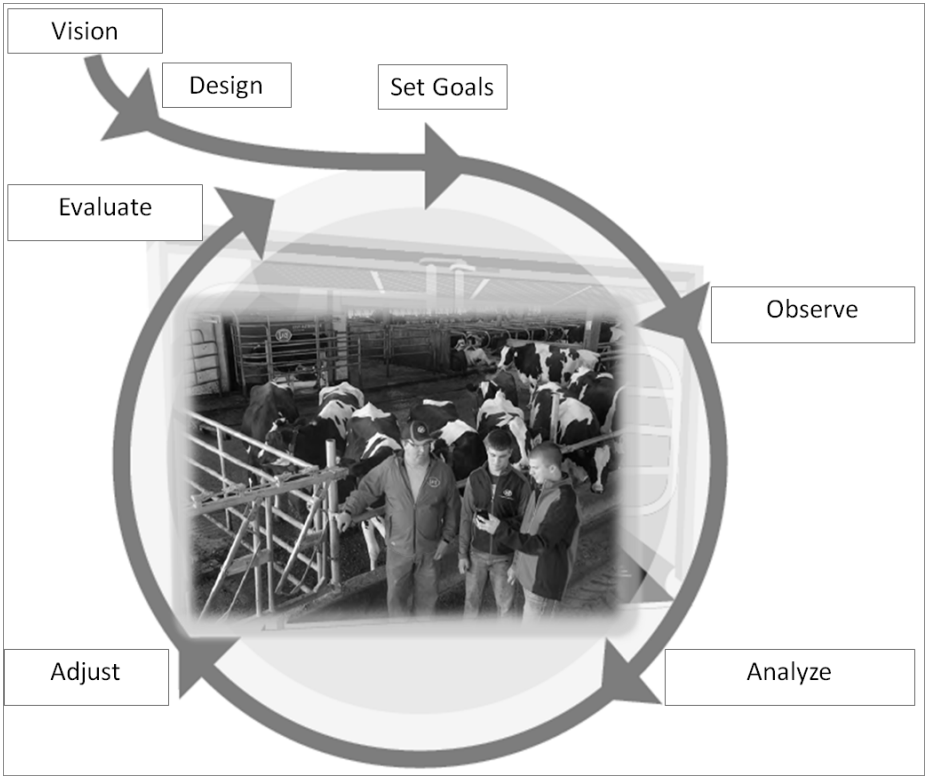

Figure 1. Precision dairy circle of efficiency and management.

Step 1: Vision

Without vision there is no way to go. Every producer will have a vision of where he wants to be with his farm in a decade or two. All goals, activities and choices made will have to point in that direction. It is important for the consultant to know and understand what the vision of the different generations of the farm are to be able to perfect a suitable advice stream.

Globally, we will have to feed over 9 billion people in 2050 according to the FAO (Food and Agricultural Organization of the United Nations). So, as a dairy industry we will have to be very thoughtful of our resources, such as land, feed, water, and will have to prevent pollution and limit waste. However, the key resource on a dairy farm is the herd of cows; therefore, as an industry we need to optimize each individual cow, which also is the precious beloved resource in the perception of the consumer. What is good for the cow and her health is also good for her talents to produce milk efficiently. Both aspects are of high interest for consumers.

What does this mean for cow management in practice: 1) Get the best out of the cow and let her show her unused production talents. 2) Observe and secure her health to tune her capabilities for tomorrow. 3) Match genetic potential of ancestors to create a better offspring. 4) Use the benefit of genetic evolution, but be cautious about what the data really tell you, especially if they are based on general monthly information or once in a lifetime measurements used by breeding associations.

Precision monitoring allows for precision handling as well; for example, no waste of the resource feed, by feeding cows according to their general needs in the bunk combined with individual portions according to their individual potential in the station or robot, with a focus on Income Over Feed Cost (IOFC) to make it financially sound.

Step 2: Design Fundament to Your Farm

Only once in a generation a producer really has an opportunity to design his barn. Every single choice will have an effect on cow comfort and her talent to efficiently use her resources. Four important factors to consider when designing a robot barn:

1) Free or Guided Cow Traffic in the Robot Barn

Analyzing data from 635 North American dairy farms with automated milking systems (AMS) for risk factors associated with increased milk production showed that free cow traffic was associated with increased production per cow/day and robot/day compared to guided systems. Free cow traffic was associated with 1.1 kg more milk/cow/day and 67.2 kg more milk/robot/day than guided cow traffic (Tremblay et al., 2015).

Let's put some perspective on these numbers: if there are approximately 20,000 Lely milk robots in the world with free cow traffic, which each producing an additional 67 kg milk per day, that would equal to an additional 40 truck loads of milk per day available to the global population.

2) Cow Pen Size with One, Two or Three Robots

The same analysis with the 635 North American AMS farms showed that a single robot cow pen was associated with decreased production/robot/day compared to pens with 2 or 3 robots per pen. On average one robot cow pens produced 59.8 kg less milk per robot/day than 2 or three robot cow pens (Tremblay et al., 2015). The production difference between robots per pen becomes larger as milkings decrease when the barn gets filled to its capacity (Tremblay et al., 2015).

3) Efficiency Based on Cow Comfort and Cow Touches

Every living creature is most efficient if it is comfortable and gets what it needs 24/7. Cows also need a comfortable life without losing energy on the wrong activities like waiting in line for feed, water or milking. This means that interruptions in the cow's day to day life have to be limited to a minimum by designing a barn where the general population is not disturbed when 'human touches' to other cows take place. The good news is that precision dairy technology also secures efficient cow touches on an 'as needed' base only, leaving the rest of the herd alone to increase efficiency of labor in the barn.

4) Precision Feeding

Feed is the main variable cost on the farm, which needs to be well managed to get the desired IOFC. Most of our current feed principles are developed a few decades ago based on circumstances without precision tools or information. Lely International found an increase of 1.9 kg milk/cow/day with robotic TMR feeders as a result of higher dry matter intake and continuous fresh feed at the feed bunk 24/7 (web site lely.com - farming tips). When designing a new facility make sure it allows for future implementation of these automatic feeding technologies.

Step 3: Set Goals

After vision and design are set, it is time to define both long and short term goals. The long term goal will determine which precision dairy technology tools could provide added value to the farm processes. The short term goals will determine which alerts and information are needed to optimize the use of the resource 'cow' on the farm.

Make these precision dairy goals SMART (specific, measurable, achievable, realistic, and time-bound) and use them to find the critical success factors on the farm to achieve these goals. For example: longevity, fat/protein per day, occurrence of abdominal or udder health problems.

Based on these factors you make a dashboard with your precision information, which can be used on a daily basis to observe the results and see whether you are 'driving in the right direction' and 'staying on track'. The producer's job is to manage the daily monitoring and to align barn workers with proper observation and work routines. However, it is the consultant's job to provide the right training and support to read these dashboard tools and provide scenarios for the herd manager to steer his results on a daily basis, rather than monthly 'after the fact go, no-go feedback' kind of advisory steps.

Step 4: Observe

The better robot systems will measure more than 120 values per cow per day. All those data points by themselves are useless and have to become meaningful for the producer and his consultant. Meaningful data lead to action. Every single value or attention a herd manager gets presented with has to lead to either actions to help cows reach the goals that the producer has set, or to save resources or time for cows/people to stimulate the goals.

Steeneveld and Hogeveen (2015) found a disconnect between the economic theory not matching the reality. Sensor systems were associated with a higher average production per cow on AMS farms and with a lower average production per cow on conventional farms after investment.

A pro-active attitude to use AMS sensor data pays off in lower somatic cell counts (SCC). A passive approach (wait till individual SCC increases, clots on filter) to decide whether a cow needs treatment will result in a higher SCC (Tol van der, 2012). The combination of milk conductivity, milk color, pre-milk time and yield per quarter lead to an action list for clinical mastitis prevention. Another example is if we see high fat/protein ratio in combination with rumination drifting off, the program indicates ketosis. Similarly, if a cow shows normal milk production, normal conductivity and color of the milk in combination with high milk temperature, we know the cow is sick but not very likely caused by mastitis.

It is the quality of the individual sensors, together with the right dashboard of meaningful summarized information along with the analysis capability of the cow person, to combine the digital picture of the data with the physical observations in the barn. We need good cow people to combine the cow signals with the summarized action data from sensors and find the cow before she has a problem!

For the producer this means:

1. Select only meaningful performance indicators to use every day.
2. Develop a solid routine to read these and change them into actions.
3. Tune the parameters so that an attention list becomes an action list for every worker in the barn.
4. Track what you treat and match weekly what the difference is between action and treatment to fine tune your action list depending on the experiences collected.
5. Require training and support from your consultant/provider to maintain proper settings.

6. Be critical of the supplier's system defaults and make sure parameters are set depending on your goal and not the goal of the supplier.
7. Use smart solutions like InHerd mobile apps to have the digital picture of the cow next to the physical picture you observe while touching the cow in the barn for an efficient work stream and to get most out of the info available.

Step 5: Analyze

On a regular basis the producer has to bring all knowledge together in a dairy advisory management team. Successful teams have helped dairy businesses to improve milk yield and quality, efficiency of workforce and IOFC or return on assets. Advisory teams can consist of veterinarian, nutritionist, robot expert, accountant, lender and extension educator who work with you on a regular basis; the teams may also include non-farm or non-agricultural members as well as other dairy producers (Holden, 2014). This advisory team analyzes results, measures the progress made and determines the most important gaps to come to a series of scenarios to be used in the following month.

All summarized sensor data graphs bring facts to these advisory gatherings. The following aspects need to be considered:

1. last month's progress as set in the dashboard defined in step 3 (Set Goals)
2. daily progress regarding milk yield, robot visits, feed intake, fat and protein levels, body weight and rumination
3. lactation progress (separate for first calf heifers and mature cows) regarding milk yield, robot visits, feed intake, fat and protein levels, fat and protein ratio and body weight
4. current lactation/yield distribution to fine tune feed bunk rations and set the sweet spot between the attraction of cows to the robot and the money spent on the ration at the feed bunk and on the robot
5. udder health status looking at progress of both current cases and new cases, using combined udder health indicators (conductivity, color, pre-milk time, quarter yield contribution, SCC, yield deviation)
6. body health status using the combination of rumination, body weight deviation, fat/protein ratios, milk temperature, yield deviation and feed intake

7. robot performance and usage: determine cow robot efficiency and check whether every milking is a useful milking and whether every minute a robot spends on a cow is adding value to milk in the tank

In general, the focus has to be on finding wastes of all possible resources (including the resource cow and robot time) and finding unused cow production talents.

For the advisor this means that you'll have to change your mind set and probably have to learn a few new things. The famer gets wiser with so much more information on a daily basis, and he will heavily lean on your professional expertise to generate scenarios for the coming period based on the findings and gaps measured each time you meet.

Step 6: Adjust

Based on the gaps found in the analysis, plans and settings can be adjusted. Thinking of precision dairy tools this means that you, the producer, should:

1) stick with your goals and choose the adjustments that bring the best result to your short term goals
2) only change 1 factor at a time, so that you always know what the effect is. If you change 2 factors with opposite results at the same time you will not see progress, although 1 of the 2 could potentially be the key factor to progress…..
3) adjust the dashboard parameters accordingly, so that the action lists presented by the system bring focus to the short term goals at hand.

Step 7: Evaluate

This step should be a twice per year reflection on:

1) the achievements in the past 12 months
2) renewed assessment of the critical success factors in the coming year
3) adjustment of the short term goals
4) adjustment of the precision information dashboard and action plans

As a producer be critical on your advisors. The evaluation assessment is there to show whether they were right or not in their scenarios and whether they will have to learn or adjust as well.

As an advisor be critical on your producers. The evaluation assessment is there to show whether they were right or not in the follow-up of your scenarios and sticking to action plans on a daily basis. One of your tasks is to hold producers (and their workers) accountable for their job in a positive way.

The evaluation step also requires benchmarking with other producers who are in the same circumstances. Historically, the DHI data have been used for very practical and good reasons. They are mostly good to use, as long as you are able to compare apples to apples.

Now with precision technology many producers ask themselves whether to stay connected with the DHI and the answer is YES for two reasons: 1) DHI makes it possible to collect data for the genetic advancements of our industry. If you quit DHI then do not ask your breeding association or semen suppliers to give you advice on bull selections; 2) DHI offers lots of opportunities for cultures and tests not available in sensors (yet) and they could be very useful for problem situations.

Many alternative benchmarking tools are available, which are based on all the precision information available on the farm. For example, Lely robot users have an integrated benchmark application where producers can compare information with each other based on all robot sensor data. A tool like this is also available as a smartphone app called FarmVisit, which can be used by the advisors too (website: lelyt4c.com).

Precision technology and the connection of all these systems is also an opportunity to make the next step in benchmarking. All herds' production data and management information can be clustered in a meaningful way using cluster analysis. This clustering approach will yield improved peer groups of farms compared with benchmarking methods based on criteria such as country, region, breed, or breed and region.

Tremblay et al. (2015) applied mixed latent-class model-based cluster analysis to 529 North American AMS dairy farms with respect to 18 significant risk factors and defined 6 meaningful clusters. Each cluster (i.e. peer group) represented unique management styles, challenges and production patterns. When compared with peer groups based on criteria similar to the conventional benchmarking standards, the 6 clusters better predicted milk produced per robot per day. Each cluster represented a unique management and production pattern that requires specialized advice. For example, cluster 1 farms are farms that recently installed AMS robots while cluster 3 farms, the most northern farms, feed high amounts of concentrates through the robot to compensate for low energy feed in the bunk. In addition to general recommendations for the farms within a cluster, individual farms can generate their own specific goals by comparing themselves to farms within their cluster based on percentile ranks. This is very comparable to benchmarking, but

adds the specific characteristics of the peer group resulting in better farm management advice. The improvement that cluster analysis allows for is characterized by the multivariable approach and the fact that comparisons between production units can be accomplished within a cluster and between clusters as a choice (Tremblay, 2015).

And Then Fine Tuning: Let the Circle Go Round

This is a key phase in the whole process, because here the circle is completed and if this is not done right the wheel will not start to turn for continuous improvement. The key elements to make this circle a perfect running wheel are as follows:

1. Connect every evaluation with a new starting point to set new short term goals and further tuning of precision tools.

2. Stick to your plans and keep all team members and advisors accountable for their contribution.

3. Don't be afraid, but keep an open mind for different ways of thinking.

4. Use the best suitable benchmark for the goals of the farm.

Keep an eye for the global challenges we have as an industry: feed over 9 billion people in 2050. As a dairy industry we will have to be very thoughtful of our resources — land, feed, and water — and prevent pollution and limit waste, not only on a large scale, but also on a farm and an individual cow scale.

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