Precision Dairy Conference and Expo

**Mayo Civic Center
Rochester, Minnesota
June 24-25, 2015**

A Conference on Precision Dairy Technologies

Organized by University of Minnesota and University of Kentucky

Precision Dairy 2015

Organized by

UNIVERSITY OF MINNESOTA
Driven to Discover℠

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College of Agriculture,
Food and Environment

Welcome to the Precision Dairy 2015 Conference and Expo!

On behalf of the organizing committee, we welcome you to the second U.S. Precision Dairy Conference and Expo in Rochester, Minnesota.

Adoption of precision technology is really picking up in the U.S. We see quite a bit of growth on cow sensor technologies for disease and heat detection. There is also a lot of interest in data management, precision feeding, automatic milking, inline sensors, calf feeders, and more! Precision dairy management is the wave of today and the wave of the future. Let's have a great time while learning more about it.

Please visit with our sponsors and speakers while you are here. They have much to share with us. Some came from a long distance to tell us about their research, their farm, or their products. I know some of our attendees have also traveled many hours to get here. Thanks to all of you, near and far, for attending our event. Enjoy the networking opportunities.

Best wishes for an enjoyable and educational time at the Precision Dairy 2015!

Sincerely,

Marcia Endres, Chair   Jeffrey Bewley, Co-Chair
Department of Animal Science   Department of Animal and Food Sciences
University of Minnesota   University of Kentucky

Table of Contents

Agenda

June 24		Speaker	Location
7:30 AM	**Continental Breakfast, Check-in, Registration & Trade Show**		**Exhibit Hall (EH)**
8:30 AM	**Opening & Welcome**	**Marcia Endres; Jeffrey Bewley**	**Presentation Hall**
8:40 AM	**Precision Dairy Farming Overseas: Experiences and Developments from The Netherlands**	**Henk Hogeveen**	**Presentation Hall**
9:15 AM	**Producer Showcase – Using Technology to Make Decisions** Homestead Dairy, Plymouth, IN: 3,500 cows in 4 locations; animal monitoring and tracking	**Brian Houin**	**Presentation Hall**
9:45 AM	**Producer Showcase – Inline Sensor Technology in Voluntary Milking System** Ritzema Dairy, Seaforth, Ontario: DeLaval Herd Navigator; 6 milking robots	**Gerhard Ritzema**	**Presentation Hall**
10:15 AM	**Break**		**Exhibit Hall**
10.30 AM	**North American Application of Automatic Teat Spray Robots for External Rotary Parlors**	**Mark Futcher**	**EH Breakout Room 1**
10:30 AM	**How to Use PRECISION in Day-to-Day Management**	**Aurora Villarroel**	**EH Breakout Room 2**
11:00 AM	**DeLaval Body Condition Scoring BCS Daily, Automatic and Consistent Scoring of Cows; Automated Body Condition Scoring Economics**	**Fernando Mazeris; Carissa Truman**	**EH Breakout Room 1**
11:00 AM	**Improving Health, Welfare and Fertility Using the Latest in Cow Monitoring Technologies**	**Conor Beirne**	**EH Breakout Room 2**
11:30 AM	**Break, Trade Show**		**Exhibit Hall**
12:00 PM	**Buffet Lunch**		**Exhibit Hall**
1:10 PM	**Precision Dairy Monitoring: Making Sense of Sensors**	**Jeffrey Bewley**	**Presentation Hall**
1:45 PM	**Producer Showcase – Cow Sensor Technologies and Calf Feeders** Ashwood Dairy, Amsterdam, NY: Freestall dairy with 200 cows; Medria software; Förster-Technik automated calf feeder	**John Balbian**	**Presentation Hall**
2:15 PM	**Producer Showcase – Dairy Farming in the Technology World** Dutch Dairy, LLC, Thorp, WI: 850 cows; CowManager to monitor ear tags; automated calf feeder barn	**Sander Penterman**	**Presentation Hall**
2:45 PM	**Break**		**Exhibit Hall**

June 24 *(continued)*		Speaker	Location
3:00 PM	**Managing the Profit Centers within a Precision Feeding System**	**Keith Sather**	**EH Breakout Room 1**
3:00 PM	**Semantic Technologies in the Information Management for Precision Dairy Farming: The Showcase of agriOpenLink Project**	**Dana Kathryn Tomic**	**EH Breakout Room 2**
3:30 PM	**Data Driven Decisions to Maximize Herd Health and Profits**	**Ray Nebel**	**EH Breakout Room 1**
3:30 PM	**Automation in Ventilation and Cooling**	**Brent Hershey**	**EH Breakout Room 2**
4:00 PM	**Break**		**Exhibit Hall**
4:15 PM	**Producer Showcase – Rumination Monitoring Technology: How it has Helped Improve Cow Comfort, Health and Reproduction Performance at our Dairy** T&C Louters Dairy, Merced, CA: SCR rumination sensors	**Tony Louters**	**Presentation Hall**
4:45 PM	**Producer Showcase – Ways to Become Successful with Robots and Achieve High Production** Kiefland Holsteins, Utica, MN: 300-cow robotic dairy with 5 Lely A3 robots	**Chad Kieffer**	**Presentation Hall**
5:15 PM	**Adjourn**		
5:30 PM	**Reception & Cash Bar at Trade Show (ends at 7:00 PM)**		**Exhibit Hall**
June 25		**Speaker**	**Location**
7:30 AM	**Full Breakfast, Trade Show**		**Exhibit Hall**
8:15 AM	**Robotic Milking Systems Data Analysis: Factors Associated with Increased Production per Cow per Day and Production per Robot per Day**	**Ben Smink**	**EH Breakout Room 1**
8:15 AM	**Producer Showcase – Managing my Dairy with Technology and Afi** Daybreak Dairy LLC, Zeeland, MI: 220 cows, Afimilk's herd management software	**Nate Elzinga**	**Presentation Hall**
8:45 AM	**Individualized Recommendations Using Clustering of Robotic Milking Systems**	**Marlene Tremblay**	**EH Breakout Room 1**
8:45 AM	**Producer Showcase – How Our Dairy is Using Automated Calf Feeders** Carlson Dairy, LLP, Pennock, MN: 1,250-cow dairy, Urban automated calf feeders	**Chad Carlson**	**Presentation Hall**
9:15 AM	**Break**		**Exhibit Hall**

June 25 _(continued)_		Speaker	Location
9:30 AM	**Automated Calf Feeders and Robotic Milking: What are Keys to Success?**	**Marcia Endres**	**Presentation Hall**
10:05 AM	**Producer Showcase – Automation has Changed the Way We Dairy** Finke Farm, Nashville, IL: Robotic milking system, automated TMR feeder, automated ventilation, curtains, etc.	**Craig Finke**	**Presentation Hall**
10:35 AM	**Producer Showcase – Using an Automated Milking System** Westvale View Dairy, Nashville, MI: Robotic milking, 220 cows, ~100 lb/cow/day	**Carlyle Westendorp**	**Presentation Hall**
11:05 AM	**Conference & Trade Show End**		

Plenary Session Speakers

Jeffrey Bewley, University of Kentucky

Dr. Jeffrey Bewley is from Rineyville, Kentucky where he grew up working on his grandfather's dairy farm. He received his B.S. degree in Animal Sciences from the University of Kentucky in 1998, his M.S. in Dairy Science at the University of Wisconsin-Madison in 2000, and his Ph.D. from Purdue University in 2008. Jeffrey's primary interests are the application of precision dairy farming technologies, economics of decisions on dairy farms, milk quality management, dairy cow comfort and well-being, records management and benchmarking, systems troubleshooting, and strategic dairy business management. Jeffrey's team of graduate and undergraduate research assistants manage multiple precision dairy research projects. Jeffrey will provide an overview of parlor-based, wearable, and internal precision dairy monitoring systems around the world. This presentation will provide an overview of questions that farmers should ask before purchasing these sensor systems and how to set realistic goals for how they can help with dairy management.

Marcia Endres, University of Minnesota

Dr. Marcia Endres is a professor and extension dairy scientist in the Department of Animal Science at the University of Minnesota. Her research interests include dairy management, welfare and behavior. She has investigated how various types of housing and management systems can influence health, welfare and performance of dairy cattle. She currently leads a USDA-funded project investigating the welfare of dairy calves when using automated calf feeders and is co-investigator on a large on-farm survey of robotic milking systems in the upper Midwest U.S. Marcia received her Ph.D. from the University of Minnesota, M.Sc. from Iowa State University, and a Veterinary Medicine degree from University Federal of Parana, Brazil. Marcia will discuss factors that are associated with effective use of precision technologies based on results of on farm studies conducted at the University of Minnesota.

Henk Hogeveen, Utrecht University

Dr. Henk Hogeveen graduated with a M.Sc. from Wageningen Agricultural University in 1989. His M.Sc. thesis was on the field of epidemiology (cystic ovarian disease) and animal health economics (economics of herd health programs). From 1989 until 1994 he worked as associated researcher at the Department of Herd Health and Reproduction of the Faculty of Veterinary Medicine of Utrecht University, where he received a Ph.D. in the field of mastitis diagnosis. After a short employment at the former Institute for Agricultural and Environmental Engineering in Wageningen, he began working as a scientific researcher in the field of herd health and management at the Applied Cattle Research Institute in Lelystad (nowadays part of the Animal Sciences Group of Wageningen UR), followed by a position as cluster manager welfare, health and milk quality at that institute. Since 2001, Henk has been working in academia, currently as associate professor at the chair group Business Economics of Wageningen University and the Department of Farm Animal Health of the Faculty of Veterinary Medicine of Utrecht University. His teaching activities are mainly directed at economics of animal health, agricultural business and veterinary business in B.Sc., M.Sc. and Ph.D. courses. His research activities are focused on economics of animal health, focusing mainly on endemic diseases. Within that field, he has developed a special interest in the use of sensors and detection models to support decisions on animal health and animal welfare. Besides other memberships of national and international committees, he is chairman of the IDF Standing Committee of Animal Health. Henk has more than 100 scientific publications (peer reviewed journals and books) as well as many publications in scientific proceedings and trade journals.

Industry Update Speakers

Conor Beirne
Sponsored by Dairymaster

Dr. Conor Beirne, MVB MBA DHHC, is an Irish dairy vet with nearly 20 years of experience in practice in Ireland, UK and Saudi Arabia. His main interests include the development and implementation of advanced technologies onto farms to assist in the day-to-day management with a goal of improving overall herd health, production and welfare. He's now senior veterinarian for Dairymaster. His responsibilities for Dairymaster include technical support for sales and marketing as well as research and development. He also trains Dairymaster's staff *and* clients on new products and new developments within the dairy industry. Before joining Dairymaster he was Senior Veterinarian for a herd of 80,000 high yielding Holsteins for Almarai Company in Saudi Arabia. That meant establishing performance targets, monitoring them continuously, and intervening immediately when performance started to deviate while supervising a team of 9 veterinarians and over 60 trained health and breeding staff. Conor will discuss improving health, welfare and fertility using the latest in cow monitoring technologies.

Mark Futcher, DeLaval
Sponsored by DeLaval

Mark Futcher is the North American Market Development Manager-Capital Goods for DeLaval Inc. Mark was raised on a mixed farm, including a dairy herd, in Southwestern Ontario. He is a graduate of the University of Guelph and Oenkerk Practical School for Dairy and Grassland Management (Friesland, Holland). Mark has been involved with DeLaval in varied roles and alliances for over 25 years and in the dairy industry his entire life. Mark has played a role in a number of innovations related to dairy equipment and dairy facility design which continue to be utilized throughout the world today. With experience working on projects and supporting dairy herds of all sizes in more than 26 countries around the world, he has been witness to the increased adoption of automation within the dairy industry at the farm level for a wide array of tasks.

Brent Hershey, Hershey Ag
Sponsored by CowKühlerZ

Brent Hershey of Hershey Ag, Marietta, PA, resides in Lancaster County, PA, with his wife and three children. He grew up on beef and chicken (layer) operation, which was turned into a small dairy concentrates feed mill in 1980. In addition to owning the mill, Brent owns a swine production business that he has operated since 1984. In his latest venture, Brent is a principle in CowKühlerZ, specializing in dairy barn ventilation and cooling. Brent has a passion for animal production systems and will share his insights into what's coming in automation for dairy barns.

Fernando Mazeris, DeLaval International AB;
Carissa Truman, University of Kentucky
Sponsored by DeLaval

Fernando Mazeris is the Vice President Farm Management Support Systems at DeLaval International AB. Having a Veterinary degree background (National University of Buenos Aires, Argentina), Fernando has been working for more than 20 years in the dairy industry. From researcher at the Argentinean National Research Institute in Agriculture, as an udder health private advisor, to different positions at DeLaval Argentina and DeLaval International. During the last 15 years at DeLaval International, Fernando has been leading teams always connected to herd management and feeding related solutions, from product development to marketing and sales.

Carissa Truman is originally from Lynchburg, Ohio, and a graduate of Lynchburg-Clay High School. While in high school she was actively involved in FFA receiving her state degree and becoming chapter president. Carissa currently attends the University of Kentucky and is pursuing a Bachelor of Science degree in Animal Sciences with a minor in Agricultral Economics. During her sophomore year Carissa became interested in the dairy field when she began assisting with graduate research projects within the dairy department. In her junior year she started working at UKY's Poultry Research Facility and later that year began dairy undergraduate research. Carissa is currently on track to obtain her degree in May of 2016.

Ray Nebel, Select Sires
Sponsored by Select Sires

Dr. Ray Nebel is Vice President of Technical Services for Select Sires Inc. in Plain City, Ohio. He received a B.S. in Animal Science from Northeast Louisiana University, a M.S. from University of Maryland, and a Ph.D. from Virginia Polytechnic Institute and State University. Between his M.S. and Ph.D. he was a Research Associate at Louisiana Animal Breeders Cooperative where he gained experience in various aspects of the A.I. industry from semen collection and evaluation to insemination training. His current major responsibility is to coordinate the Select Reproductive Solutions™ program for Select Sires Inc. and its nine-member organizations. Activities range from conducting training seminars covering the entire gamut from basic bovine reproduction and A.I. to advanced reproductive management. He was a Professor and a Dairy Extension Specialist in the Department of Dairy Science at Virginia Polytechnic Institute and State University from 1985 to 2005 and received Professor Emeritus status in 2006. Ray's presentation will cover data driven decisions to maximize herd health and profits.

Keith Sather, K.S. Dairy Consulting, Inc.
Sponsored by Feed Supervisor

Keith Sather is President of K.S. Dairy Consulting, Inc., a diversified corporation that works with consultants, dairy farmers and hoof trimmers around the world. Keith is a graduate of the University of Wisconsin River Falls and has served the dairy industry as a nutrition consultant for over thirty years. Keith developed Feed Supervisor®, Hoof Supervisor™, and Truck Supervisor™ software products which he markets under the brand Supervisor Systems. Keith will address effectively managing the profit centers within a precision feeding system.

Ben Smink, Lely North America
Sponsored by Lely North America

Ben Smink is the manager of farm support for Lely North America. Ben was raised on a dairy farm in the Netherlands. He worked for 26 years at various dairy equipment positions in Europe. In 2008, Ben moved to Madison, WI, with Lely to bring the experience regarding herd management systems and robotic systems management to North America. Ben currently trains Lely dealers and independent consultants to improve the management Lely milking systems. Ben will discuss factors associated with increased production per cow per day, and production per robot per day for Robotic Milking.

Dana Kathrin Tomic, FTW
Sponsored by MKW Electronics

Dr. Dana Kathrin Tomic, PhD, is a Senior Researcher at FTW, a Competence Centre for Information and Communication Technology in Vienna, Austria, and is a coordinator of the project agriOpenLink (Adaptive Agricultural Processes via Linked Data and Services, www.agriopenlink.com) focusing information management in the precision agriculture. Dana studied electrical engineering and computer science, and received her PhD in 2007 from the Vienna University of Technology. Her recent research includes methods and technologies for

data management, data analysis and integration in knowledge-based decision and recommendation systems, focusing on semantic, service-oriented and context based solutions for the Internet of Things scenarios in general, and precision dairy farming in particular. Dana has acquired industrial and academic experience in her previous working affiliations, and has (co-) authored more than 50 refereed papers in international journals, conference and workshop proceedings.

Marlene Tremblay, University of Wisconsin
Sponsored by Lely

Dr. Marlene Tremblay, DVM, received her BS degree in Animal Sciences from the University of Kentucky in 2009 and her DVM from the University of Wisconsin-Madison in 2013. She is currently an epidemiology and public health research intern in the Food Animal Production Medicine Department at the University of Wisconsin-Madison. Her interests range from applied mathematical models of infectious diseases and bioinformatics to techniques for large data analytics. Current projects focus on digital dermatitis, malaria, and foodborne diseases such as STEC 0157 and Campylobacter.

Aurora Villarroel, Americas West, Afimilk, Ltd.
Sponsored by Afimilk, Ltd.

Dr. Aurora Villarroel, DVM, MVPM, PhD, DACVPM, CVA, CTP Application Support Manager for Americas West, Afimilk, Ltd. Dr. V (as most people call her) grew up on a small Holstein dairy in Leon, Spain. She received her DVM from the University of Las Palmas de Gran Canaria (Spain) in 1996. After graduation she was Director of Animal Operations at Tauste Ganadera, S.A. in Zaragoza (Spain), an integrated farm with its own cheese production plant that still milks 1,500 cows today. There she first worked with the Afimilk system using activity, production and conductivity information to diagnose individual cow health problems as well as monitoring herd health. From 2000 to 2003 she completed a residency in Food Animal Reproduction and Herd Health at UC Davis, California, where she also obtained a Master's in Preventive Veterinary Medicine (MPVM). After receiving her PhD in Epidemiology at Colorado State University, she joined the College of Veterinary Medicine at Oregon State University in 2006 as Assistant Professor in the Department of Clinical Sciences, and as Extension Veterinarian in the Department of Animal Sciences. As a complement to her long-lasting medical education, Dr. V became a Certified Veterinary Acupuncturist and Tui-Na practitioner. In 2013 she joined the industry as Global Director for Dairy and Udder Health for Merck, Inc. Since October 2014 she has worked at Afimilk, Ltd., where her main focus is training farmers, veterinarians, nutritionists and other industry partners to use the Afimilk solutions to make the best management decisions for a health dairy herd.

Producer Showcase Speakers

John Balbian, Ashwood Dairy, Amsterdam, NY
Sponsored by Medria

John Balbian uses precision technology on his freestall dairy to monitor 200 cows. Currently, John uses Medria HeatPhone, FeedPhone, Vel'Phone and San'Phone, and a Förster-Technik automatic calf feeder. John feels that the technology is a good way for him to stay on top of things. In addition, day-to-day operations are much easier, and decisions are much more transparent and objective. Although they are still in the implementation phase of some of the technology, it has already brought about consistently better results. The technology is cost-neutral based on labor saving or reduced inputs.

Chad Carlson, Carlson Dairy, LLP, Pennock, MN
Sponsored by Purina

Carlson Dairy, LLP, a 1250-cow dairy farm near Willmar, MN (approximately 100 miles west of Minneapolis), is run by 3 Carlson families: Curtney and Louise Carlson with their two sons and wives, Chad and Kindra Carlson, and Carl and Kellie Carlson. They have been dairying in partnership as Carlson Dairy, LLP since 1999. Their milking herd is housed in a 10-row, cross-ventilated, sand-bedded freestall facility, and their sand is continuously recycled through sand settling lanes. The Carlsons recently built a cross-ventilated automated calf feeder (Urban calf feeders). These feeders can provide a milk meal to four calves simultaneously.

Nate Elzinga, Daybreak Dairy LLC, Zeeland, MI
Sponsored by Afimilk

Nate Elizinga and his wife along with their 4 children live and work on the farm he grew up on as a child. Nate graduated high school in 2004 and then attended Michigan State University completing the 2-year dairy program. After college he returned home and became a partner with his father (Dan Elzinga) and his brother (Paul Elzinga). Nate's responsibilities include animal health, repro management, nutrition, genetics and employee management. Daybreak Dairy was started by Dan Elzinga in 1976 milking 60 cows in tie-stalls. In 1994 they expanded to 150 cows and moved to a parlor and free-stalls. Afimilk equipment was installed in 2009 and last year they started using Afimilk as their primary herd management software. Today Daybreak Dairy is milking 220 registered Holsteins and raising all their replacements. Some of their herd stats include 31,000 lb RHA, 20-month age at first calving, 25-30 pregnancy rate, and 40-60 fresh cows marketed annually for dairy. They use AfiFarm herd management software, milk meters, and a combination of AfiAct and AfiAct II heat detection system.

Craig Finke, Finke Farm, Nashville, IL
Sponsored by AMS-Galaxy-USA

Craig Finke is a producer from Nashville, Illinois. His dairy farm features a 5-row free flow barn with dry cow and heifer rows, GreenStalls (dividers), 133-stalls for milk cows, and 45 stalls for dry cows. They also use the Galaxy Astrea 20.20 Robotic Milking system with one robot arm and two milking boxes; a Trioliet TMR robot feeder; a flush system with sand-bedding; three 24′ Big Ass Fans, two grooming brushes, and thermostat sensor-controlled sidewall curtains.

Brian Houin, Homestead Dairy, Plymouth, IN
Sponsored by Afimilk Ltd.

Brian Houin was born and raised on the dairy farm in north central Indiana. He attended Purdue University for 3 years to study meteorology with a minor in Spanish. During his senior year, he realized he was more interested in dairy management and soon he was back on the farm. Today Brian is co-owner of Homestead Dairy, Plymouth, Indiana, with his brother-in-law, cousin,

and his cousin's brother-in-law. They milk 3,500 cows in four locations and have a grower unit about 30 miles away from the main farm. Brian heads the heifers operation and manages the milkers.The farm monitors and tracks calf weight and performance history using computers including three hand-held systems which allows them to monitor the performance of every animal in real time and manage every animal individually. Genomic net merit scores allows them to focus on the traits they want with much greater reliability and enables them to improve herd performance much faster than using traditional systems. In addition, Brian has developed several of his own monthly management Excel reports that he follows closely.Brian is very active in the industry; he is on the Indiana Dairy Producers Board and active in Farm Bureau.

Chad Kieffer, Kiefland Holsteins
Sponsored by Grandview Concrete Grooving Inc.

Chad Kieffer is part owner of their family 300-cow robotic dairy in Utica, MN. They have 5 Lely A3 robots and use all the information from the software such as rumination, daily activity, daily weights, milk fat, protein, and conductivity to help optimize milk production on the farm. They complement their use of Lely software with Dairy Comp 305 and DHIA monthly test. They also have a Lely Juno feed pusher and a concentrate feeder. Chad graduated with a dairy science degree from UW-River Falls in 2002 and for the last 13 years has worked as a dairy nutritionist for a cooperative in Lewiston, MN. He consults with robotic milking dairies throughout the U.S.

Tony Louters, T&C Louters Dairy, Merced, CA
Sponsored by SCR-Dairy

T&C Louters Dairy is a family owned and operated Holstein dairy herd located in Merced, CA, managed by Tony Louters since 2003, and owned by him and his wife Colina Louters. They are currently milking 600 Holstein cows averaging 90 pounds of milk per per day. Louters changed the way they manage the dairy after acquiring the SCR Heatime® activity and rumination monitoring system. With insights during the dry period and early lactation performance, they were able to improve fresh cow management by diagnosing diseases before clinical signs and by monitoring closely the evolution of veterinary treatments. The improvement during the transition period - driven by better animal care and well-being, less lockup times, and accuracy of treatments - along with a solid tool used to identify animals in estrus also boosted the herd's reproductive performance.

Sander Penterman, Dutch Dairy, LLC, Thorp, WI
Sponsored by AgStar

Dutch Dairy, LLC is a family owned and operated dairy farm in Thorp, WI, owned by Sander and Amy Penterman. Dutch Dairy started as a 300-cow operation in 2002 and has grown to 850 cows currently. They have implemented CowManager which is a web application utilizing SensOor monitoring ear tags. In early 2015, they finished the construction of their automatic calf feeding barn.

Gerhard Ritzema, Ritzema Dairy, Seaforth, ON
Sponsored by DeLaval

For Heather and Gerhard Ritzema of Seaforth, Ontario, caring for their robotic milking herd is just like training athletes. They want their herd to operate at peak performance and just like elite athletes, they need to be at the top of their game, stay focused and be able to reduce illness and achieve optimum health. For the Ritzemas, DeLaval's automated on-farm lab, Herd Navigator, is fundamental to their ability to manage their herd to realize these goals. Prior to installing Herd Navigator in July, 2014, Heather and Gerhard drew the analogy of functioning in life without proper prescription glasses, unable to see clearly, without the data and tools to be decisive. Now by incorporating Herd Navigator in their business model, their training program is extraordinary. The innovative proactive tool allows the couple to understand key indicators for

potential biological imbalances within the cow's uterus, understand her heat cycle and when she is pregnant. They also know whether she is developing mastitis before she shows clinical signs and can evaluate her energy balance status by knowing her level of ketosis. Herd Navigator does this by measuring milk constituents automatically and providing the Ritzemas with agreed-upon standard recommendations for dealing with the test results. The result is that with Herd Navigator they are able to achieve successful pregnancies and make suitable cow longevity decisions relating to production and reproduction.

Carlyle Westendorp, Westvale View Dairy LLC, Nashville, MI
Sponsored by Lely

Westvale View Dairy LLC is a family operation run by Doug Westendorp, his wife Louisa and their sons, Carlyle, Troy, Eric and Levi. The Westendorps changed the way they milk when they transitioned from a parlor to a robotic system anchored by four Lely Astronaut A4 robotic milking machines in September of 2012. The change allowed the family to double their herd of registered Holsteins to 220 without additional labor and freed them from milking three times a day. The Westendorps appreciate the information the robots provide on their herd. With more than 120 points of information provided for each cow every time she visits the robots, Doug and his family are able to identify sick cows more quickly and make more informed decisions about their herd. They also appreciate the flexibility their Lely robots provide. Located in Nashville, MI, the Westendorps also operate a creamery, Mooville Creamery.

Conference Planning Committee

Marcia Endres, Program Chair
Department of Animal Science
University of Minnesota, St. Paul
miendres@umn.edu

Jeffrey Bewley, Program Co-Chair
Department of Animal and Food Sciences
University of Kentucky
jeffrey.bewley@uky.edu

Brad Heins
West Central Research and Outreach Center
University of Minneosta, Morris
hein0106@umn.edu

Kevin Janni
Department of Biosystems and Agricultural Engineering
University of Minnesota, St. Paul
kjanni@umn.edu

Jim Salfer
University of Minnesota Extension
St. Cloud, MN
salfe001@umn.edu

Barbara Wadsworth
Department of Animal and Food Sciences
University of Kentucky
barbara.wadsworth@uky.edu

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See Sponsor/Exhibitor Index with Booth Numbers on Page 138, and
Trade Show Floor Diagram on Page 141.

Precision Dairy Farming Overseas: Experiences and Developments from The Netherlands[1]

W. Steeneveld[1] and H. Hogeveen[1,2]
[1]Chair Group Business Economics, Wageningen University, Wageningen, The Netherlands
[2]Dept. of Farm Animal Health, Faculty of Veterinary Medicine, Utrecht University, Utrecht, The Netherlands
henk.hogeveen@wur.nl

Introduction

A sensor system can be defined as a device that measures a physiological or behavioural parameter of an individual cow and enables automated, on-farm detection of changes in this condition that is related to a health event and requires action by the farmer (Rutten et al., 2013). So far, research on sensor systems mostly focused on the development of the sensors and the detection performance (see for a review Rutten et al., 2013).

It was found that the use of sensor systems can improve oestrus and disease detection performance. It is, however, not known whether using sensor systems also improve measures of health, reproduction and production such as the average days to first service and the average SCC. So, it is not known whether the use of SCC sensors improve the average SCC of the herd, and whether the use of sensor systems for oestrus detection result in a lower average days to first service of the herd. Probably, the use of sensor systems is associated with an increase in the milk production level of the herd as well as it is known that a shorter calving interval results in a higher milk production (Auldist et al., 2007) and that a high SCC is associated with milk production losses (e.g., Halasa et al., 2009).

Farmers mentioned that reducing labour and easing management were important reasons for investing (Steeneveld and Hogeveen, 2015). This would mean that the dairy farmers who invested in sensor systems use their labour more efficiently after the investment in sensor systems. Therefore, probably a change in labour costs can be observed. The economic effects of investing in sensor systems was only investigated in normative studies (Bewley et al., 2010; Rutten et al., 2014), and no empirical studies were performed yet on the economic effect of investing in sensor systems.

The first objective of this study is to investigate the effect of sensor systems on milk production, days to first service and SCC of the herd. The second objective is to investigate the impact of investment in sensor systems on several cost components and revenues.

Material and Methods

Data:
In the Netherlands, in 2013 a survey was conducted about the use of sensor systems at dairy farms. A link to the survey was sent by email to 1,672 Dutch dairy farmers. The list with email addresses was provided by a Dutch accounting agency (Accon AVM, Leeuwarden, The Netherlands). The farms were located all over the Netherlands, but the majority was located in the north of the country. In total, 512 farms completed the survey (response rate of 30.6%), 202

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farms indicated that they have sensor systems and 310 farms indicated that they did not have sensor systems. For the farms with sensor systems information was available on the type of sensor system, whether the sensor system was part of an AMS and the year of investment. More information about the data collection is described by Steeneveld and Hogeveen (2015).

In total, 414 farms (152 with sensor systems and 262 without sensor systems) gave permission to use the measures of health, reproduction and production that CRV (Cattle Improvement Cooperative, Arnhem, the Netherlands) has about their farms. CRV provided information about yearly averages for milk production, SCC and reproduction of those 414 farms for the years 2003 to 2013. An overview of the sensor systems available at the 152 farms with sensor systems is provided in Table 1.

In addition, for 217 out of the 512 dairy farms Accon AVM provided accounting data for the years 2008 to 2013. Data of 54 farms with sensor systems on an automatic milking system, 36 farms with sensor systems on a conventional milking system (CMS) and 127 farms without sensor systems was available The accounting data included information on revenues (e.g., revenues from milk and other farm activities), depreciation (e.g., on buildings and machinery), fixed costs (e.g., costs for maintenance of buildings and machinery), variable costs (e.g., costs for feed, breeding and energy and water) and general farm information such as the number of cows, number of hectares, amount of milk quota and the available full-time equivalent (FTE).

Table 1: Overview of sensor systems present at farms with an automatic milking system (AMS) and a conventional milking system (CMS).

Type of sensor system at the farm	No. of AMS farms (n=103)	No. of CMS farms (n=49)
Electrical conductivity sensor	101	20
Colour sensor	64	1
Somatic cell count sensor	15	0
Lactate dehydrogenase (LDH) sensor	2	1
Activity meters or pedometers for dairy cows	47	46
Progesterone sensor	1	1
Milk temperature sensor	52	3
Weighing platform	32	3
Fat and protein sensor	23	0
Rumination activity sensor	11	10
Temperature sensor	6	9
Beta-hydroxybutyrate (BHB) sensor	2	1
Urea sensor	1	1
Other sensor systems	4	4
Activity meters or pedometers for young stock	13	17

Analyses on effect on production, reproduction and health:
In total 3 statistical analyses were performed to investigate the effect of sensor systems on production (milk production per cow), reproduction (days to first service) and health (somatic cell count). In the first analysis, average yearly production per cow was the dependent variable and year, percentage growth in herd size and whether the farm have sensor system were included as independent variables. In the second analysis, average SCC was the dependent variable,

and year, percentage growth in herd size, and whether the farm has a sensor system for mastitis detection were included as independent variables. In the third analysis, the average days to first service was the dependent variable and year, percentage growth in herd size and whether the farm has a sensor system for oestrus detection for dairy cows were included as independent variables. In all analyses, growth in herd size was defined as the percentage increase or decrease in number of cows in comparison with two years earlier. Whether the farm has a sensor system for the years in the data was defined as follows: 0=years without sensor system for farms who never invest in sensor systems, 1=years before the investment in sensor system on AMS farms, 2=years after the investment in sensor system on AMS farms, 3=years before the investment in sensor system on CMS farms, 4=years after the investment in sensor system on CMS farms. Herd was included as a random effect.

### *Analyses on costs and revenues:*
Average values for all costs and revenues over the years 2008 to 2013 were determined for farms that never invested in sensor systems, for AMS farms before and after the investment in sensor systems and for CMS farms before and after the investment. Total capital costs included fuel costs, expenses and depreciation on buildings, expenses and depreciation on machinery and equipment, and miscellaneous costs. Total variable costs included costs for roughage, concentrates, substitutes for concentrates, milk products, minerals, fertilizer, pesticides, breeding, health care, energy and water, manure removal and miscellaneous costs. Total labour costs included costs for contract work, paid labour and calculated costs for own labour, which was calculated by using the available FTE and assuming 52 weeks, 40 hours a week and a hourly rate. The hourly rate was different for the years 2008 to 2013, and varied between €19.80 and €21.89 (CBS, 2014a). Total revenues included milk revenues, livestock revenues, revenues from other farm activities and miscellaneous revenues. To compare costs and revenues of the years 2008 to 2013 it was necessary to recalculate the variables on costs (total labour costs, total capital costs and total variable costs) and revenues. For that purpose, price indices obtained from Dutch economic institutes (CBS, 2014b; LEI, 2014) were used and the year 2008 was defined as the base year.

Results and Discussion

Having sensor systems was associated with the average yearly production per cow. AMS farms with sensor systems had a 189 kg higher average production per cow after the investment, while CMS farms with sensor systems had a 428 kg lower average milk production per cow after the investment in sensor systems. These results are consistent with previous research that found that milk production increased with an AMS. The increase is due to a higher milking frequency (e.g., Kruip et al., 2002). It was, therefore, hard to determine whether the increased milk production was caused by the increased milking frequency or by the use of sensor systems.

CMS farms with sensor systems had a lower milk production in the years after investment in sensor systems. This is an unexpected observation. Most likely, the reason behind the decreased milk production is that 96% of the farmers with sensor systems and a CMS indicated that the investment in sensor systems went together with another major change at the farm, such as a new barn and/or a new milking system (Steeneveld and Hogeveen, 2015). Most likely, these changes have led to a drop in milk production which could not be compensated by the use of sensor systems. Because almost all farmers indicated that there was a major change at the farm in the year of investment in sensor systems it was not possible to separate the effect of the sensor system and the effect of the other major change. It might be expected that at the longer term, the milk production will be increasing again, but we do not have enough long-term data to confirm or reject such a hypothesis.

Having a mastitis detection sensor system, year and growth in herd size were associated with the average SCC of the herd. AMS farms had, on average, an increase in SCC of 12,000 cells/ml after the investment. CMS farms with a mastitis detection system had, on average, a decrease in SCC of 10,000 cells/ml in the years after the investment (Figure 1). Because all AMS farms have mastitis detection sensor systems, results of our study can be directly compared with earlier studies on the effect of the introduction of AMS on SCC. Many aspects change when farms start milking with an AMS, and one of the changes is that farmers are not present anymore during the milking process and have to use the mastitis detection sensor systems to detect clinical mastitis. These detection models are not perfect (e.g., Rutten et al., 2013). It is interesting to see that CMS farms with mastitis detection sensor systems have a lower SCC after the investment. When using mastitis detection sensors in a CMS, the farmer is present to check the alerted cows immediately. Moreover, also non-alerted cows with mastitis can be found as the farmer still can visually inspect the cows before milking. In addition, on CMS farms the investment in mastitis detection sensor systems is made deliberately, and, most likely, farmers use it therefore intensively (Steeneveld and Hogeveen, 2015) resulting in more attention for mastitis detection and, therefore, a lower average SCC.
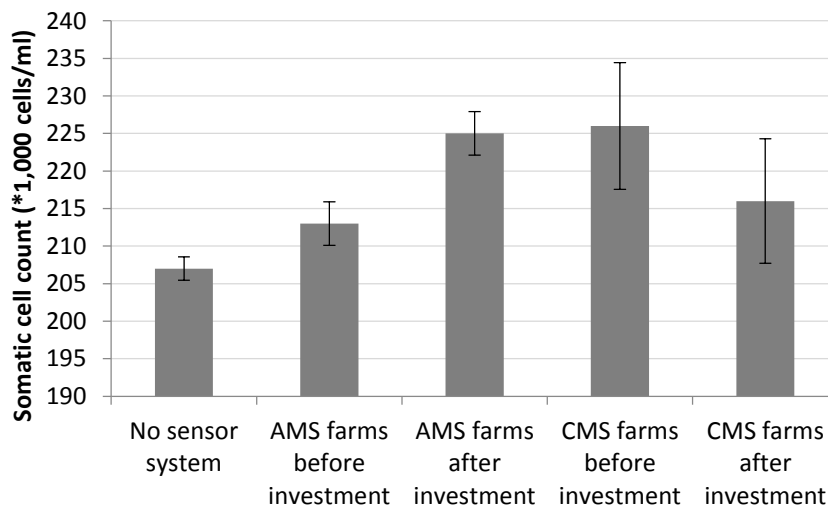
Figure 1: Estimated average SCC for farms who never invested in mastitis detection sensor systems, for farms with an automatic milking system (AMS) before and after the investment in mastitis detection sensor systems and for farms with a conventional milking system (CMS) before and after the investment in mastitis detection sensor systems. Values represent model predictions, and bars represent SE.

Having oestrus detection sensor systems did not have an effect on the days to first service. It is frequently mentioned that using oestrus detection sensor systems results in an improved oestrus detection (e.g., Kamphuis et al., 2012), but current results show that the dairy cows are not inseminated earlier. It is possible that the farmers detect the oestrus better but still use the same rules on when to start inseminating as without oestrus detection sensor systems, which results in equal days to first service. For instance, starting to inseminate cows after a voluntary waiting period is such a rule. Another reason for a lack of effect might be the motivation to invest. Most farmers invested in sensor systems for oestrus detection to improve the oestrus detection rate as well as to reduce labour (Steeneveld and Hogeveen, 2015). This means that the farmers are investing in sensor systems to ease management at the farms, and are thus less focused on improving reproduction measures of the herd. A final reason for not finding an effect on days to first service can be that the majority of the investments in oestrus detection

sensor systems was in recent years (Steeneveld and Hogeveen, 2015), which means that the positive effect of improved oestrus detection has yet to come.

During the years 2003 to 2013 the average number of cows on farms that never invested in sensor systems was 95. In the years before investment in sensor systems on AMS farms the average number of cows was 91, and this number increased to 104 cows in the years after investment. In the years before investment in sensor systems on CMS farms the average number of cows was 123, and this number increased to an average of 126 cows in the years after investment. An overview of the costs, revenues and profit on farms without sensor systems, on farms with sensor systems at an AMS and on CMS farms with sensor systems is provided in Table 2. A separation is made on the costs, revenues and profit in the years before and after the investment in sensor systems on both AMS and CMS farms. Total capital costs, total labour costs, total variable costs and total revenues were €11.28, €12.38, €18.55, and €46.28 per 100 kg of milk on farms without sensor systems. After investment in a sensor systems at AMS farms the total capital costs increased significantly from €10.49 to €15.08 per 100 kg of milk. This increase was due to the significant increase in depreciation on buildings, expenses on machinery and equipment and fuel costs. Labour costs (contract work, paid labour and own labour) and variable costs did not significantly change after investment in sensor systems on AMS farms. Total revenues were higher after the investment in sensor systems on AMS farms, especially due to higher milk revenues. On CMS farms there were no differences in costs, revenues and profit between the years before and after the investment in sensor systems.

A decrease in labour costs was expected after investment in sensor systems. The results show, however, no decrease in labour costs after investment in sensor systems on both AMS and CMS farms (Table 2). The costs for own labour were determined by using the FTE, and not finding a decrease in FTE might have several reasons. First, farms in the current dataset may be more focused on increasing in size than on having more free time thus showing no decrease in FTE as they plan a transition to more cows. This movement to an increased size probably means that the released labour when starting using sensor systems is put into other farm activities that coincides with increasing in size. Another explanation for no change in FTE, could be that labour savings after investment in sensor systems are not as large as first expected. It is clear that some labour requirements are reduced, but those may be replaced with other labour requirements (interpreting sensor data and checking alerts), which results in the net labour change being ambiguous. There are no studies that investigated the change in labour time after investment in sensor systems. Finally, we used a very rough measurement to evaluate the changes in labour use. The FTE data were provided by the farmers themselves and they may record a full FTE regardless of the actual hours worked each year, which may be reduced by using sensor systems but still considered full time by most. A significant increase in total capital costs was observed after investment in an AMS (Table 2). Other studies evaluating investing in an AMS reported an increase in capital costs as well (e.g., Steeneveld et al., 2012). Also a significant increase in milk revenues was observed after investment in an AMS (Table 2), and this may be due to more than two milkings per day (e.g., Kruip et al., 2002). Milk revenues were higher in the years after investment in an AMS. Because of higher capital costs as well, the profit was lower in the years after investment in an AMS.

Table 2: Average values[1] for the costs, revenues and profit (€/100 kg milk) over the years 2008 to 2013 for farms without sensor systems, for farms with an automatic milking system (AMS) before and after the investment in sensor systems, and for farms with a conventional milking system (CMS) before and after the investment in sensor systems.

	Included farm accounting data	No sensor systems	Sensor system at AMS		Sensor system at CMS	
			Before	After	Before	After
Capital costs	Expenses on buildings	1.37	1.57[a]	1.33[a]	1.60[c]	1.76[c]
	Depreciation on buildings	2.10	1.15[a]	3.36[b]	2.44[c]	2.84[c]
	Expenses on machinery and equipment	4.55	4.33[a]	5.98[a]	4.62[c]	4.60[c]
	Depreciation on machinery and equipment	2.14	2.44[a]	3.09[a]	2.26[c]	2.01[c]
	Fuel costs	0.90	0.77[a]	1.11[b]	0.89[c]	0.99[c]
	Miscellaneous	0.22	0.23[a]	0.21[a]	0.16[c]	0.14[c]
	Total capital costs	11.28	10.49[a]	15.08[b]	11.97[c]	12.34[c]
Labour costs	Contract work	3.06	2.53[a]	2.93[a]	3.28[c]	3.08[c]
	Paid labour	0.36	0.89[a]	0.70[a]	0.94[c]	0.94[c]
	Own labour	8.96	8.27[a]	7.67[a]	7.08[c]	6.41[c]
	Total labour costs	12.38	11.69[a]	11.30[a]	11.30[c]	10.43[c]
Variable costs	Total variable costs	18.55	17.89[a]	18.69[a]	17.39[c]	18.25[c]
Revenues	Milk	40.52	39.21[a]	40.80[b]	40.52[c]	41.40[c]
	Livestock	4.04	3.35[a]	3.33[a]	3.52[c]	3.66[c]
	Other farm activities	1.03	0.89[a]	1.55[a]	1.26[c]	1.40[c]
	Miscellaneous	0.69	0.48[a]	0.70[a]	0.47[c]	0.72[c]
	Total revenues	46.28	43.93[a]	46.38[b]	45.77[c]	47.18[c]
Profit	Total revenues – total costs	4.07	3.86[a]	1.31[b]	5.11[c]	6.16[c]

[1] Corrected for price indices with year 2008 as base year.

[a–b] Averages with different superscript in the columns before and after investment in sensor systems on AMS farms are significantly different ($P<0.05$).

[c–d] Averages with different superscript in the columns before and after investment in sensor systems on CMS farms are significantly different ($P<0.05$).

Conclusions

Having mastitis detection sensor systems are associated with a decreased average SCC on CMS farms and with an increased average SCC on AMS farms in the years after the investment. Having sensor systems was associated with a higher average production per cow on AMS farms, and with a lower average production per cow on CMS farms in the years after investment. Having oestrus detection sensor systems did not improve the reproduction performance. Total capital costs and milk revenues increased after investment in sensor systems on AMS farms. A decrease in costs for own labour after investment in sensor systems was observed, but this decrease was not significant on both AMS and CMS farms.

Acknowledgements

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Homestead Dairy LLC
Plymouth, IN
Brian Houin
brian@homesteaddairy.com

Family owned and operated since 1979

Homestead Green Energy Est. 2013

Farm History

➢ Partnership began in 1979
- Purchased family farm from parents
- Began by milking 110 Holstein cows
- Gradual growth through early years

➢ Parlor expansion in the early 90's
- Milking herd grew to 800 cows
- Future growth required further expansion
- As the family grew, so did the farm

➢ Built new parlor and free stall barn in 2000
- Allowed for continued expansion
- Purchased neighboring facility in 2004
- Next generation purchased own dairy in 2007

Manure Solids

- Our choice for bedding
- Easy to handle
- Renewable source

Where We Are Today - 3 Milking Parlors

1. Homestead double 25 parallel parlor built in 2000
   - Afifarm and Afilab
   - Currently houses maternity area and all fresh cows
   - Milking 1850 cows, 3 times a day
   - Holds all hospital cows milked in original parlor

2. H2 or Larry's double 8 Herringbone purchased in 2004
   - Afifarm
   - Expanded to a double 10 Herringbone in 2008
   - Currently Milking 630 cows, 3 times a day
   - Houses all heifer calves from birth to 6 months of age
   - Approximately 1100 heifer calves

3. Legacy Dairy Purchased in 2007 as a double 8 parallel parlor
   - Afifarm
   - Expanded in 2010 to a double 12 parallel
   - Currently milking 730 1st lactation cows, 3 times a day

Day Of Birth

Calf Growth

Weigh all calves
- Birth
- Weaning
- 4 Months old
- 6 months old

Aides in culling

Have done research with Purdue

Heifer Raising

H2 (pictured left)
- Calf huts and calf barns

Rollin'-Acres Holsteins, LLC
- Raise 800 heifers from 6 months to breeding

Shaum Family Farms
- Raise 2000 heifers
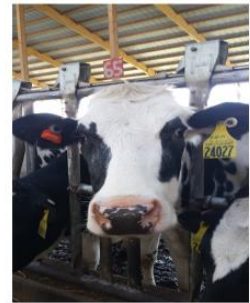- Breeding heifers to springers
- Cow Manager System

---

zoetis   CLARIFIDE.
Predict the future now.

Genetic Testing

- Valuable Tool to rank your herd
- Aides in Culling Decisions
- Confirms Parentage
- Reduce In-Breeding
- Speed up your genetic gain

CowManager

- Information on the cloud
- Location of tag critical
- Records activity, eating time, rumination, and ear temperature

---

How We Utilize Clarifide Testing

- Bottom 5-10 % Used As Recipients

- Bottom 10-50% bred conventional AI

- Top 50 % bred sexed semen

- Top ~ 2 % IVF

Heifer Breeding

Conception Rates by Breeder

95% CI	Total	7	507
Nicolas	44-50	57-69	38-45
Eduardo	50-55	64-74	44-50
Vidal	50-55	62-73	45-51
EM	–	–	–
OTHERS	–	–	–
TOTALS	49-52	64-70	44-47
Percent			
Nicolas	47	63	42
Eduardo	53	69	47
Vidal	53	68	48
EM			
OTHERS			
TOTALS	51	67	45
Count			
Nicolas	1119	290	829
Eduardo	1505	389	1116
Vidal	1186	281	905
EM	20		20
OTHERS	23		23
TOTALS	3853	960	2893
Pregnant			
Nicolas	528	183	345
Eduardo	794	269	525
Vidal	624	190	434
EM	7		7
OTHERS	4		4
TOTALS	1957	642	1315

CR Conventional   CR Sexed

Pregnancy Rates

ds AIDAT	Br Elig	Bred	Pct	Pg Elig	Preg	Pct	Aborts
1/01/14	216	172	80	214	116	54	1
1/22/14	210	149	71	209	84	40	2
2/12/14	257	190	74	255	115	45	6
3/05/14	241	184	76	240	106	44	3
3/26/14	236	192	81	235	96	41	3
4/16/14	258	210	81	254	95	37	2
5/07/14	230	191	83	227	82	36	3
5/28/14	231	179	77	228	75	33	3
6/18/14	257	217	84	254	82	32	2
7/09/14	303	227	75	299	108	36	6
7/30/14	286	221	77	283	109	39	3
8/20/14	296	247	83	293	154	53	4
9/10/14	233	189	81	231	109	47	2
10/01/14	175	145	83	174	78	45	1
10/22/14	304	195	64	299	96	32	1
11/12/14	342	238	70	341	140	41	1
12/03/14	295	200	68	293	111	38	4
Total	4370	3346		4329	1756	41	47

Heat Detection   Preg Rate

Slide 1

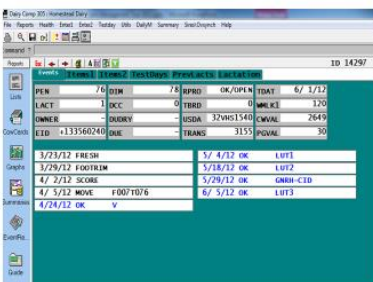DairyComp 305
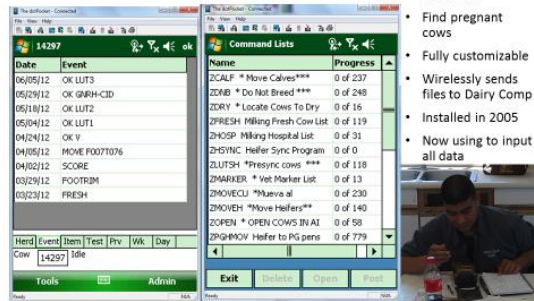
Herd Management Software

- Our first piece of technology
- Purchased in the late 90's
- Tracks history of each animal
- Current status
- Creates lists automatically
- Generates graphs and reports

ID 14297

PEN	76	DIM	78	BPRD	OK/OPEN	TDAT	6/ 1/12
LACT	1	DCC	0	TBRD		WMLK1	120
OWNER	-	DUDRY		USDA	32vms1340	CWVAL	2649
EID	+133560240	DUE		TRANS	3155	PGVAL	30

3/23/12 FRESH — 5/ 4/12 OK — LUT1
3/29/12 FOOTRIM — 5/18/12 OK — LUT2
4/ 2/12 SCORE — 5/29/12 OK — GNRH-CID
4/ 5/12 MOVE F007T076 — 6/ 5/12 OK — LUT3
4/24/12 OK — V

Slide 2

Pocket Cow Card

- Vet lists
- Sort cows
- Find pregnant cows
- Fully customizable
- Wirelessly sends files to Dairy Comp
- Installed in 2005
- Now using to input all data

14297

Date	Event
06/05/12	OK LUT3
05/29/12	OK GNRH-CID
05/18/12	OK LUT2
05/04/12	OK LUT1
04/24/12	OK V
04/05/12	MOVE F007T076
04/02/12	SCORE
03/29/12	FOOTRIM
03/23/12	FRESH

Command Lists

Name	Progress
ZCALF * Move Calves***	0 of 237
ZDNB * Do Not Breed ***	0 of 248
ZDRY * Locate Cows To Dry	0 of 16
ZPRESH Milking Fresh Cow List	0 of 119
ZHOSP Milking Hospital List	0 of 31
ZHSYNC Heifer Sync Program	0 of 0
ZLUTSH *Presync cows ***	0 of 118
ZMARKER * Vet Marker List	0 of 13
ZMOVECU *Mueva al	0 of 230
ZMOVEH *Move Heifers**	0 of 140
ZOPEN * OPEN COWS IN AI	0 of 58
ZPGHMOV Heifer to PG pens	0 of 779

Cow 14297 Idle

Slide 3

DairyComp 305

Calving Report

EVENTS: CALF Report for 06/10/11 - 06/09/12

Month	Fresh	None	Twins	%T	Male	Female	%F	Alive	Dead	%D	M:Dead	%M	F:Dead	%F
Jun11	261	0	10	4	103	147	59	244	6	2	3	3	3	2
Jul11	358	3	11	3	141	224	61	342	23	6	6	4	17	8
Aug11	369	0	10	3	144	232	62	356	20	5	7	5	13	6
Sep11	344	0	7	2	143	206	59	324	25	7	11	8	14	7
Oct11	341	0	12	4	135	215	61	330	20	6	10	7	10	5
Nov11	317	2	14	4	143	183	56	313	13	4	6	4	7	4
Dec11	331	0	14	4	147	197	57	326	18	5	9	6	9	5
Jan12	370	1	15	4	162	218	57	365	15	4	3	2	12	6
Feb12	379	0	9	2	149	239	62	367	21	5	11	7	10	4
Mar12	359	0	7	2	159	205	56	349	15	4	8	5	7	3
Apr12	322	7	9	3	136	188	58	306	18	6	8	6	10	5
May12	338	2	14	4	150	199	57	334	15	4	9	6	6	3
Jun12	121	1	7	6	69	58	46	117	10	8	6	9	4	7
TOTAL	4190	16	139	3	1781	2511	59	4073	219	5	97	5	122	5

Milk Summary

By PEN	Pct	Count	AvWMLK1	AvDMLK1	Av DIM	Tt MILK
1	10	173	109.9	108.0	68	18589
2	10	180	108.2	106.6	95	19703
3	10	179	76.6	77.8	65	12857
4	9	172	107.3	107.0	85	18653
5	14	252	80.7	80.6	224	20320
6	18	322	78.7	79.0	236	25885
7	8	143	61.2	67.5	10	1589
8	10	177	76.6	74.0	306	13031
9	2	38	64.6	47.8	108	2636
16	10	182	81.9	84.3	215	15026
Total	100	1818	86.2	86.7	158	148289

Slide 4

afimilk
The Heart of the Dairy Farm

- Installed at Homestead Dairy in 2005
- Installed at Legacy Dairy in 2010
- Installed at H2 in 2011
- Real time monitor identifies cows when they enter the parlor
- Also records amount of milk given by each cow

Afi Real Time Monitor

GERMANIA – Afifarm real time processing Ver. 3.075

01	14108	4590	20.6
02	14167	3813	20.8
03	13832	3050	24.7
04	14740	3421	24.9
05	13880	3579	25.6
06	14839	1184	25.8
07	14130	2176	32.1
08	14317	4501	17.0
09	14536	0736	31.7

Slide 5

Bluetooth EID Reader

- Reads microchip in white button tag
- Sends tag number to handheld computer

Slide 6

afimilk
The Heart of the Dairy Farm

Lactation Graph

Milk : 12065

Lact. yield	12065	Predicted production	20095
Peak yield	--	Total yield (forecasted)	32160
DIM at peak yield	--	Lact. ECM (m.t.)	--
Persistency (%)	--	Lact. FCM (m.t.)	--

afimilk®
The Heart of the Dairy Farm

Health Problems

Sub-Clinical Ketosis

AfiLab™

In-Line, Real-Time Milk Analysis

afimilk

Installed March 2015

1. Records individual fat, protein, and lactose of the milk

2. Finds sub-clinical ketosis, before the cow shows clinical signs

3. Finds mastitis cows

4. Have a DHI test every day of the month

5. Monitor Feeding

05/14/2015   GERMANIA - AfiFarm v 3.076   04:28:4

Group component

Calculated: 05/14/2015 04:28:43

Index	Status+ group	Total animals	Daily yield	Last week	Daily ECM	Daily avg. ECM	Daily Fat[%]	Daily Protein[%]	Daily Avg. Fat[%]	Daily Avg. Protein[%]	Daily Lactose[%]
1	101	186	104.0	109.1	97.5	--	3.05	2.95	3.02	2.94	4.53
2	102	173	92.4	97.5	98.3	--	3.88	3.22	3.88	3.23	4.54
3	103	174	68.6	72.2	70.7	--	3.64	3.17	3.60	3.19	4.48
4	104	184	103.3	108.5	98.9	--	3.15	3.06	3.16	3.05	4.54
5	105	242	74.1	82.1	75.0	--	3.49	3.20	3.45	3.18	4.49
6	106	363	67.2	79.6	68.6	--	3.55	3.22	3.48	3.20	4.47
7	107	95	79.9	93.2	79.2	--	3.37	3.13	3.33	3.12	4.56
8	108	179	83.2	88.4	85.3	--	3.59	3.20	3.40	3.17	4.45
9	109	49	63.5	65.9	71.0	--	4.20	3.39	3.45	3.07	4.20
10	116	183	62.7	95.5	62.4	--	3.40	3.12	3.30	3.12	4.48
11	119	89	141.9	111.2	138.4	--	3.30	3.03	3.26	3.06	4.52
Total	--	1917	--	--	--	--	--	--	--	--	--
Avg.	--	--	82.6	90.6	82.8	--	3.48	3.15	3.40	3.14	4.49

Production sum. by DIM- Comp. (05/14/2015 18:07:39)

DIM	Total animals	Cows lact. 1	Cows lact. 2	Cows lact. 3+	Pregn. cows %	Confirmed pregnant	Do not breed	Calving	Bred no preg check	Confirmed open	Daily yield	Last week	Daily Fat[%]	Daily Protein[%]	Daily Fat/Protein	Daily ECM	Daily FCM
0 - 30	359	153	104	102	--	--	--	359	--	--	71.7	89.5	3.81	3.20	1.19	75.6	75.5
31 - 60	277	123	83	71	--	--	11	232	10	--	89.8	103.7	3.23	3.00	1.08	86.6	85.6
61 - 90	272	82	112	78	--	--	12	67	185	--	90.9	109.9	3.13	3.03	1.03	86.6	85.1
91-120	295	94	98	103	21	62	22	7	203	--	89.3	104.2	3.22	3.06	1.05	86.4	85.0
121-150	341	118	113	110	48	164	13	--	164	--	81.4	96.9	3.22	3.05	1.05	78.6	77.4
151-180	309	123	93	93	66	203	12	--	93	--	72.1	91.4	3.29	3.09	1.06	70.6	69.6
181-210	318	137	84	97	78	247	17	--	54	--	68.7	86.8	3.45	3.15	1.09	69.0	68.1
211-250	448	211	119	118	83	370	20	1	55	--	65.7	80.7	3.56	3.22	1.11	67.2	66.4
250+	735	392	190	153	76	555	151	3	25	--	57.7	72.4	3.72	3.30	1.13	60.5	59.8
Total	3354	1433	996	925	--	1601	258	669	789	--	--	--	--	--	--	--	--
Avg.	--	--	--	--	--	--	--	--	--	--	73.2	89.4	3.46	3.15	1.10	73.1	72.2

Suspected Sub-acute Acidosis-Homestead (05/12/2015 09:06:52)

Index	Status+ group	Total animals	DIM	Daily yield	Daily avg. yield	Daily yield <%>	Daily Fat[%]	Daily Avg. Fat[%]	% suspect acidosis	Low fat cows
1	101	186	76	82.4	97.9	-16	3.06	3.04	9.1	17
2	102	138	22	74.8	83.6	-10	3.78	3.90	--	--
3	103	147	20	45.1	59.6	-24	3.51	3.62	--	--
4	104	182	89	84.8	102.2	-17	3.18	3.15	7.7	14
5	105	246	230	65.5	72.3	-9	3.51	3.43	--	--
6	106	377	249	51.7	64.7	-20	3.54	3.46	--	--
7	107	95	119	71.8	80.7	-11	3.31	3.31	2.1	2
8	108	183	207	59.0	74.8	-21	3.44	3.37	--	--
9	109	57	118	66.4	67.8	-2	3.66	3.50	--	--
10	112	1	427	--	--	--	--	--	--	--
11	116	183	191	63.7	79.0	-19	3.33	3.28	--	--
12	119	91	77	80.6	97.5	-17	3.25	3.25	8.8	8
Total		1886	--	--	--	--	--	--	--	41
Avg.	--	--	151	65.6	79.1	-16	3.42	3.39	--	--

SARA

- Tells you % of group with low fat

- Changes to blue if more than 10%

- Great tool for Nutritionists!

WeighRite — Inventory Tracker

FeedWatch — Feeding Software

Installed in 2006
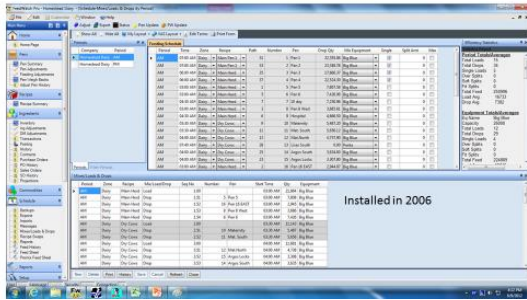
Questions?   Thanks

brian@homesteaddairy.com

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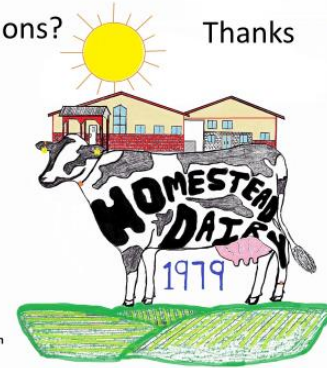
vas. CHEMWATCH — Handheld NIR Reader Measures DM in Seconds

The Ritzema Family

ritzemafarms@hotmail.com

Daily Farm Routine Around Robots

- ✓ Morning
  - ✓ Fetch Overdue Cows ~4%
    - ✓ Groom Free stalls
  - ✓ Fetch Incomplete Cows ~2%
  - ✓ Lockup Head Gates and Feed
    - ✓ Breed and Drench any cows
  - ✓ Robots Daily Cleaning and Maintenance Routine
- ✓ Noon
  - ✓ Fetch Fresh Cows an Extra Time
- ✓ Evening
  - ✓ Fetch Overdue Cows ~4%
    - ✓ Groom Free stalls

Ritzema Dairy Ltd.

My Daily Management Routine

- ✓ New **Herd Navigator** Heat Alarms and Cow to Breed report
- ✓ Fresh Cow Check report
- ✓ New **Herd Navigator** Ketosis report
- ✓ New **Herd Navigator** Mastitis report
- ✓ Feed Check report

Ritzema Dairy Ltd. By The Numbers

- ✓ 335 Cows Milking and Dry
- ✓ 6 Row Free stall Drive Through Feed Alley
- ✓ 6 DeLaval VMS and **Herd Navigator**
- ✓ 2 Groups with 3 Robots Each 1 Group for Cows 1 Group for Heifers
- ✓ 10750 KG (23700 lbs) of Milk @ 4.2% BF Average of Current 305 Day Lactations
- ✓ 180,000 SCC
- ✓ 22.1 Months Age at First Calving
- ✓ 12.3 Month Calving Interval
- ✓ 33.4% of Herd 3rd+ Lactations
- ✓ 89% of Herd in Milk

New HN Heat Alarms & Cow to Breed Report
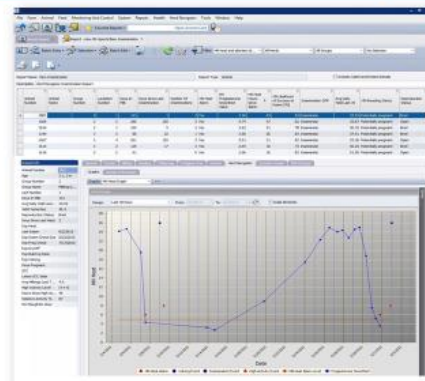
Fresh Cow & Feed Check Report

How Herd Navigator Measures Up On My Farm

- Reproduction **before** Herd Navigator :
  - ➤ 5 Year Average of 26% Pregnancy Risk
  - ➤ 5 Year Average of 109 Days Open
  - ➤ All Cows Enrolled into a Strict Synchronization Protocol at a Cost of $31 CAD per Cow + Resynch if needed
  - ➤ Maximum 4 Insemination before 220 DIM
- Reproduction **after** Herd Navigator :
  - ➤ 1 Year Average of **34% Pregnancy Risk**
  - ➤ 1 Year Average of **98 Days Open**
  - ➤ Breed All Reproductively Health Cows on HN Heat Alarm for **<10% of All Cows that are Anoestrus or Cystic wait or use targeted hormones**
  - ➤ Now **Maximum 7 Insemination** if needed before 220 DIM

My Weekly Routine

- ✓ **Herd Navigator** Luteal Cyst report
- ✓ **Herd Navigator** Follicular Cyst report
- ✓ Double Check DC305 for missed cows:
  - ✓ DIM >70 still FRESH
  - ✓ DSLH >35 not PREG
  - ✓ Lookup any cows **Herd Navigator** Progesterone graph

GRAPH BRED\S\D1825
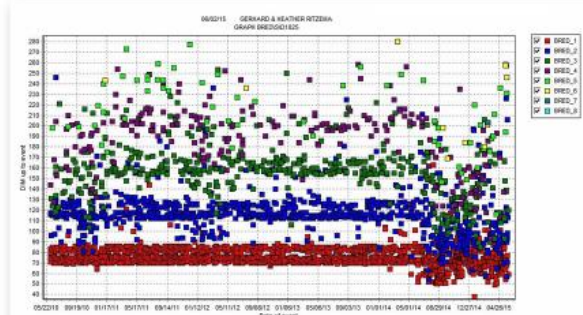
No Missed Cows

50% of Cows Pregnant by 83 DIM
70% of Cows Pregnant by 104 DIM
21 Day Preg Risk of 1 year with HN
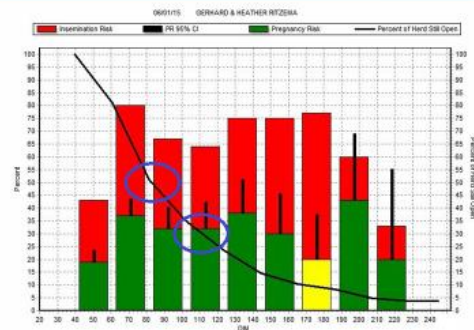
50% of Cows Pregnant by 105 DIM
70% of Cows Pregnant by 149 DIM
21 Day Preg Risk of 5 years before HN
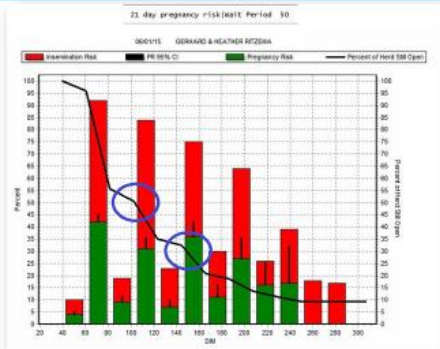
Herd Navigator Pays Back On My Farm in 7 Years (CAD)

- $172K Herd Navigator Capital Investment
- $4.5K Yearly Preventative Maintenance
- $115 per Cow per Year for HN Consumables
- $207 per Cow per Year Grand Total
- $62 per Cow per Year Net Profit for Improving Preg Risk
- $98 per Cow per Year Reduction in Veterinary Cost (hormones and labour)
- $47 per Cow per Year Selling 10 Extra Fresh Heifers
- Now Faster Advancing Genetics by Culling Harder

Thank You!!

For more information/updates please follow us on Twitter
@ritzemadairy

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twitter

North American Application of Automatic Teat Spray Robots for External Rotary Parlors

Mark Futcher
Market Development Manager - Capital Goods
Sales Company North America - DeLaval Inc.
Bannockburn, IL
mark.futcher@delaval.com

Introduction

Throughout the past 50 years, significant gains have been realized as related to milk quality and animal health (MQAH) within the dairy industry. These improvements stem from a focused effort by all involved including, but not limited to-

- Dairy Producers
- Academia
- Extension
- Advisors and Advisory Councils
- Manufacturers of Dairy Equipment and Supplies

It is commonly accepted that a wide array of variables impact MQAH at any given moment in time. Pre- and post-milking teat disinfection are proven tools for management of milk quality. But certainly, an adherence to a proven Standard Operating Procedure (SOP) each and every milking of each and every cow, optimizes the benefit of these tools. The dairy industry and individual dairy producer alike are not immune to leveraging technology(s) in attempts to become more efficient. Today we are beginning to realize a greater adaptation of robots to perform tasks related to milk extraction: what may have once been considered a novel technology is sure to become the norm going forward.

The same can be said for rotary parlors- these are not something new. In fact, the first rotary parlor was commissioned commercially in 1930 at the Walker-Gordon Farm in Plainsboro, NJ. While rotary parlors throughout the 20th century fell in and out of favor, today they have evolved, or 'revolved' to a point where they have clearly demonstrated the possibility of increased efficiencies. Perhaps this alone is the reason why a growing number of large(r) dairy operations, those intending to milk in excess of 1000 cows, are utilizing external rotary parlors in North America, or aspire to do so in the future when replacing existing milking systems.

As such, the industry is actively seeking to combine robotic solutions with external rotary parlors.

History of Automatic Teat Sanitation

It is appropriate to look backward to understand the benefits of and need for robotics to standardize operating procedures.

Wash Pens-

The advent of wash pens could be considered the first semi-automatic or automatic teat spray use with milking parlors. They were first introduced predominantly in arid climates and with dry-lot style dairies.   Wash pens followed by a drip or drying pen, utilize(d) sprayers at defined spacing in a holding area or collection yard where cows are corralled prior to milking, to deliver

potable water with a cleaning or sanitizing addition. For a defined period of time, the wash pens rinse and remove organic matter from the mammary system, udders and teats of cows. Teats/udders were visibly cleaner and published research showed while teats were by no means sterile, bacteria counts could be reduced by 90-95%. By default this system also may serve to provide some cooling of the cows as a means of heat stress abatement. This was, and remains, a pre-milking practice only.

Mechanical Teat Sanitation with Milking Parlors-

This type of system incorporated a nozzle or multiple nozzles connected to a pump, to spray a disinfectant such as iodine, in the direction of the teats and udder. These systems spray blindly, meaning without a teat recognition device, coverage of the receiving teats realize marginal hit rates under the best circumstances. These mechanical devices may have been located within or on an extension from the milking parlor platform, or floor-mounted within the entrance and exit (return) lane(s) of the parlor.

Mechanical devices typically would be configured with a type of cow sensing device, such as a simple wand or photo-cell that would trigger the spray of the product upward for a defined period of time. Whether an adequate hit rate with a disinfectant is achieved will vary due to cow gait, speed, nozzle type and cleanliness, pattern of spray cone/fan, ambient air velocity, nozzle distance from teat, and so on. Underbellies, navels, feet and legs, maybe even the sides of cows could also be sprayed, but not necessarily the teats of the same cow.

Automatic Milking System (AMS)-

Although the first patents involving automatic teat sensing/recognition date back to the mid 1970s, it was not until the early 1990s when the first AMS were installed at both university research facilities and commercial dairies in both Europe and North America. An AMS, often referred to as a robot or robotic milker, performs most all of the milk extraction functions that are completed manually in a conventional system such as a parlor. Of course, successfully identifying teats is paramount for pre-milking cleaning/disinfection, cluster attachment and post-milking teat disinfection.

An AMS ideally mirrors the industry-proven SOPs for teat sanitation both pre and post milking, though these may be achieved in a number of ways. Some robotic milkers utilize the milk cup attached to a teat to also perform pre-milking sanitation. Some utilize brushes, while others utilize a fifth cup, or pre-milking cup, to perform pre-milking sanitation on each teat as well as stimulation and foremilking. In addition, some robots have the ability to pre-spray teats via a nozzle located on the arm before the steps noted above occur.

For post-milking, the application of a post-milking sanitary product varies depending on the manufacturer. Some may have a nozzle located in the floor of the robot beneath the udder, operating much like a mechanical teat sprayer noted earlier. Some may apply product within the milk cup, while others may spray the teats with a nozzle located on the arm performing a defined path of movement which is 'smart'. This means that it knows the location of teats based on the last series of milk cup attachments.

Automatic Application of Post Milking Disinfectant Product within Milk Cup (Liner)-

This type of system is used for both conventional and automatic milking parlors. Market adaptation to this point has been somewhat limited, perhaps due to several perceptions and/or realities-

    i.   Limited choice of associated inflation/liner and/or milking unit

ii.   Weight of milking unit

iii.   Ergonomics of milking unit

iv.   Concern of milk safety/contamination risk if system (valve) failure and/or residue on milk contact surfaces

v.   Inconsistent teat coverage and hit rate

Automatic Teat Spray Robots in External Rotary Parlors-

Over the past 6 years we have witnessed the first entries of automatic teat spray robots incorporated with rotary parlors. These robots perform only the function of automated teat disinfection application. They can be employed for pre- or post-milking teat dip application and have the potential to provide consistent teat coverage and hit rate while reducing labor cost. Today they are suitable for external rotaries but not in-line or batch parlors such as herringbones and parallel parlors. There are several reasons for this, namely-

i.   The cows come to the robot- meaning the robot must not travel considerable distance to perform the task on individual cows

ii.   Safety- per above, the robot is fixed in place allowing for a defined space of operation and barrier from contact with people

iii.   Cost effectiveness

Automatic teat spray robots were a natural progression stemming from the experience gained with AMS and use of a teat recognition/sensing device. The sensing device may include lasers, or various types of cameras- 3-D, Time Of Flight (TOF) and/or a combination. The effectiveness of this technology requires a diligent management routine to maintain the consistent function of the robot as there is often not a human present to see if the robot performance is becoming less consistent.

Teat Candidates-

As indicated, teat position identification accuracy is critical for these robots, but in reality the technology is identifying teat candidates.

What is a teat candidate? A teat candidate is an object the robot could potentially misidentify as a teat. For example, organic material clinging to udder hair 'may' present as a teat candidate. For this reason, it is critical the dairy management have a strict SOP for monitoring and maintaining udder hair at a minimal length.
Similarly, a long switch (the hair at the end of the tail) of a cow may present itself as a teat candidate. As with udder hair, it is important this too is routinely maintained at a short length, preferably at the end of the tail bone. It should be noted this practice is not considered tail docking, nor is absolute tail docking a requirement for use of automatic teat spray systems.

Teat spray robots when used with external rotary parlors have a tool, or end effecter, attached to the robotic arm which gains proximal access to the udder and teats by means of entry between the rear legs of the presented cow. In most cases, it is mandatory that a device is strategically positioned on the floor or deck of each stall of the rotary platform to effectively widen the stance/position of the cow's rear feet and legs and help fix the cow location. Such a device is referred to as a cow locater, cow positioner, or at times, leg spreader. Without the use of a cow locater, a cow which is genetically somewhat sickled in the rear legs (inside of hocks touching or close together), a smaller framed cow having an abundant amount of lateral space in the stall, or perhaps a somewhat lame cow may not present a broad enough opening for the end effecter to enter. In addition, when using a robot to perform the post milking application of a

sanitary solution to teats, a milking unit remaining attached to a cow would obviously eliminate any possibility for access to teats.

Teat Hit Rate and Coverage-

We should note, as an industry our mandate is to ensure all teats are properly covered with a pre and post milking solution 100% of the time. This goal MUST remain. Teat disinfectant application can be measured by the hit rate, percent of teats with a droplet of product (dip) on the teat tip, and coverage, the percent area of the sides of the teat that are covered. In a conventional system with manual (human) application of hygienic solutions (dip) to teats, both pre- and post-milking, the hit rate, and coverage of the entire barrel of a teat is rarely 100%. While a 100% hit rate of dip on teats is possible when manually applied, it has been suggested, based on unbiased real-time observation, this hit rate and coverage at a given moment in time varies from 50 to 100% for dipping, but is often not greater than 50% for manual spraying.

There are a number of reasons for this deviation-

    i.   Dip Cups- Is the teat properly immersed in the dip? Secondly, was the dip cup physically held and oriented parallel to a particular teat's angle?

    ii.   Dip Sprayers- If a sprayer is used, is the sprayer properly held and moved around a teat at the time of dip application?

    iii.   Individual responsible for teat dipping/spraying is focused on another task and/or misses some teats/cows.

    iv.   Product (dip) limitations and/or same for device utilized for delivery to teats.

    v.   A nervous or flighty cow makes it unsafe for an individual to put their arm and hand beneath udder.

    vi.   Compromised adherence to defined SOP by a particular individual (parlor operator).

    vii.   Others

Some automatic teat spray robots, when properly installed, maintained and operated can certainly achieve hit rates approaching or consistent with industry norms.

Rationale of Applying Automatic Teat Spray Robots for External Rotary Parlors-

From dialogue with dairy producers exploring the possibility of incorporating an automatic teat spray robot in conjunction with their external rotary, it seems the reasons for doing so may include one or all of the possible benefits listed-

    i.   Efficiency- most often expressed as a reduction in labor demands associated with the task of dipping/spraying teats both pre and post milking.

    ii.   Consistency- cows thrive on routine and consistency. A properly designed and maintained automatic teat spray robot can be remarkably consistent in performing a task.

    iii.   Safety- for both cow and operator. A properly designed and maintained automatic teat spray robot should be quiet and not pose any risk of injury to the cow. Further, the risk of human injury from a flighty cow is decreased proportionately to the elimination of a manually performed task.

    iv.   Accuracy- Achieve status-quo or enhance due to consistency.

    v.   Return On Investment- ROI often measured by the reduction of labor and associated wage(s) and benefit(s) per annum in addition to possible operational savings from a reduction in disinfectant (dip) use.

The 'Big 3'-

In many cases, three (3) demands are placed on an automatic teat spray robot for external rotary parlors-

1. Speed- fast operation or ability to function and perform the task at a given rotation speed is often expressed on the basis of seconds per stall rotation speed of the rotary platform.
2. Accuracy- apply product (dip) to the teats presented.
3. Consistent product (dip) use.

The 'Big 3' exhibit direct co-relations. As illustrated in Figure 1, a high speed may be possible while sacrificing accuracy or using a lot of product to achieve accuracy; or, little product may be used but accuracy will suffer.

Robotic moment of operating as fast as possible, applying product to teats as accurate as possible, while using as little product as possible
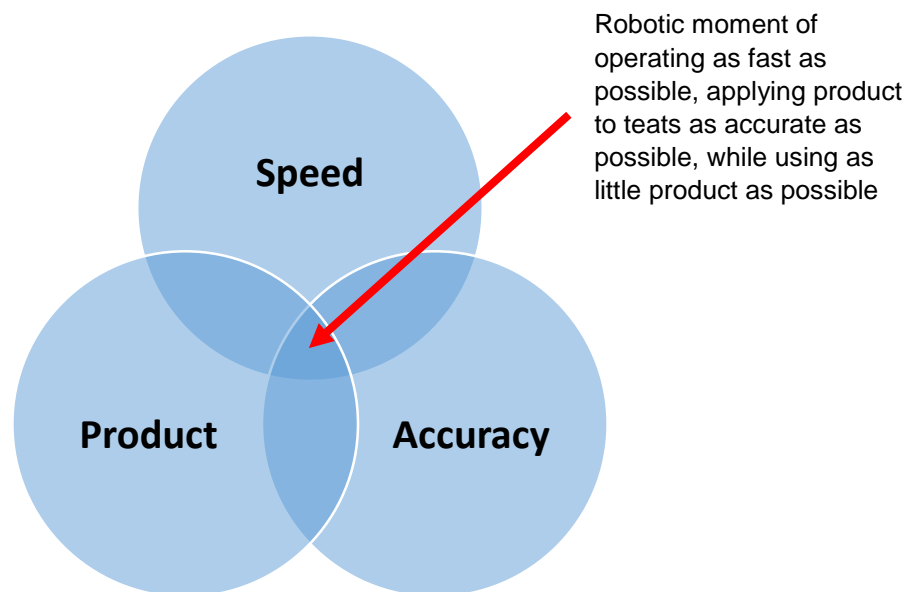
Figure 1.

Some automatic teat spray robots when used with external rotary parlors are able to achieve a speed of 9 seconds per stall (400 cows per hour) while utilizing between 9-15ml of product and achieving a hit rate of 90-95%. This productivity is acceptable in many cases, but not all as-

i. Some external rotary parlors have a faster rotation speed
ii. Some dairy producers are not willing to accept decreased accuracy
iii. Some dairy producers are not willing to accept greater product use

Anecdotal evidence and numerous studies indicate when teats are manually applied with disinfectant consumption of the product can range from as little as 5ml to as much as 30ml on a per cow basis. At all times, the waste of product should be minimized. Product waste may be defined as the amount of product consumed which was not applied to teats.

The 'Big 3' are the key aspects to evaluate when considering the investment of an automatic teat spray robot, or some number of them for use with an external rotary parlor. Of course, dependent on a particular technology, the initial capital expenditure combined with associated maintenance costs will have a direct impact on the ROI.

Summary

The performance of robots within the dairy industry has improved steadily over time. Together, we will adapt and refine robotic technology at the millisecond level; this is a process that had a beginning but will have no end. It is reasonable to assume additional tasks related to the milking process will one day be performed in external rotary parlors by robotic solutions beyond automatic teat spray. These improvements will stem from a focused effort by all involved including, but not limited to-

- Dairy Producers
- Academia
- Extension
- Advisors and Advisory Councils
- Manufacturers of Dairy Equipment and Supplies

There are several manufacturers with automatic teat spray robots and other products mentioned within this paper, available for use with external rotary parlors. Please contact applicable manufacturers for further detail and explanation.

How to Use PRECISION in Day-to-Day Management

Aurora Villarroel, DVM, MPVM, PhD, DACVPM, CVA, CTP
Americas West, Afimilk, Ltd.
aurora@afimilk.com

This conference focuses on precision dairy management, defined as the use of automation for information collection and process management to improve productivity and profitability. However, information is not collected *per se*, but in the form of data that then needs to be transformed into information. There are many data options to be collected on a farm: calving dates, insemination dates, whether the breeding was successful or not, dry-off dates, etc. Then, certain calculations and data combinations give us the information we need to evaluate certain areas of the farm, as in this case, reproduction. The main issue becomes in establishing what data we need to collect on each farm that will give us the required information to best manage it within the confines economic viability.

There are many areas on the dairy farm that need to be evaluated for optimal performance, but today we will concentrate specifically on reproductive management and sick cow detection and monitoring.

Reproduction

The eternal question for reproduction in dairy cattle is 'what breeding protocol do I need to follow to get cows pregnant?' However, this is not the real question, because, what do we get by getting every single cow pregnant if later every single one of them aborts? Will be happy if we get them all pregnant after 200 DIM? So, in keeping with the focus of this conference, let's make this question more precise: **'what breeding protocol do I need to follow to get all cows pregnant in time so they calve again within 12-14 months?'** To figure out this protocol, there are two different things that need to happen in series:

1. Cows needs to conceive
2. Cows need to stay pregnant

This means that we need to monitor two separate metrics to evaluate these two separate events. First we need to know how many cows of those we inseminate do conceive. This metric is called **conception risk** (CR) and is calculated dividing the total number of cows diagnosed pregnant at fist preg check by the total number of cows inseminated. Most people are used to hear the term **conception rate**, which only applies when it is calculated for a specific timeframe, such as for example a 21-day period.

$$Conception\ risk\ (CR) = \frac{number\ of\ cows\ that\ conceived}{number\ of\ cows\ inseminated}$$

The second thing we need to know is how many cows abort. This metric is called the **abortion risk**, and it is calculated by dividing the total number of abortions by the sum of the total number of pregnant cows and the cows that aborted.

$$Abortion\ risk\ = \frac{number\ of\ cows\ that\ aborted}{number\ of\ pregnant\ cows + number\ of\ cows\ that\ aborted}$$

The rationale behind this is that, epidemiologically speaking, a risk is calculated as animals with a specific event in the numerator, divided by animals eligible to see that event in the

denominator. The cows that have aborted were eligible to abort only because they were pregnant, so they need to be included in the denominator. For comparison, think for example of the following metric: if we say 15% of the people attending this conference drove to the meeting (as opposed to 85% flew in), the calculation takes into account in the numerator only those that drove, but in the denominator are all of the attendees to the conference, those that drove and those that flew in.

To complicate matters further, we know that some cows do indeed conceive, but they lose the embryo before preg check. These cows fall into a grey category called early embryonic death (EED), also called embryonic absorption. These are commonly evaluated by <u>assuming</u> that normal heat cycles have 18-25 days intervals, and that anything beyond 25 days is early embryonic death. This then begs the use of another metric to evaluate these cows, and that is the **proportion of insemination intervals that are greater than 25 days**. It is very important to stress that this is an <u>assumption</u>, and that not all cows that have insemination intervals greater than 25 days have indeed absorbed the pregnancy, but they could have had bad heat detection as seen in Figure 1. The counter part of this situation is in situations where cows are bred without being in heat but within a normal interval. This will make the metric look OK, effectively hiding the real problem on the farm (Figure 2).

Although EED and abortions can be due to infectious diseases such as BVD, IBR and leptospirosis, a weak embryo can die early without any other external factors influencing it. Part of the viability of the embryo is derived from an on-time conception with a mature oocyte and vigorous well-capacitated sperm. Other factors include genetic abnormalities and environmental conditions affecting the utero (e.g. fever and prostaglandin release due to inflammation in the cow). Therefore, correct insemination timing is important in making sure that conception happens, but also to make sure that the embryo has the best conditions to survive long-term. But **how do we determine when is the best time to breed a cow?** To answer this question we need information about reproductive physiology, specifically, the duration of certain intervals that have been evaluated with research and are presented in Table 1. Using these ranges, it becomes obvious that the largest variability is in the duration of the actual heat, which is likely the determinant for fertility, and yet it is not something that most heat detection systems are measuring.

- If we only know that the cow 'is in heat' (i.e. rubbed off or standing), we need to guess at which point of the heat she is. Timing to ovulation could be anywhere between 10-30 hours; obviously a very large range to determine when to breed.

- If we know when the cow started to become in heat (i.e. increased activity), we need to guess how long she is going to be in heat. Timing to ovulation could be anywhere between 24-42 hours. A narrower range to determine when to breed, but with too much lag time (although this may help farmers that can only breed once a day).

- If we know when she stopped being in heat, we need to guess how long it will be until ovulation. Narrow range of breeding time and short lag time, which doesn't leave much time for decision making, but provides the best breeding time.

Therefore, if we have a method to determine how long a cow is in heat, we can optimize insemination time. With the advancement of activity monitors over the past recent years, it has become possible to collect data on cow activity every hour of the day, so that decisions can be made almost immediately. For example, with the new AfiAct II system from Afimilk Ltd. it is possible to, not only determine when a cow starts coming in heat (increase in activity to over twice the baseline), but it is also possible to determine when the peak of that activity happens, as well as when it ends (Figure 4). This leads to much more precise decisions on when the best

time to breed a cow is. To fine-tune the best insemination time for each cow the farm can use automatic sorting gates that will place the cows in an accessible area without having to disturb the entire pen. Another viable option is to determine what the pattern of the majority of the cows is, and then adequate insemination times to the average cow in that farm. Collecting data on each cow on the farm will produce enough information to be able to customize the day-to-day management based on results on that specific farm, as opposed to basing decisions on research performed in different farms and under different conditions.

Table 1. Critical timings for fertilization in cattle.

Event	Avg time (hrs)	Range (hrs)
Pro-estrus duration (start of activity)	6	
Estrus duration (standing heat)	12	6 - 24
Estrus to ovulation	28	24 - 42
Oocyte life span		10 - 12
Oocyte migration to fertilization site	6	
Sperm life span		8 - 24

Sources:

- Senger PL. *Pathways to pregnancy and parturition*. 1999. Current Conceptions, Inc. Pullman, WA. 1st Rev Ed. 281 pages.
- Saumande J and Humblot P. The variability in the interval between estrus and ovulation in cattle and its determinants. *Anim Reprod Sci*. 2005 Feb;85(3-4):171-82.
- Hawk HW. Sperm survival and transport in the female reproductive tract. *J Dairy Sci*. 1983 Dec;66(12):2645-60.
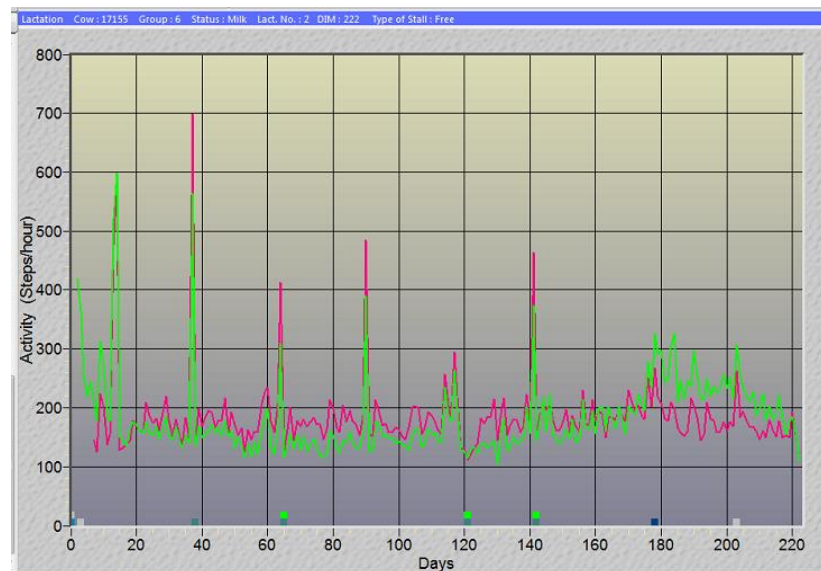
Figure 1. Cow inseminated 56 days after previous insemination that had a normal heat 25 days after previous insemination. Notice the heats indicated by high activity in the graph at 14, 37, 65, 90, 119 and 141 DIM. Inseminations are indicated by lime green boxes next to the X axis, at 65, 130, 121 and 141 DIM. The rugged activity past 180 DIM likely indicates lameness. Notice that she was in heat at 90 DIM but was not bred. Therefore, she will count in the metric as a long interval between breedings, which will be assumed an EED, when in fact she was in heat but was not bred (breeders in this farm were not following instructions correctly). This cow conceived to the breeding at 141 DIM, as indicated by the blue box next to the X axis at 178 DIM 9day of preg check).

Source: AfiFarm software, Afimilk Ltd.
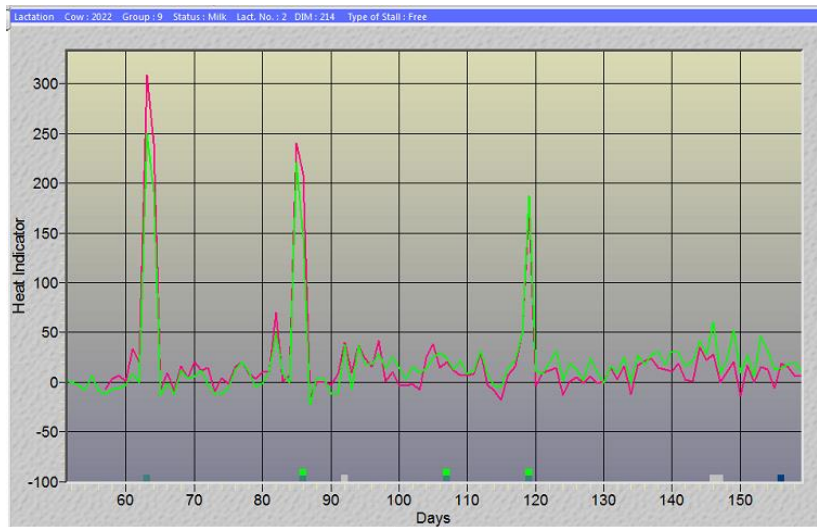
Figure 2. Cow that has been in heat 3 times and has been bred 3 times, but not at the appropriate times. Heats are indicated by high activity days at 63, 86 and 119 DIM. However, she was not bred at 63 DIM (before VWP). Instead she was bred at 86, 107 and 119 DIM, indicated by the lime green boxes (the breeders on this farm were still detecting heats visually and estimated that this cow was rubbed off). This cow will count as a normal breeding interval of 21 days (107-86) <u>and</u> a short breeding interval of 12 days (119-107), when in fact her real interval as determined by the high activity measured by the pedometers is 33 days (119-86), indicating a problems of early embryonic death (EED) that will be hidden from the evaluation if only numbers are being evaluated. This cow conceived to that last insemination, as indicated by the blue box at 156 DIM.

Source: AfiFarm software, Afimilk Ltd.

Farm A

	Heifers (pre)	Heifers (pre) %	1st lact.	1st lact. %	2nd lact	2nd lact. %	3+ lact.	3+ lact. %	All cows	All cows %	Total	Total %
Distribution of cycles: 5-17 days	6	5.56	16	12.90	4	7.69	3	3.41	23	8.71	29	7.80
18-25 days	93	86.11	76	61.29	35	67.31	51	57.95	162	61.36	255	68.55
26-35 days	3	2.78	14	11.29	5	9.62	14	15.91	33	12.50	36	9.68
36-60 days	6	5.56	18	14.52	8	15.38	20	22.73	46	17.42	52	13.98
Average days between Breedings	22		24		25		28		25		24	

Farm B

	Heifers (pre)	Heifers (pre) %	1st lact.	1st lact. %	2+ lact.	2+ lact. %	All cows	All cows %	Total	Total %
Distribution of cycles: 5-17 days	--	--	10	5.56	46	6.07	56	5.97	56	5.97
18-25 days	--	--	91	50.56	357	47.10	448	47.76	448	47.76
26-35 days	--	--	43	23.89	188	24.80	231	24.63	231	24.63
36-60 days	--	--	36	20.00	167	22.03	203	21.64	203	21.64
Average days between Breedings	--		28		28		28		28	

Figure 3. Comparison of interval between breedings in two farms. Farm A has a normal profile (5-17 days <10%, 18-25 days >60%, 26-35 days <15% and 36-60 days <15%), Farm B has a problem with early embryonic death (EED) evidenced by the large proportion of cows with long intervals between breedings (target in our farms is <15%).

Source: AfiFarm software, Afimilk Ltd.
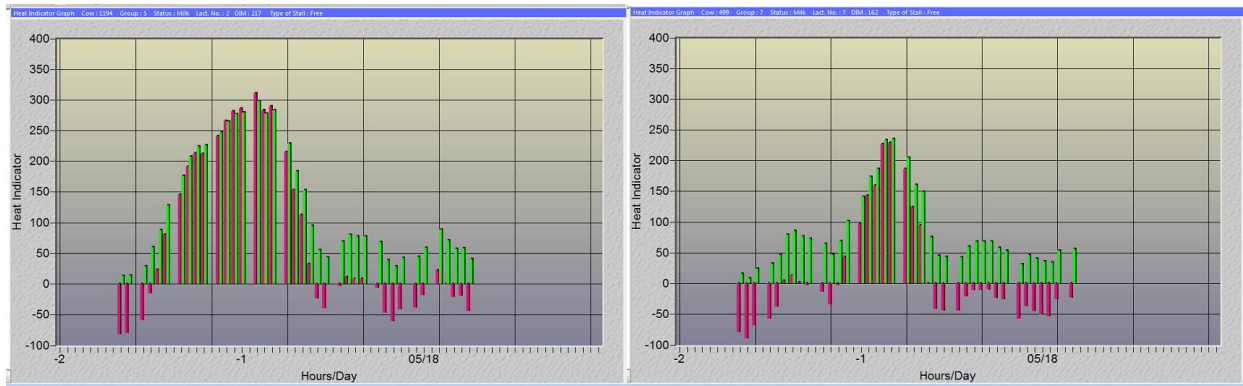
Figure 4. Hourly graphs of activity. The cow on the left was in heat for 16 hours, while the cow on the right was in heat only for 6 hours. Both belong to the same farm.

Source: AfiAct II software, Afimilk. Ltd.

Sick Cow Detection

As any living being, cows will encounter health issues along the way, and therefore, we must maintain vigilant every day to detect which cows may be having issues, so they can be treated promptly and effectively to ensure prompt recovery. Then we need to monitor them until they recover, so we can make sure that our treatment protocols are appropriate and, if not, we have the ability to make an informed decision to change those protocols.

When evaluating sick cows, typically most farmers look at milk production. Although it is a good indicator, it is not very specific, so we can see milk drops in cows that have changed pens or cows that are in heat. This means that, in addition to milk information, we now need event information and activity (for heat detection). Compare for example the cow in Figure 5 and Figure 6; both have dropped milk by more than 30% in the last 1-2 milkings. The difference is that the cow in Figure 5 is in heat, so that the drop in milk can be explained by the increased activity and lack of resting /eating times, while the cow in Figure 6 has mastitis, as evidenced by the increased conductivity. Figure 7 shows a cow that has dropped in milk, but is not in heat and does not have mastitis; she is likely off-feed, which can be due to a digestive issue or pneumonia (can't eat well because she can't breathe well). Finally, Figure 8 shows a cow that is lame, as evidenced by the ragged activity graph. It is not affecting her milk production much as of now, but it is severe enough to cause a slight drop. Therefore, with a milk meter that provided information on milk production and conductivity, and a pedometer that measures activity, we can now detect not only that a cow is sick in general, but actually hone into what the likely diagnosis is. The addition of other sensors that can measure milk components such as butterfat, protein and lactose, can help fine-tune the diagnosis even further.

43
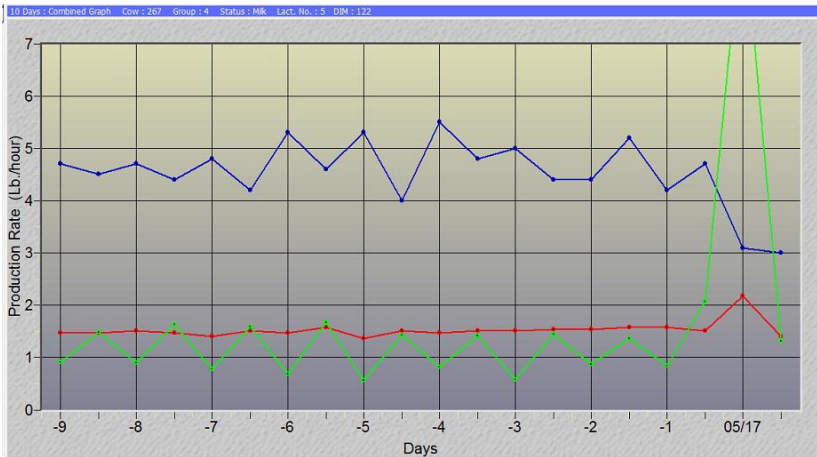
Figure 5. Graph showing milk production (blue) at each milking (2x) and activity (green) for a cow that has dropped in milk production because she is in heat. Conductivity (red) shows a small rise typical of cows that retain their milk (heat).

Source: AfiFarm software, Afimilk, Ltd.
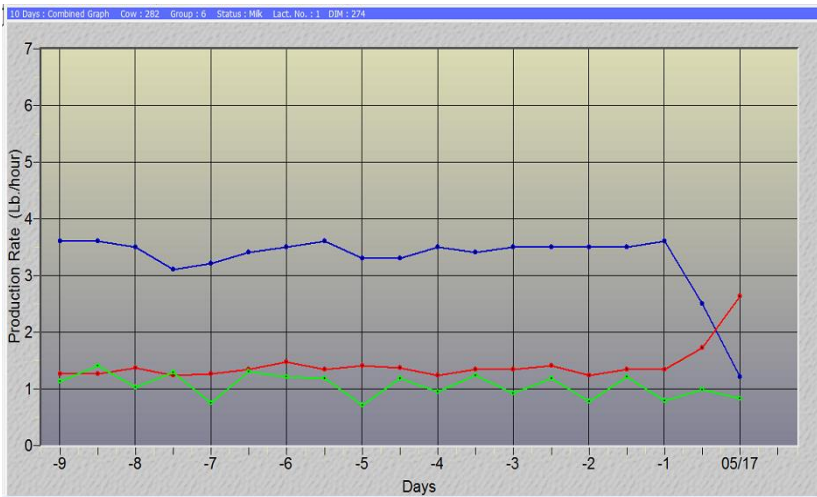
Figure 6. Graph showing milk production (blue), activity (green) and conductivity (red) at each milking (2x) for a cow that has dropped in milk production because she has mastitis. Conductivity shows a sharp rise and activity is flat or slightly decreased.

Source: AfiFarm software, Afimilk, Ltd.

Figure 7. Graph showing milk production (blue), activity (green) and conductivity (red) at each milking (2x) for a cow that has dropped in milk production because she has digestive issues. Conductivity and activity are flat, while milk production dropped over a span of at least 2 days (-4 to -2). After treatment the cow regained milk production quickly.

Source: AfiFarm software, Afimilk, Ltd.
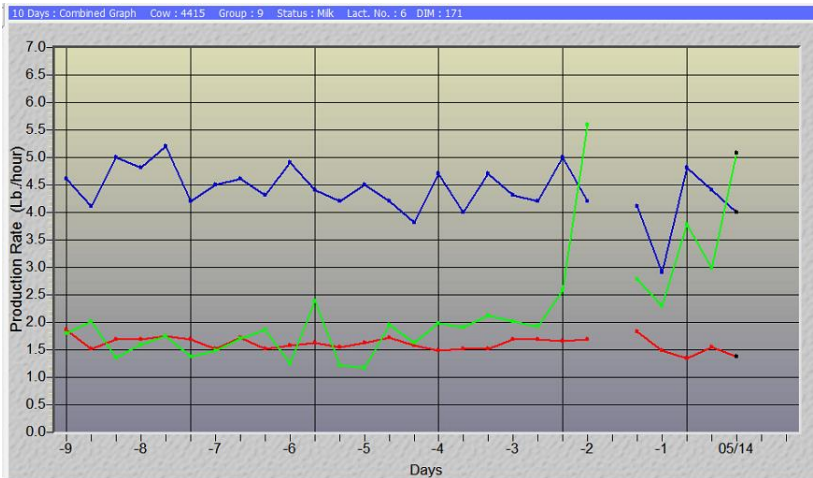
Figure 8. Graph showing milk production (blue), activity (green) and conductivity (red) at each milking (2x) for a cow that has dropped milk production because she is lame. Activity has a ragged graph as opposed to a consistent pattern as the other graphs.

Source: AfiFarm software, Afimilk, Ltd.

In conclusion, the use of automatic data collection tools and the evaluation of specific combinations of the data provided by these tools can give us the necessary information to manage a farm on a day-to-day basis. Having more sensors and more data, however, is not useful if the data provided by these technologies is not integrated to provide information on which one can base decisions such as when to breed a cow to optimize pregnancy to term, or how to optimize the ability to provide an accurate diagnosis for a sick cow within 1 or 2 milkings so the cow can be adequately treated and promptly recover.

There are many options of technology available to dairy farmers nowadays, anywhere from automatic calf feeders to automatic in-line milk components sensors. To determine what fits within a farm, all technology needs to be evaluated trying to answer the question of '**what information will we get from the data provided by this tool and how will we change the management in response to that information?**' That is what provides precision in day-to-day management.

DeLaval Body Condition Scoring BCS[1]
Daily, Automatic and Consistent Scoring of Cows

Fernando Mazeris
DeLaval International AB
fernando.mazeris@delaval.com

Introduction

Body condition scoring is the most accepted and used methods for assessment of the nutritional status of dairy cows. A herd with an unfavorable distribution of body condition scores (BCS) over the lactation cycle will display reduced milk production, decreased feed efficiency, impaired reproduction performance and an increased number of post partum diseases with significant negative impact on farm profitability.

Milk yield is greatly influenced by the body condition score. Difference in milk yield between a too lean cow compared to one in an optimal body condition score could be as high as 545 kg (1200 lbs) during the first 120 days of lactation[2]. Moreover, a cow will not resume cyclic ovarian activity until she has regained a positive energy balance. The key to optimizing the resumption of ovulation is an appropriate pre-calving nutrition and management so that cows calve in optimal BCS (2.75 to 3.0) with *postpartum* body condition loss restricted to <0.5 BCS units. An over conditioned cow could take more than 100 days to return to regular cyclicity compared to an average around 60 days. Also, very lean cows will exhibit a delay in regained sexual functions. An extended calving interval is associated with a cost of about 2.5 USD per day. A high BCS at dry-off and calving is one of the most important risk factor for metritis, milk fever, displaced abomasums, fat cow syndrome ketosis and other metabolic diseases. All findings demonstrating the urgency of keeping the body condition of each cow in the herd under control over the whole lactation cycle.

Despite the huge potential in an improved profitability as a result of close management of body condition scores, few farmers score their cows frequently enough, if at all. This is mainly due to lack of either specific knowledge or time, or alternatively hesitance to spend money on a professional scorer. Further on, the subjective nature of manual body condition may result in a too low precision of the method.

As an alternative, body weight is often used to monitor the the nutritional status of dairy cows However, body weight will vary in relation to recent feed and water intake, milkings, urination and defecation. Compared with weighing the body condition therefore better reflects the nutritional status of the cow.

This paper describes the recently launched body condition scoring system, *DeLaval body condition scoring BCS*, which overcomes the hurdles hampering the wide spread implementation and systematic use of body condition scoring for optimizing herd performance.

Description of the Solution

The technology is based on a 3D camera, linked to an RFID system which is continuously running. Anytime a cow passes under the camera, the system recognizes the movement and selects the best image of the cow in the video sequence.

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[2] Relationship Between Body Condition Scores and Milk Yield in a Large Dairy Herd of High Yielding Holstein Cows, J.J. Domecq, A.L. Skidmore, J.W. Lloyd and J.B. Kaneene, Michigan State University.

The 3D camera uses light coding technology, which works by projecting a pattern of IR dots on the back of the cow. The DeLaval BCS then measures the distance between these dots to create a 3D image of the back. With an accurate 3D image, the system uses an algorithm to convert that information into a body condition score. The scale used is the 1 to 5 scale, where 1 corresponds to the lowest and 5 to the highest condition score.
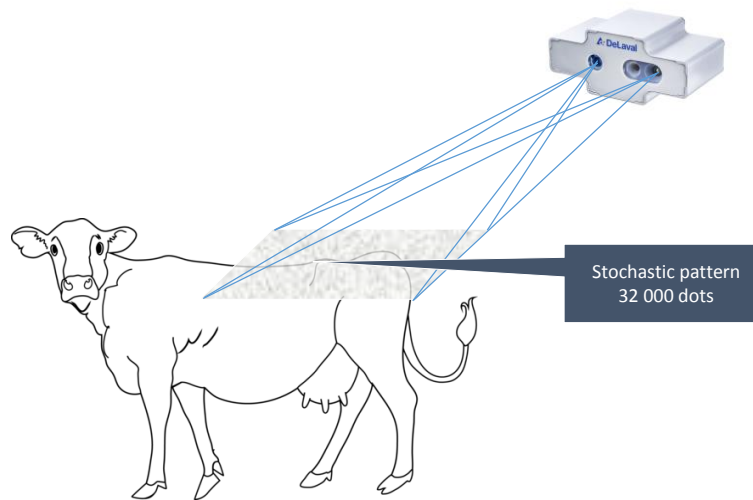
The system is fully automatic. It provides daily scoring of all cows that pass under the camera. Depending on the camera location, it can score a cow 2-10 times per day. Average daily scores are recorded and 7-day averages are used for tracking body condition increase or decrease. The system is capable of scoring cows walking at a speed of up to 1 m/s (3.3 feet/s). Since the system has its own source of IR light, it is not dependent of ambient light. On the contrary, in daylight condition shade has to be created.

DeLaval BCS can be mounted on a DeLaval VMS (milking robot) or sort gate. The system is integrated with DelPro, DeLaval's farm management system. The body condition scores of cows in the herd are displayed as a function of Days Since Last Calving (DSLC) and each cow is represented by a small green triangle (see below). On herd level the desired body condition score can be set by the user defining the min, max and optimum levels related to DSLC. This facilitates the judgment of the herd as being under-, over- or accurately -conditioned.
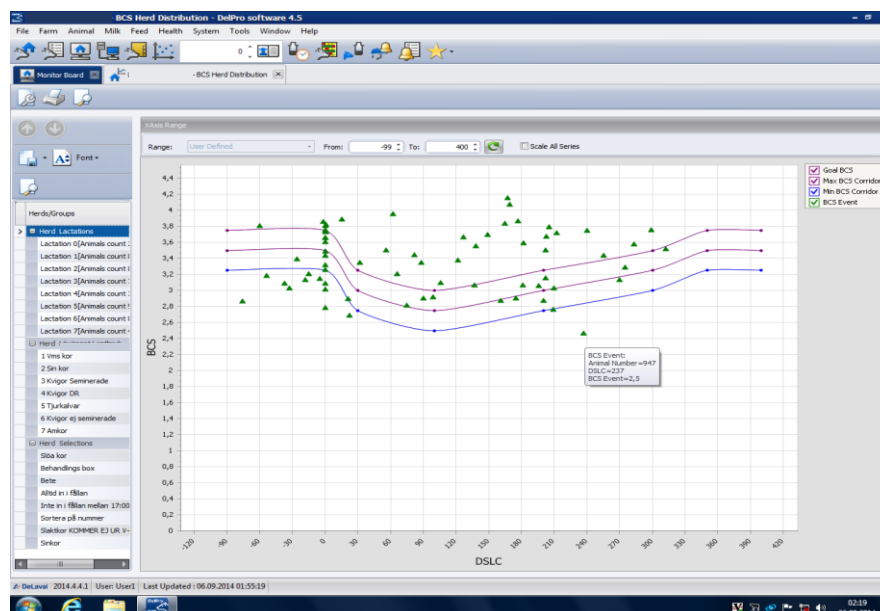
Individual cows can be monitored with their body condition score developed over time. Events such as calving, insemination and confirmed pregnancy are displayed. Also, individual cows increasing or decreasing their body condition scores > 0.25 or > 0.5 respectively over the last two and four weeks are highlighted.
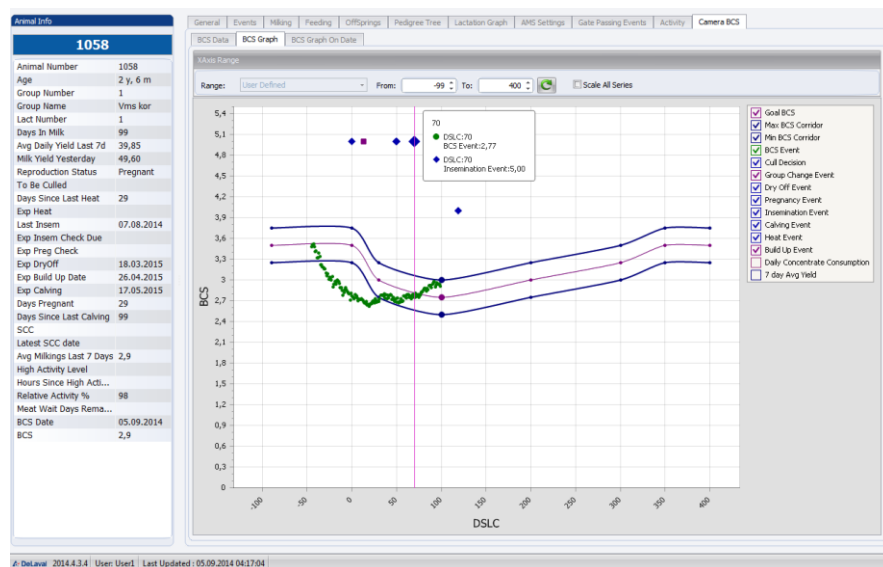
Moreover, milk yield and concentrate intake can be shown in the same graph. Additionally customized reports can be generated, to help sorting out cows in need of special attention.

Intervention

The procedures for adjusting feed rations in order to optimize body condition will be different depending on the feeding system applied in the herd. In larger farms with different feed groups cows could, based on body condition, be moved to the next feed group or kept longer in the old feed group. The feed ration of an entire feed group could of course also be adjusted. Smaller farms with feeding stations and VMS farms using different PMR groups have the option to fine tune the feed ration on individual cow level in the feeding stations. At VMS farms with controlled cow traffic and multiple groups, cows could be moved to groups with higher/lower energy PMR.

Performance Testing

The performance of the DeLaval BCS has been verified through comparison with a professional scorer. Currently there are algorithms available for scoring Holsteins including similar breeds and Fleckvieh. Scoring has been performed at several farms of different types and sizes in Europe and North America from 60 – 1600 cows by comparing 5 day averages.

The graph below is an example from a farm with 1 022 cows. The manual scores of individual cows are represented by blue crosses. The scores generated by DeLaval BCS are represented by the green line. The blue and red lines define a ± 0.25 score interval from the system scores, which is a generally accepted precision in manual scoring. DeLaval research shows that a manual scorer scores within ± 0.25 scores in 60% of all scoring events, compared to his/her own multiple scoring of the same cow. 98% of the manual scores are within the ±0.25 interval.
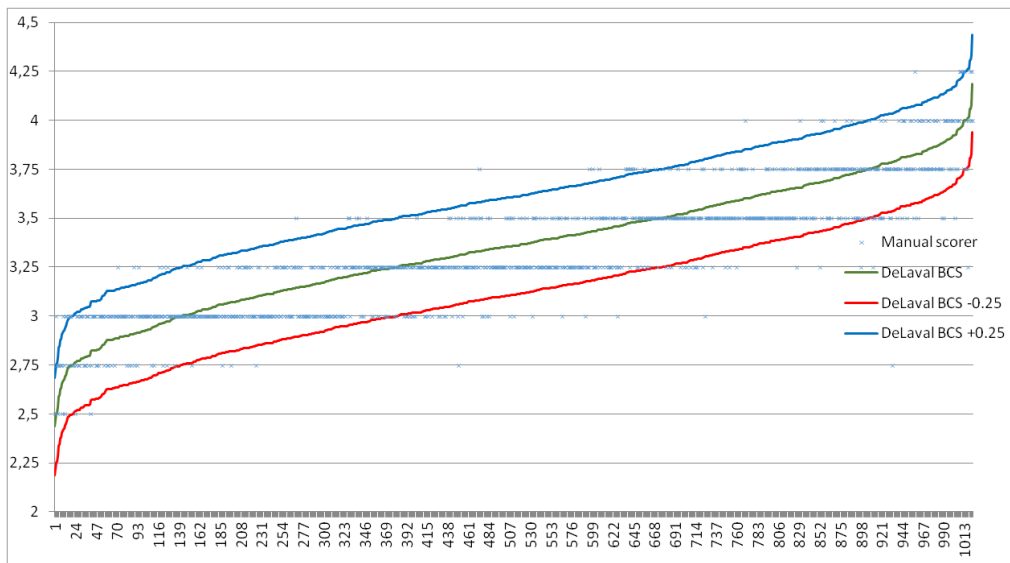
Manual scoring compared to scoring of DeLaval BCS. Unit of x-axis is cow individuals. Unit of y-axis is body condition scores

Repeatability

The standard deviations of the scores generated by the DeLaval BCS at the tests above were calculated. The graph below is an example of standard deviations for individual cows at a farm with 139 cows. In general the standard deviation is less than 0.1 scores.
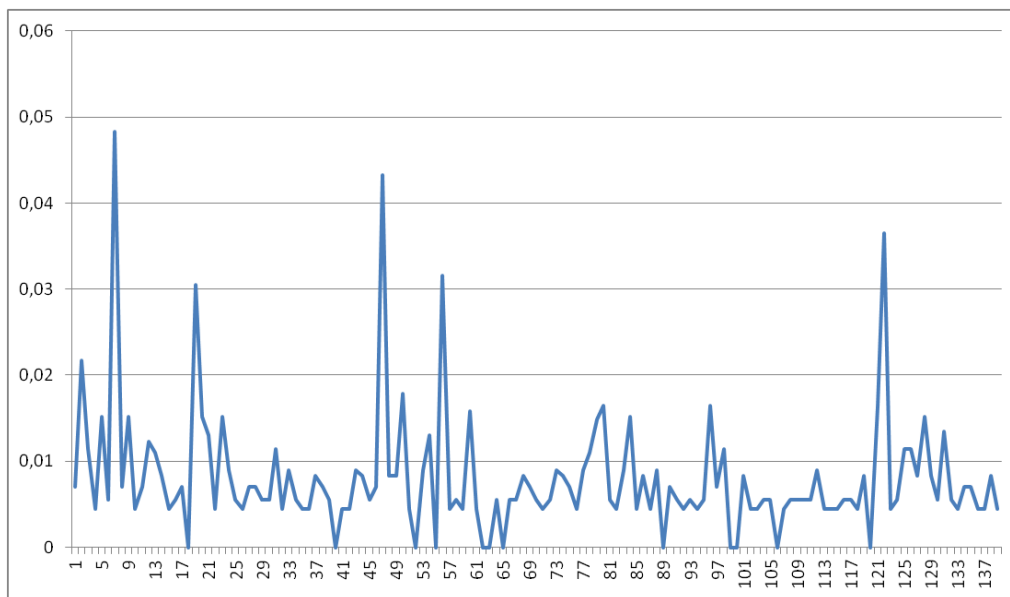
Standard deviation of body condition scores at a specific farm. Unit of x-axis is cow individuals. Unit of y-axis is standard deviation.

Summary

DeLaval BCS provides a fully automatic daily body condition scoring of dairy cows. In comparison with a human professional scorer, 98% of all assessments from the system range within ±0.25 scores. Cows are scored with a standard deviation of less than 0.1 scores. The system is able to score cows that walk with a speed of up to 1 m/s (3.3 feet/s).

Automated Body Condition Scoring Economics

UK KENTUCKY
College of Agriculture

PRECISION DAIRY & COW ENVIRONMENT CONSORTIUM

Carissa Truman
carissa.truman@gmail.com

Jeffrey Bewley
jbewley@uky.edu

DeLaval Body Condition Scoring System
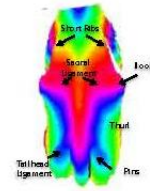
Body Condition Scoring (BCS)

▶ Tool for dairy management

▶ Assesses energy reserves

▶ Provides an estimate of energy status

Body Condition Scoring

▶ Recommended to score the cow 4-5 times throughout her lactation

▶ Recommended times are at dry-off, calving, and 3 times throughout the lactation

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Body Condition Scoring

▶ Optimizes milk production

▶ Increases reproductive efficiency

▶ Decreases metabolic diseases and lameness

Reproductive Efficiency

▶ Reduced body condition → decreased ovarian activity

▶ Lower conception and heat detection rates lower → pregnancy rate

▶ Reduced pregnancy → more days open

▶ More days open increases the costs for reproduction

Metabolic Diseases

▶ Higher or lower body condition at calving results in higher metabolic disease incidence

▶ Diseases such as metritis, ketosis, and milk fever

Lameness

▶ Lameness incidence may increase with loss or low body condition

▶ Chance of recovery may also be affected by the cow's body condition

Body Condition Scoring Economic Model

▶ Compares current herd BCS with the target BCS

▶ Evaluates increased reproductive efficiency and reduced disease incidence with improved herd BCS

▶ Net present value analysis to show economic returns from investment

Improving Health, Welfare and Fertility Using the Latest in Cow Monitoring Technologies

Conor Beirne, Jiska Roessen
Dairymaster
cbeirne@dairymaster.com

1   Introduction

Technology is revolutionising our lives on a daily basis. Everyone is connected through the internet, social media, smartphones, Twitter, YouTube, and so on. Technology can also change the lives of cows. What does every farmer want? Easy, accurate heat detection, more calves at the right time, healthy cows and the best genetics possible.

Can you remember when you got your first mobile phone and what it looked like? Do you remember receiving your first SMS or text message and who it was from? If I told you back then that someday your cows or your client's cows would be text messaging you would definitely think I was crazy. Well this is what is happening on a daily basis on many farms all over the world. People involved don't just receive text messages, they receive fertility and behaviour alerts from cows.

Careful observation of cattle is very time consuming and labour intensive. Cows need to be lobserved several times during the day and night to avoid missing heats and health events. No matter how big farms become they will always be comprised of individual cows. A herd can only operate efficiently if great attention is given to the health of individual animals within that herd, regardless of the number of cows. In countries where labour is less expensive this requires a management system that observes cattle. In countries where labour is expensive this can only be achieved through the use of technology.

Cows will always tell us the truth about their health status but we need to learn to listen. If cows are dirty – their environment is not clean. If they have hock lesions – beds are not comfortable or the animals are agitated. If cows have loose manure and poor dry matter intakes then the TMR is upsetting their rumens or the animals are sick. Cows will not deliberately get mastitis nor will they get lame on purpose. It's up to the farmers, the farm staff, farm advisors, vets and nutritionists to be able to see the signs the cows are telling us and make accordingly the right decisions for the mutual benefit of all concerned.

One very real challenge that affects the dairy industry worldwide is the availability of enough well trained and motivated staff to detect cows in heat and cows that are sick and look after them. Sensors can play a major role here in helping farm management and staff by doing the work of heat detection and health monitoring for them and consequently improving health, welfare and fertility of individual herds.

Sensing technology has been in use in the form of auto-identification (RFID-eartags were in use in Dairymaster milking parlours since 1993), accelerometers, and automated voice commands for milking parlours, GIS systems, smart feeding software, hyper spectral imaging, automatic drafting and weighing scales and so on. With these revolutionary technologies herd owners can help manage their farms from anywhere on the planet. Profitability, productivity and the need to have a more effective use of labour are the main drivers to developing these technologies. Attention to detail is key in optimising farm performance. Now the focus can be put back again on the performance of each individual animal.

2   Importance of Reproductive Performance

2.1   Increase productivity at farm level

If we increase herd fertility we can increase farm profitability. We can improve reproductive performance by reducing the calving to conception interval, the number of straws used per conception and the number of cows culled for infertility. Heat detection is the first vital area where sensors can improve reproductive performance. Without sensor technology heat detection can get very labour intensive and requires a skilled observer. If heat detection is poor healthy cows will be leaving the herd unnecessarily and milk production is reduced.

Accurately detecting cows that are in heat has been made even more difficult by the fact that selection for 'high production' traits has caused fertility to decrease in the last decade (Boichard & Brochard, 2012). This is why heat detection sensors are becoming essential as part of modern dairy farm management.

2.2   Introducing the MooMonitor+

The MooMonitor+ is a wireless wearable sensor that allows farmers detect individual cow heats and health events with ease through advanced data analysis. It monitors cows on a daily basis and identifies specific types of behaviour such as feeding, rumination, resting time and different types of activity intensity. These features can aid in detecting heats, monitoring feeding and rumination patterns, monitoring cow welfare and managing the health status of your farm.

The system is designed for both indoors and outdoors and with a range of 1,000 meters by line of sight so the majority of cows can be monitored anywhere around the farm. Every 15 minutes the system sends back information about each individual cow. Shorter feedback intervals give more precise information about the onset of heat allowing more timely inseminations (AI). To assign or alter records of your cow, simply swipe a compatible smartphone over the tag and you can immediately update records so there is no paperwork involved. The system is accessible from anywhere in the world is accessible on an unlimited number of devices (mobile, tablet, desktop) connected to the internet via a secure login. The battery life has been extended lasting up to and above 2 average cow lifetimes.

2.3   Problem breeders

The identification of non-pregnant cows through accurate heat detection of repeats is another vital function of the system. In order to get more cow's pregnant farm staff need to know what type of heat the cows are having (e.g. repeat breeder) and what cows are not coming in heat. This allows for action to maximise the pregnancy rates for each expressed heat, optimising conception rates on farm level. Cows that require a veterinary inspection – such as cows that have not been in heat before the end of the voluntary waiting period or cows that have health events entered during the transition period – can be listed under farm records or can be individually drafted to coincide with the next veterinary visit. Identification of problems allow staff to follow pre-set protocols for each individual cows requirements.

3   How Fertility is Linked to Health

3.1   Health issues in the transition period

Most diseases of dairy cows happen around the time of calving making proper dry cow and fresh cow management vitally important. High producing cows are prone to typical production related problems such as ketosis, (sub-acute) ruminal acidosis, (sub)clinical ketosis, retained foetal membranes, abomasal displacement, endometritis and (sub)clinical milk fever (Mulligan & Doherty, 2008) Any issues that influence the health of cows will have an unfavourable effect on fertility.

3.1.1 Negative energy balance and disease

Ketosis is the one of the most common diseases of the modern dairy cow worldwide. It is a result of fat tissue being mobilised about two weeks before to four weeks after calving. This phenomenon occurs to compensate for decreased energy intakes in that period at a time when energy demands are high (milk production). At this time the cow is said to be in negative energy balance (NEB). A cow with ketosis will suffer from anorexia, causing further decrease in dry matter intakes (DMI) which leads to a more profound negative energy balance and more severe ketosis – the cow enters a vicious cycle.

Negative energy balance pre and post calving has a major impact on the fertility of dairy herds either as a primary cause through lack of energy in the diet or as a secondary cause through illness and reduced energy intake. Excess or prolonged NEB is more likely to occur in higher yielding cows. This can cause reduced fertility and digestive, metabolic and infectious disease especially mastitis (Roche et al, 2000, Leroy et al, 2006, EFSA 2009). Negative energy balance also has implications for body condition score loss and immune function leading to higher levels of retained foetal membranes and endometritis post calving (Walsh et al 2011).

3.1.2 Happy and healthy cows ruminate more

A cow's digestive tract is designed to digest plant components through the act of rumination. If you look at a cow from the inside, the size of her rumen takes in a large part of her digestive tract. Likewise is the vast majority of the cow's time is spend on digesting food (Brown, et al., 2013). If you look at a cow's body a large percentage of it is taken up by the reticulorumen and a cow spends the majority of her time eating or ruminating. The rumen functions to store food, mix food, ferment food and break food down into smaller particles. If this reticulorumen is functioning properly then the cow will be happy and will chew her cud.

Usually when a cow's health is compromised she will stop or reduce the time spent chewing her cud, therefore decreased rumination is an excellent indicator of early sickness – especially for fresh cows. A sick cow might continue to eat and drink but her rumination levels will change at an early stage. This is valuable information to have for sick cows, because not all cows that are under the weather will have a fever. For example: in the case of primary ketosis there is no infection or inflammation present and the cow's temperature remains unchanged. However her rumination and feeding patterns will be altered. On the other side: good rumination and feeding indicates proper food digestion and conversion into milk.

Returning sick cows to healthy production levels requires early detection of illness in combination with correct diagnosis, correct treatment and correct follow up. The goal is to identify the disorder early enough so that milk production is less affected. It is therefore important to monitor the time of rumination to look for changes that could indicate sickness.

3.2 High performance sensors for the individual animal and the entire herd

It is important to remember that herds are made up of individual animals. And for the reasons mentioned above it make sense to continuously measure the animal's behaviour. If normal behaviour is known, data of cows showing abnormal signs can be identified and action can be taken much sooner (Lindgren, 2009; Fregonesi & Leaver, 2001). Early identification of the onset of disease is often first identified by sensing technologies, whereas visual observation alone is often inadequate. Sensing technology is proven to have a positive impact on calving interval (Stevenson, et al., 2014). Using the sensing device as a heat detector, more heats can be picked up and more animals can be submitted for insemination. This leads to more pregnancies and calvings per year and an overall greater life production due to more peak lactations in this period. Watching parameters such as rumination, feeding and resting time increases the knowledge about the individual animal. It also gives indications when she is sick or recovering from a certain problem. It identifies problems in early stages due to due to a continuous information flow.

4 Monitoring Dairy Cow Welfare

The new Lisbon Treaty that has been in force since December 1st 2009 states that animals are sentient beings. Therefore animal welfare and in particular dairy cow welfare will carry considerably more weight in the future. It is very likely that advanced smart sensor technology will play a pivotal role in future in assessing animal welfare on farms by monitoring behavioural characteristics of cows. Any metric that can be used as an indicator of welfare and health can assist to enforce this. Monitoring daily resting time is an excellent example – Increased resting allows up to 30% greater blood flow through the udder which can increase milk yield, because 400-500 litres of blood need to pass through the udder to produce 1 litre of milk. Resting also relieves pressure on the cow's feet resulting in less lameness and better claw health. However excessive resting time can indicate that there might be health issues present such as lameness. A recent trial carried out by Roessen analysed daily resting time for 172 cows from one herd over a 4 month period. It was found that daily resting times play an important role in expressing a cows emotional and physical health status. It can be used as a key indicator for monitoring cow welfare on farm. In this study one aspect of animal welfare – namely health – was observed to find out what effect a health event has on the daily resting time of an individual animal. It was concluded that animals experiencing a health event rest on average 101 minutes longer (CI: 92 to 110 minutes) than animals that are not experiencing a health event (Roessen, 2015).

Sensors will be able to show that the cow is provided with the five freedoms through assessment of her behaviours. Freedom from thirst, hunger and malnutrition, freedom from discomfort, pain, injury, disease and distress and finally freedom to express normal behaviour. This can serve to reduce public concern of the welfare of cows kept in high input production systems. For example reduction in resting times for groups such as high yielding cows can indicate deficiencies in adequate provision of cubicle space. Housing design could then be assessed to see where improvements can be made. (Nicole, 2011) describes the role of animal behaviour in welfare – by identifying the behavioural needs of animals which can help to develop housing and management systems to improve welfare. A knowledge of animal behaviour can be used in troubleshooting to identify problems. Equally it can be used to provide assurances that animals are content and in good health.

5 Sustainability

As the milk markets become globalised and consumers look for products that are of higher quality processing companies need to differentiate themselves in terms of quality and sustainability. Suppliers of milk will need to be able to demonstrate that these consumer needs are being meet. Sensors such as the MooMonitor+ provide real time indicators of health and welfare that can be used to build consumer confidence in individual farms that have invested in this advanced cow monitoring technology.

Since the year 2012 less than 38% of the land available can be used as agricultural land and with this we are facing considerable challenges in the decades to come considering food production (World Bank, 2012). Thus, there is a high need to get the most out of our land, animals, water and people in the most efficient and environmentally friendly way possible. The use of new technologies has become indispensable in this picture. It diminishes workload and physical effort for both operator and manager. This increases work efficiency, reduces the risk of farm related injuries and at the same time facilitates working processes. It will also mean a better work environment for employees, making the whole farming processes more profitable, enjoyable and sustainable.

6   Reducing Costs and Expenses

The MooMonitor+ system offers excellent return on investment through reduced labour requirements for heat detection and detecting sick cows. Synchronisation of oestrus and fixed timing of AI are no longer necessary so hormone usage is almost eliminated except for problem breeders. Greater reproductive efficiency and higher conception rates reduce straws used per conception and cow culls. Factors such as increasing replacement rates can have a detrimental effect on farm profitability. By detecting sick cows earlier more cows can simply be treated with supportive therapy decreasing the amount of milk withheld for antibiotics. By using group analytics tools we can compare the average rumination and feeding times for different diets and different groups giving an indication of the consistency of the TMR management and its effectiveness for feed conversion into milk.

7   Conclusion

The health and fertility of dairy cows are fundamental to farm profitability. Sensors can help farm management treat every cow as an individual by monitoring behavioural characteristics for each individual cow and sending these notifications to farm management to alert them that a cow may be in heat or be a problem breeder, may be sick or may be underperforming relative to other cows within the group. We can use sensors to assess the numbers of animals affected, the severity and duration of the problem. Once problems have been recognised then they can be assessed using activity, rumination time, feeding time and resting time data, allowing decisions to be made to achieve a successful outcome. All this contributes to improved health, reproduction and cow welfare.

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Precision Dairy Monitoring: Making Sense of Sensors

Jeffrey Bewley, PhD, Extension Dairy Specialist

Amanda Stone, Randi Black, Barbara Wadsworth, Di Liang, Karmella Dolecheck, Matthew Borchers, Lauren Mayo, Nicky Tsai, Maegan Weatherly, Melissa Cornett, Samantha Smith, Megan Hardy, Jenna Klefot, Juha Hietaoja, Barbara Wolfger, Elizabeth Eckelkamp, Savannah Meade, Carissa Truman, Alison DiGennaro, Emory Thomas, Amanda Lee, Joey Clark, Denise Ray

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Precision Dairy Monitoring

- Technologies to monitor
  - Physiology
  - Behavior
  - Milk content
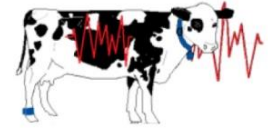
- Focus on preventive health and performance at the cow level

- Make more timely and informed decisions

Happy Cows via Technology?

Areas to Monitor a Dairy Cow

Methane emissions, Rumination/pH, Fatness or Thinness, Temperature, Respiration, Feed intake, Chewing activity, Heart rate, Mastitis, Milk content, Animal position/location, Lying/standing behavior, Hoof Health, Mobility

Craig Johnson
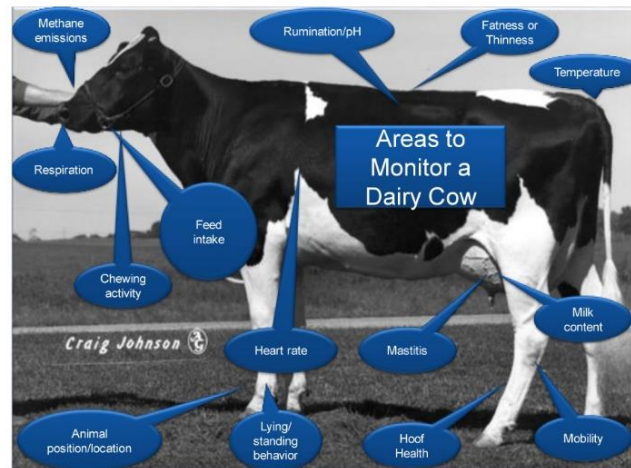
Ideal Technology

- Explains an underlying biological process

- Can be translated to a meaningful action

- Cost-effective

- Flexible, robust, reliable

- Simple and solution focused

- Information readily available to farmer

So Many Options!!!!

Parlor Precision

Inline Somatic Cell Count

Mastiline

Lely MQCC

DeLaval OCC

CellSense
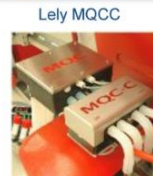
Spectroscopy

- Visible, near-infrared, mid-infrared, or radio frequency

- Indirect identification through changes in milk composition

- AfiLab uses near infrared

  –Fat, protein, lactose

DeLaval Herd Navigator™

Milk measurements

- Progesterone
  – Heat detection
  – Pregnancy detection
- LDH enzyme
  – Early mastitis detection
- BHBA
  – Indicator of subclinical ketosis
- Urea
  – Protein status

Wearable Technologies

Sleep

Blood Pressure

Calories

ECG

Fall Detect

Stress

Total Activity

SpO2

Skin Temp

Pedometer + fitbit

Continuous HR

Body Scale Withings

Neck or Ear Based Behavior Monitoring

Medria

SCR PRECISE DAIRY FARMING

Cow with tag "NIR Tag"

CowManager

DeLaval

DeLaval activity meter system
Keep control of your breeding

Physiology Monitors

Vetcheq

Lying Behavior Monitors

- On-farm evaluation of lying time:
  - Identification of cows requiring attention (lameness, illness, estrus)
  - Assessment of facility functionality/cow comfort
  - Potential metric to assess animal well-being

ENGS Track a Cow: Feeding Time

Cable
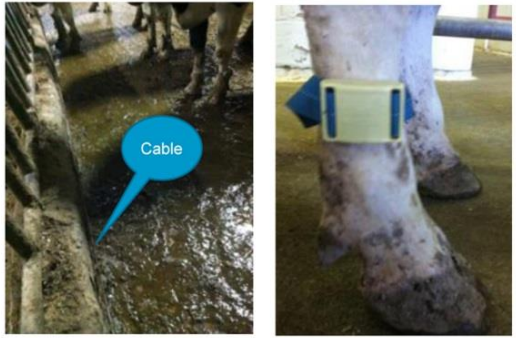
Real Time Location Systems

Calving Detection

Vel'Phone Calving Detection
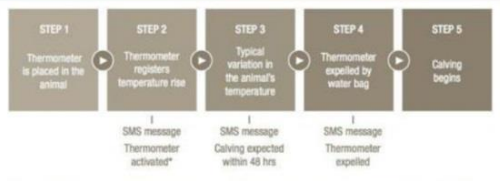
Precision Dairy Benefits

- Improved animal health and well-being
- Early detection
- Increased efficiency
- Improved product quality
- Minimized adverse environmental impacts
- More objective measures

Disease Detection Benefits
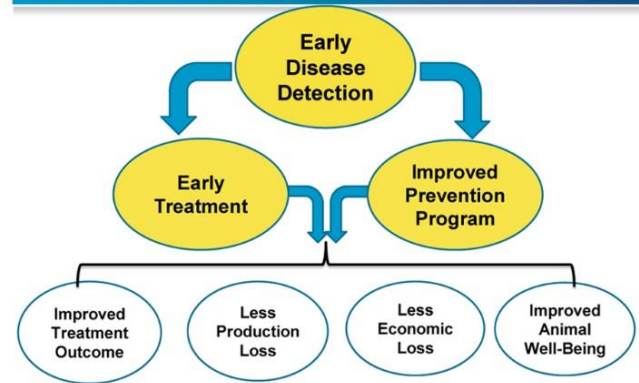
University of Kentucky Research

Gaitwise-Van Nuffel ,2014
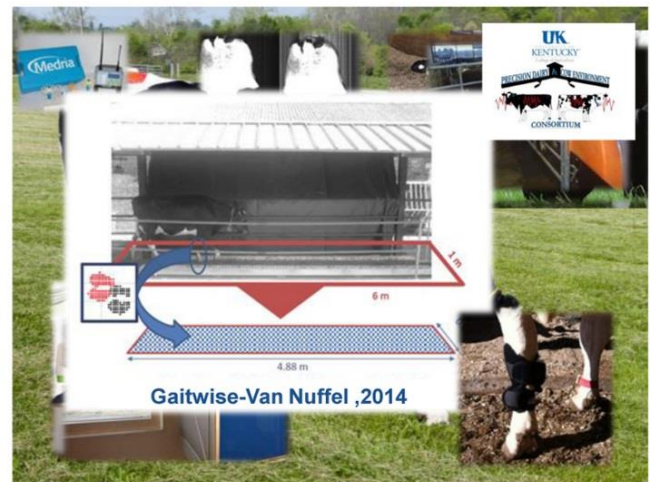
What Are the Limitations of Precision Dairy Farming?

REALITY CHECK AHEAD

- Maybe not be #1 priority for commercial dairy producers (yet)
- Many technologies are in infancy stage
- Not all technologies are good investments
- Economics and people factors

Gartner Life Cycle
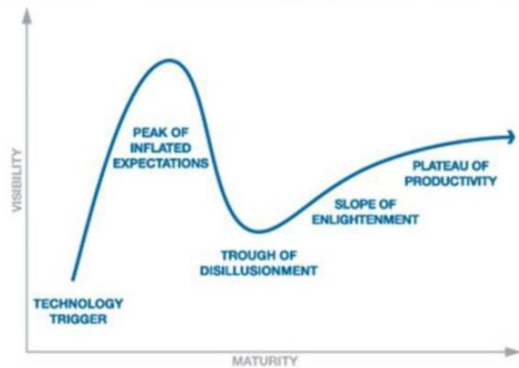
Technology Pitfalls

- "Plug and play," "Plug and pray," or "Plug and pay"
- Technologies go to market too quickly
- Not fully-developed
- Software not user-friendly
- Developed independently without consideration of integration with other technologies and farmer work patterns

Technology Pitfalls

- Too many single measurement systems
- Lack of large-scale commercial field trials and demonstrations
- Technology marketed without adequate interpretation of biological significance of data
- Information provided with no clear action plan

PDF Reality Check

- **Maybe not be #1 priority for commercial dairy producers (yet)**
- **Many technologies are in infancy stage**
- **Not all technologies are good investments**
- **Economics must be examined**
- **People factors must be considered**

Lessons Learned

- Be careful with early stage technologies
- Need a few months to learn how to use data

UK Herdsman Office
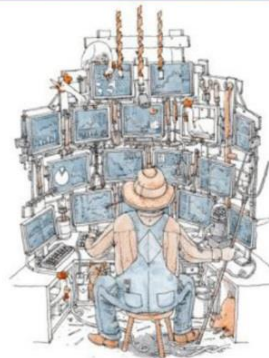
How Many Cows With Condition Do We Find?

80 Estrus Events Identified by Technology

20 Estrus Events Missed by Technology

Example: 100 estrus events
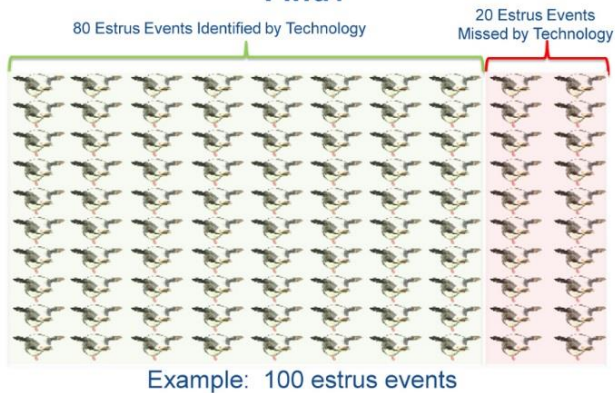
How Many Alerts Coincide with an Actual Event?

90 Alerts for Cows Actually in Heat

10 Alerts for Cows Not in Heat

Example: 100 estrus events

The Book of David: Cow People Benefit Most

Precision Dairy Technologies: A Producer Assessment

Matthew R. Borchers and Jeffrey M. Bewley
University of Kentucky
Department of Animal and Food Sciences
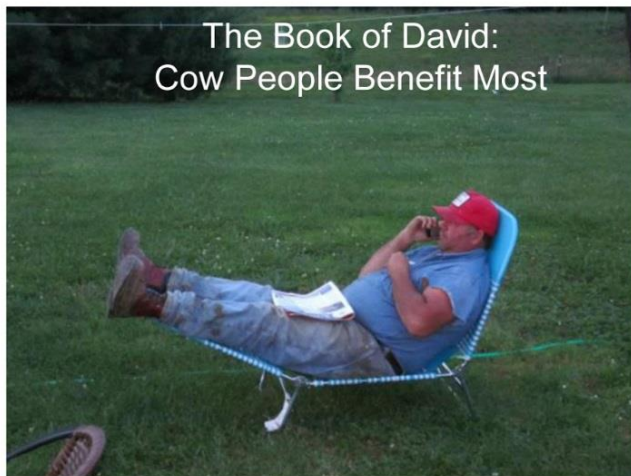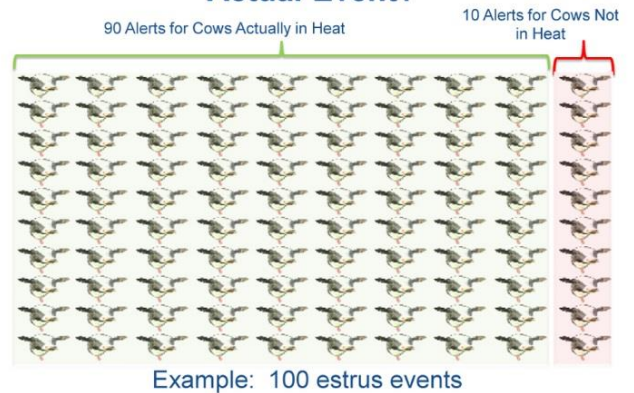
What do producers consider before purchasing one of these technologies?

Matthew Borchers, 2014

Consideration #1.
Benefit: cost ratio
(4.57 ± 0.66)

Matthew Borchers, 2014

Consideration #2
Total investment cost
(4.28 ± 0.83)

Matthew Borchers, 2014

Consideration #3. Simplicity
and ease of use
(4.26 ± 0.75)

Matthew Borchers, 2014

What parameters do producers find most useful in technologies?

Matthew Borchers, 2014

Important Parameter #1. Mastitis
(4.77 ± 0.47)
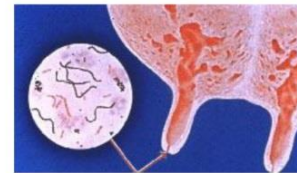
Matthew Borchers, 2014

Important Parameter #2
Standing heat
(4.75 ± 0.55)

Matthew Borchers, 2014

Important Parameter #3 Daily milk
yield
(4.72 ± 0.62)

Matthew Borchers, 2014

Customer Service is Key

- More important than the gadget
- Computer literacy
- Not engineers
- Time limits
- Failure of hardware and software

"Can I return these?...They're nice and all, but they just scare the snot out of me."

Cautious Optimism

- Critics say it is too technical or challenging
- We are just beginning
- Precision Dairy won't change cows or people
- Will change how they work together
- Improve farmer and cow well-being

"Opportunity is missed by most people because it is dressed in overalls and looks like work." – Thomas Edison

Path to Success

- Continue this rapid innovation
- Maintain realistic expectations
- Respond to farmer questions and feedback
- Never lose sight of the cow
- Educate, communicate, and collaborate
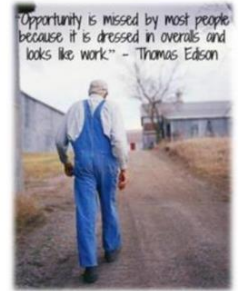
Future Vision

- New era in dairy management
- Exciting technologies
- New ways of monitoring and improving animal health, well-being, and reproduction
- Analytics as competitive advantage
- Economics and human factors are key

Questions?

UK KENTUCKY
College of Agriculture

PRECISION DAIRY & COW ENVIRONMENT
CONSORTIUM

Jeffrey Bewley, PhD, PAS
407 W.P. Garrigus Building
Lexington, KY 40546-0215
Office: 859-257-7543
Cell: 859-699-2998
Fax: 859-257-7537
jbewley@uky.edu
www.bewleydairy.com

@bewleydairy

facebook

https://www.facebook.com/PrecisionPatty

Cow Sensor Technologies and Calf Feeders

John Balbian
Ashwood Dairy, Amsterdam, NY
JBalbian@grober.com

We are currently monitoring 200 cows in Amsterdam, NY, milking them in a double-10 parallel parlor. Juggling another full-time career, I have learned to embrace technology that is not only innovative and supports my goals of a healthy and productive herd, but also empowers my (six) employees to be smarter and more effective with the data they have at their fingertips. Currently, I am using European-based technology from Medria: HeatPhone, FeedPhone, Vel'Phone and San'Phone, and also utilize Forster-Technik's automated calf feeder.

Within a year, I have seen the Medria products work together to really prove their worth on my farm. An investment of about $38,600 (for all four systems, plus tablets) has yielded the following results:

- Improved reproductive measurements in transitioning from Ovsynch to HeatPhone

- Increased pregnancy rate by 2%

- Decreased services per conception from 2.3 to 2, with more sexed semen

- Decreased days open by eight days (on average)

- Ration adjustment , adding three pounds of milk per cow

- Decreased antibiotic use in calves from 17% to 8%

- DOA rate dropped 4%

- 92% of all heifer calves born, calve in for the first time

This is just the beginning of what I've witnessed the technology can do. We are currently working on protocols for transition and fresh cows using these tools.

My automated calf feeders investment of $26,200, has also achieved a nice ROI. We average 55 calves per feeder and 36 square feet per calf:

- 2.1 pound average daily gain on a 60-day schedule

- 2 pound average daily gain on a 50-day schedule

- A 2.3% dead loss over the last three years

I am encouraged by the results yielded so far, but am even more excited knowing we have not peaked. We are still in the implementation phase of some of the technologies, and there is a learning curve that must occur before we can truly experience the full value. Meanwhile, I consider this an investment in my employees because the data collected allows them to work in a fact-based environment in which decisions are made by tools they are taught to use. Day-to-day operations are much easier and decisions are more transparent, providing consistency in everyone's abilities and consistency in herd performance.

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DAIRY HERD
MANAGEMENT

Dairy Farming in the Technology World

Dutch Dairy LLC
Sander and Amy Penterman
Thorp, WI

dutchdairyllc@gmail.com

Using computer technology from AGIS for optimal herd health on your dairy operation.

Follow Dutch Dairy LLC on Facebook

AGIS CowManager SensOor-

How it works:
- Ear tag has chip inside that measures:
  - Temperature, eating, ruminating and behavior
- Routers collect data every hour
- Data is delivered through software on PC or smartphone
- Can access information anywhere you have internet

Dutch Dairy LLC
Sander and Amy Penterman

History

Sander immigrated to America in 1999 and worked on a large dairy farm near Baldwin, WI.

In 2002 with the help of Hemmy and Hermien Penterman Dutch Dairy was founded.

Started out as a 320 cow dairy and has gone through 2 expansions

2015 Converted free stall barn and fresh cow barn to tunnel ventilation also added a new calf facility with automatic calf feeder and upgraded power to 3 phase.

- 850 cows milked 3 times per day
- Own and Rent 1100 acres
- Field work is custom hired
- 8 full time employees, 4 part time employees
- Double 12 parallel parlor

AGIS CowManager SensOor-

Herd Health
- Able to run report each morning, immediately see any major issues
- Saved time temping each fresh cow, only look at problem cows
- Detect sick cows faster
- Detect problems with calving
- Vet cost savings
- Labor savings

Heat Detection
- Provide optimal time to breed
- Reduced use of injections
  - 90% reduction of Lutalyse and GnRH
- No longer breeding on standing heats

AGIS CowManager SensOor-

After a visit by Gerard Griffioen CEO of AGIS to Dutch Dairy and observing the daily care of cows, came the idea to optimize and do things smarter and later became the AGIS CowManager Sensoor program .

We waited for 3 years for USDA to approve the use and sale in America.

AGIS is based in The Netherlands

AGIS CowManager SensOor-

Information at a glance

Red: High activity

Orange: Active

Yellow: Not Active

Green: Eating

Blue: Rumination

AGIS CowManager SensOor-

Information at a glance
Red: High activity
Orange: Active
Yellow: Not Active
Blue: Rumination
Green: Eating
Black: Feed Factor

AGIS CowManager SensOor-

Heat Activity
Blue: Heat state
Red: High activity

AGIS CowManager SensOor-

Information at a glance
Red: High activity
Orange: Active
Yellow: Not Active
Blue: Rumination
Green: Eating

AGIS CowManager SensOor-

Days around calving + -
Red: High activity
Orange: Active
Yellow: Not Active
Blue: Rumination
Green: Eating
Black: Feed Factor

AGIS CowManager SensOor-

Temperature
Blue: Temp of cow
Green: avg temp of group

AGIS CowManager SensOor-

Improvements Since Implementing AGIS

➢ Higher conception rate: 39% in 2014
➢ Heat Detection 60% (50% before AGIS)
➢ Pregnancy Rate 24% (22% before AGIS)
➢ Calving interval 390 days (410 days before AGIS)
➢ Finding and treating sick cows earlier

AGIS CowManager SensOor-

It's this easy....

Automated Calf Feeding

Automated Calf Feeding

- January 2015 started work on new calf facility
- Installed Urban calf feeder (Alma model)
- One unit feeds 4 pens of 25 calves
- Use pasteurized milk from dairy along with additives for optimal growth
- Calves are moved 5 – 10 days into group pens
- Milk Lines are circulated every 15 minutes

Automated Calf Feeding

Automated Calf Feeding

Other Tech Updates

Milk Tank Alarm

- Digitally reads milk tank temp
- Sends alarm via text message to cell phone

Questions?

Managing the Profit Centers within a Precision Feeding System

Keith M. Sather
Feed Supervisor
Dresser, Wisconsin, USA
ksather@feedsupervisor.com

Feed is one of the largest operating expenses on any dairy. Therefore, the ability to track feedings and feed inventories helps ensure you derive the most value from your feed commodities. Feed management systems help farms save money by reducing clean-up, shrink and operator error. Through ration and feed bunk management, operator performance and inventory control, Feed Supervisor® helps you manage every aspect of your dairy feeding program. This paper will go into detail on how you can extract maximum value out of your feed management system by addressing ways to effectively manage your feeders and exploring how to fully utilize the software's numerous profit centers.

Section I. Effectively Managing Feeders

Precision Feeding – Addressing the Human Factor

Many early adopters of feed management systems bought into the technology as a way to monitor the accuracy of their feeders. The programs were often implemented out of distrust by managers following the "Big Brother" principle. But what these managers really needed was a way to better communicate with and manage their feeders. If they properly trained these employees, the feeders would be well-equipped to do the job that was expected of them.

When feeding dairy cows, how can you be sure the ration so carefully balanced by your nutritionist is the one your cows are actually eating each day? The human factor is one of many obstacles that can prevent us from meeting the goal of delivering to cows the diet that was specially prepared for them. Feed management software systems, such as Feed Supervisor, provide the industry with a unique tool for monitoring and training those responsible for feeding the herd (a.k.a. the "feeder") – ensuring that every mouthful a cow consumes is properly balanced. Managing your feeder does not mean carrying a big stick, but rather, opening up the lines of communication.

Supervisor Systems monitored the performance of feeders using this type of software in the Midwest and found them to be very accurate. On lactating diets, the average deviation amongst the ten feeders we were tracking was 0.6%. However, when feeding the transition cow group, the same feeders had a deviation of 9%. Early diagnosis labeled the problem as "big truck" syndrome. This occurs when you try to feed a small group of special needs cows with the same equipment used to feed the main herd as quickly as possible.
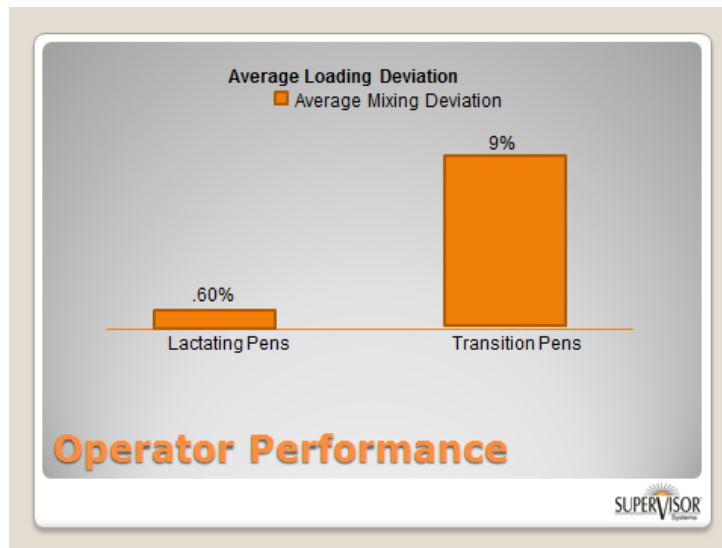
Assessing Operator Performance

    i.   Loading Accuracy

Was it true we could not expect our feeders to accurately load small amounts of feed? We began monitoring the loading accuracy of fourteen feeders during a 30-day period. Using feed management software, we took the average deviation for each ingredient (choosing ingredients that each dairy had in common) accounting for every time that ingredient was placed into the TMR mixer. Loading devices used were either a payloader, telehandler or skid steer. Results were measured in average deviation in pounds.

The data showed that accuracy was not affected by the type of equipment being used; instead, operator error was to blame. A high level of accuracy could be achieved using any of the three loading devices. Feeding mistakes were made by operators who were in a hurry to complete the task at hand.

Deviation by Loading Type

Corn Silage Trends

	Payloader	Telehandler	Skidloader
Average	109	80	62
Low	59	33	45
High	216	106	88

Deviation by Loading Type

Cottonseed Trends

	Payloader	Telehandler	Skidloader
Average	60	22	37
Low	29	16	11
High	108	27	65
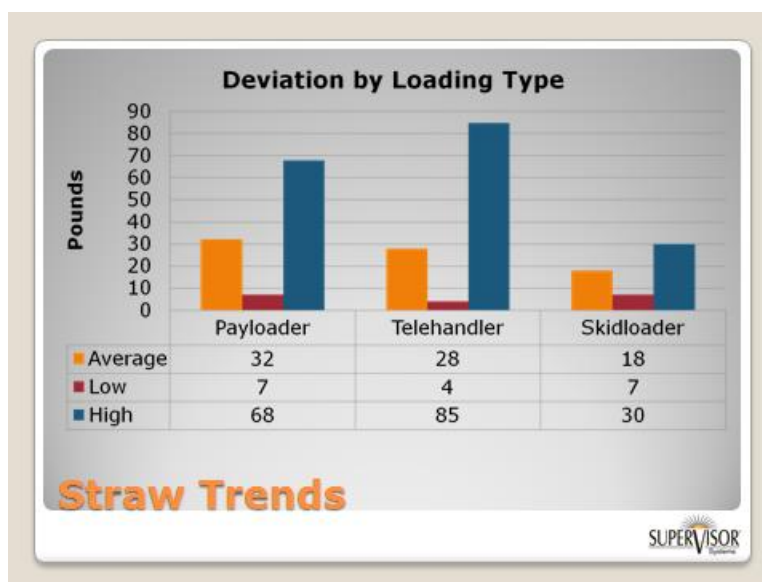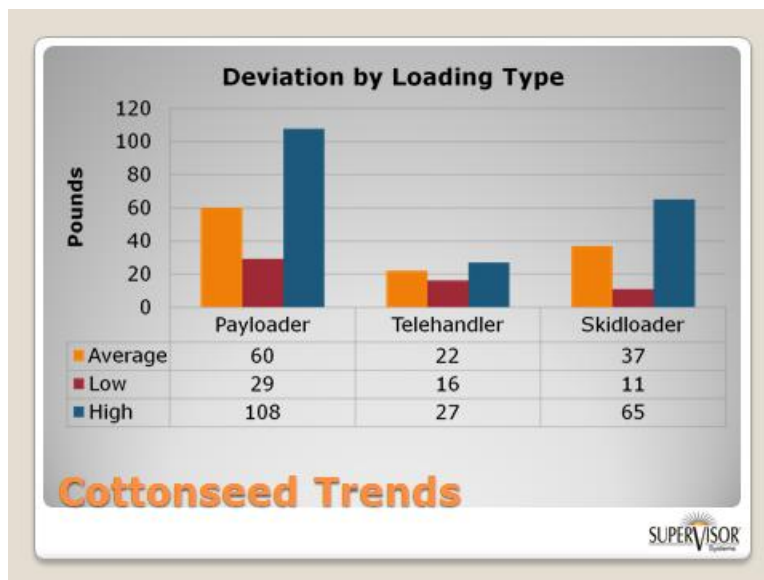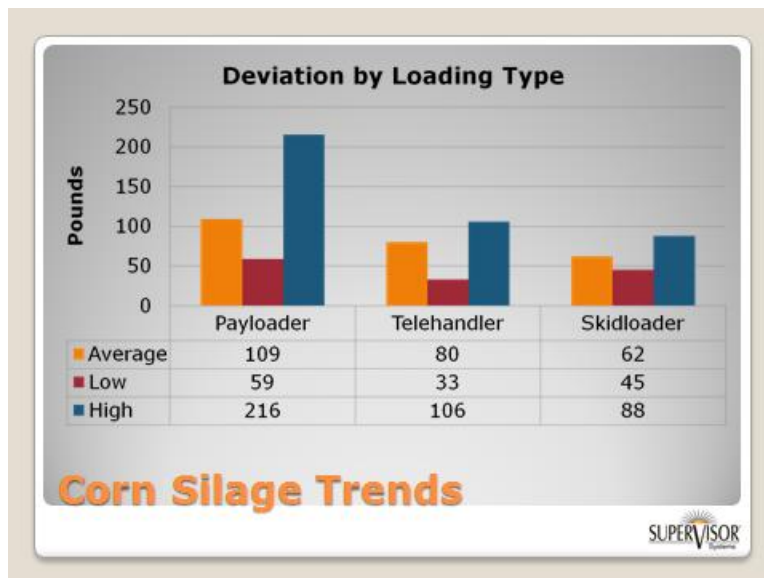
ii.   Mixing Feed Correctly

Oftentimes the culture is at fault for feeder inadequacies. How well is management training their people and what level of accuracy are they expecting? Feed management systems should be used to monitor, communicate, manage and educate. When used properly, a feed management system becomes a communication tool to help you work more successfully with your feeders. The following example from a Wisconsin dairy illustrates how this can be done.

Using feed management software to record the accuracy of a feeder team on both lactating and transition cow pens, we took into account crude protein, potassium and NDF to monitor the affect that operator error would have on the nutrition of these diets. These nutritional factors were calculated based on the ration, and the daily errors were recorded in the software. Feed was being loaded into the mixer with a payloader.
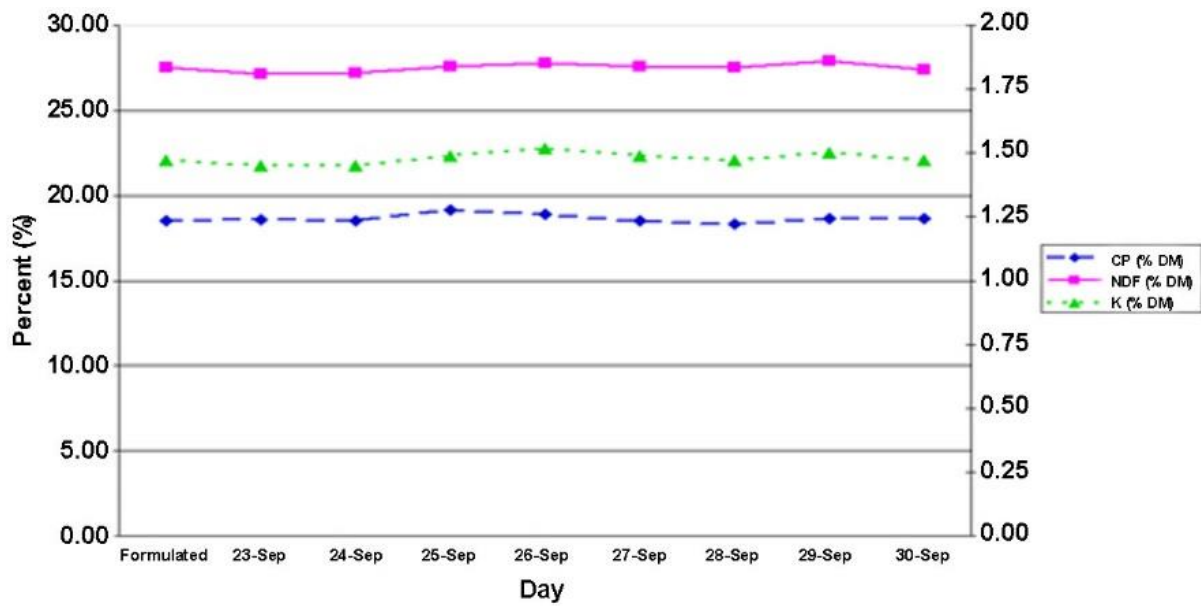
The graph above shows results similar to what we observed in our original study of the group of Midwestern feeders. Our three nutritional monitors are very consistent on a whole-herd basis when observed over a week's time. The problem area showed up when these same feeders prepared feed for the transition cow group. Crude protein ranged from 11 to 20 percent, as shown in the bottom left graph. After discovering this serious problem, management held a meeting with the feeders. Issues such as the importance of this group of cows to the dairy were discussed, and protocols were put into place to ensure accuracy. Feeders were required to use a scale to weigh out small ingredients before placing them in the mixer. This resulted in a consistent daily ration containing the intended nutrition being fed to transition cows on a daily basis, as shown in the graph on the right.

76
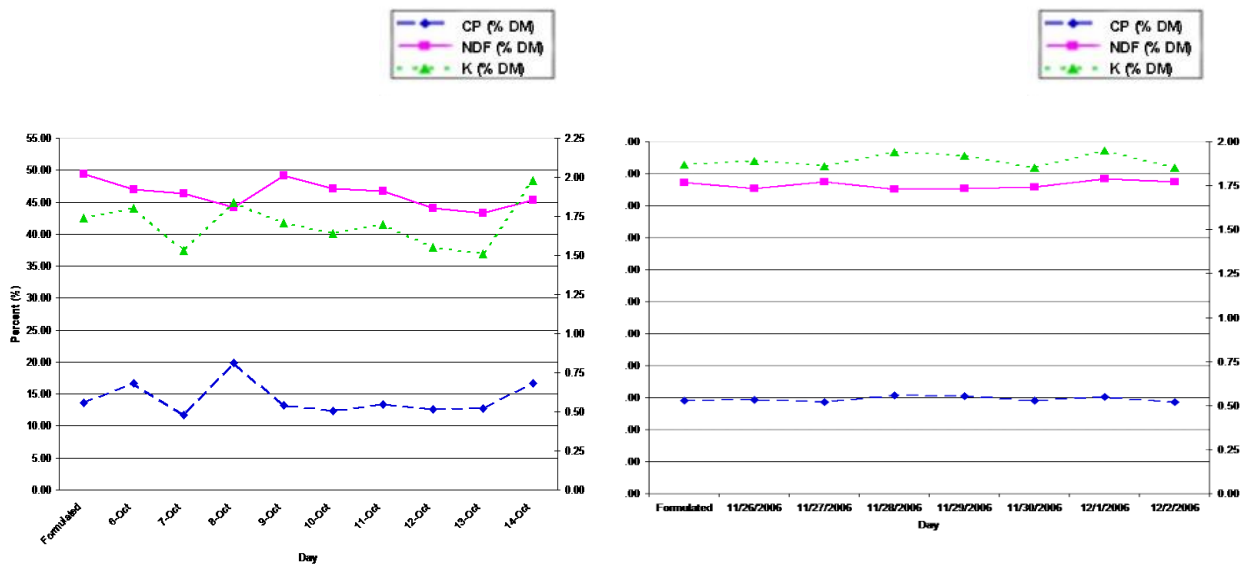
iii.   Feeding at the Right Time

The timing of fresh feed delivery is crucial for optimal milk production and a major influencer of cows' eating patterns. Having fresh feed in front of cows when they return from the parlor can pay attractive dividends. Nutritionists and farm managers are sometimes incorrectly convinced feed is being delivered before cows return from the parlor. However, they then find the opposite to be true. In one situation, the feeder was waiting for cows to come back from the parlor so that he didn't have to open and close the crossover gates. The result? Rather than eating, cows were lying down after milking. Your feed management system can point out issues such as this. The example dairy shown below saw a 2-pound-per-cow-per-day milk increase in response to adjusting feed delivery times to occur before cows returned from the parlor. This correction could yield $0.40 per cow per day or over $40,000.00 per year to the dairy involved.
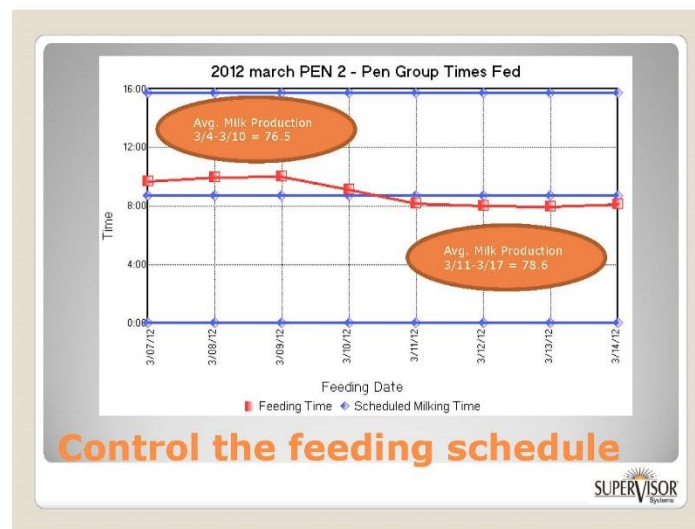
iv.   Feed Bunk Management

The astute feeder regularly assesses eating behavior and manages the feed bunk accordingly. The measuring of weigh-back or clean-up helps feeders accurately gauge where adjustments should be made. Without this figure, it's just a guess as to how much feed is actually being consumed.

A feeding summary report illustrates how much feed cows were fed yesterday, how much clean-up there was today, and monitors how the feeder is responding. If the bunk is empty, is the feeder reacting quickly and making the appropriate modification – increasing feed when a shortage is experienced? Depending on a feeder's response to bunk levels, managers can follow up by teaching them the proper actions to take if they're currently making mistakes.

Use Information to Teach and Communicate with Feeders

Feeding accuracy is definitely possible to achieve and should always be expected of your feeders. While even the most reliable feeder can make mistakes in special needs pens – an area where accuracy is of the utmost importance – clear communication involving the review of actual data can make them even more accurate. A feed management system provides the data necessary for supervising feeders and the means to manage and control your entire dairy feeding program. It helps ensure accurate mixing and distribution of feed, while making

employees accountable for each pound of feed that is fed. Consistent feeding practices help eliminate costly mistakes and can actually save a dairy thousands of dollars each year.

Section II. Effectively Managing Feed Management Software

Get the Most out of Your Feed Management Software System

From rations and bunks to inventory and employees, Feed Supervisor gives you a clear picture of every feed transaction occurring on your dairy. Whether it's a lack of time or lack of understanding as to the value of certain modules, feed management systems are often under-utilized, however. Producers are guilty of ignoring profitable programs that can directly impact their bottom line. These profit centers place powerful data regarding dry matter intakes, feed efficiency, shrink and more right at your fingertips. It's information you can use to make informed management decisions that both save money and make money.

i.   Dry Matter Intake…a Critical Measurement of Feeding Program Performance

When it comes to analyzing ration effectiveness, just knowing how much cows are being fed is not enough. You must also be in tune to how much they are actually consuming. In this era of precision ration balancing, it's shocking to find that many nutritionists are handicapped by not knowing exact dry matter intakes – a critical number in determining ration formulation.

Clean-up: to weigh or not to weigh?

To achieve an accurate picture of dry matter intake, you must weigh the clean-up or weigh-back feed material. However, less than 50% of managers require their feeders to weigh this leftover feed. Consequently, many people fall short of knowing exactly how much feed their cows are consuming. Without knowledge of actual dry matter intake, how can your nutritionist make educated adjustments to your ration?

Guesstimates of dry matter intake simply will not suffice. The monitoring and measuring of dry matter intake provides a significant management tool that allows you to make decisions based on facts. If a dairy is balancing down to the gram of an amino acid, knowing exactly what cows are eating is imperative for obtaining that level of precision. You must monitor actual intakes on a daily basis, and Feed Supervisor's Ration Management module enables easy recording of the information.

Accurate dry matter intakes graphed over a month will reveal trends and overall efficiency in the feeding program. A smooth graph would suggest cows are being fed on time, weigh-backs are being picked up, the nutrition is sound and cows are not sorting significantly. It can also identify how often bunks are running empty. If the dry matter intake line is choppy, you need to drill down and find out why. When you weigh clean-up, you're armed with a dashboard of dry matter intake data, which will inform you of how well your feeding program is functioning. You can then customize your feedings to reflect daily changes.

Tracking clean-up against dry matter intake and milk production will help a dairy discover what level of clean-up maximizes milk output while limiting the amount of wasted feed. An acceptable guideline is 1% to 4% but will vary based on housing type and the timing of feeding versus milking.

Herd Daily DMI vs Milk Production Per Cow with Clean-up
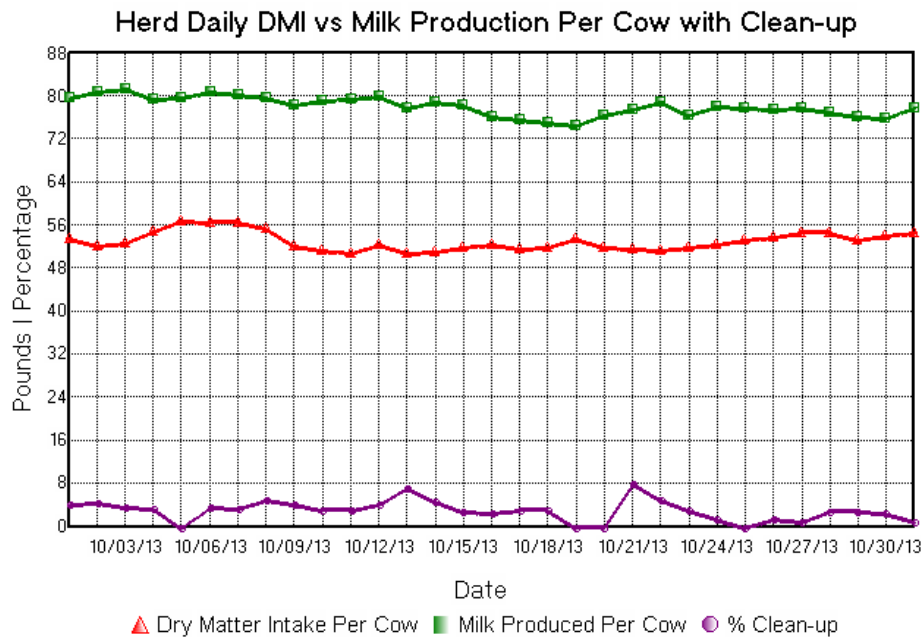
ii. Feed Efficiency – How Well are you Converting Feed to Milk?

Feed efficiency ratios are effective in evaluating a feeding program's success. When assessed as an efficiency value comparing dry matter intake to milk production, it can demonstrate how well feed is being converted to milk. When used at the farm level however, this number loses its value. Comparing it to all incoming feed or all feed fed to cows versus how much milk produced is a flawed method as it doesn't separate out clean-up and weigh-backs. Merely examining the amount of feed fed makes you oblivious to many factors. Feed consumed versus milk production is the scenario in which the real value of feed efficiency can be found. How well is the nutrition of this diet producing the end result?

It's also important to understand the market in which your milk is being sold. For example, if you're selling milk in a cheese market, the amount of protein and butterfat produced is going to take precedence over milk volume. Feed Supervisor gives you the means to evaluate these components so you can determine how well your ration is performing. You can run reports for feed efficiency ratios, fat- and energy-corrected feed efficiency ratios, feed cost per cow, per hundred weight and income over feed cost.

iii. Inventory Control: Understanding Shrink – the Final Frontier

It's the silent thief that shows up in various forms – wind, birds, rodents, spillage, spoilage. Shrink equals waste. How can you minimize this loss of feed? The first step is to identify where shrink is taking place. Reducing shrink by even 3% makes a huge difference, so you need to look for opportunities to decrease it wherever possible.

Don't assume you have shrink until you measure it. Unfortunately, this particular software feature is very under-utilized, even among the most diligent feed management system users. Knowing how much shrink you have can save you from making unnecessary, costly investments. For example, if multiple producers were experiencing a range of shrink from 1.2% to 11.0%, the person at the high-end would be wise to make plans for improvement, such as putting up bins. The producer at the low-end is doing everything right; no further action is required. You can't manage shrink if you don't measure it.

How often should you calculate shrink? At a minimum, shrink should be measured quarterly, but monthly monitoring is recommended if you really want to be accurate in managing trends. Of course incoming feed weights and costs must be entered into the system in order to manage shrink and feed inventories effectively. Truck Supervisor™, a truck-scale interface and time-saving companion product to Feed Supervisor, automatically records this information and directly downloads it into Feed Supervisor's Inventory module, eliminating the need for manual entry of incoming feeds.

Management Style – Where do we Direct our Energy?

Is it better to save $10 a ton on a load of soybean meal or reduce shrink by 3%? You'll save more money in the long run by paying attention to shrink versus per-ton feed pricing. The reality is that saving $10.00 per ton on soybean meal may return only two or three cents per cow per day. Determining the cause of shrink on your dairy and reducing it by 3% could save twenty-five cents per cow per day.

While most managers are motivated to purchase a feed management system to monitor operator performance, the fastest payback often comes from understanding the actual level of a dairy's weigh-back. In addition to the importance of accurate daily weigh-backs as they impact dry matter intakes and ration management, weigh-back also has a direct impact on your dairy's bottom line as it relates to actual feed costs. Managers may estimate clean-up to be 2% to 3% when it is actually running at 5% or 6%. This variation had an impact of $30,000 per year on a 400-cow dairy in Wisconsin. Once the farm started monitoring clean-up and made changes based on those numbers, they saw substantial savings. By reducing the amount of clean-up, you can dramatically lower feed costs because you have a better grasp on how much to feed your cows.

How can we best utilize our feed management system to seize profitable opportunities?
The ability to manage feeders is just one piece of the puzzle – Feed Supervisor can do so much more. When you take advantage of all its profit centers, you can track, measure, monitor and manage every angle of your feeding program. By eliminating the guesswork, you can continually improve the performance of your dairy operation.

Semantic Technologies in the Information Management for Precision Dairy Farming: The Showcase of agriOpenLink Project

Dana Tomic[1], Wolfgang Auer[2], Sandra Hoermann[3]
[1] FTW, Austria, [2] MKWE, Austria, [3]Josephinum Research, Austria
tomic@ftw.at

Introduction

Precision Dairy Farming stands for the farm management practices that rely on robotics and automated control, advanced sensing, communication and information management technologies, and the decision support tools. These technologies help dairy producers to meet the growing demands of sustainable herd management, particularly those rising in large herds. Advanced robotics and animal monitoring technology with the decision support functions promise to facilitate in optimal use of resources, resulting in the improvement of the animal health and wellbeing and reduction of the production costs. The adoption of the Precision Dairy Solutions is still getting momentum, but in the future it will change the way the dairy herds are managed (Bewley, 2013). Even today farmers are surrounded with a growing number of specialized systems, which they have to handle and interact with. This interaction presents numerous challenges. It is often perceived as time consuming, sometimes the very same data needs to be inserted in different systems, e.g., the milking robot and the concentrate feeder both require the animal data, the output information is abundant, but offered primarily for visual inspection and manual processing. Furthermore, the utility of some data in not clear and the general feeling is that of 'information overflow', and so only a fraction of available information is really being used. Herd Management Systems (HMS) aim at alleviating these problems and are indispensable tools especially for large herds. HMS provides a single interface towards different farm systems, which presents a significant improvement for the farmers. On the other hand the ultimate goal of an HMS solution is to combine data from different equipment and information systems, and offer decision support. The system and data integration in *multi-vendor* systems is however a tedious task, because it requires strong, extensible and well adopted interface standards for interfaces between different systems, as well as standard data models. Today, the existing communication and data format standards, such as ISO17532: Stationary equipment for agriculture - Data comm. network for livestock farming, ISO 11787, Machinery for agriculture and forestry - Data interchange syntax (ADIS), and ISO 11788, Electronic data interchange between inf. systems in agriculture - Agricultural data element dictionary (ADED) jointly used under ISOagriNET framework (www.isoagrinet.org), are still not broadly adopted, the pace at which new information is added is slow, and the data models focus primarily on the formats (syntax) of data, rather than on their meaning within the data integration context. In fact, the way the standards are developed and maintained today, do not allow for fast changes, which is in a dare contrast with the pace at which new Precision Dairy Farming technology is being developed. In addition, these standards do not include ways to encode knowledge. It is instead encoded directly within the dairy farming systems in a proprietary, and often in a 'hard-wired' way. This makes the integration of new knowledge even more difficult than the integration of data, or data sources. The dairy farming information integration needs to be addressed from the *knowledge engineering / knowledge management* perspective (Eastwood et al., 2009). Modern knowledge management solutions embrace the Semantic Web Technology because of the numerous benefits it offers (Davies et al., 2009). Just as semantics focuses on 'meaning', the semantic technology introduces means to add meaning to the data or data formats (schema), through additional *metadata,* which better describe or interrelate them. It also offers standardized *description techniques* for formalizing the concept (knowledge) descriptions, so that they can be more easily shared, extended, interlinked and used to automatically infer new knowledge. The semantic technology has been tested in applications requiring knowledge

management in numerous domains such as open government solutions, but also for corporate information systems in eHealth, tourism, media publishing, smart energy, and as a result the standards and tools have reached considerable maturity (Auer, 2014). Within the agricultural domain the Semantic Web approach already inspired a number of solutions in the research spectrum, e.g., (Chaplinskyy et al. 2013),(Gao, 2005),(Athanasiadis et al., 2009) and is also embraced by the Food and Agriculture Organization of the United Nations (FAO; http://aims.fao.org) in their global initiatives for agricultural information management systems (AIMS), AGROVOC vocabulary, and agricultural ontology service (Lauser et al., 2006).

The agriOpenLink platform for information, knowledge and process management in the dairy farming that was implemented in the equally named multi-disciplinary research initiative (www.agriopenlink.com) adopts the Semantic Web approach and is a showcase for its unique flexibility both in the knowledge management, and in the system design, configuration and maintenance. For example, the flexibility in schema description is the most significant characteristics that distinguishes semantic technology from the traditional relational data base schema modelling. While the relational approaches, e.g., as one for dairy farming presented in (Schulze et al, 2007) exploit schema-centric optimizations they difficult to extend and interconnect. In the foreground of the agriOpenLink solution is not the semantic technology itself, but its benefits and how they can be employed to simplify the standardization workflow, system integration, and knowledge-based collaboration among the dairy producers, experts (feeding consultants and veterinarians) and system vendors. agriOpenLink platform supports incremental integration of new systems, new data and new knowledge. Currently, this is particularly relevant for the integration of emerging health monitoring systems, many of which are in the market entrance phase, but will soon be indispensable as they add vital information to improve nutrition and fertility management, animal wellbeing and health.

Integration of Precision Dairy Farming Systems in Multi-Vendor Production Environments

The rational for the integration of data from a growing number of different precision dairy systems is grounded in the results of the dairy farming research, i.e., in the models that have been discovered and verified in numerous studies, revealing correlations between parameters of the environment, herds, and individual animals, including animal health parameters, fertility, nutrition needs and milk yield and quality. The dairy farming researchers are early adopters of the Precision Dairy Farming technology, and the way they use systems in their experimental setups both reflect the capabilities of the systems and the benefits these offer in their commercial applications. A study about the sensor systems for the health monitoring on dairy farms (Rutten et al., 2013) has reviewed reported studies and solutions along the 4-level model of system functionality. The model includes: Level 1 - the measurement level, where the individual parameters are assessed, e.g., activity measurement; Level 2- the interpretation level, where sensor data is translated into status information, e.g., estrus; Level 3 - the integration level, at which sensor information is supplemented with other systems' information to produce advice, e.g., whether to inseminate a cow or not; and Level 4 - the automation / the decision support level where farmers make decisions based on the system output or the system makes the decision autonomously, e.g., to call the inseminator. A review of 126 publications describing 139 sensor systems, revealed firstly the fields of the most reported research: detection of mastitis (25%), fertility (33%), locomotion problems (30%), and metabolic problems (16%), secondly, it shows that none of the studies presented sensor systems at levels 3 and 4, and thirdly for systems at level 1 and 2 it is concluded that the detection performance, the selection of the most appropriate indicators, sensor techniques, and gold standards still require further work. These results indicate that considerable additional efforts are needed in order to transition sensor technology together with models exploiting sensor readings into decision support systems (level 3 and level 4 systems), but also show the trend to add level 3 and level 4 functions which is characteristic for the emerging systems. E.g. a system based on ear tags,

detects fertility, locomotion and metabolic events and alerts farmers that additional attention is needed (MKWE, 2015). The results also explain why it is still challenging to quantify benefits of individual systems in terms of their financial impact, e.g., cost reduction, or other performance indicators, also perceived by dairy producers (Bewley, 2013). As a single solution is often not sufficient to make effective prediction and decide upon the follow-up action (or the advice), it has to be put in the context of the existing farm and animal management procedures, in particular how it adds value to the existing production environment, what new (automated) management practices / models it supports, how it contributes to cost reduction, how it integrates with other systems, and how it impacts the overall usability. Today, from the perspective of the level 1 and level 2 system vendors it is often difficult to show how a new system can be used with / or benefit from other systems – what is its integration path and cost, how it can contribute to the common information context. Without an efficient integration concept and the ability to use the information of other systems, a new system may remain just yet-another-system with its own specialized interfaces, no integration context, and adding little value to level 3 and 4 functionalities. Herd Management Software aim at realizing level 3 and level 4 functions by offering an integration concept for other solutions. However, because of the broadly adopted proprietary 'hard-wiring' approach to integration the market entrance barrier especially for the level 1 and 2 systems is still quite high. Hard-wiring approach means that two systems are tightly integrated using mostly proprietary interfaces and data models, and is commonly used in single vendor solutions. On the other hand, new technologies and best practices should find their way into level 4 systems for commercial dairy production, even when a dairy producer does not rely solely on the technology of a single equipment vendor. The quantification of the impact of the Precision Dairy Solutions presents a challenge also because the data needed to verify the validity of prediction models for different farm configurations and constraints are still not available. Current realizations of the interfaces of systems that produce these data but offer no programmatic access to them, present huge roadblocks even towards data collection (in experimental and commercial setups), which precedes any data interpretation, integration and decision support.

The system designers and integrators for the level 3 and level 4 dairy farming solutions need to address the system growth – adding of new equipment, knowledge and information. A negative impact of traditional hard-wiring approach on the data acquisition and processing presents a motivation to select technologies that are successfully adopted within other application contexts presenting similar demands regarding system growth. Web service technology, and increasingly Semantic Web Service technology is currently adopted especially in service-based enterprise systems that dynamically change, and must be dynamically configured by combining available services (Mezaour et al., 2014). Service-oriented approach offer high re-usability, and semantics additionally reduces cost of necessary extensions or changes of the system configuration as compared to the conventional realizations.

In agriOpenLink we address the challenges of the system, data and knowledge integration along the mentioned 4 level functionality model, and use semantic technology to enable in particular level 2, level 3 and level 4 functionalities. One distinctive decision in this approach is the use the Semantic Web standards for the description of the dairy farming domain data and knowledge models. Adopting the Semantic Web terminology we refer to the dairy farming domain model as the Dairy Farming Ontology (DFO). Ontologies are formal explicit conceptualization of shared knowledge that facilitate sharing and reuse of structured knowledge (Jepsen, 2009). DFO is a formalized description of the livestock and the dairy concepts most of which are currently captured in the ADED data dictionaries. DFO is a unifying model for functions at all levels. At the level 1, which is concerned with the parameter measurements and their acquisition from the physical devices agriOpenLink introduces the concept of a Plugin. A Plugin is a software component that controls the interface between the equipment – a sensor, a robot, or a database – and the agriOpenLink platform, and it extracts and prepares the data for integration. At the level 2, which deals with the initial data interpretation we use the concept of

the service-oriented interfaces, where a service presents an external interface towards the data access or control capability of each Plugin. Services use DFO as a unifying model for their input and output data. The Plugin services are described with additional metadata, which are saved in the service registry which make them easy to discover and combine. At the integration level (level 3) the ease with which DFO can be maintained, as well as the ease with which external concepts (Ontologies) can be linked with DFO play a central role. The decision support level (level 4) includes the approaches and tools for editing the expert knowledge and its integration and actuation within the system. The knowledge is described by standardized means, end expressed in form of DFO classes, queries, and services, which makes it easy to extend. The tools for automated execution of queries and reasoning support triggering of support/control actions.

The Benefits of DFO as a Data and Knowledge Integration Standard for Dairy Farming

Formal description of the domain knowledge is a prerequisite for the automated reasoning, a function required by decision support systems. The Semantic Web corpora of standards and tools include schemas and languages for formal description of concept hierarchies, for description of rules and expressive queries, as well as tools to store this information in a unifying format and to reason upon it (W3C SW, 2014) (Cardoso, 2007). The web ontology language (OWL) is commonly used for knowledge description, based on the description logic (W3C OWL, 2013). It includes classes, data properties, and object properties as constructs for resource modelling. The resources are described as instances of a particular OWL class with specific data properties. The classes defined in the ontology either belong to the basic hierarchy of concepts (the primitive classes) or are specified for classification purposes (defined classes) Defined class types are automatically inferred by software tools, the so-called reasoners (Mishra & Kumar, 2011). The goal of DFO is similar to that of the agricultural data dictionary (ADED): to create a hierarchy of the concepts, including classes such as Animal, Organization, Location, and properties that can efficiently represent values of configured, measured or observed parameters coming from different devices or data sources. We created primitive classes of the basic hierarchy as well as their properties in DFO, by semi-automatically extracting them from ISOagriNET dictionaries, and extended it with the additional equipment information, e.g., from the milking robot, and the monitoring system. The expressiveness of the DFO is higher that of a dictionary as it includes classification information. Defined classes specify constraints on properties to be used for classification. In the agriOpenLink platform, DFO is saved in the repository that is accessed by the collaborative editing tool. DFO can be collaboratively extended, with new primitive classes, propertied, and defined classes, as well as interlinked with other ontologies. The need for an extension to DFO emerges when a Plugin is created for a new data source – a new equipment – which contributes data still not captured in DFO. In designing the DFO we adopted the best practices of building the enterprise applications using semantic technologies (Mezaour, 2014).

The Benefits of Semantic Web Services for Flexible Process Workflows

The service-oriented design and its Web Service (WS) realization are broadly adopted in networked systems and business processes (Athma et al., 2014). Web services present standard interface towards the embedded functionality and are invoked by using standard Web communication protocols. The parameters used for the service invocations are defined in the service descriptions. Web services come in different flavors and modern software development environments support service-oriented development by integrating implementations of the protocol stacks. The services that are described with the semantic metadata, e.g., service ontology, which use and generate semantic data, are referred to as Semantic Web Services (SWS), but come in many different flavors (Cardoso, 2007). Benefits of describing services by using Semantic Web schemas and languages are in the uniformity and expressivity of the

service parameters. Moreover, service descriptions are available in service repositories that can be queried to automatically discover needed services.

agriOpenLink platform adopts a SWS approach inspired by the Semantic Automated Discovery and Integration (SADI) concept, a semantic extension of the REST WS (Athma et al., 2014)., initially introduced in the area of the scientific workflows for bioengineering (Wilkinson, 2010). In our approach each Plugin implements and publishes semantic services that consume and generate semantic data-instances of Classes defined in DFO. Each service is described in the service registry. By querying the registry an instance of a service of a specific input or output class, belonging to a specific Plugin can be find. Plugin Services are invoked via a Plugin Server. The Plugin Server implements a standard Web Server interface based on the HTTP Protocol (Berns-Lee, 2010). It answers the HTTP calls by forwarding them to the corresponding Plugin Services, and by returning the results within the same HTTP session. A 'plugin-based' infrastructure and tools enable flexible integration of any agricultural equipment within the platform. An open source approach has been taken for plugin creation: the process of plugin creation is supported by plugin development environment, plugin skeleton and reusable code which implements common plugin functions.

agriOpenLink Platform Implementation and Demonstration

The constituents of the agriOpenLink platform can be grouped within three broader components: 1) the Plugin Component encompassing the layer 1 and layer 2 functionality; 1) the DFO Component integrating layer 3 functions; and 3) the Query Component with layer 4 functions.

The Plugin Component includes the Plugin server and all the Plugins, which run on the Plugin Gateway. Plugin Server dynamically load and configure individual plugins, and register their services. The Plugin Gateway is an industrial computer with communication interfaces suitable to connect dairy farm devices. Plugins communicate with their corresponding devices and extract relevant data. Plugin Services translate these data into the corresponding classes and properties defined in DFO. A Plugin Service translate the instances of the Input Class into the instances of the Output Class by adding corresponding properties. The Plugin Services can offer interfaces towards both monitoring and control functionality of the equipment, they be automatically discovered and dynamically invoked. An additional component is a Plugin Development Environment, in which Plugins can be developed and tested before being deployed.

The DFO Component includes DFO, which presents the integration standard, the DFO repository in which DFO is saved, and the Ontology Editor to collaboratively edit the ontology.

The Query Component: In addition to the ontology the knowledge can be also described as a query in a specific query language. A query language for semantic data is SPARQL (W3C SPARQL, 2013)
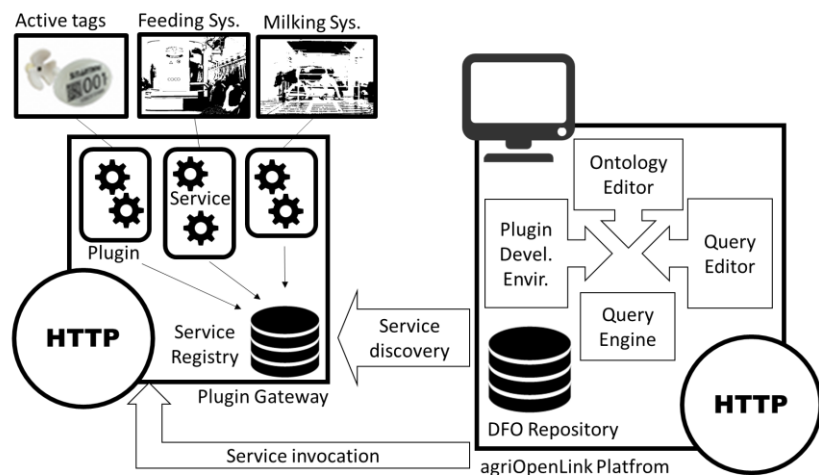
Figure 1. agriOpenLink Components

which has a high expressivity in specifying query constraints. A query defines a search template which when executed returns matching data and metadata. A template defines restrictions on properties of instances of specific classes which will be filtered out. For example, a query over all instances of the Animal class, restricted on properties capturing specified yield and mobility, filters out only matching animals. The Query Component include the Query Editor and the query Engine. A Query Editor offers a GUI for creating templates based on the class and property definitions as existing in the DFO repository. In addition queries that are already prepared (by an expert) are saved, and each query is annotated with a description in a natural language. A query can be invoked through the GUI or automatically executed. The Query Engine translates each query into a chain of plugin service invocations resulting in the answer to the query. A query resolution and answering workflow includes reasoning about classes and properties specified in the template, discovery of services that provide data of specific classes, service invocations and data collection, reasoning and classification on the gathered data. For example a query "find all instances of cows, which had a milk yield above average within the last month, and has condition that requires medical attention" will be resolved by finding out all relevant DFO classes and Plugin Services that offer data of these type, and by classification on the obtained data. For example the instances of the Animal class are used to query Services of the Milking System and the Monitoring System plugin; obtained data is classified based on the DFO class definitions to filter out Animal instances according to restrictions on milk yield and medical conditions (Tomic, 2014). The filtering according the medical conditions can be based on parameters acquired from services of different Plugins / Devices, as well as external services. The agriOpenLink platform offers interfaces for the farmers, precision system vendors, and experts (consultants, veterinarians). The experts use the knowledge integration interface – the Query Editor and the Ontology Editor for level 3 and 4 functions. The system vendors use the Ontology Editor and the Plugin Development Tools, to extend DFO to their needs and generate plugins corresponding to the unified data model. The farmers benefit from the integrated data and knowledge by receiving advices based on automatically executed queries created by experts.

agriOpenLink platform is implemented and demonstrated first in the lab and then in an experimental setup on a dairy farm in Upper Austria. The lab setup demonstrated a design, and integration of four different Plugins realizations; a Plugin for a LELY Milking Robot based on the T4C application, a Plugin for MKWE SMARTBOM monitoring system based on the access to the data in the cloud and Plugins for the DeLawal Milking Robot data and the Wasserbauer concentrate feeder data accessed via the REST service wrapping. The lab-setup used the data of the farm at which the real world tests were conducted. In the real-world setup three plugins are implemented: for the LELY T4C, the SMARTBOW and the Wasserbauer Food Mixer. The system is extended with the application that automatically triggers selected queries resulting in the notifications to the farmer.

Conclusions and Outlook

As the Precision Dairy Farming solutions become more and more economically viable the dairy producers will find stronger incentives to adopt a variety of new systems. As a result they will be increasingly concerned with the question how to best integrate new sources of information within their existing processes. Data and systems' integration is already an issue for the farm equipment vendors, the Herd Management Systems' vendors and farmers. Semantic technology offers benefits in data, information, knowledge and process management in systems which data, knowledge and process models that are not static, which is a characteristic of systems that grow.

To support integration of new technologies and knowledge in system with decision support and automation functions, the agriOpenLink platform adopts an architecture based on service-

oriented interfaces and a common shared semantic knowledge model. Such architecture has a potential to deliver up to the expectations that the higher the number of precision technology solutions within the production environment, the higher the level of sophistication of the decisions/advices this environment can offer.

By implementing and testing the agriOpenLink platform, both in the lab environment and at a selected dairy farm, we demonstrated the validity of perceived benefits achieved through the semantic approach: 1) the platform flexibly integrates and interlink data from new equipment or data source as they get incrementally introduced 2) the platform supports collaboration in model construction, knowledge encoding and sharing. Semantic web technology hence presents itself as viable candidate to create and maintain a de-facto standard for data and knowledge integration in the dairy farming, and also to enable flexible process workflows for process optimization based on semantic service-oriented design.

The experience obtained during the design of Plugins helped to improve the Plugin Development Environment. In the next step we plan to support interested system vendors in the design of their own plugins, and in experimenting with the DFO extension. Related to DFO, future steps include evaluating and optimization of the expressiveness and performance of semantic queries.

Acknowledgements

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Data Driven Decisions to Maximize Herd Health and Profit

Ray Nebel, PhD
Select Sires Inc.
Plain City, OH

rnebel@selectsires.com

Roadmap

- Disruptive Technology
  - Individual Cow Management
  - Will Your Protocols Change
- Technologies Available
  - No two Systems are Alike
- Heat Alerts
  - Secondary Sign of Heat
  - Timing of A.I.
- Health Alerts
  - Based on Rumination/Eating and Resting
- Return on Investment
- Service
- What's NEXT!
  - There will Always be Enhancements

Disruptive Technology

- A disruptive technology is a significant innovation, discovery or technology that creates new markets and displaces a previous technology or manual process.

- A disruptive technology is often a collection of technologies and might be better called a disruptive product.

- Predictions as to which technology will dominate or when the next technology takes hold have been notoriously inaccurate. Almost always, disruptive technology can only be identified in hindsight.

Individual Cow Management

Systems for Breeding

- Visual Observation
- Walk and Chalk
- Timed A.I.
- Activity Monitoring
- Natural Service
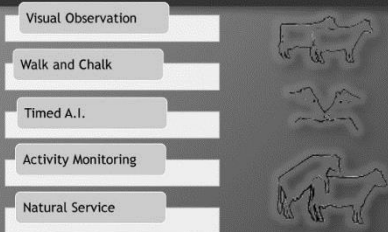
Ovulation Synchronization Protocols

Pre-Synch 14/12	Lut-Ovsynch
PG 6-day CIDR	5-day CO-Synch + CIDR
G - 6 - G	Double Ovsynch
7-day CIDR	7-day CO-Synch + CIDR
Pre-Synch + CIDR	OvSynch 56
MGA - PG	14-day CIDR

1995
Timed AI

Ovsynch

CO-Synch 72
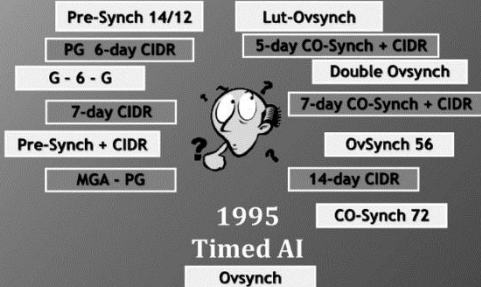
Sun	Mon	Tue	Wed	Thu	Fri	Sat
					GnRH	
					PGF	
	GnRH					
	GnRH					
	PGF	PGF	Shift 2 GnRH	Shift 1 breeding		

Feb 2015 prices
GNRH $1.41 x 4 = $5.64
PGF $1.73 x 3 = $5.19
Total = $10.83

First Service TAI Protocol - ~ 50% Conception Rate

Activity Systems Timeline

Rumination monitoring becomes available

Advanced accelerometer introduced as mechanism for activity measurement

Measures standing to be mounted

First ear tag based health and activity monitoring device with temperature

First research report of heat detection using pedometers. USDA, Beltsville, MD
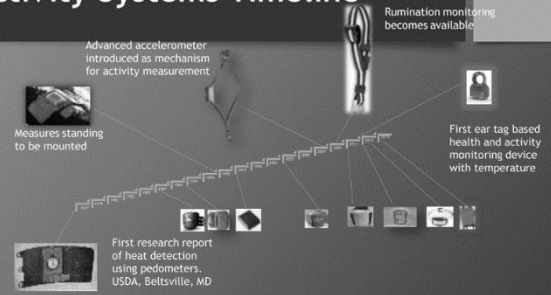
NO Two Activity Systems Are the Same!

Detection of Estrus

- To achieve accurate and efficient heat detection, many factors have to be taken into account.
  - The cow must EXPRESS estrus!
  - Someone or something must DETECT it!

Activity is a Secondary Sign

"Fifty Shades of Gray"

Interval from Onset of High Activity to A.I. on Conception Rates
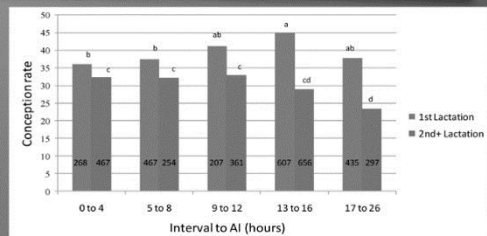
A.I. Guideline

Onset of Heat Alert	Should be inseminated:
Morning	Afternoon of the Same Day
Afternoon/ Evening	Morning of the Following Day

Health Alerts

- Rumination
- Eating
- Resting Non-Active
- Laying\standing bouts
- Temperature
- Conductivity
- Heart rate
- Rumen pH

What Have WE Learn About Health Alerts

CowManager

- **Suspicious** – subclinical ketosis has been the most common disorder seen by producers.

- **Sick** – moderate metritis, ketosis, some cases of mastitis, acidosis, and diarrhea have been health events reported with this alert. Lame cows are usually identified in this category. They are not actually "sick" but their eating times are reduced and activity is lower!

- **Very Sick** – Disorders such as, displaced abomasum, severe mastitis, many times E.coli, pneumonia, and milk fever are the cows that appear in the very sick category.

Reproductive Performance

Pregnancy Rate

Conception Rate

Submission Rate

Voluntary Waiting Period

21-day Pregnancy Rate

6,917 DRMS Holstein Herds

Median = 17.7%
Mean = 18.6%

Number of Herds

600
500
400
300
200
100
0

<6 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35

(January 2015)

21- Day Pregnancy Rate
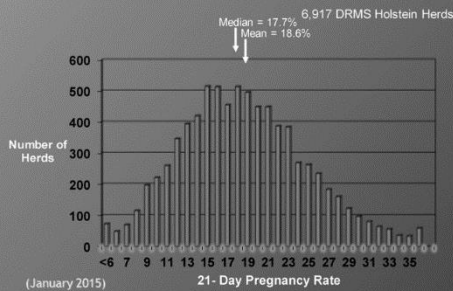
PREGNANCY RATES
MORE PREGNANCIES = MORE PROFITS

Quick Calculation of Expected Monetary Value difference between current and expected 21-day Pregnancy Rate

CURRENT 21 DAY PREGNANCY RATE

Annual Value of improving 21d PR ($/cow/year)

For 2,000 cows @ $45/cow/yr = $90,000!

Goal 21 Day Pregnancy Rate

Goal \ Current	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
11	32																			
12	62	30																		
13	90	58	28																	
14	117	85	55	26																
15	141	110	80	51	25															
16	165	133	103	75	48	23														
17	187	155	125	97	70	45	22													
18	207	176	145	117	91	66	43	21												
19	227	195	165	137	110	85	62	40	19											
20	245	213	183	155	128	103	80	58	38	18										
21	262	230	200	172	145	121	97	75	55	35	17									
22	278	246	216	188	162	137	113	91	71	51	33	16								
23	293	261	231	203	177	152	128	106	86	66	48	31	15							
24	307	276	246	217	191	166	143	121	100	81	62	45	29	14						
25	321	289	259	231	204	179	156	134	113	94	76	59	43	28	13					
26	333	302	272	243	217	192	169	147	126	107	89	71	55	40	26	13				
27	345	313	283	265	229	204	181	159	138	119	100	83	67	52	38	23	11			
28	357	325	295	266	240	215	192	170	149	130	112	95	78	63	49	36	23	11		
29	367	335	305	277	251	226	202	180	160	140	122	105	89	74	60	46	34	22	11	
30	377	345	315	287	261	236	212	190	170	150	132	115	99	84	70	56	44	32	21	10

Cabrera V. 2011 – UW Madison, 2011. ReproMoney Program®

Timed AI without Heat Detection

126 9 Month 21 Day Pregnancy Rate by Days In Milk

No Exclusions
Lact>=1 L1VWP:60 L2+VWP:60 PgCk:35

Days In Milk (DIM)	Bred #Eligible	#Reported	Pct	Pregnancies #Eligible	#Reported	Rate	#Abort
1-18	0	0		0	0		0
19-39	0	0		0	0		0
40-60	0	0		0	0		0
61-81	493	463	94	429	153	36	13
82-102	310	20	6	315	7	2	0
103-123	316	270	85	281	71	25	10
124-144	248	30	12	243	9	4	1
145-165	248	195	79	223	57	26	5
166-186	178	30	17	176	11	6	2
187-207	176	132	75	160	33	21	3
208-228	142	30	21	138	12	9	3
229-249	126	96	76	113	32	28	1

Activity System without TAI

126 12 Month 21 Day Pregnancy Rate by Days In Milk

No Exclusions
Lact>=1 L1VWP:55 L2+VWP:55 PgCk:40

Days In Milk (DIM)	Bred #Eligible	#Reported	Pct	Pregnancies #Eligible	#Reported	Rate	#Abort
1-34	0	0		0	0		0
35-55	0	0		0	0		0
56-76	890	582	65	794	215	27	17
77-97	627	365	58	569	153	27	10
98-118	455	258	57	424	105	25	8
119-139	339	179	53	313	71	23	2
140-160	267	148	55	244	64	26	4
161-181	186	108	58	169	47	28	2
182-202	135	72	53	120	22	18	0
203-223	99	57	58	90	13	14	2
224-244	84	42	50	71	10	14	1

Timed AI with Activity System

126 12 Month 21 Day Pregnancy Rate by Days In Milk

No Exclusions
Lact>=1 L1VWP:70 L2+VWP:70 PgCk:40

Days In Milk (DIM)	Bred #Eligible	#Reported	Pct	Pregnancies #Eligible	#Reported	Rate	#Abort
1-28	0	0		0	0		0
29-49	0	0		0	0		0
50-70	0	0		0	0		0
71-91	821	780	95	760	305	40	31
92-112	515	279	54	484	108	22	11
113-133	403	233	58	369	72	20	10
134-154	324	207	64	297	73	25	9
155-175	255	159	62	228	52	23	3
176-196	198	115	58	178	36	20	3
197-217	162	101	62	148	37	25	4
218-238	122	66	54	112	17	15	1
239-259	102	64	63	91	16	18	0

Reproductive Performance

- Pregnancy Rate
- Percent Pregnant at 120 or 150 DIM

ROI

ROI

Service – Installation, Training, Monitoring

Remote Monitoring Service

What is Next?!?

Automation in Ventilation & Cooling

Brent Hershey

brent@hersheyag.com

COW KULTERZ
Editing Solutions

HERSHEY AG
Superior Production Systems

Basic Air & Cooling Needs

- Air Exchange/Breathability
  - Natural
  - Mechanical
- Air Velocity
- Water Cooling

Fresh Air

Fresh Air

Hot Air

Hot Air leaving barn

Side Wall

Air Flow (average 10 - 20 mph)
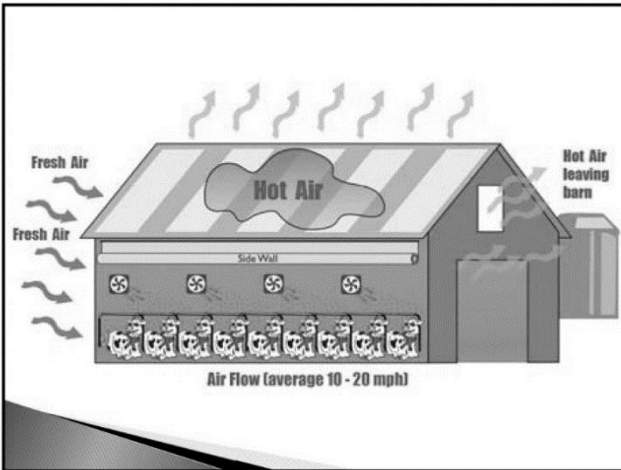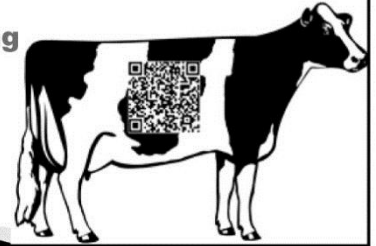
Air Exchange - Natural

- Curtain Controls
  - Temperature
  - Wind direction
  - Rain/Storms
- Automated ridge vents
- Variable speed roof vents
- Automated chimneys
- Thermostats

Curtain Controls

Curtain Controls

HEAT - HUMIDITY - RAIN

AUTOMATE> Your Cooling Systems

Ridge Vent
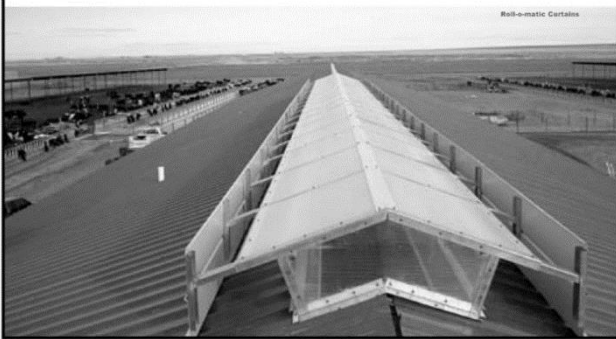
Automated Chimney

Air Exchange - Mechanical

- › Tie Stall
- › Free stall
- › Tunnel
- › Cross
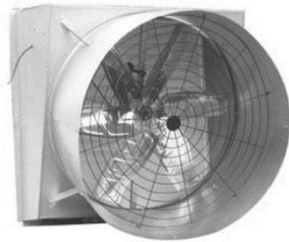
Tie Stall Tunnel
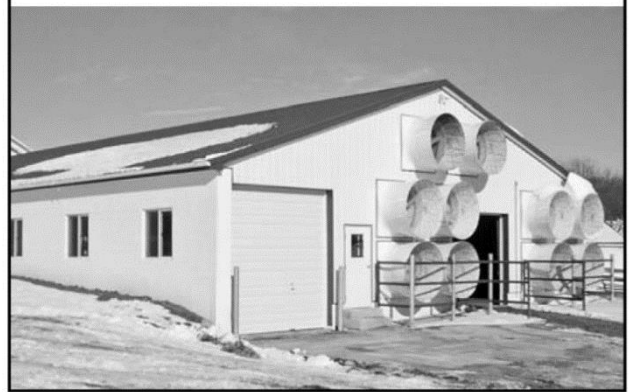
Tie Stall Tunnel

Free Stall Tunnel

Free Stall Tunnel
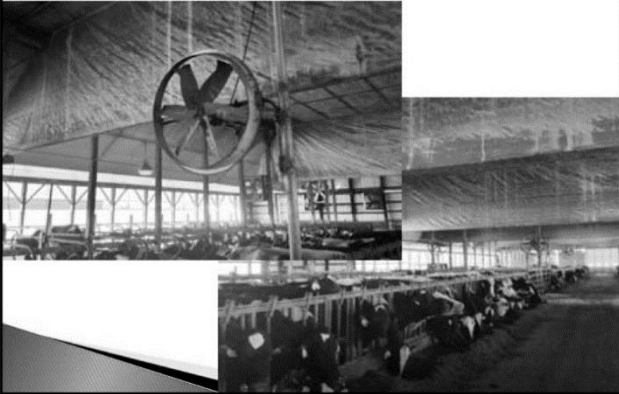
Cross Ventilation

Air Velocity

- Next step after air exchange
- Essential for water cooling
- Many fan options
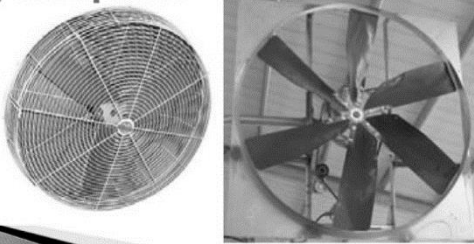
Air Velocity

- Types of controls
  - Thermostats
  - VFD motors
  - Variable speed
  - EC motor
  - Automated potentiometer
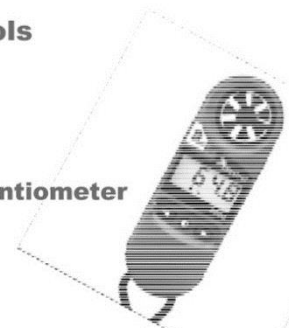
Avg. Daily Temps - Central US.
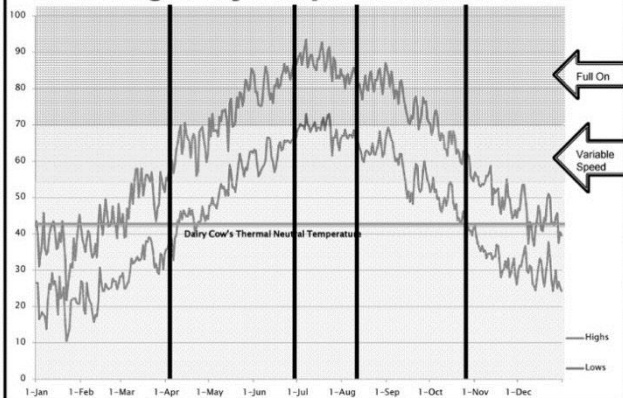
Energy Aware

Water Cooling

- Soakers with thermostats
- Cool cells
- THI controls

Total Barn Cooling

- Stalls
- Feed bunk
- Bedded pack
- Holding area
  - Time Clock
  - Automated fan and water cooling controllers
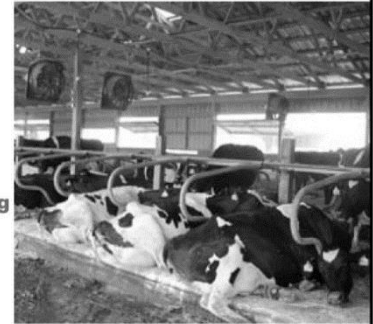
Bedded Pack
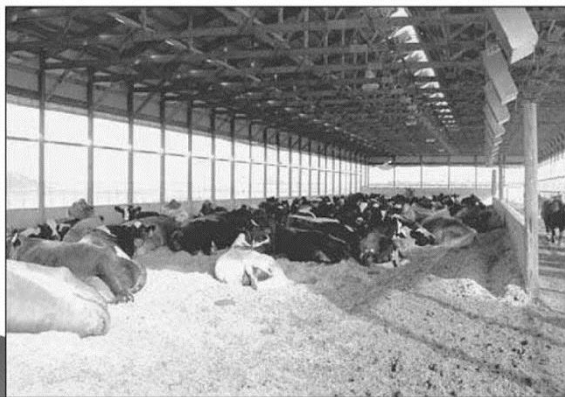
Holding Area – High Priority
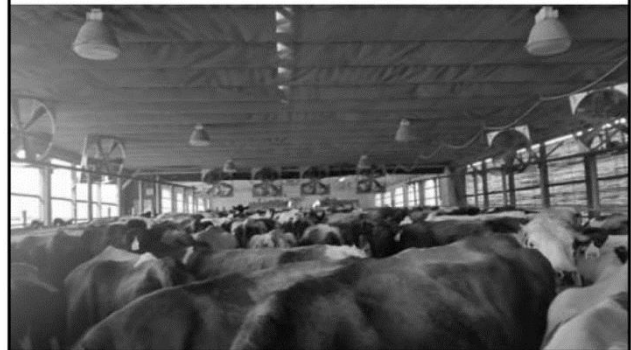
Holding Area

Holding Area – High Priority
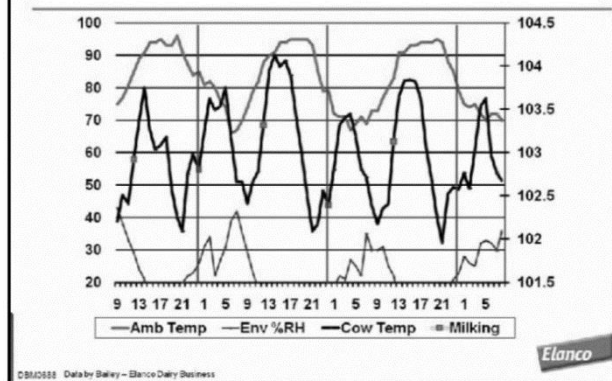
Don't Forget Dry Cows
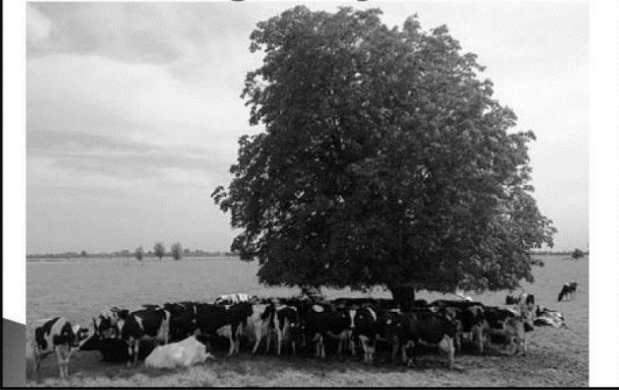
Heat Stress Apps

- Thermal Aid – University of Missouri
- QualiTech Heat Stress Mobile App
- University of Guelph

Cost of Automation

- Basic upgrades as low as $10/cow
  - VFD motors
  - Thermostats
- High tech upgrades $350/cow
  - Variable speed fans
  - Cool cells

Basic barn building investments are
$4,000 - $5,000/stall
Optimizing stall comfort pays off

Benefits

- Increased milk production
- Improved conception
- Fewer health issues
  - E.g. - Pneumonia
- Better feed intake

$20 - $100+/Cow/Year

Summary

- Air exchange
- Air velocity over the cows
- Water for cooling
- Automate controls
  - Cows' comfort level

Technology is what makes you better!

100

Rumination Monitoring Technology:
How it has Helped Improve Cow Comfort, Health, and Reproduction Performance at our Dairy

Tony Louters
T&C Louters Dairy, Merced, CA
tonylouters@gmail.com

The objective of this article is to describe how the incorporation of the SCR Heatime® Activity and Rumination technology to the herd's management system has helped our dairy improve cow comfort, health, and reproduction performance.

T&C Louters Dairy is located in Merced, CA, and is currently milking 600 Holstein cows, with 725 total cows. Cows are milked three times a day in a double 15 parallel parlor. Current average daily milk production is 90 pounds per cow.

I was born and raised in Hollandale, MN, and started in the dairy business in 2003. I earned a college degree with a major in business administration and accounting from Dordt College in Sioux Center, IA. Upon graduation, I moved to San Diego, CA, and worked in Corporate America for 5 years, then decided to move to the dairy industry. I worked on my father-in-law's operation from 2003 to 2005 in San Diego, then decided it was time to move forward and start my own business. I moved to Merced in 2005 and have been the owner and general manager of T&C Louters Dairy since then. I am married to Colina and we have 4 children, Alexis (17), Bryce (15), Tyler (12) and Breann (10).

I first became interested in monitoring technology 4 years ago when activity monitoring became more widely used. In February 2014, we decided to invest in SCR animal monitoring technology to optimize herd performance and profitability. The SCR Heatime® HR LD (Activity, Health and Rumination – Long Distance) is a radio-frequency (RF) device. It combines rumination, heat detection and cow identification to give dairy farmers a tool to monitor cows in real-time, 24 hours a day.

The HR LD tag contains a motion sensor, microprocessor, memory, and specially-tuned microphone that detect the cow's activity and rumination. Each HR LD tag collects information and transmits it to the SCR system a few times per hour via RF technology, so the information in the system is up-to-date at all times no matter where the cow is located. The data generated by the tag is captured by an antenna and is processed by the SCR software (Figure 1) based on mathematical algorithms that create a graphical representation of the daily activity and rumination patterns for each individual animal in the herd (Figure 2).

The HR LD tag includes a unique sensor that accurately measures each cow's body movements and their intensity under any conditions 24 hours a day/7 days a week. With its high degree of precision, the HR LD tag is capable of detecting even relatively weak signs of activity during heat. With this information, the system is able to detect the onset and peak of activity so cows can be inseminated at the optimal time, and decreases in activity to help catch health problems earlier than other clinical signs.

In addition to the activity monitoring system, the SCR HR LD tag includes technology that detects and records daily rumination patterns. All of the rumination data provided by these RF tags is immediate and actionable, sent wirelessly to the system a few times per hour. This information is used to monitor feed and mixing changes, and cow health which helps to identify

and treat diseases early and prevent more serious illnesses. This unique combination of activity monitoring and rumination monitoring has been successfully implemented in dairy farm management enabling timely, data-based decision making of heat detection and cow health.
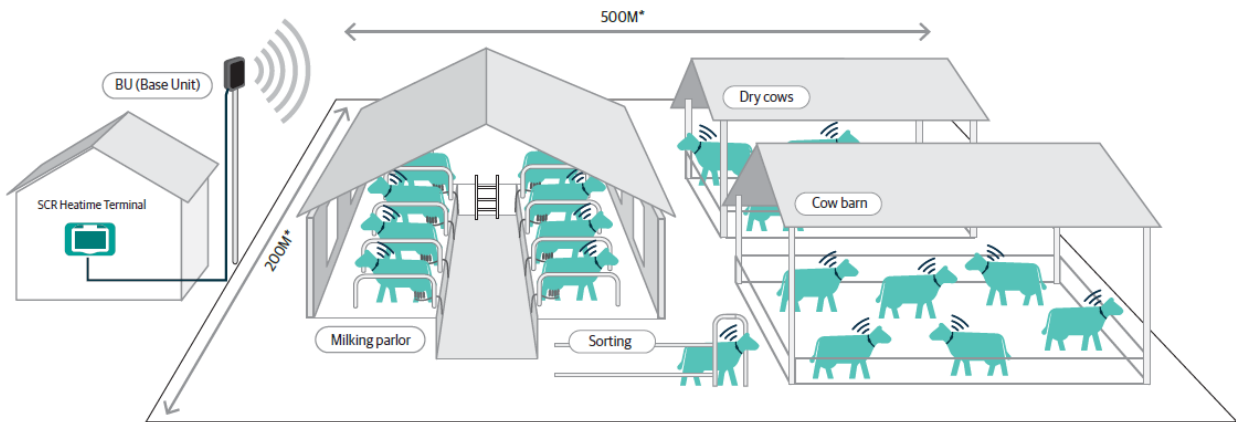
Figure 1: Schematic representation of an antenna range and capture of data generated by the monitoring devices.

Figure 2: Graphic representation of an animal (cow ID 4081) with weighted activity and rumination data provided by the monitoring device.

We decided to invest in the technology based on the desire to improve fresh cow management and fill gaps that could be present as a result of not being diagnosed by the standard operating procedures we had in place. With the collars being placed on in the dry period, we also wanted to monitor dry cow performance and their transition to the milking string. We were confident that the data generated by the system would help to achieve the next level of confidence in overall herd health.

Additionally, we were seeking fast insight into the effectiveness of the veterinarian treatments that were given to sick cows. We wanted a tool that could help to identify the evolution of treatments, monitor success rates, and help with decisions to make changes if necessary. After a formal presentation and calculations regarding the return on investment, we only needed one visit to an operation that was already using and enjoying the benefits of the system to make our decision to invest.

We started adding tags to the cows when they were moved to the dry pen in June 2014, and by December we had the whole herd monitored by collars.

In order to have the system work, it's necessary to embrace the technology and use it as a partner. To help optimize the benefits of the system, attention to detail and trust in the information provided is crucial.

Management was adapted to maximize the use of the system. On the reproduction management side, cows are identified by the system and the decision to perform artificial insemination is based on the heat index profile and ideal time to AI (Figure 3). Cows then receive their service two times a day to maximize heat detection and conception rates. At first, we were detecting cows in estrus based on tail chalk removal. We decided to keep chalking cows until we were comfortable with the reports generated by the system. It took less than a couple of months to quit this strategy. The system never missed a cow and it was finding cows that we would have missed.
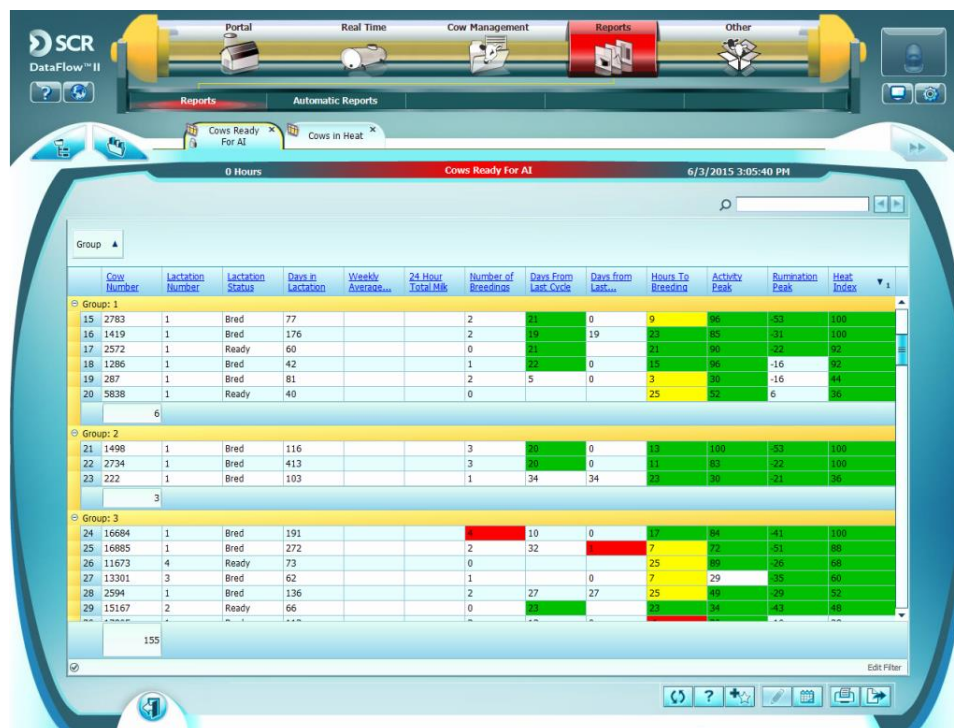
Figure 3: "Cows Ready for AI" report generated by the software, with the heat index on the last column.

On the animal health monitoring side, reports are set up on the software to flag cows that either had their own pattern of activity and rumination changed substantially from the day before and from the average of the last three days, being identified by the health index (Figure 4), or individually if they differ from the group average, with the dry cow group, for example.

Figure 4: Health report generated by the software, with the health index on the last column.

Cows that are in the Health Index Report are set aside for further investigation and treatment if needed. After treatment, the pattern of returning of rumination to the normal level is monitored and decisions to stop or change treatment strategy is taken. For the majority of post-partum health events, the system has been able to identify cows earlier than before.

When the decision was made to invest in the purchase of the system, the return on investment calculation, being extremely conservative on numbers used, showed a "break even analysis" estimation of the payoff on the investment in 18 months, taking into consideration the addition of sufficient monitors to all cows in the herd. Calculation is based on decreasing severity of health events on treatments, impact on displaced abomasum and death loss, milk response, time management, and reproduction performance.

Time management used for collar and data management needs to be taken into consideration. In addition, some extra time to look at cows that are not showing on the heat and health reports until familiarized and comfortable with the information provided by the software, which is a natural learning curve that took two months.

After an increase of 3% on pregnancy rate and on average 2 extra pounds per cow per day, due to lower the lockup time, more effectiveness and better transition period care, saving on pharmaceutical cost at the 60% range, it was determined that a 12-month period to receive the return on the investment with a cash flow of $1,500 a month right after installation. With the increase in pregnancy rate alone, based on the University of Wisconsin – Cornell University calculator, an extra $27,550 was added to our revenue.

Even though we made the decision to invest in the technology based on the help we would receive by intensively checking fresh cows, the system showed its benefits on the management of the dry period. Fresh cows were presenting a range from 25% to 30% on retained placenta on the first week post-partum, and the early culling rate was higher than the average of 8%.

Before monitoring all cows, we were vaccinating and moving cows from the far-off to the close up pen on the same day three weeks before parturition. In December last year, we were able to add monitors to all cows and started to monitor the dry period closely. We then noticed a substantial drop in rumination right after the performance of those weekly tasks. We changed the management by generating two lists of cows to be managed. Cows four weeks prior to calving received the vaccine injection, and cows three weeks prior to calving were moved to a different pen. The drop in rumination occurred on both cases, but cows recovered well after the split on the tasks, and a reduction in retained placenta to 5% was observed. Additionally, the early culling rate is currently below 5%. The benefits of confidence in veterinary treatments by checking the recovery of rumination has been achieved.

Extra benefits on the reproductive side, after the whole monitoring of cows in place and with better reproductive parameters, we started to perform genomic testing on our cows. We now select the bottom 30% of genetics in our herd to receive Angus bull semen. Based on the calculation from the University of Wisconsin-Madison, we are adding an extra $30,000 to our bottom line by having a premium payment for day-old crossbred calves.

Acknowledgement:

Robotic Milking System Data Analysis

Factors Associated with:
- Increased Production per Cow per Day
- Increased Production per Robot per Day

Marlène Tremblay[1], Justin P. Hess[1], Brock M.Christenson[1], Kolby K. McIntyre[1], Ben Smink[2], Arjen J. van der Kamp[2], Lisanne G. de Jong[3], Dörte Döpfer[1]

[1] University of Wisconsin-Madison, Madison, Wisconsin, USA
[2] Lely North America, Pella, Iowa, USA
[3] Lely International N.V., Maassluis, The Netherlands
mtremblay@wisc.edu
This work was supported by Lely North America
June 2015

Presented by Ben Smink,
Manager Farm Management Support Lely NA

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Outline

- Background and Goals
- Data & Methods
- Results
- Discussion
- Summary
- Conclusion
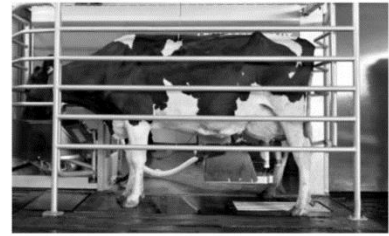
Precision Dairy Farming Rochester, MN, June 2015
Marlène Tremblay, DVM, Food Animal Production Medicine UW Madison, WI

Background

635 North American dairy farms with Lely robotic milking systems had weekly data collections for four years (2011-2014)

Goal

- Determine predictors for:
  - Milk production per cow per day and
  - Milk production per robot per day
  using generalized linear mixed regression models
- Specifically, determine the optimum:
  - Pen size: number of robots per pen
  - Traffic type: Free or guided/select

Precision Dairy Farming Rochester, MN, June 2015
Marlène Tremblay, DVM, Food Animal Production Medicine UW Madison, WI

DATA & METHODS

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Data (Categorical)

Variable	Levels
Traffic Type	Free
	Guided/Select ***
Pen Size	1
	2 ***
	⩾3
	(More and 0)
Breed	Holstein***
	Jersey
	Other
New or Retro	New***
	Retro
Goal (country)	Quota- CAN***
	Max production/MP-USA
	(Grazing/Organic)

Variable	Levels
Time since installed	0-1 yr
	1-2 yrs
	2-3 yrs
	3-4 yrs
	⩾ 4 yrs***
Robot % free time	0-5 %
	5-10 %
	10-15 %***
	15-20 %
	⩾20 %
Year	2011***
	2012
	2013
	2014
Season	Winter***
	Spring
	Summer
	Fall

*** reference level
() not used in analysis

Precision Dairy Farming Rochester, MN, June 2015
Marlène Tremblay, DVM, Food Animal Production Medicine UW Madison, WI

Data (Numeric)

Variables
Cows per Robot
Average DIM
Kg concentrate per 100 kg
Rest feed %
Number of refusals (per cow/ day)
Number of failures (per robot/ day)
Production per cow per day (kg)
Production per robot per day (kg)
Number of milkings (per cow/ day)
Milkspeed (kg/min)
Average boxtime (minutes)
Number of connection attempts (per cow/ day)

Precision Dairy Farming Rochester, MN, June 2015
Marlène Tremblay, DVM, Food Animal Production Medicine UW Madison, WI

Methods

- Removed missing observations and outliers
  - 54,065 observations remained
- All numeric variables were:
  - log transformed
  - centered
  - scaled
- The correlations between numeric variables were examined

0.61 0.01 0.60 0.21 -0.23 -0.22 -0.24 -0.21 -0.28 0.39 0.06
0.78 0.45 0.25 -0.18 -0.12 -0.09 -0.47 -0.11 -0.06 0.08
0.12 0.15 -0.06 0.02 0.08 -0.45 0.07 -0.38 0.04
-0.10 0.02 -0.30 -0.11 -0.25 -0.09 -0.02 0.10
-0.16 -0.07 0.17 -0.46 -0.11 -0.43 0.07
0.03 0.05 0.08 0.10 -0.08 0.00
0.27 0.29 0.07 0.16 -0.04
-0.05 0.18 -0.33 -0.01
0.06 0.49 -0.01
-0.14 0.20
0.05

Methods

- Generalized linear mixed regression models
  - Random effect of farm ID to adjust for differences between farms and repeated measure between farms
  - Interaction terms to examine the effect of one predictor upon the other
- Stepwise forward selection of interactions using a t-value limit
- Backwards elimination of simple fixed effects using entire data set
- Used R (3.0.1)

RESULTS

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Major predictors: Milk production/**cow**/day

Increase	Decrease
Free traffic type (vs G/S)	Jersey (vs Holstein)
15-20% free time (vs 10-15%) *	0-4 years since installation (vs. >4 years) **
Season Spring (vs. Winter)	↑ failures
↑ Avg boxtime	↑ connection attempts
↑ Milk speed	↑ Refusals
↑ Number of milkings	Season Fall (vs. Winter)
2012-2014 year (vs 2011)	↑ Days in milk (DIM)

*for 2012 only, ** for retro farms only

Major predictors: Milk production/**robot**/day

Increase	Decrease	
Free traffic type (vs G/S)	Pen size 1 (vs. pen size 2)	
↑ Avg boxtime	Jersey (vs Holstein)	
↑ milkspeed	0-4 years since installation (vs. >4 years) **	
↑ Number of milkings	↑ connection attempts	↑ failures
Season Spring (vs. Winter)	Season Fall (vs. Winter)	↑ refusals
Season Summer (vs. Winter)	2013-2014 (vs 2011)	↑ Days in milk

**2013, 2014 only

SUMMARY

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What is the difference between **breeds**?

Holstein

Jersey

-3.72 kg/cow/day
(CI: 3.29-4.14)
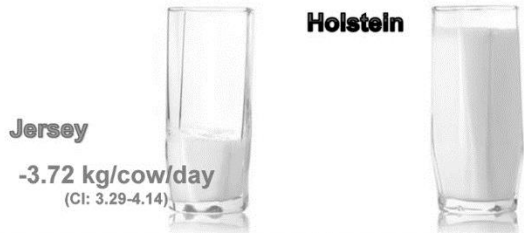
There is no significant difference between
the Holstein and the Other Breed category

What is the effect of **time since installation**?
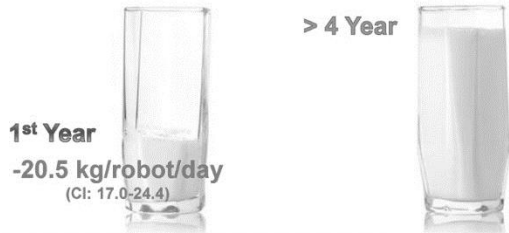
> 4 Year

1st Year

-20.5 kg/robot/day
(CI: 17.0-24.4)

What is the **traffic type** recommendation?

Free

+ 67.21 kg/robot/day
(CI: 48.6-86.0)

+1.11 kg/cow/day
(CI: 0.79-1.43)

**Select/
Guided**

What is the optimum **pen size**?
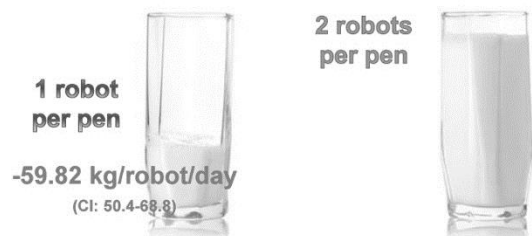
**2 robots
per pen**

**1 robot
per pen**

-59.82 kg/robot/day
(CI: 50.4-68.8)

Conclusion

- Free **>** Guided/Select
- Pen size 2 **>** 1 robot per pen
- Retrofit = New barns after 2 years

- Note: results based on farms in this study.

- These results will help guide future recommendations to
  producers looking to transition to a robotic milking system
  and maximize their production.

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Thank you for your attention!!

LELY

Managing My Dairy With Technology and Afi

Nathan Elzinga
Daybreak Dairy LLC
Zeeland, Michigan
njelzinga85@msn.com

Introduction

- 250 Registered Holsteins Milking and Dry
- 200 Replacements
- RHA 31,036 lbs, 1124BF, 956Pro
- Average Age Calving 20 months
- Annual Preg. Rate 25-30 %
- Partnered with Dad and Brother
- 4 Full time employees

Quick Tour
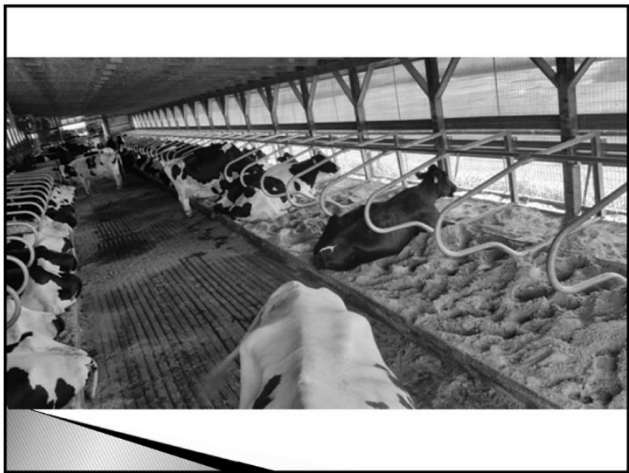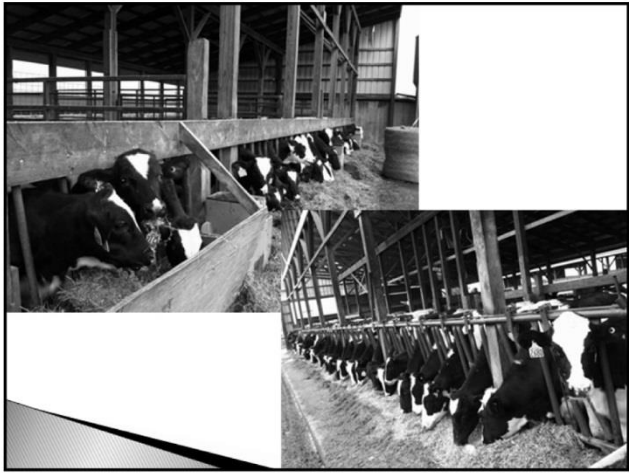
Tech Used On Farm

Afi
- Afifarm Software
- Milkmeters
- Afiact 1 and 2

Auto Calf Feeder

Coloquick Colo. Management

TMR Tracker

Smartphone

Cameras/Dvr

Other Software
- Microsoft Excel
- Holstein Redbook
- Spartan 3 Ration Balancing
- Enlight
- Teamviewer

Afi Equipment

Afi Data Collection (My Farm)

Daily Milk Weights

Flow Rates and Unit on Times

Conductivity

Activity (Footsteps)

Rest Time and Ratios (lying vs standing/walking)

Act 2
- Data collected multiple times hourly to determine ideal breeding time

Afi Data- Other Inputs

- Monthly Component Tests (DHIA)
- Milk Pay Price (To calculate iofc)
- Daily Herd Activity (ie Diagnosis, Treatments, Drugs)
- Breedings and Calvings
- Heifer Measurements
- BCS
- Genetics
- Breed Classification Scoring

The Afi Big Picture

- Cow Health (Monitoring, Auto Scheduling)
- Repro Management (heat detection, automated sync schedules, fertility tracking)
- Parlor Management (Cow/Employee)
- Herd and Production Planning
- Protocol Development and Record Keeping
- Animal Classification
  - Genetic Focus
  - Cull Selection
  - Disease Control
  - Animal Profitability

Using Afifarm
‣ Daily Health Check
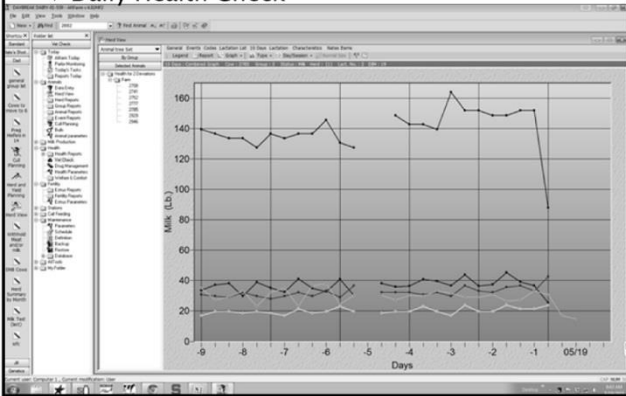
Using Afifarm
‣ Heat Detection/Breeding
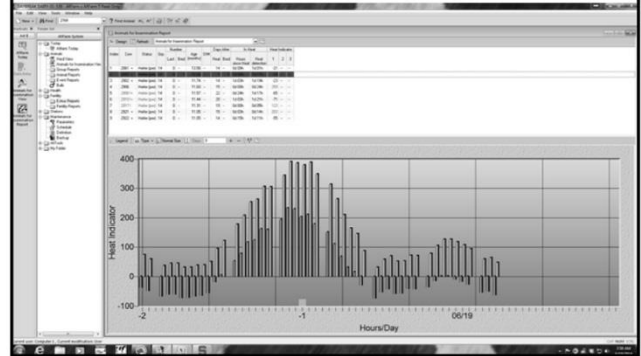
Using Afifarm
‣ Task List

Task List

‣ Scheduled Daily Treatments
‣ Vaccines
‣ Breeding Sync Schedule

‣ Easily Organized By Cow/Group/Treatment
‣ Easy to confirm when tasks are complete

Using Afifarm

‣ Codes
  ◦ Use in Software to organize cows
  ◦ Communication with parlor
    · Treated Cows (locks milking unit)
    · Dry Cows
    · ¼ Identification
    · Actions needed by milkers
    · Milkers can send codes back

Using Afifarm

‣ Automatic Hoof Trimming List
  ◦ Routine Trimming 3 week intervals
    · Early lactation trim at least 120 days from last
    · Late lactation trim either open or just preg at least 120 days from last
    · Dry-off trim at least 60 days from last
    · High Maintenance Trim at least 60 days from last (milking only)
    · Heifers before calving

    · No More Hand Written Lists

Using Afifarm

▸ Other Farm Diagnostics
  ◦ Parlor Monitoring
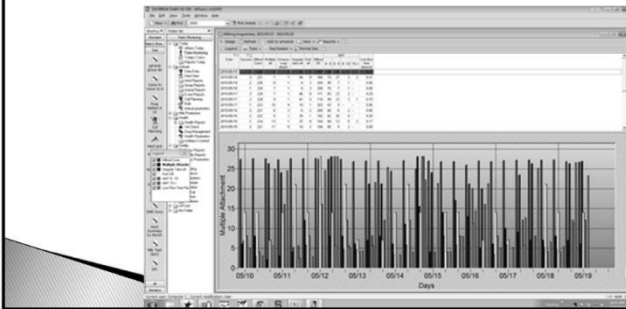
Parlor Monitoring
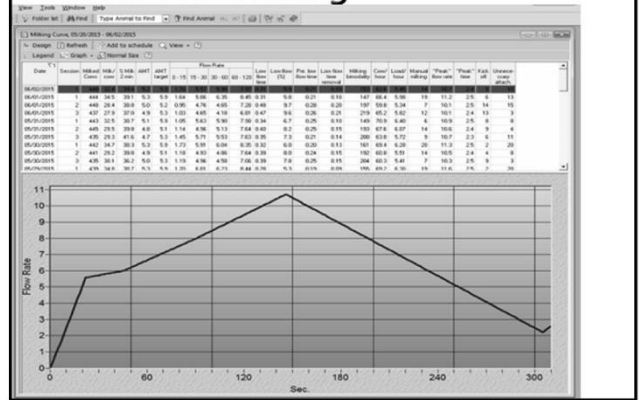
Using Afifarm
▸ Other Farm Diagnostics
  ◦ Diagnosis Summary
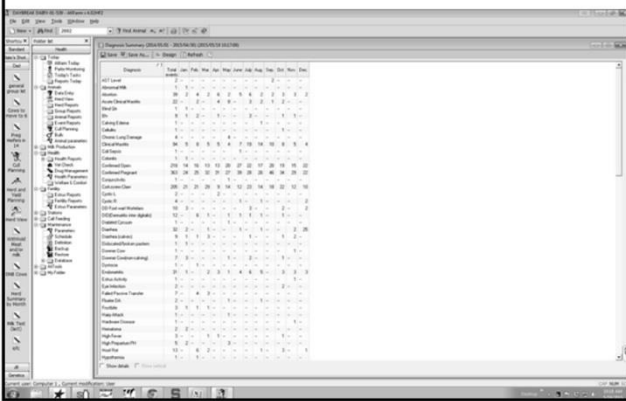
Using Afifarm

▸ Other Farm Diagnostics
  Fertility Reports
    HDR
    CR by 1st service/dim, Service #, Breeder, Service Sire

Customizable

▸ Hours Rest Time
▸ FCM
▸ ECM
▸ IOFC
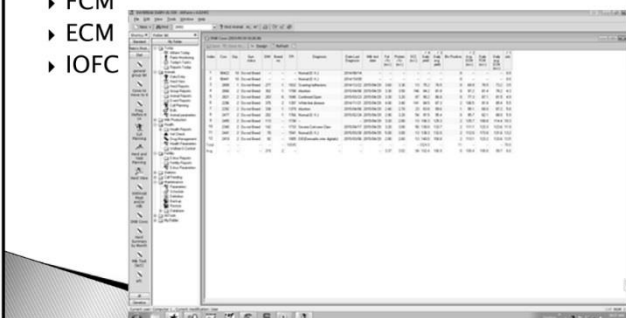
Auto Feeder, Holm and Laue

- Provide Optimal Nutrition for Optimal Early Development
- Decrease Manual Labor
- Need Good Eyes/Management
- More Labor Required for Optimal Enviroment
- My Farm
  - Lower Concentration/higher volume
  - More meals
  - Has led to Lower Calving Age
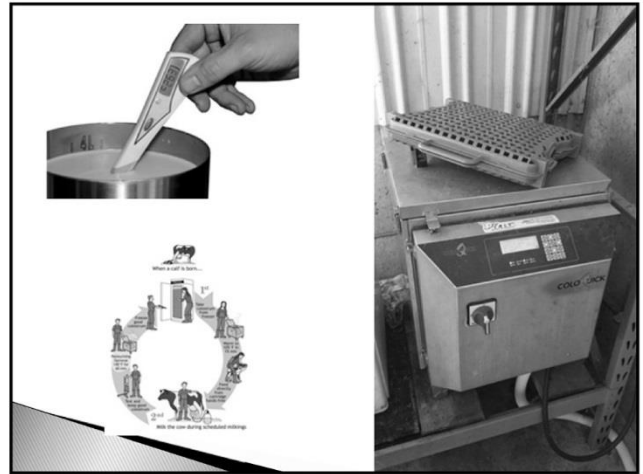
Coloquick, Holm and Laue

- Gallon Bag Pasteurizing/thawing/freezing
- Easy Management
- Less Time/Higher Quality
- 1. Thaw and Feed Frozen Pasteurized Colo. To new calf (under 30 min.)
- 2. Collect new Colo. After next milking, test/sort/pasteurize
- 3. Freeze new colo. In bank for future calves

TMR Tracker

- Recipes Built in for Feeder
- Measures Mixing accuracy
- Determines DMI accurately
- Tracks feed inventories
- Helps estimate future needs based on diets
- Links with afi for group numbers and milk weights

Cameras/DVR (Speco Tech.)

- Accessible anywhere (Smartphone)
- Monitors live calvings
- History on DVR for troubleshooting and calf ID

Spartan 3

- On Farm Ration Balancing
- Easy Benchmarking
- Ration Balancing and heavy data collection complement eachother

Excel

- Most Heavily used next to Afi
- Partial Budgets
- Devolpment of new tools
  - Pricing
  - Mating
  - Herd growth

Excel
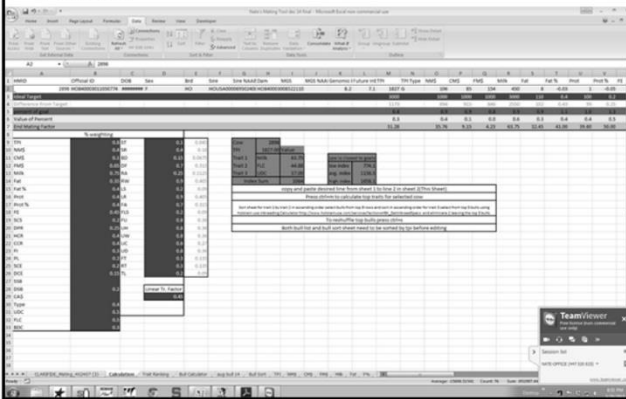
Excel
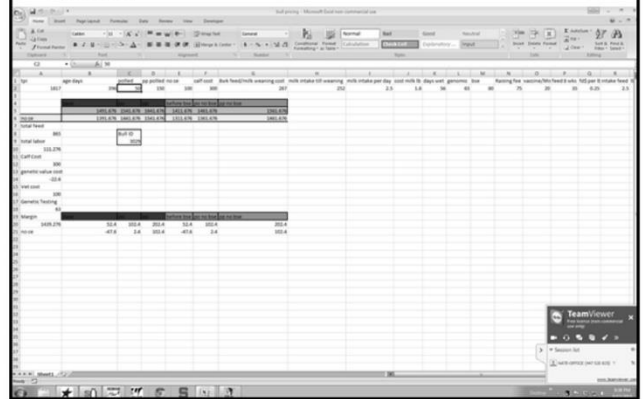
Red Book/ Enlight

- Bull Selection
- Measuring Genetic Progress
- Identifying elite animals
- Eliminating Paper
- Use as a formating medium between web and mating tool/ afi

Redbook

Enlight

Enlight
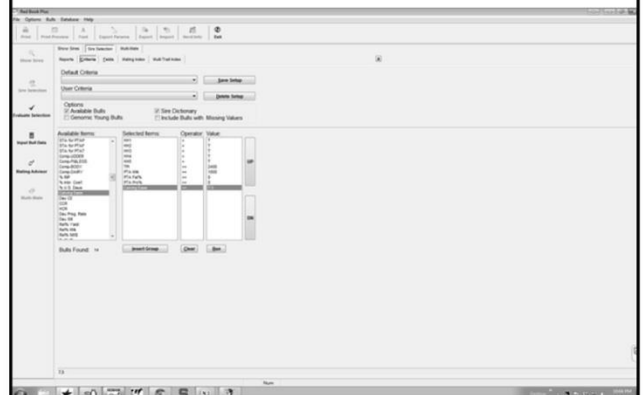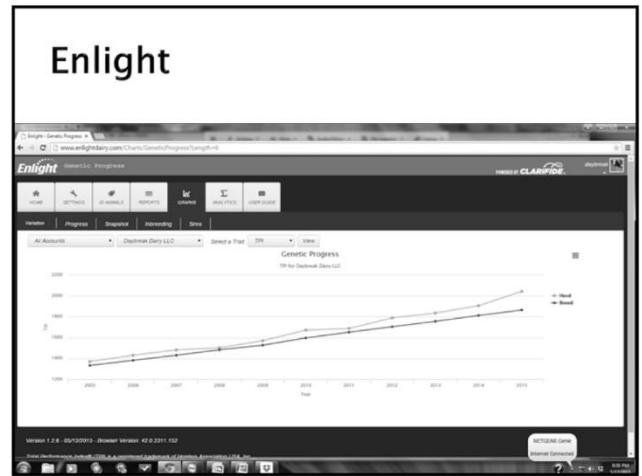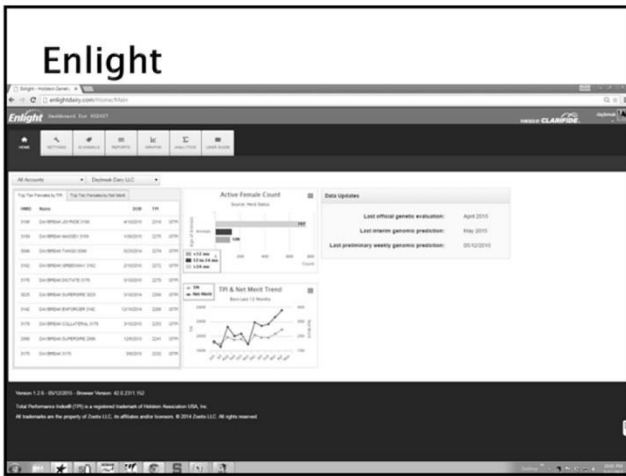
The Final Piece

▸ My Phone and Teamviewer
  ◦ Staying connected to afi, cameras, all farm computers, and social media/contacts

INDIVIDUALIZED RECOMMENDATIONS USING CLUSTERING OF ROBOTIC MILKING SYSTEMS

Marlène Tremblay[1], Justin P. Hess[1], Brock M.Christenson[1], Kolby K. McIntyre[1], Ben Smink[2], Arjen J. van der Kamp[3], Lisanne G. de Jong[3], Dörte Döpfer[1]

[1] University of Wisconsin-Madison, Madison, Wisconsin, USA
[2] Lely North America, Pella, Iowa, USA
[3] Lely International N.V., Maassluis, The Netherlands
mtremblay@wisc.edu

Outline

- Background and Goals
- Data & Methods
- Results
- Summary
- Conclusion

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Background

635 North American dairy farms with Lely robotic milking systems had weekly data collections for four years (2011-2014)

Goal

- Determine clusters of farming patterns
- Use results to prioritize and customize advice for producers regarding their farm management

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DATA & METHODS

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Data

- Started with 71,213 observations
- Removed missing observations and outliers
  - 54,065 observations remained (529 farms)
- Used the 19 variables in the generalized linear mixed regression analysis significantly associated with milk production per cow:

Production/ cow/ day	Cows per robot	Traffic type	Average DIM	rest Feed %	Average boxtime	Record yr
Kg concentration per 100kg milk	Number connection attempts	Number refusals	Number failures	Number milkings	Year install	Farm Goal
Robot free time	Season	Pen size	Breed	Milk speed		

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Location

n=529 farms

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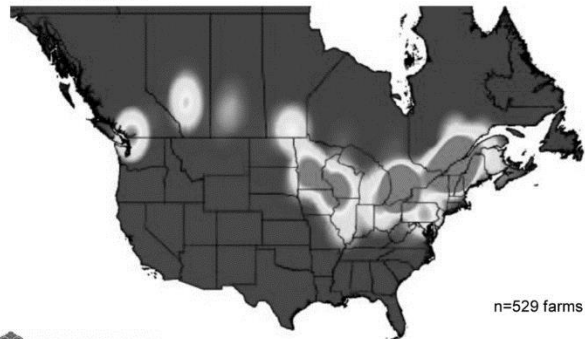
Methods

- Compared three clustering techniques:

1. Hierarchical
   - agglomerative clustering (UPGMA)

2. Non-Hierarchical
   - K-means
   - Partitioning Around Medoids (PAM)

RESULTS

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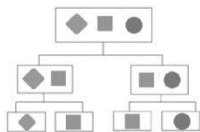
Clustering Method

- Best technique: K-mean had the fewest misclassifications (see negative widths in Figure)

- Final number of clusters: 11 (based on fewest misclassifications)

- Number of farms per cluster ranges from 31 to 61 farms

Silhouette plot - k-means

n = 529   11 clusters C_j
                j: n_j | $ave_{i \in C_j}$ s_i
                1 : 61 | 0.12
                2 : 47 | 0.19
                3 : 42 | 0.13
                4 : 46 | 0.15
                5 : 31 | 0.10
                6 : 60 | 0.15
                7 : 35 | 0.25
                8 : 59 | 0.13
                9 : 50 | 0.09
                10 : 57 | 0.05
                11 : 41 | 0.28

Silhouette width s_i
Average silhouette width : 0.14

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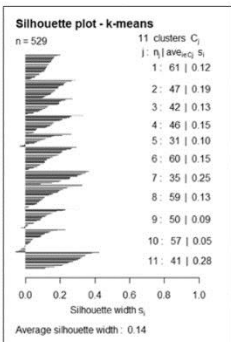
Categorical Variables (e.g. pen size, traffic type)

Pen Size	Cluster										
	1	2	3	4	5	6	7	8	9	10	11
1 (60/2)	0	47	0	4	24	40	14	5	50	7	17
2 (120/2)	54	0	36	41	7	20	21	53	0	42	21
3 (180+/3+)	7	0	6	1	0	0	0	1	0	8	3

Traffic Type	Cluster										
	1	2	3	4	5	6	7	8	9	10	11
Guided/ select	0	0	0	0	0	0	35	0	0	1	0
Free	61	47	42	46	31	60	0	59	50	56	41

Numeric Variables

	Prod per robot d	Prod per cow d	cows per robot	Avg. boxtime	Milk- speed	Milkings	Refusals	Failures	connect attempts	kg conc per 100kg	rest feed %	Avg DIM
1	1934	35.3	54.4	7.05	2.8	2.84	1.08	4.81	1.41	13.9	5.7	180
2	1937	35.4	54.4	6.97	2.82	2.86	1.08	5.84	1.45	14	5.34	174
3	1569	34.5	44.7	6.68	2.71	3.04	1.66	5.22	1.47	13.2	6.02	167
4	1867	32.6	56.9	7.21	2.64	2.69	1.15	4.32	1.39	13.1	8.38	176
5	1397	27.3	51.1	6.53	2.46	2.85	2.07	8.25	1.51	17.4	7.28	187
6	1171	32.8	35.5	6.39	2.61	3.21	3.27	4.2	1.38	14.9	6.2	176
7	1564	30.3	50.9	6.96	2.63	2.7	1.58	6.43	1.37	14.3	8.2	190
8	1591	30.6	51.5	6.67	2.51	2.99	2.58	5.37	1.41	24.5	11.22	183
9	1566	32	48.4	6.58	2.59	2.99	2.35	7.11	1.48	14	6.99	175
10	1323	27	47.1	6.66	2.43	2.69	1.96	7.86	1.39	15.7	12.07	190
11	1573	30.4	50.9	6.85	2.42	2.92	2.1	6.71	1.47	15.7	7.69	172

Brighter colors indicate extremely high or low values per column.
Green shading means preferred averages, dark red shading means less preferred averages.

SUMMARY

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Cluster 1 & 2

Clusters 1 and 2 consist of free traffic type, Holstein farms in the **USA** (max production). They have the **highest production** per cow and robot per day.

	Prod per robot d	Prod per cow d	cows per robot	Avg. boxtime	Milk- speed	Milkings	Refusals	Failures	connect attempts	kg conc per 100kg	rest feed %	Avg DIM
1	1934	35.3	54.4	7.05	2.8	2.84	1.08	4.81	1.41	13.9	5.7	180
2	1937	35.4	54.4	6.97	2.82	2.86	1.08	5.84	1.45	14	5.34	174
3	1569	34.5	44.7	6.68	2.71	3.04	1.66	5.22	1.47	13.2	6.02	167
4	1867	32.6	56.9	7.21	2.64	2.69	1.15	4.2	1.39	13.1	8.38	176
5	1397	27.3	51.1	6.53	2.46	2.85	2.07	8.25	1.51	17.4	7.28	187
6	1171	32.8	35.5	6.39	2.61	3.21	3.27	4.2	1.38	14.9	6.2	176
7	1564	30.3	50.9	6.96	2.63	2.7	1.58	6.43	1.37	14.3	8.2	190
8	1591	30.6	51.5	6.67	2.51	2.99	2.58	5.37	1.41	24.5	11.22	183
9	1566	32	48.4	6.58	2.59	2.59	2.35	7.11	1.48	14	6.99	175
10	1323	27	47.1	6.66	2.43	2.69	1.96	7.86	1.39	15.7	12.07	190
11	1573	30.4	50.9	6.85	2.42	2.92	2.1	6.71	1.47	15.7	7.69	172

Cluster 2 - pen size (1 robot per pen).

Cluster 1 - pen size of 2 or 3 (2 robots or 3 robots per pen)

Located in the **Midwest.**

n= 61   n= 47

Cluster 4 & 6

Clusters 4 and 6 consist of free traffic type, Holstein farms, mostly in Canada (101/106) with a mixture of pen sizes. They have similar production per cow and milkspeed but have very different production per robot because of **extreme cows per robot.**

Cluster 4 has an average of **57 cows per robot**.
n=46

Cluster 6 has an average of **36 cows per robot**.
n=60

Cluster 3 & 9

Clusters 3 and 9 consist of free traffic type, Holstein, mostly in **Canada** (quota farms) with **average production**.

Cluster 3 has pen sizes of 2 or 3 robots per pen.
n=42

Cluster 9 only has pen size of 1 robot per pen

n=50

Cluster 5 & 10

Clusters 5 and 10 consist of free traffic type, **low producing farms with low milk-speed and high numbers of failures**. These clusters have 11 of the 15 Jersey farms.

30/31 cluster **5** farms are in the USA
N=31

56/57 cluster **10** farms are in **Canada**.
N=57

Cluster 7

Cluster 7 farms are the **guided or select** traffic types. Most of them are on the east coast.

Cluster 8

Cluster 8 farms are free traffic types, Holstein, quota farms with a mixture of pen sizes. They feed **high amounts of concentrate** per 100kg of milk.

Cluster 11 farms represent breeds other than Holstein (39 **Other breed farms**, 2 Jersey farms) with **low milk speed**.

Conclusions

- Cluster analysis defines a farm's nearest neighbor in terms of production patterns rather than geographic location

- Knowing what cluster a farm belongs to helps pin point major challenges and individualize advice.

- It is best for advisors to measure progress and set goals using data from the same cluster.
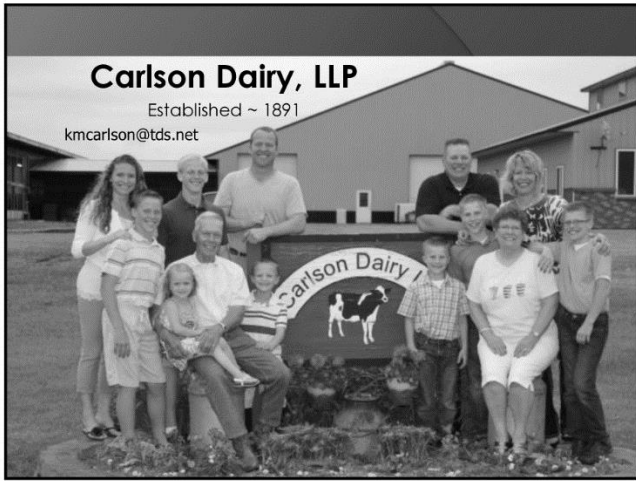
Carlson Dairy, LLP
Established ~ 1891
kmcarlson@tds.net

Today's Farm Facts

Century Farm ~ 4th Generation
(Curtney's grandsons the 5th)

1,250 Milking Cows

Double-18 parallel milking parlor

Custom rearing of most heifers

720 tillable acres

20 – 25 employees

Our Mission

To Operate a **HIGH-PRODUCING**, **well-managed**, INNOVATIVE, and *Sustainable Family-owned* dairy.

Carlson Dairy

A favorite Mark Twain Quote:

"Twenty years from now you will be more disappointed by the things that you <u>didn't do</u> than by the ones you did do."

BABY CALF PROGRAM

Maternity Pens
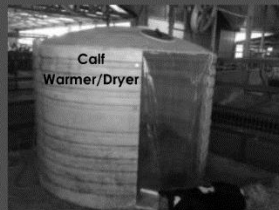
Calf Warmer/Dryer

Calf Mover

Nursery Calf Facility

- Cross ventilated barn constructed 2014
- 4 pens on each half with that are a mirror image of each other
- Mixing and utility room in center of barn
- Flume drain pipe in barn

Nursery Calf Facility

- Ventilation tubes
- Large and small exhaust fans (north side)
- Temperature controlled curtains (south side)
- Air inlets in ceiling when curtains closed

Nursery Calf Facility

- 4 Urban calf feeders in barn
- 8 total pens of calves w/2 nipples per pen
- 2 starter pens – 12 calves/pen
  - Calves move into these pens at day 1
  - This feeder set up for whole milk and/or milk replacer
    - Currently feeding approx. 20% milk
- 6 additional pens of calves; approximately 25 calves/pen

Urban CalfMom Alma with Parallel Feeding

- **Feeds up to 60 Calves**
  - 4 calves can drink at once
- **Self Cleans**
  - 2x per day
  - Alternate b/w detergent and acid
- **Nipple Changed 2x/day**
- **Machines calibrated 1x/week**

Urban CalfMom Alma

Mixing milk replacer   Inside feeder

Parallel Feeding
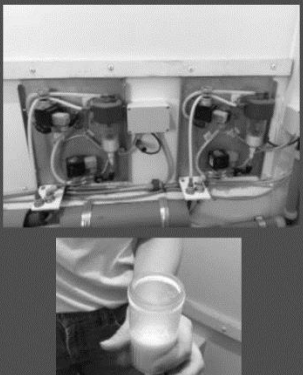
- **Feeds up to 60 Calves**
  - Feeding stations set up parallel
  - Milk supplied in level controlled glass cylinder (85 ml at a time)
  - 4 calves can drink at once
  - Reduces waiting time at nipple

Feeding Stations

Milk Temperatures Checked Daily

Free Choice Electrolytes

Dry Feed

- ◉ **22% Protein Texturized Starter**
  - Starter consumption weighed for pen intakes
  - Remain on starter through weaning
  - Switch to complete pellet 'til 3 months age

Weaning

- ◉ **Timeline**
  - All calves start weaning at 42 days
  - Completely weaned at 52 days
  - Each calf is weighed when moved into barn and out of pen
  - Moved to another coverall building
    - For 4 add'l weeks
    - Same starter pellets

Next Move

- ◉ **At 3 months**
  - Moved to Open-Front heifer barn
  - Stay until 7 months old
  - Introduced to TMR of chopped hay, haylage, and dry beet pulp

Thank You!

Automated Calf Feeders and Robotic Milking: What are Keys to Success?

Marcia Endres
University of Minnesota, St. Paul
miendres@umn.edu

Automation in feeding and milking improves labor management and lifestyle of dairy farm families. There has been consistent growth in the upper Midwest U.S. on the number of farms installing automated computerized calf feeders and/or robotic milking systems. Some farms in our area have both of these technologies. We have been conducting field studies and producer surveys to helps us learn how to best utilize and manage these precision dairy systems.

This talk summarizes some of the findings of two field studies we are conducting at the University of Minnesota involving 38 farms with calf feeders and 52 farms with robotic milking systems. These types of longitudinal cross sectional studies can provide descriptive information on housing and management practices and by collecting many animal and facility measurements, we can identify factors that are associated with successful use of these systems. This methodology does not provide a direct 'cause and effect' connection, but we can identify guidelines and factors that can be important and then further investigated.

Automated Calf Feeders

Housing and management observations:

The following charts summarize some key practices used on the farms we visited. The average number of calves per pen (Figure 1) was approximately 18, which is less than the maximum suggested by the dealers (up to 30), and the space per calf was 4.6 square meters (about 50 square feet). Average peak milk was about 8 liters per day and start milk about 5 liters per day (Figure 2). Calves were placed on the feeder at about 5 days of age (range of 0 to 14 days; Figure 3); 10 farms placed calves in the group at 0 to1 day of age.
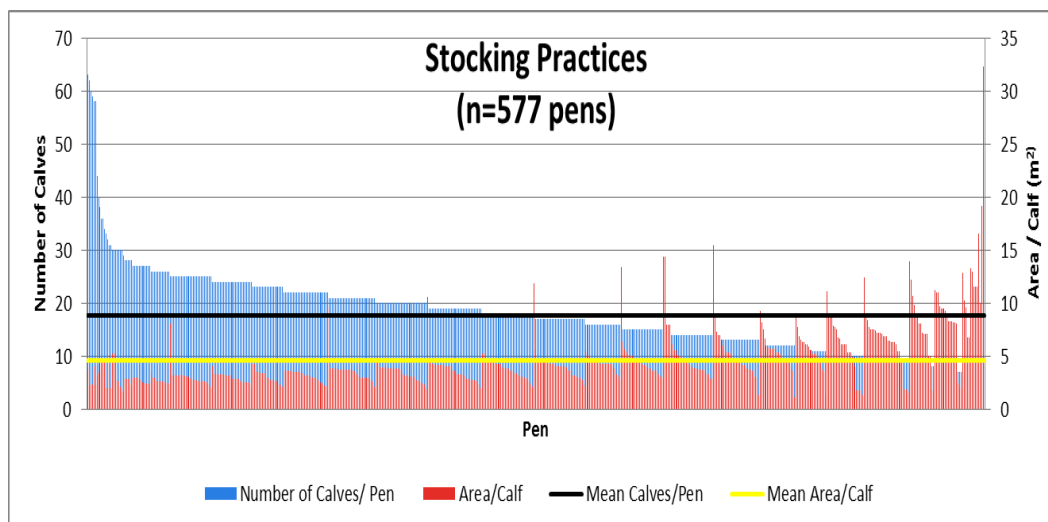
Figure 1. Stocking density as number of calves per pen and area per calf.
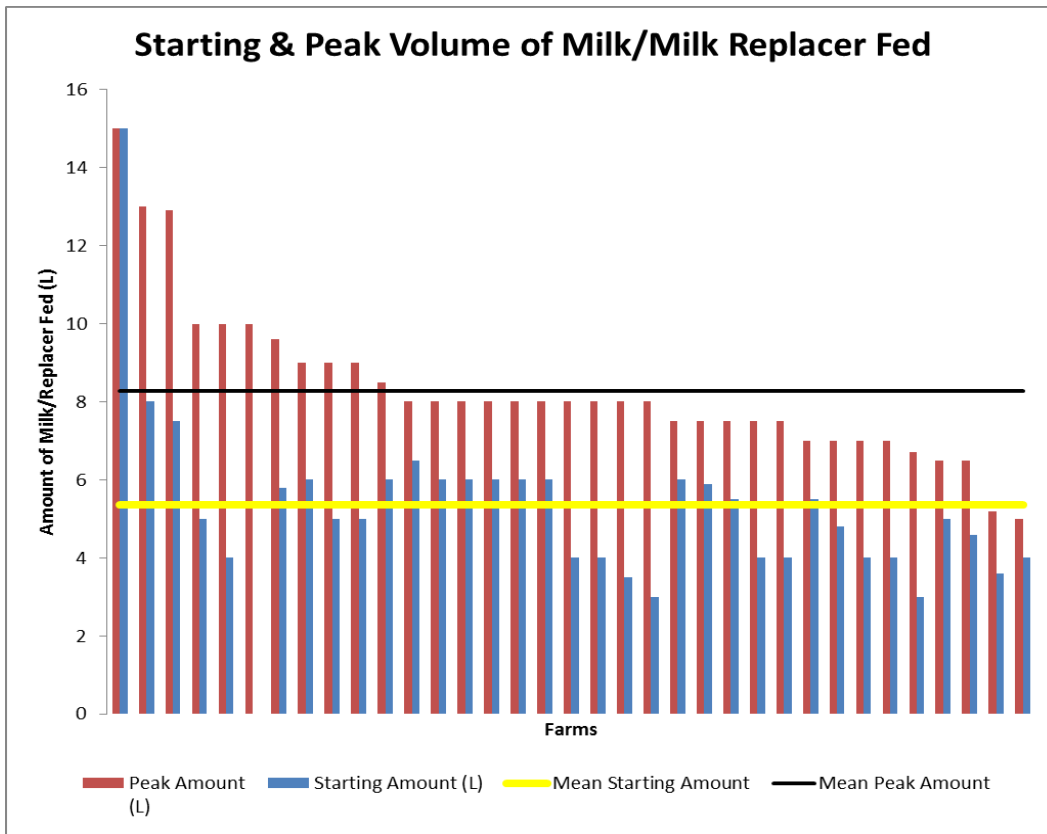
Figure 2. Starting and peak amounts of milk/milk replacer fed.
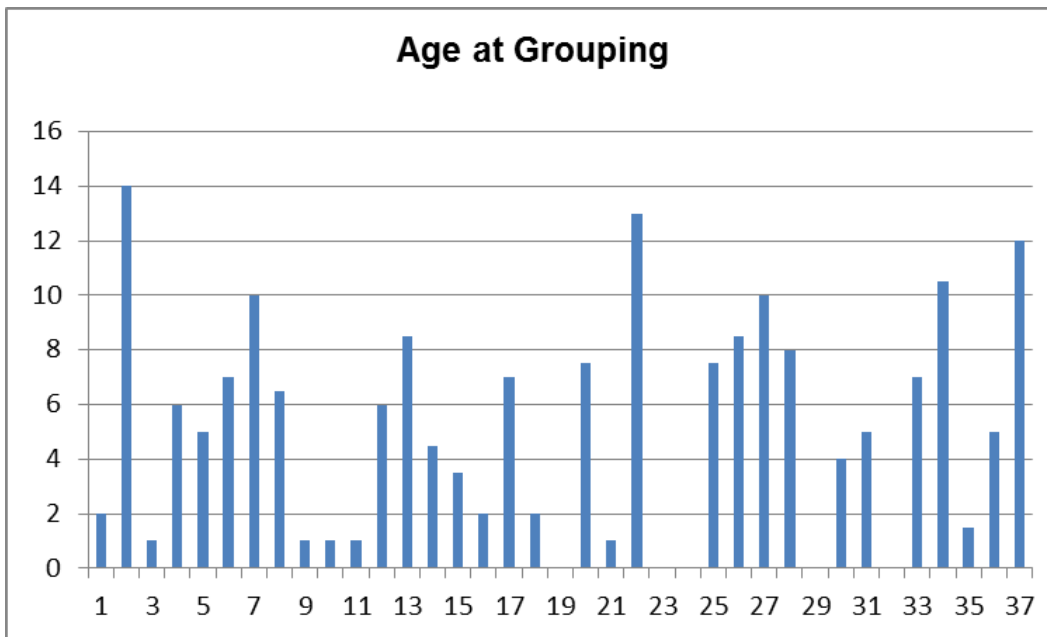
Figure 3. Age calves are introduced to group feeding.

Calf health:

At each visit, our research personnel scored calves for health in the youngest and oldest (plus a middle one in larger dairies) pens including attitude, eyes, ears, nose, cleanliness and body condition (n= 10,179 calves). Blood samples were collected from calves younger than 5 days of age to test for serum protein concentration as an indicator of passive immune transfer (n = 985 calves). Body temperature was measured if a calf had an abnormal health score. During five visits in different seasons, milk samples were collected from the mixer and the feeder tube to test for standard plate count (SPC) and coliform count. Figure 4 summarizes the calf health scores for the top 10th and the bottom 10th percentile farms. There was considerable variation among farms, indicating that housing and management factors can definitely influence the success of using these feeding systems. Table 1 summarizes the SPC and coliform counts for the top and bottom farms. Again, there is a lot of variation and some very extreme numbers were detected. Ideally, the milk the calf is drinking should have less than 100,000 CFU/ml for total plate count.
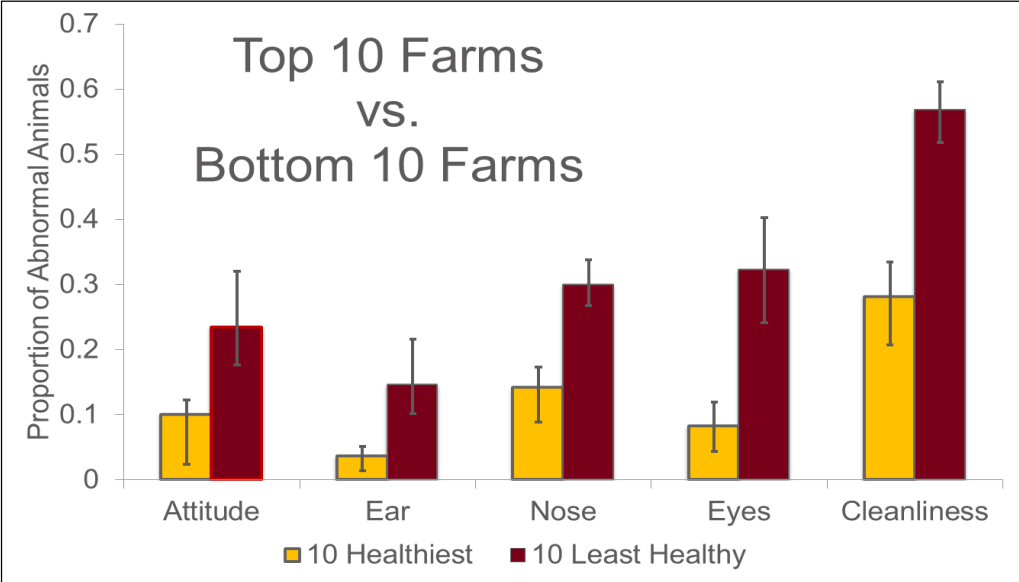
Figure 4. Average proportion of abnormal scores (indicating potential disease presence).

Table 1. Farm average bacterial counts (cfu/ml) across visits for top and bottom 10 farms.

Item	Tube Coliform	Mixer Coliform	Tube SPC	Mixer SPC
Median of Top 10 (Q1-Q3)	887 (206-1,211)	12 (3-15)	87,590 (32,603-134,940)	9,006 (2,308-9,392)
Median of Bottom 10 (Q1-Q3)	5,659,567 (1,198,059-14,344,063)	522,263 (64,564-20,001,213)	21,140,625 (18,644,538-71,642,610)	10,209,920 (3,204,500-43,673,293)

Risk factors for abnormal health scores:

Our preliminary statistical analysis indicated that the following factors are positively associated with abnormal health scores; therefore, farms that have these characteristics are more likely to have more sick calves, and be less successful using an automated calf feeder system.

- Number of calves per group – the greater the number, the more sick calves.

- Number of feed stations per pen – same as above.

- Space per calf – less space per calf associated with higher number of abnormal scores.

- Time to reach peak milk allowance – sooner was better.

- Air speed in resting area/ feeder – faster air movement at resting area associated with nasal scores, an indicator of respiratory disease; air speed at the feeder associated with abnormal ear scores.

- SPC on tube samples >100,000 cells/ml – higher counts were associated with higher number of abnormal health scores.

We are at the time of this writing still further investigating these relationships and an update will be presented at the conference.

Suggested practices for feeding calves in groups:
(Adapted from Godden, 2014)

- Excellent colostrum management - a must for any type of calf housing system.

- Excellent ventilation, no drafts – positive pressure tubes are recommended.

- Clean, dry, abundant bedding – high nesting scores, especially in winter.

- Minimum of 40 ft^2 per calf – it seems to be a factor for success.

- Free choice water and high quality starter pellet in the pen available free of choice.

- Careful, frequent observation of calves to detect illness early – harder to observe in group setting, also use computer information such as drinking speed and unrewarded visits to the feeder to help detect sick calves.

- Smaller groups – if all-in all-out situation, one could probably have 20 calves per group; research shows that in general groups of 12-15 are better than 25-30.

- Narrow range of ages – helps reduce disease transmission.

- Do not restrict milk intake - Large meal and daily allowances.

Robotic Milking Systems

Our research with 52 farms in Minnesota and Wisconsin has shown that one of the main reasons producers invested in a robotic milking system was to improve their quality of life or lifestyle. Comments such as - now, I have time to attend my kids' games - were common. Other reasons included improved labor management or flexibility of labor, improved health, desire to use the latest technology and consistency of milking cows the same way every day.

Figure 5 shows the number of milking boxes or robot units per farm in our study. All the farms in the study had either Lely or DeLaval units. Other options in the U.S. market today include AMS-Galaxy and GEA Farm Technologies.

We visited the farms once to collect housing and management information and then collected daily data remotely from the farm computer for approximately 18 months. Our preliminary analysis of the data showed that on average cows were milked 2.6 times per day, produced 71.3 pounds of milk per day, and consumed 11 pounds of concentrate in the robot box per day. The number of cows per robot box was 70 and it was greater for guided flow compared to free flow farms (75 vs. 65.5 cows per robot). Forty farms had exclusively free flow cow traffic. Milking speed was 2.24 ± 0.40 L/min and total milk yield per robot unit was 4,062 pounds/day.
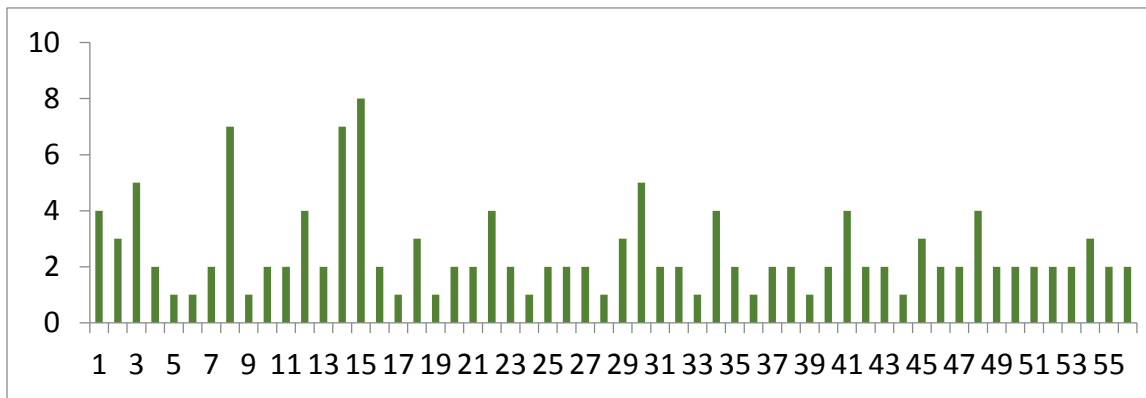
Figure 5. Number of robot milking units per farm. Average was 2.5.

Total daily milk yield per robot has been suggested to be an important characteristic to assess the efficiency of robotic milking systems. A preliminary analysis of factors associated with yield per robot and milk yield per day showed that factors most strongly associated with *yield per robot* were milk per cow per day (r = 0.81) and average milking speed (r = 0.76). Other factors moderately associated with yield per robot were average concentrate consumed per day (r = 0.31) and exit length from the milking box (r = 0.32). Protected exit lane averaged about 9 feet long. Factors associated with *average daily milk yield* were milking speed (r = 0.79), exit length (r = 0.51) and average concentrate consumed per day (r = 0.41). Further multilevel regression analysis will provide a clearer picture of factors influencing efficiency of robotic systems in the U.S.

Based on our research and interactions with producers and advisors, we have learned there are questions a producer needs to ask if he/she is interested in using this technology:

Do you or your employees like working with cows?

If you install a robotic milking system (RMS), you still need to work hard and pay close attention to your cows. We have seen in our research that the most successful producers enjoy working with cows and don't have the attitude of putting a robot in the barn and leaving cows to their own. Barn and stalls need to be cleaned daily, cows bred and treated, cows fetched, cows fed, etc. It just makes one chore – the tedious milking chore – easier since you don't have to do it yourself, giving you more work time flexibility. That is very helpful especially for smaller operations run with family labor.

Can you have the best ration/feeding management?

How and what cows are fed in a RMS farm is one of the most important keys for success. We learned from a dairy producer in Pennsylvania that daily average milk production on his farm went from about 60 to 80 pounds per cow by changing ration formulation and feeding management under the advice of an expert RMS nutritionist. It is important to balance the partial mixed ration that goes in the feed bunk to less than the average daily milk production goal per cow then supplement cows according to stage of lactation with the robot pellet. The robot pellet needs to be palatable, as it attracts cows to the milking station. So, do you have a trained/expert nutritionist to work with you?

How is/will be your barn? Comfortable? Properly designed?

As you know, cow comfort is important in any dairy production system. For RMS, it is even more important that cows are healthy and willing to come to the milking station, so for example, a high prevalence of lameness will probably increase the number of fetch cows and reduce efficiency of the robot. It is necessary to have good cow flow (be it free or guided) so that we don't hinder attendance to the robot. You also need to think about how to design the barn to accommodate special needs cows and make your life easier when managing/treating them.

Are you handy with equipment?

These systems are hi-tech and expensive. If you can learn how to fix little things, it will help make RMS more affordable to you in the long run and reduce the number of failures and problems that can affect robot efficiency. A key factor for success in RMS farms is the amount of milk produced per robot per day. Excellent dairies are getting 5,000+ pounds per day.

Is the service provider nearby?

For major repairs and routine maintenance, it is important to have a company within a certain radius. If the RMS breaks down for a long period of time, things can get really out of control and create a 'train wreck' very fast. You depend on that one unit to milk 60 to 70 cows and you only have the one unit for that number of cows (and probably more if you have a multiple box system). Keep it at top performance!

Do you like technology?

Get the most out of it. There is so much information about every cow that you can use to optimize performance and health. RMS companies are developing even more decision making tools that will help organize your day and create a task list every morning.

Are you ready to pay for the cost of repairs and maintenance (and your loan)?

A sophisticated piece of equipment requires money to maintain and repair. You can't just go to the local hardware store to get all the parts you need. Please be financially prepared.

Do you have strong management skills?

As one of our successful project collaborators, Doug Kastenschmidt, said: "Management makes milk. Robots only harvest it!"

Acknowledgments:

Finke Farm

Craig Finke
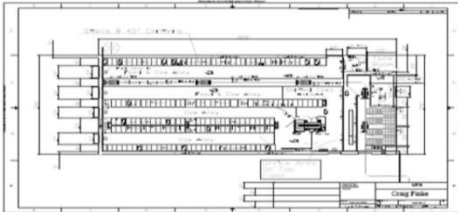finkefarms@gmail.com

PRECISON DAIRY CONFERENCE 2015

Finke Farm

- ▶ Full Time Employees 1
- ▶ Part Time Employees 1
- ▶ Acres Farmed 1,300
  - Corn 500
  - Beans 700
  - Wheat 300
- ▶ Cows Milking 117

Barn Design / Features

- Barn – Clear Span Steel -- 106' X 226'
- Milk Cows -- 133 stalls, 4 rows
- Dry Cows -- 45 stalls
- Galaxy Astrea 20.20 - 2 milking boxes, 1 robot arm
- Trioliet TMR Feeder
- Flush System with sand bedding
- Green Free Stall Dividers
- 3 – 24' Big Ass Fans

Page 3

Precision Dairy Features

- Astrea 20.20 – AMS Galaxy USA
- iPhone Access & Control
- 14 IP Web Cameras
- Orion 6 lamp sealed Lighting – laptop program. Or iPhone
- 4 – 24' Big Ass Fans
- 2 - Grooming Brush
- Thermostat Sensor Controlled Curtains
- Text messaging cow alerts

Page 4

Precision Dairy Features

- Astrea 20.20 Automatic Milking System – AMS Galaxy USA
- 1 Motoman Industrial Robot Arm – Preps and attaches in 2 boxes and milks 120 cows
- Low maintenance / high durability more than 270,000 arms in operation world wide in various industrial applications
- Steam cleaning system – cleans teat cups after every milking
- Superior teat preparation

Page 5
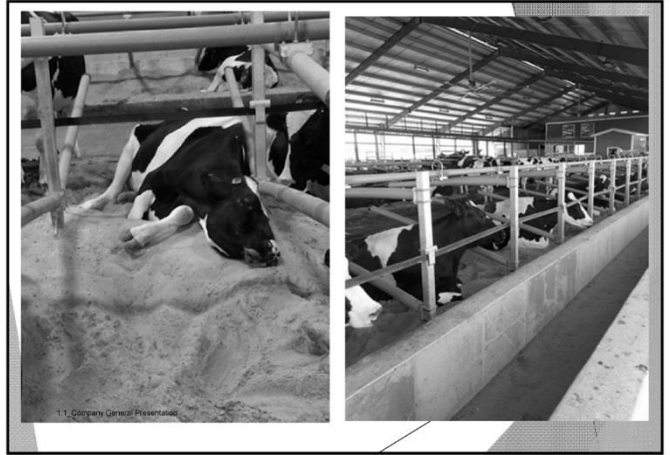
Thank you

In communities across our nation, no tradition runs deeper from generation to generation than that of working on a family farm.

Using an Automated Milking System

Carlyle Westendorp
Westvale View Dairy LLC, Nashville, MI
cwestend6@gmail.com

At Westvale View Dairy, we have Lely A4 robots that use the SCR technology for both activity and rumination. We use the T4C computer program to monitor milk temperature, milking speed, box time (milking and attach time), and activity along with other items. Since we are not physically attaching the milking unit, we rely on computer information to help us identify cows that are down in milk. We find rumination for fresh cows and to identify sick cows early is valuable technology. Because the activity helps us catch more cows in heat, we use less shots for synchronizing cows.

We invested in this technology because we needed to expand. I farm with my dad and I also have three more brothers coming home from high school and college. Also, our old barn and parlor were 42 years old and needed major remodeling. One of our goals of installing robots was to expand and not have to hire employees. We are all family labor and wanted to keep it that way. We expanded from milking 90 cows 3x in a double 8 parlor to 220 cows and continue to only use family labor.

The robots have change the way I manage the farm. The biggest change is in feeding the cows. With robots the cows don't only eat at the bunk, they also eat the pellet in the milking box, which has to be accounted for when balancing the partial mixed ration (PMR). It is very important that this is understood by everybody involved (including the nutritionist). Having a nutritionist that understands how to work with the robots is key. That was our biggest battle.

Our barn is a standard 6 row barn with a center feed alley. It has a total of 228 freestalls. On the two year old side, the stalls are 48 inches wide and on the mature cow side, stalls are 52 inches wide. Robots are on the outside walls of the barn in the middle of each pen.

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Exhibit Hall/Trade Floor Diagram

Precision Dairy Conference 2015

General Information

Conference Venue
The Mayo Civic Center is located at 30 Civic Center Drive SE in Rochester, Minnesota. It is the largest event venue in southern Minnesota. The facility offers state-of-the-art technology, skyway access to downtown hotels, restaurants and shopping, over 1,700 first class hotel rooms connected by skyway, and 3,900 parking spaces within two blocks as well as an 11-acre park within a short distance of the Civic Center. Presentation Hall, EH Breakout Room 1 and EH Breakout Room 2 will be used for conference sessions.

Registration & Information Desk
Located at the North Lobby, Mayo Civic Center. Registration will be open on Wednesday, June 24, 7:30 a.m. to 4:30 p.m., and on Thursday, June 25, 7:30 a.m. to 9:30 a.m.

Trade Show
The Trade Show will take place in the Exhibit Hall is on the ground floor at the Mayo Civic Center. We encourage you to visit the Trade Show.

Refreshment Breaks
Breaks will take place in the Exhibit Hall at times shown on the conference schedule.

Breakfast & Lunch
Breakfast and lunch will be served in the Exhibit Hall.

Reception & Cash Bar at Trade Show, June 24, 5:30-7:00 p.m.
A reception with cash bar will be held in the Exhibit Hall.

Name Badges
Your name badge is your admission to all presentations and to the Exhibit Hall for the trade show, breakfast, breaks and lunch. Wear it at all times while at the event.

Certificate of Attendance
Request a Certificate of Attendance at the registration desk if your organization requires one. They will not be automatically distributed to everyone.

Internet Access
Complimentary wireless Internet access is available throughout the facility.

Emergency Calls
Dial 911 (for emergencies only) if there is a need for an ambulance, the police, or the fire department.

Shopping in Rochester
Rochester has a few shopping options located in close proximity to the Civic Center, including:
- Shops at University Square, 111 Broadway Avenue South *(approx. 4 blocks from the Civic Center)*.
- The Grand Shops, 20 SW Second Avenue, are connected to the Kahler Grand and Marriott hotels *(approx. 5 blocks from the Civic Center)*.
- Apache Mall, Highways 52 South and 14 East *(approx. 3 miles from the Civic Center)*.

Map of Surrounding Area
Maps are available at the registration desk.

Mayo Civic Center Floor Plan
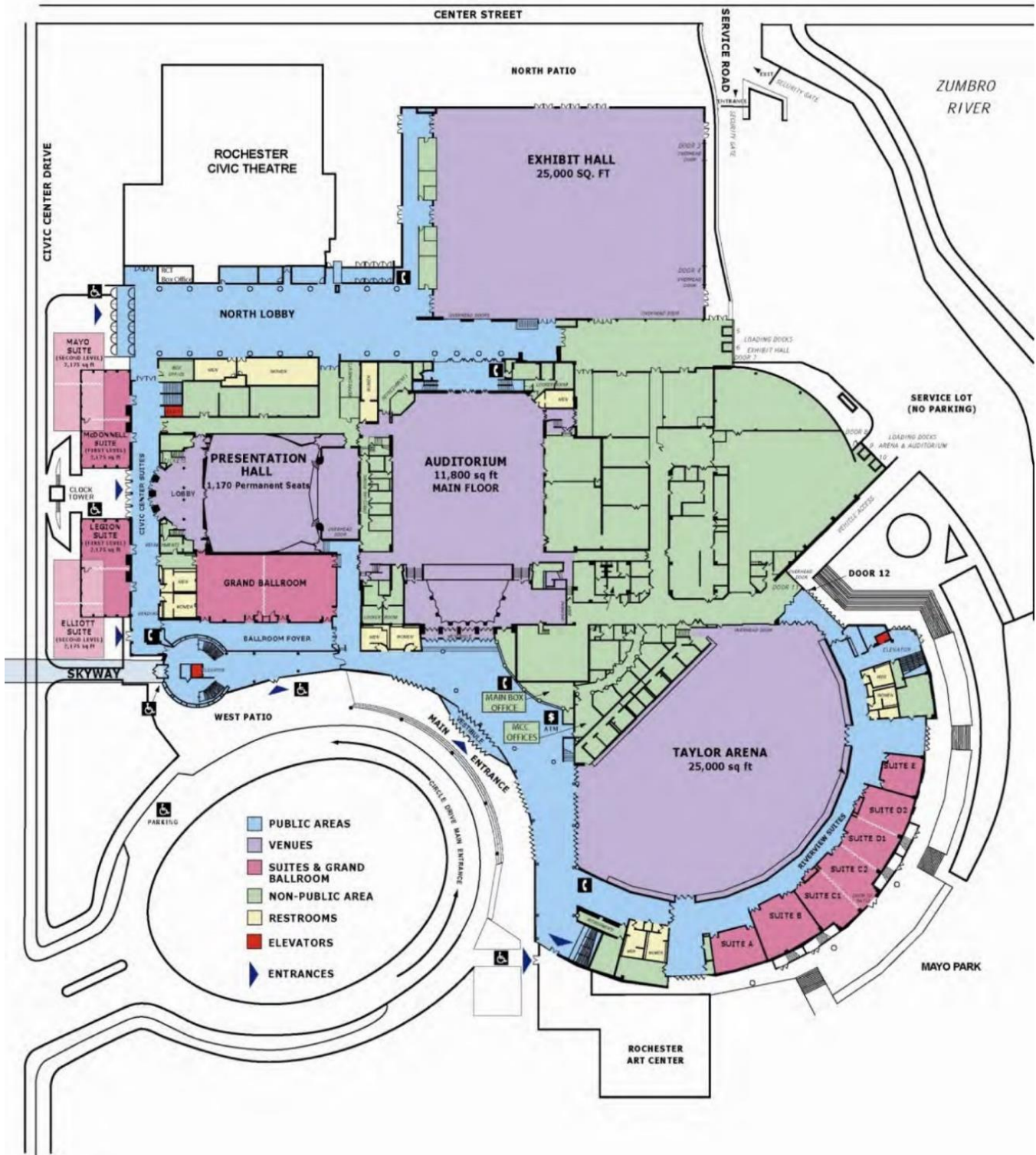
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