The Society for engineering in agricultural, food, and biological systems

Paper Number: 033018
An ASAE Meeting Presentation

Survey of Management Practices of Farms Using Automatic Milking Systems in North America

Wilco de Jong and Albrecht Finnema

Van Hall Institute

Leeuwarden, Netherlands

Douglas J. Reinemann, Ph.D.

Professor of Biological Systems Engineering

University of Wisconsin – Madison

Milking Research and Instruction Lab

djreinem@facsatff.wisc.edu

Written for presentation at the
2003 ASAE Annual International Meeting
Sponsored by ASAE
Riviera Hotel and Convention Center
Las Vegas, Nevada, USA
27- 30 July 2003

Abstract. *A survey was conducted of 10 farms in the USA and 15 farms in Canada using automatic (or robotic) milking systems (AMS) to determine how AMS facilities were being designed and managed in the North American setting. Surveys were conducted in-person with the farm manager during visits to the farm. The survey was based on a similar survey performed on 120 AMS farms in the Netherlands. All of the AMS users surveyed indicated that, overall, they were satisfied to very satisfied with AMS. Most users indicated that AMS has allowed them more time for managerial tasks, and more importantly, more time for themselves and their families. They further indicated that the addition of AMS has decreased stress levels for themselves and their cows.*

Keywords. Automatic Milking, Dairy Management.

Introduction

Automatic milking systems (AMS) are gaining popularity around the globe. The first commercial AMS installation occurred in the Netherlands in 1990 and today there are over one thousand farms using AMS technology in Europe. In Europe, the use of AMS is often accompanied by a moderate expansion of the number of cows milked on farms that are managed and operated by families.

The first commercial North American AMS installation occurred in 2000 and there are now about 50 AMS farms in operation or under construction in North America. The limits to farm expansion as well as the general economics of milk production are different in North America than in Europe.

A survey was conducted of farmers using AMS technology in North America to determine how AMS systems were being designed and managed in the North American setting. This survey was based on a similar survey performed on 120 farms in the Netherlands. Some survey questions were added, deleted or modified to reflect rules, regulations and management practices unique to North America. The survey form used for this study is attached in the appendix. Twenty-five farms were surveyed; 10 farms in the USA and 15 farms in Canada. Surveys were conducted in-person with the farm manager during visits to the farm. The results of this survey are presented below.

Farm Characteristics

Six of the farms surveyed had been using AMS for longer than two years, about ½ of the farms (52 %) using AMS for 1 to 2 years, and seven farms had been using AMS for 6 months to one year. Only farms that had been using AMS technology for 6 months or more were surveyed. Most farmers indicated that the switch to AMS required an adjustment period of a few months in order for themselves and the cows to grow accustomed to the new system.

While automatic milking systems are intended to reduce the amount of physical labor required to run a dairy farm, many farmers informed us that the hours of work did not decrease significantly after implementation of the robotic milking system. However, they did report that their work schedule was much more flexible.

The average number of cows on all farms surveyed was 110, with 16% of farms milking less than fifty cows, 40% of farms between 51 and 100 cows and the remaining 44 percent of farms milking more than 100 cows. The farms included in our survey used an average of 1.9 milking boxes/farm (all systems surveyed had one robot arm per milking box). There was a great deal of variation in the number of cows/milking box, with a minimum of 25 cows/box, an average of 57 cows/box and a maximum of 70 cows/box. The farms reported an average 1.9 full time persons employed on their farms with an average of 57 milking cows per full time employee.

Barn Design

In accordance with the switch to an AMS, most farms chose to build completely new free stall barns while a few set up the robotic systems in existing free stall barns. Slightly more than ½ (56%) of the farms had a six-row barn, or as defined in the survey, three stall rows per robot or pen. About 1/3 of farms (32 %) had a four row barn (two rows of stalls per pen) and one farm had an eight row barn (four stall rows per pen). Four of the farms (16%) with two or more robots split their cows into different management groups by production level. Most farms surveyed

indicated that they had not yet filled their barns to capacity (less than one cow/stall). Four farms (16%) reported that they overstocked their free stall barns by about 10%.

The most common type of bedding, used on 13 farms (52%), was a combination of mattress and wood shavings. Five farms (20%) used straw only, two farms (8%) used mattresses only, two farms (8%) used compost, and two farms (8%) used sand.

The most common form of manure handling was an auto scraper (17 farms or 67%). Five farms (20%) had a slatted floor, two farms (8%) removed manure with a tractor/bobcat and one farm (4%) had a flush system.

Cow Traffic

A number of combinations of free and forced cow traffic systems are being used on the farms surveyed. Most began by using forced cow traffic (one way gates between resting and feeding areas, forcing cows past robots). However, many farms switched to free cow traffic with a holding pen in front of the robot after the cows became accustomed to voluntary milking. At the time of the survey only four farms (16%) used totally forced cow traffic, while eight farms (30%) used a totally free traffic system with a holding pen in front of the milking box. The remaining farms used some combination of free and forced traffic systems. In comparison, more than 70% of farms surveyed in the Netherlands study used free cow traffic systems, with almost all of these farms using holding pens within the vicinity of the robot.

The AMS farms surveyed averaged 2.6 milkings/cow/day, with 36% of the farms below 2.5 milkings/cow/day, 44% between 2.5 and 3 milkings/cow/day and 20% with more than 3 milkings/cow/day. We found no correlation between average number of milkings/day, cow traffic system and months of experience with the AMS. Many farmers reported obtaining more milkings/cow/day when animals were fed a greater number of times/day. This increase in milkings per day could be attributed to the ability of feeding periods to stimulate cows to move through the milking box.

The stocking density of the AMS pen appeared to influence use rates. Pens with more than 60 cows/milking box averaged 2.4 milkings/cow/day while pens with less than 60 cows/milking box averaged 2.8 milkings/cow/day. In an attempt to reduce stress levels associated with calving and adjusting to the new robotic system, 24% of the farmers in this study put the heifers in the robot pen before calving.

AMS users reported that the traditional milking times (early a.m. and late p.m.) are still the busiest milking times, particularly for the older cows. Visiting times appeared to be more evenly spread throughout the day in AMS pens that milked only 1st lactation cows. Early afternoon and nighttime were reported to have the lowest AMS use rates for all farms.

AMS Management

While most cows require little or no special care, some cows will require attention (inspection for mastitis detection, lameness or general health) on most days. About 1/3 of farmers (30%) walk through the barn to perform visual inspection of their cows less than three times/day, 42% report barn walks four times/day and 29% walk through more than four times/day. There was no association between the number of daily visual inspections and self-reported bulk tank somatic cell count or milk production level. Slightly less than ½ of the farms (42%) reported that they ensure that all cows are milked at least twice daily by escorting cows that have not attended the milking station voluntarily.

Results from this survey reveal that farmers use the attention lists generated by the computer management systems in a number of differing ways. The most common parameter used for putting cows on an attention list was deviation in daily milk yield (compared to a rolling average for individual cows), with 84% of farms using this parameter, 68% of once/day and 16% two or more times/day. The milking interval (time since last successful milking) was used by 73% of farms, with 40% of these checking milking interval once/day, 32% twice/day, and 20% more than twice/day. About ½ of the farms surveyed (47%) reported using milk conductivity as a parameter on their attention lists (for mastitis detection). Many farms reported that they were less likely to use milk conductivity on their attention list as they gained more experience with AMS. Some farms (28%) also reported using information from attention lists for assistance in breeding. Farms in the Netherlands and North America did not differ substantially in their uses of attention lists.

Most users said that the attention lists are helpful, but not the key to success. Good farm management technique and positive treatment and handling of the cows are the best ways to prevent mastitis and other animal health and productivity problems.

Feeding Strategies

Access to feed is a primary motivator of voluntary cow movement. All farms differed in the amount of concentrates fed in the robot and at the feed manager. All but 2 of the 25 farms surveyed used TMR feeding. TMR feeding is less common on AMS farms in the Netherlands than in North America. The average amount of forage in the TMR was 65%. However, eleven farms reported a forage percentage between 48% and 60% in the TMR.

The amount of concentrate fed in the robot is adjusted for the amount mixed in the TMR. One farm feed all of the concentrates in the robot; 72% of farms reported feeding less than 5 kg/cow/day of concentrate in the milking robot and 28% of farms more than 5 kg/cow/day. Most farms (88 %) reported using pelleted concentrates in the milking robot. We were unable to conclude from this study that type or amount of concentrate fed in the robot had any influence on reported average number of milking/cow/day.

Hygiene and Milk Quality

The average of self-reported bulk tank SCC decreased from an average of 230,000/ml to 186,000/ml after the switch from conventional milking systems to AMS. A decrease in bulk tank SCC was reported by 40% of farms, no change by 20% of farms, and an increase by 12% of farms (28% did not report on change in SCC). Half of the farms surveyed (52%) reported that they checked individual cow SCC once/month. About 40% of farms indicated that they were aware of the major types of mastitis pathogens appearing in their bulk tanks with coliform the most commonly reported, followed by *staphylococcus aureus*, and *staphylococcus non-aureus*.

More than half (56%) of the AMS users clean the free stalls twice/day. An additional 24% of farmers clean free stalls once/day, and 20% clean them more than 3 times/day. An association was found between number of stall cleanings and SCC levels, with more frequent cleaning of the free stalls leading to a reduced SCC level.

Most farms used an auto scraper to clean barn floors at least four times/day. Five of the farms (20%) had a slatted floor and did not clean the barn floor. The area around the milking robot was cleaned once/day on 24% of farms, twice/day on 56% of farms, and four or more times/day) on 28% of farms.

Most farmers singe or trim udder hair when needed, while 20% of farms use a planned schedule (averaging once/month). Many farms also singe udder hair just before or just after calving. Tail docking was practiced on 32% of farms. The remaining percentage follows the same grooming schedule for the cow's tail as they do for their udders.

Pre-cooling (passing milk through a plate cooler immediately after harvest) was used on 36% of AMS farms. The remaining percentage cooled milk in the bulk tank. No significant difference was observed between milk cooling methods and the self-reported bacterial quality of milk in this study. Separate milking facilities were maintained by 48% of farms for sick, infected, treated, and special needs cows. The vast majority of farms (23 farms or 92%) use both pre and post milking teat disinfectants.

Milk filters were changed once/day on eight farms (32%), twice/day on thirteen farms (52%), and three times /day on four farms (16%). Two farms reported changing the filter before a complete wash of the milk handling system and 4 farms reported changing filters after system cleaning. The remainder did not coordinate filter changes with cleaning. A significant association was found between increased frequency of filter change and reduced bacteria count of bulk tank milk.

Most farms reported flushing the cluster after each milking (89%), with 19% reporting rinsing the cluster after a treated cow, 18% after a specified idle time, 17% after a colostrum cow, 5% after a specified number of cows, and 6% after milking a cow with high SCC. In addition, most farms programmed a short rinse period to clean the milking equipment from cluster to milk jar. Most farms (92%) reported a programmed rinse after milking a cow treated with antibiotics and after milking a cow with colostrum milk (86%). A programmed rinse is also used by 68% of farms after a specified idle time, by 42% of farms after milking a specified number of cows (ten to twenty), and by 7% of farms after milking a cow with high SCC.

The average self reported SPC on the 10 US farms increased from 3000 cfu/ml before AMS to 5000 cfu/ml after the switch to AMS. The self-reported Bactoscan on the 15 Canadian farms averaged 17,900 before AMS and 16,300 after the switch. A decrease in Bactoscan was reported by 41% of Canadian farms and no change by 18% of farms (12% did not report on this change). AMS users did not consider milk quality to be a major problem. The general feeling was that while fluctuations in SCC, SPC or Bactosan do occur, these changes are similar to those that occur when switching to any new conventional system, such as a new milking parlor.

Milk Production

The average self-reported milk production on the 25 AMS farms surveyed was 9500 kg/cow/year (21,000 lb/cow/yr), which is 17 kg/cow/year more than the self reported milk production before switching to AMS. Increased milk production was reported by 36% of farms, no change by 22% of farms, and a decrease by 36% of farms. However, many farmers attribute a decrease in milk production to expansion efforts on the farm.

Service and Maintenance

AMS farms In Canada are required to have a service contract (15 of 15 Canadian farms surveyed), while only ½ of the US farms have a service contract (5 of 10 farms surveyed). Routine service is provided once a month or more on 68% of farms and every six weeks on 32% of farms with a service contract.

User intervention is required once every 2 to 4 weeks with the most common user interventions being replacement of hoses that have been kicked off by cows and cleaning of the teat location

laser. Intervention by a dealer (beyond routine service) was required once/month on 24% of farms, once/ six-months on 20% of farms and once/year on 16% of farms.

Conversion to AMS

The survey asked each farmer to indicate his or her reason for buying a milking robot. Most farmers (84%) indicated that they bought the robot because it allowed for a more flexible work schedule. After implementation of the robot, more than half of the farmers reported more flexibility in their work schedule. The second most common reason for buying a robot was the expected reduction in cost of hired labor. More than 70% of AMS users reported a decrease in the cost of hired labor. Farmers expected the robot to bring about less work hours on the farm. These expectations were not entirely met, as farmers reported no decrease in work hours. Instead, the new system brought about a change in type of work load because the robotic system required the mastery of new managerial skills and tasks.

An expected increase in milk production/cow was given by 40% of farms as a primary reason for switching to a robotic system. However, at the time of the survey, not all farmers had experienced the increase in milk production that they expected. Other reasons for buying an AMS included reasons of personal health or hobby. Some farmers answered that they believed in robotic milking and that the intrigue of a new milking system inspired them to buy one.

About 70% of farms reported having to cull cows because they could not or would not adapt to the new milking system. The cows from the original herd reportedly culled for this reason averaged 4%. The percentage of cows culled appeared to be reduced after an initial introductory period. Most of these cows are culled (60%) because of an unsuitable udder configuration. Other reasons were restlessness in the milking stalls and failure to voluntarily enter the milking stall.

User Experience

All of the AMS users surveyed indicated that, overall, they were satisfied to very satisfied with their automated milking system. We asked farmers to indicate what had been the biggest problem they encountered when switching to AMS. Farmers indicated that problems arose most often in cold weather, when freezing water pipes and steam and condensation interfered with optical teat location as the cluster was rinsed. Fortunately, these problems were easily solved once they were discovered.

Another problem area was the behavior of older cows. Older cows that have been raised with traditional milking methods appeared to have more difficulty adapting to AMS. The older, low-producing cows were noted as the most problematic. Early lactation and younger cows were reported to be much easier to work with.

Some farmers indicated that it was difficult to switch to the new system when the size of the herd was greater than 60 cows/AMS. According to the survey, the ideal number of cows to start with was under 55/milking box to ease the labor requirements of training a larger group of cows all at once.

As would be expected, virtually every AMS user had advice concerning the use of AMS. Many stressed that adopting AMS technology changes not only the milking management, but also changes the entire farm management strategy. Other notable advice included:

- AMS users must be genuine herdsmen in order to make the system work.
- Farm management skills are the most important factor to consider when deciding whether or not to switch to AMS.

- When you are considering AMS, visit other farms and look at different systems in order to gather ideas about how to plan your system and manage it.
- It is much easier to manage cow traffic when implementing a robot in a new barn
- Some users believe that robot milking is not suitable for farms with more than 150 cows, because farms of this size will require hired labor whether they use AMS or not. In this situation it is easier to work with hired labor and a parlor.
- Many farmers said that patience is required when adapting to the new system. The first two weeks are generally very stressful. However, many farmers agree that things calm down and become easier to work with after this introductory period.

Conclusion

In conclusion, the overall experience of the farmers with the robot seems very positive. Most farmers indicate that the robot allows them more time for managerial tasks, and more importantly, more time for themselves. Farmers also reported that the primary advantage of AMS is the decrease in stress levels for the cows and the farmer.

Acknowledgements

We want to thank Yvonne van de Vorst from ID Lelystad for the survey form and data that she provided to make this research possible. We would also like to thank the AMS dealers from Lely, Boumatic, and De Laval and Roy Malik and Jim Dell from the Pennsyvania Department of Agriculture for their help in arranging farm visits. Last but certainly not least, we thank all the farmers who we visited for the information and wisdom they provided.

Appendix

AMS Management Survey Form

General Farm Information

1. Full time labor on Farm: 1 2 3 4 Persons
2. Number of Milking Cows: _____
3. Overstocking? No Yes If so how much_____
4. Number of stall rows in each pen: 1 2 3 4 5 6 Rows
5. Type of bedding used in Free stalls: (farms can use a combination of bedding types)
   Sand Mattress
   Shavings Straw Other
6. Number of Pens: _____
7. Are cows grouped by production? Yes No
8. Manure removal:
   Tractor/Bobcat Auto Scraper
   Slatted floor Combination
   Flush Other:_____
   Cleanings/day _____

Robot information

9. Brand of Robot: _____
10. Number of Milking Stalls: _____
11. Number of robot arms: _____
12. Months since starting robotic milking: _____
13. Average of milkings a day:
14. Cow traffic:
    a. Forced
    b. Free
    c. Combination
    d. Holding pen by robot
    e. Preselection gates

Feeding

15. Do you use TMR? Yes No
16. % of forage :_____
17. % Corn silage____% Haylage _____%
18. Dailey average intake (DM): _____
19. Maximum amount of concentrate fed in Robot:
20. What kind of concentrates?

Kind	*Yes/no*
Pellets	
Meal	
Molasses	
High protein	
High energy	
High patability	

Udder health

21. Teat sanitation:

Teat Disinfection Product		*Post Milking*
None Chlorhexidine Iodine Lactic acid Other		

22. Controlling udder health and milk quality

How often do you check?	*Per day, month of year*	*When needed*	*Never*	*Notes*
Individual cow SCC Bulk tank SCC Bulk tank SPC (Bactosan–Canada) Identify Bulk tank Pathogens				

23. What mastitis pathogens occur on your farm?

Pathogen	*Major*	*Minor*
Staphylococcus aureus		
Staphylococcus - not aureus		
Streptococcus agalactiae		
Streptococcus dysgalactiae		
Streptococcus uberis		
Coliform bacteria		
Other		
Don't Know		

24. Which milk cooling methods do you use?:
    a. Pre cooling
    b. Cooling in the bulk tank
25. Do you have a buffer tank? No Yes

Farm Hygiene:

26. How often do you clean the free stalls?
    Once a day Twice a day
    Three times a day Four or more times a day
27. How often do you clean the barn floor?
    Once a day Twice a day
    Three times a Day Four or more times a day
28. How often do you clean the area around the robot?
    <1/day 1/day 2/day 3/day 4 or more/day
29. Do you trim or singe udder hair?:
    No Yes, how often_____
30. Do you trim, or dock tails?:
    Trim, how Often? _____ Dock
31. Do you have another milking facility for treated/sick/fresh cows?
    No Yes, where_____

Robot Hygiene

32. How often is the cluster rinsed (short rinse)? (You may give more than one answer)
    After each cow After treated cow
    After colostrum cow Specified idle time
    Specified # cows After high SCC cow

33. How often is short cleaning applied from the cluster up to and including the milk jar/air separator? (You may give more than one answer)

After each cow	After treated cow
After colostrums cow	Specified idle time
Specified # cows	After high SCC cow

34. How often is the filter changed?: 1/day 2/day 3/day 4/day
35. When is the filter changed?:

Before cleaning	(10%)	After cleaning	(6%)
During cleaning	(4%)	Not synchronized with cleaning (81%)	

Robot/cow management:

36. Management

How often do you check?,	*1/ day*	*2/day*	*>2/day*	*Notes*
The cows in the barn				
Fetch cows to robot				

37. Which attention lists do you check and how often?

Milk Yield	1/day	2/day	more
Milking interval	1/day	2/day	more
Conductivity	1/day	2/day	more
Other			

38. Service and breakdowns on robot

How often do you have?,	*Per , month, year*	*When needed*	*Other info*	*Notes*
A dealer service			Service Contract	Yes No
Minor break down, own service			Most common	
Major break down, dealer service			Most common	

39. In your opinion, what are the 2 most important indicators of mastitis?

Milk temperature	Milk Conductivity
Clots on filter	Milk Color
Increased Milking interval	Reduced milk yield
Visual cow check	Other: _____

40. When switching to the milking robot did you have to cull cows because they where unsuitable for robot milking, If so how many?
    No Yes: _____% cows
41. Percent of cows culled ongoing?_____
42. What was the most important reason for culling these cows?, Number of cows?
    a. Cows where restless in the robot: _____
    b. Cows would not come voluntary to the robot: _____
    c. Unsuitable udder/arrangement: _____
    d. Other: _____
43. Visiting the milking robot:

Rank top 3 times for milking and the 3 slowest times, as indicate when feed is delivered.	Busiest	slowest	Feeding Time
Midnight – 2 am			
2 am – 4 am			
4 am – 6 am			

6 am - 8 am	
8 am – 10 am	
10 am –noon	
Noon – 2 pm	
2pm – 4 pm	
4 pm – 6 pm	
6 pm – 8 pm	
8 pm – 10 pm	
10 pm – midnight	

44. Are the heifers put in robot pen before calving? Yes No.
45. What have been the most important problems to emerge on your farm since the switch to the robot?_____

Milk production

46. What was and is your production?

Average figures	*Before robot*	***Now***	*Target*
RHA Milk Production*			
Lb/cow/day*			
ME305*			
SCC			
SPC			
Bactoscan			

(* circle values when BST was used)

Deciding to buy an robot

47. What where the reasons to buy a robot?

Rank the most important reasons for choosing a milking robot?	Rank	Have your expectations been met? (**T**otally, **M**ostly, **P**artially,**N**ot at all)
Less work hours		
Increased milk production		
Recommended by other farmers		
More Flexible work schedule		
To Improve udder health		
Expand herd with no additional labour		
Reduce Hired labour		
Keep children in the business		
Calmer less stressed cows		
Other…….		

48. Tips for other (milking robot) farmers _____
49. Other Comments _____