



Automatic milking systems (robotic milking)

1. Introduction

The defining feature of an automatic milking system (AMS) is that the cows decide when they will come to the milk harvesting area. Thus, automatic milking is much more than just another way of milking cows. It is an entirely new way of dairy farming because milking becomes a background operation taken care of by the AMS and the cows themselves.

2. Interpretation and relevance to Australian conditions

Given Australia's competitive edge in producing milk from pasture with relatively low inputs (by world standards), should Australian dairy farmers also start to think seriously about automatic milking systems? The short answer is "yes". Automatic milking systems have the potential to revolutionize the way of life on Australian dairy farms.

As the differences between costs of automatic and conventional systems decrease, an increasing number of Australian farmers are expressing an interest in voluntary milking for reasons such as:

- improvement in lifestyle, with more time for family and leisure activities
- less physical work, especially for older farmers or those with physical health problems
- increased opportunities for attracting and keeping skilled labour
- personal choice for innovators who want to try new ideas.
- potential for increased profitability based on increased milk production potential and lower labour costs.

3. Relationship to CowTime goals

The major potential benefit is that automatic milking will make dairy farming a more socially-attractive occupation making it easier to attract and retain staff within the industry. People with skills can be employed with the focus being on farm system management and performance, without the expectation of skilled people capable of doing such tasks also being required to harvest milk. Herd management becomes less time-bound so the labour inputs can be more flexible. The routine repetitive task of milking the herd fourteen times per week, or more, is replaced by the tasks of checking attention lists from a computer and observing cows regularly at times other than at milking.

When considering how much labour automatic milking will save for a particular farm system it is important to identify what labour is used in removing milk from cows in that system. The important point for each farm enterprise is to clearly identify what tasks will be replaced by the automatic milking system on their farm. How that benefit is captured on each farm will be different for each farm or enterprise. Some people will have the same number of labour units on farm but will reduce the length of their working days. Other people may capture the saving through a reduction in the number of labour units on the farm with limited reduction in the number of hours worked each day.

4. Main features

Encouraging cows to come for milking

Automatic milking is reliant on voluntary cow traffic. It also requires a distributed pattern of traffic and therefore milkings to enable a high level of machine utilisation, minimal length of cow queues at the dairy and a high ratio of cows to milking stations. Feed (either concentrate fed during milking or the prospect of forage or pasture after exiting the AMS) is the main motivator for cows to move voluntarily into the automatic milking installation. In most of the overseas systems, cows are managed by a controlled traffic system between feeding and loafing areas and motivated by the prospect of some tasty concentrate feed in the milking box. In a series of on-going studies in NZ, access to drinking water is used to help encourage cow movement without limiting water intake. However, even within the NZ system, feed is by far the greatest incentive with water providing for additional motivation at some times of the year. The desire to be milked is not in itself a great motivator for movement. Research in both Australia and New Zealand has found that it is difficult to achieve a milking frequency much above two milkings per day for an extended period, therefore increases in production due to increases in milking frequency are unlikely.

Changes in milk yield

In some conventional dairy systems increasing individual cow production involves milking more than twice a day as well as an appropriate feeding and breeding management system. The use of automatic milking systems potentially enables an increase in milking frequency without increasing the need for more labour or requiring labour at very unsociable times of the day.

Research carried out in NZ and Australia indicates that there is no reason to expect any change in average milk production unless the quantity and/or quality of feed is altered in combination with an alteration in the average achieved milking frequency. Increased milking frequency alone will not result in an increase in milk production in the long term and could result in reduced reproductive performance, reduced cow condition and inefficient utilization of the units.

Milk quality and udder health

Studies in several countries indicate an initial deterioration in somatic cell count, total bacterial counts, freezing point depression and free fatty acid levels in the first few months following the introduction of automatic milking, after which the situation usually improves.

More importantly, the great variation in results from individual farms suggests that:

- the initial deterioration is much less marked with the newer automatic installations
- the quality of on-farm management influences the extent to which udder health and milk quality deteriorate, or whether they do so at all.

The one thing that is for certain is that when an automatic milking system is implemented it is important that people are aware of the monitoring and management that is required to detect and treat any clinical mastitis cases to ensure that bulk milk quality is maintained.

Cow behaviour

Reports from many 'robot' users suggest that cows become amazingly quiet within a few weeks or months of changing to an automatic milking system. It has become clear that cows are much less frightened by machines than by people, presumably because the cows are free to choose their milking times and because the robot does not become angry or impatient with them or hurt them!

It is strongly believed that cows "like" predictability and routine. An AMS is extremely predictable in that it reacts to certain situations in the same way, all day, every day. It will not react differently on a Sunday morning to a Tuesday night. The only pressure placed on the cows within an AMS is the pressure that they place on each other.

AMS capacity / performance

Tables of *potential* AMS performance based on European management systems (cows housed and fed TMR) are provided by the manufacturers and an example is tabulated below:

AMS Time budget	Hours per 24 hour day
Idle time	2.00
Complete system cleaning 3x	1.00
Small cleanings (average 3)	0.50
Net Milking time	20.50

AMS Capacity	8,000kg cow production	10,000kg cow production
Average process time per cow	7.5 mins	8 mins
Cows per unit per hour	8 cows	7.5 cows
Milkings per 20.5 hour day	164 milking s	154 milking s
2.6 milkings per cow per day	63 cows per unit	59 cows per unit
2.7 milkings per cow per day	61 cows per unit	57 cows per unit
2.8 milkings per cow per day	59 cows per unit	55 cows per unit

Throughput like those above may be achievable throughout the year in a very well managed system with year-round calving and very consistent herd size and milking frequency. The above indicators of utilisation and number of milkings per day will change through the lactation and depend largely on the number of cows per AMS and the targeted milking frequency. Throughput may also be different for cows in a pasture-based system with larger walking distances and depends largely on the rhythmic behaviors displayed by cows (e.g. bouts of grazing, rumination, sleeping etc). It is also important to understand that the above milking frequencies may not be required to achieve the production levels targeted. At the Australian research farm (Camden) cows are milked at about 2.3 milkings/cow/day in early lactation (milking frequency drops off gradually as they move through the lactation), average milking frequency throughout lactation is around 1.7 milkings/day and an average milk production level of 7,800 litres is achieved.

5. Potential challenges with implementation

Farmers who have changed to automatic milking report their biggest challenges as:

- Being properly prepared for the initial installation/commissioning period. Preparing for the worst is more useful than being inadequately prepared;
- learning to let go of the task of milking, learning how to utilize the extra time to manage the farm as a business and to monitor the herd in other ways;
- leaving the cows alone to learn (from other experienced cows) how to enter the milking system voluntarily;
- being obliged to become competent with computers and learning how to access and understand the information needed to manage the herd; and
- good maintenance will decrease the number of failures but someone needs to be on call at all times, day and night. Clearly, the successful deployment of automatic milking installations in Australia will need to be supported by a regional network of skilled technicians

6. Robustness of this information

Because automatic milking is such a new and rapidly-evolving way of dairy farming, it is likely that ideas, costs and recommendations will be quite different for the next generation of robots. Currently there are no automatic milking systems in Australia or New Zealand milking more than 100 cows per robot (the closest is a farmlet in New Zealand with 92 cows/AMS managed in seasonal calving low input – 97% grass - system).

Automatic milking research in NZ is looking to milk 140-180 cows using only two robots. The research goals are that cows should get most of their nutritional requirements from pasture and, on average, they will be milked less than twice per day during peak lactation in an attempt to increase the total milk harvested from each AMS. There is a single calving in spring. Perhaps this approach could offer a cost-effective alternative for Australian farms because our pasture-based cows produce much less milk than the heavily fed cattle in the Northern Hemisphere.

AMS Utilisation at peak lactation in the New Zealand experiment*	4,200kg cow production
Average process time per cow	8.7 mins
Cows per unit per hour	6.8 cows
Average number of milkings undertaken per AMI per 24 hours	120-150 milkings
Cows on average have 1.4 milkings per cow per day at peak	92 cows per unit

*Actual data for peak lactation in a spring calving only system (September/October)

Australian research is probably more in line with the average pasture based Australian dairy system. Here a split calving is operated with the herd size peaking at 165 cows through two milking stations. Milking frequency is targeted at 2-2.5 milkings/cow/day in early lactation. Lower milking frequencies are targeted through mid and late lactation when milk production drops off. This allows a reasonably high number of cows to be milked through the two milking stations without compromising production per cow in this reasonably low input system.

AMS Capacity in the Camden experiment	7,800kg cow production
Average process time per cow	7.5 mins
Cows per unit per hour	8 cows
Average number of milkings undertaken per AMI per 24 hours	120-150 milkings
Cows on average have 1.8 milkings per cow per day (2.0-2.5 during peak of lactation)	82 cows per unit during peak number of cows in milk

Lely has supplied the following results for the last year from a commercial farm in Gippsland (Max and Evelyn Warren)

AMS Capacity from the Warren's farm as reported by Lely	7,850 kg cow production
Average process time per cow	7.7 mins
Cows per unit per hour	7.8 cows
Average number of milkings undertaken per AMS per 24 hours	120-168 milkings
Cows on average have 2.3 milkings per cow per day during peak of lactation	80 cows per unit during peak number of cows in milk

When looking at numbers it is important to consider how they are achieved and calculated. Cow numbers, calving patterns, feeding systems, production targets, human intervention, etc. all have an influence in the systems success. Every installation of AMS will have its teething problems and take time to achieve the results appropriate for that farm and the level and skill of management applied to it.

There is now a significant amount of information available to farmers to allow them to make more educated decisions about the feasibility of incorporating AMS into their farming systems. There are two commercial AMS farms milking cows in Australia with several others to come on line and an additional two in New Zealand. Each of the farms is of varying levels of intensity and bought in feed. There is an AMS research farm in each country as well. The data generated by these farms should allow farmers to make sound decisions about whether or not to invest in the technology and to be successful with implementation on farm. The technology is continually developing and the understanding of how to integrate it into grazing systems is evolving rapidly so it is important to keep up to date if you are considering installing an automatic milking system.

7. References and further reading

Proceedings of the First North American Conference on Robotic Milking, Toronto, Canada, March 2002, especially the following papers:

"Automatic milking experience and development in Europe." Kees de Koning, Yvonne van der Vorst and Albert Meijering, Research Institute for Animal Husbandry, Lelystad, The Netherlands.

"Global acceptance of robotic milking systems." A. van't Land, Lely Industries, The Netherlands.

"Evolution of automated milking in the USA." Douglas J. Reinemann, University of Wisconsin, USA

"Managing the change to a robotic milking system." John Baines, Fullwood Ltd, UK.

Woolford, M. (2002) "The use of robotic milking machines in pastoral dairy systems" in Dairyfarming Annual 2002, Proceedings of Massey Dairy Farmers Conference, Massey University, Palmerston North, NZ

For Australian research information/results on AMS visit www.futuredairy.com.au

For NZ research information/results visit www.dairynz.co.nz

Max and Evelyn Warren's automatic dairy can be visited through the web at www.roboticdairy.com

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