Prospects for Robotic Milking in Wisconsin

Douglas J. Reinemann, Ph.D.
Associate Professor of Biological System Engineering
University of Wisconsin – Madison, Milking Research and Instruction Lab
US Representative to the International Dairy Federation, Machine Milking Group

Proceedings of the Arlington Dairy Days, December 1998

The technology of automatic or robotic milking is developing at a rapid pace. There are over 200 systems in operation on commercial dairy farms in Europe. Several companies are planning to introduce these systems in the US in the next 1to 2 years. A committee of the International Dairy Federation's Machine Milking Group (A32) has been formed to prepare a bulletin on robotic milking systems. Information from the most recent meeting of IDF Group A32 is presented here along with preliminary economic analysis of robotic milking systems compared with Parlor / Freestall operations.

Current Status of robotic milking systems in Europe

Netherlands: In September 1998, approximately 150 farms were using one or more robotic milking systems. The total number of farms using robotic systems is expected to be about 200 farms by the end of 1998. Two research institutes have robotic milking systems; all others are operating on commercial farms. There are also about 12 farms in Belgium and France using robotic milking systems. The majority of robotic systems are on farms with 40 to 130 cows. It is expected that the number or farms with robotic milking systems will increase to 700-800 by the year 2000.

The national research station at Lelystadt is offering one-day courses for farmers who are interested in buying a milking robot. The main topics of this course are economics, the available systems, barn layout and management, milk quality assurance and experiences of a farmer using a robotic system. The dairy industry has formulated some special rules as part of the Dutch Total Quality Management System for dairies. Robotic milking systems must be accessible by an operator via a clean passageway. The minimum number of cleanings per day of the milking machine has been established.

Germany and Switzerland: There are currently about 50 automatic milking systems installed in Germany and one in Switzerland. Approximately 25% of the systems are installed at regional education and research stations. All of the systems are under close supervision of research institutes or universities. Automatic milking systems have been shown to function reliably but there are still some unanswered questions including; the ability to assure milk quality, claims of yield increase, economic benefits, animal welfare, etc. It is expected that the number of systems will remain small for some time.

United Kingdom: There are 10-15 farms with automatic milking systems in the UK. In general they have been installed on small farms. A robotic system is in use at the Silsoe research institute, but the cows are moved to the robot and milked in batches rather than

by voluntary entry. The research at Silsoe is focused on animal health and milk quality. The UK has a regulation that cows are not allowed to be milked if they have visible wounds. Discussions are in progress with regulatory agencies on how this and other sanitary regulations will apply to robotic systems.

Scandinavian countries: There are there are 3 robotic milking systems operating in Sweden with a clear and growing interest in robotic milking. There are some concerns regarding the sanitary regulations. The dairy industry will not accept milk from robotic farms, unless they are approved by the Department of Agriculture. The three farms have temporary permission to deliver the milk and one system is running a special test to answer questions relating to milk quality assurance, animal welfare, and worker safety.

There are 5 robotic systems operating in Denmark. There are also concerns about robotic milking and the sanitary regulations (Hygiene Directive). Danish regulations require that the operator inspect foremilk so that abnormal milk will not enter the bulk tank. A study is underway to determine the ability of robotic systems to detect abnormal milk. Preliminary results indicate that it is difficult for the current a robotic system to detect mastitis.

Milk Quality Issues

Milk quality assurance is a major issue for the adoption of automated milking in Europe. It is likely to be an issue in the US also. The main concerns at present are

How to ensure that abnormal milk does not enter the bulk tank, and secondarily

How to ensure that the milking machines and cleaned and sanitized effectively.

We will certainly benefit from the experience in Europe when dealing with these issues.

Manufacturers

There are 5 manufacturers who have introduced robotic systems to the European market

Lely (Astronaut)
Prolion (Liberty)
Fullwood (Merlin)
Alfa Laval (VMS)
Westfalia/Surge (Leonardo)

Housing / Milking system designs

Design guidelines for integrating automated milking systems with cow housing have been provided by the manufacturers. It is recommended that the milking system be positioned between the resting and eating areas. Cows move from the resting area to an identification station. Cows are identified and directed to 1) the milking stall, 2) feeding area(s), or 3) a holding area for special treatment. Higher producing cows are milked more frequently (up to 4 times per day) and lower producing cows less frequently. This helps to maximize the number of cows that each robotic unit can accommodate, (typically 50 to 60 cows per unit).

All systems have some form of automatic teat and udder cleaning system that is either part of the milking unit or a separate device. Conductivity, milk flow and duration of

milking are measured by quarter. Data is stored and processed by a computerized management system. Teat cups are removed automatically and teats disinfected. Cows are then directed to the feeding area.

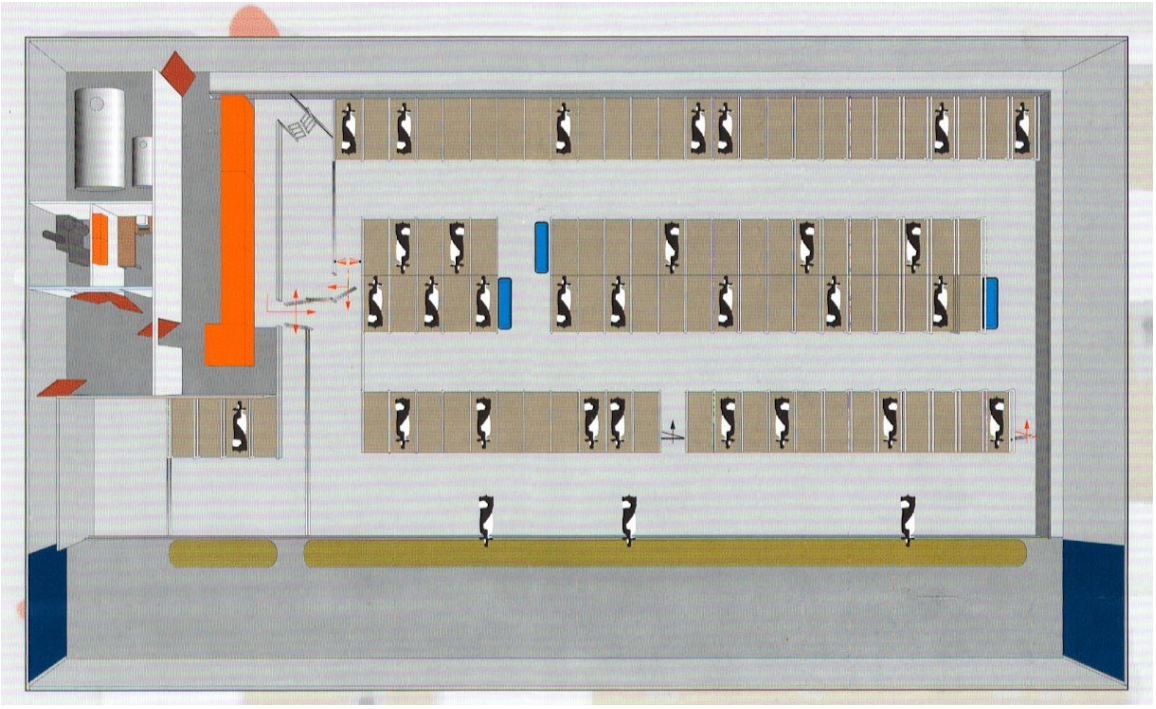

Figure 1. Example Housing Design (From Prolion product Literature)

Economics

The manufacturers of robotic milking systems are targeting small farms as the most likely potential market for these systems. Fully automated milking is indeed an attractive option, as milking comprises about 1/2 of the labor expended on small Midwestern dairy farms. As with any technology, the economics of purchasing, maintaining and operating must be competitive with other production systems.

A preliminary economic analysis was performed using two scenarios, a robotic milking system on a small farm (60- 80 cows) and a milking parlor with freestall barn for 400 cows. The latter was chosen as a typical future production system in the Midwest. Robotic milking systems tend to also have highly mechanized feeding and manure handling systems. Cow ID is required so that management decisions on milking and feeding can be made by a computerized management system. Some of the systems use TMR feed with drive-by feed bunks while others make use of automated concentrate feeders with Cow ID.

This analysis assumes that new facilities will be built for both systems.. The automated milking systems used in Europe are being installed with freestall housing for cows. Special facilities and automated cow handling equipment is required so that cows will voluntarily enter the milking area. It may be impractical or impossible to renovate existing buildings for these special purposes.

Typical ranges of facilities costs are used for each scenario. These scenarios were created using recently updated "Parplan" software available for download from the UW Extension Center for Dairy profitability Web site: http://www.wisc.edu/dairy-profit/.

As the exact cost of robotic milking systems is unknown at this time estimate were used which are expected to cover the possible range of cost for this technology ($150,000 for low cost, $200,000 for medium cost and $250,000 for high cost). Maintenance will be critical for the success of these highly mechanized systems. A maintenance cost of 10% of the initial cost per year was assumed for the robotic systems and 5% for the conventional milking parlor. An annual interest rate of 9% with a 10 year life on equipment and 20 year life on buildings were assumed for both scenarios. A labor cost of $10.00 per hour was assumed for both scenarios.

Production levels are assumed as 60, 75 and 90 pounds/cow/day for low, medium and high level management. The number of cows milked by the robotic system is assumed as 60, 70 and 80 cows for low, medium and high level management.

Costs are presented for total investment per cow including milking system, housing and milking buildings and manure collection and storage facilities. Costs for feed and feed storage were not included. These results are presented in the following table.

The long term viability of robotic milking system will depend on the ability of these systems to produce milk at cost which are comparable to other widely used systems. These estimates suggest that the level of capital investment for robotic milking systems will likely be higher than for milking parlor operations. The cost per hundredweight of milk produced is quite sensitive to the installed cost of the automatic milking system. There is also a large effect of the level of management.

Using the lowest cost estimate for the robotic system with the highest management level, the cost of milk harvest approaches the worst case assumptions for a milking parlor system (high cost and low management). There may be a future for robotic milking systems for producers with excellent cow management and equipment maintenance skills, provided that the cost of robotic systems allow them to be competitive.

Investment per cow for Milking System, Animal Housing and Manure handling and storage

Capital Cost	***Robotic***	*Parlor*
Low	**$4,700**	$1,800
Medium	**$5,700**	$3,100
High	**$6,500**	$4,300

Cost per cwt. For Milking Facilities and Milking Labor

Management Level	**Robotic** / Freestall Cost			Parlor / Freestall Cost		
	Low	Medium	High	Low	Medium	High
Low	**$4.00**		**$6.13**	$1.28		$2.19
Medium		**$3.44**			$1.59	
High	**$2.06**		**$3.13**	$0.63		$1.37

Cost per cwt. For Milking, Housing and Manure Facilities
and Milking, Feeding, and Manure handling Labor

Management Level	**Robotic** / Freestall Cost			Parlor / Freestall Cost		
	Low	Medium	High	Low	Medium	High
Low	**$5.32**		**$8.19**	$1.95		$3.86
Medium		**$4.99**			$2.85	
High	**$2.97**		**$4.52**	$1.28		$2.74

Statement of the International Dairy Federation, Milking Machine Group A32, on Robotic milking
25 September 1998

There are already 250 automatic milking systems installed in Europe. Automatic milking provides significant positive opportunities for improved cow welfare:

- reduced stress
- consistent teat preparation
- a more natural milking frequency
- frequent health monitoring

The herdsmen also benefits:

- better management information
- less social exclusion

The current EU Hygiene Directive 89/362 was drafted before introduction of automatic milking systems. Automatic systems must meet the objective standards for high milk quality (bacteria and cell counts). It may not be possible to meet the literal requirement of the Hygiene Directive for the milker to inspect the appearance of the milk.

IDF group a32 proposes that IDF requests a temporary derogation pending the development of sensing systems which will fully meet the requirements of the current Hygiene Directive for the benefit of food quality and consumer safety.