Development of the robotic rotary

Automatic milking systems (AMS), or single boxes as they are referred to, have been used commercially overseas for many years.

They were developed for the traditional European market which has small, indoor herds.

FutureDairy research has proven single boxes can operate effectively in Australia's pasture-based system, achieving both high pasture utilisation and acceptable AMS unit utilisation.

However single boxes are best suited to herds of less than 300-400 cows, due to capacity (number of cows that can be milked by each unit in a 24-hour period) and cost.

FutureDairy's investors – DeLaval, Dairy Australia, Industry & Investment NSW and the University of Sydney – recognised that the Australian dairy industry needed an affordable automatic milking system capable of milking herds with more than 300 cows.

The concept of a robotic rotary had the potential to meet these needs.

The robotic rotary design was developed by DeLaval engineers in consultation with FutureDairy researchers, particularly Professor Bill Fulkerson and Dr Kendra Kerrisk.

The initial concept development began in 2005, with the first prototype built at DeLaval's research facility in Sweden in 2008. The Camden pilot was installed in 2009 for testing under Australian conditions.

The system has been progressively developed and refined as a result.

The next step in Australia will be the installation on two commercial farms during 2011.

These installations are closely monitored and supported by DeLaval and the FutureDairy team. The experience provides the opportunity to identify issues and continue development of the system in the 'real life' situation.

Collaboration the key

The development of the robotic rotary involved an unusually close and large scale collaboration between scientists, commerce and industry.

Achieving a revolutionary product in such a short time was made possible by the combined contribution of DeLaval's engineering and product development expertise, FutureDairy's scientists and the industry context from Dairy Australia and Industry and Investment, NSW.

It's a testimony of what can be achieved by a private-public-industry partnership of both intellect and funding.

For some years, Australian dairy farmers have asked for a robotic rotary. The collaboration allowed Dairy Australia to invest farmers' levy funds in a project that attracted the additional investment and expertise needed to develop a system to meet Australian farmers' needs.

Dairy Australia – Your Levy at Work
DeLaval
The University of Sydney
NSW Government – Industry & Investment

FutureDairy is a research program to help Australia's dairy farmers manage the challenges they are likely to face during the next 20 years.

These challenges relate mainly to the cost of land, water and labour and the associated lifestyle issues. The two major areas of research are automatic milking and complementary forage systems.

FutureDairy is a partnership of DeLaval, Dairy Australia, the University of Sydney and Industry & Investment NSW (formerly DPI, NSW).

Guidelines

The FutureDairy Management Guidelines for Pasture-based AMS farms provide the practical information needed to adapt a dairy management system to suit an AMS. They are based on the findings from our research at Camden and experiences from commercial AMS dairy farms in Australia and New Zealand.

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FUTUREDAIRY

Robotic Rotary

Automatic milking for larger herds

The world's first robotic rotary dairy, developed by DeLaval in collaboration with Australia's FutureDairy project, was revealed in Germany and Australia in November 2010.

A pilot of the robotic rotary is operating at the Elizabeth Macarthur Agricultural Institute, Camden, NSW. While the Camden pilot is fully operational, its presentation is not as 'slick' as the commercial product, having been installed for research, development and testing purposes.

Developed for Australia's pasture-based dairy systems, the robotic rotary is suited to herd sizes between about 300 and 800 cows.

The robotic rotary automates most milking tasks, enabling the job to be performed as a background activity, without the presence of a human operator.

As with any automatic milking system, there are certain milking-related tasks that require operator input. In the case of the robotic rotary, these include:

- activating the washing system;
- changing filter socks and rubber-ware;
- attending to alarms;
- managing a separate herd of cows whose milk is not intended for the factory (eg antibiotic and colostrum cows); and
- monitoring individual cow performance.

However the timing of these tasks tends to be more flexible, eliminating the need to start the working day early in the morning and finish in the evening.

Dairy Australia – Your Levy at Work
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FUTUREDAIRY

Robotic Rotary

Automatic milking for larger herds

Benefits

The benefits of automatic milking have been well recognised overseas where single unit robotic boxes have been widely adopted in herds up to about 300 cows. The robotic rotary makes these benefits available to operators with larger dairy herds. While there are significant savings in labour (time and/or cost), overseas experience shows that the most-valued benefits are in terms of flexible working conditions and the associated lifestyle improvements.

Automatic milking removes the twice-a-day milking task from the daily routine, allowing greater flexibility for the working day on a dairy farm. The impact of this flexibility reaches far beyond the dairy, potentially changing the whole approach to the dairy business. Automatic milking frees up dairy farmers' time and energy to use on their priorities, whether they be farming, business, family or lifestyle just to name a few.

Design

The robotic rotary has an internal, rotary herringbone platform, with cows facing outwards and the robots housed in the centre.

While the Camden pilot has 16 milking points or bails, the commercial product is likely to have 24 with the option of two to five robots, depending on the required capacity of cow throughput. The system will perform the tasks of teat-washing and drying; applying the milking cups, cup removal, teat disinfection and cup flushing. It also monitors milk yield and quality.

The two robot system has a robot for teat washing and drying and another to apply the cups.

The five robot system has two robots dedicated to teat washing, two for cup attachment and a fifth for teat disinfection after milking. Each teat is sprayed independently using a camera that locates teats in real time 3D.

Cows stand at a 30 degree angle which allows the robotic arms to approach the cow from the side. This is very different to a conventional parallel rotary where the operator applies the cups through the cow's back legs.

Unlike a conventional dairy, there are no clusters in the robotic rotary. Instead, four individual cups are attached, enabling 'individual quarter milking'. This means milk flow rates, yield, colour and conductivity are measured for each quarter.

Cows wear electronic identification collars. The system uses historical records to determine expected milk yields per quarter and regularly updates the co-ordinates of each teat.

This speeds up the process of locating the teat. A sensor located above the platform detects the cow's precise position, enabling the laser-guided cups to be attached.

The design enables the cups to be attached to cows of varying sizes with equal ease, for example from to a large mature, Holstein to a small Illawara heifer.

At this stage, the commercial robotic rotary does not have feeding stalls. Out-of-dairy automatic feeders can be installed if needed.

The robotic rotary arm cannot be retro-fitted to a conventional rotary dairy, a key reason being that a conventional rotary involves accessing the udder from between the back legs and this is beyond current robot and laser technology.

Milking approach

The robotic rotary is suited to either batch milking, voluntary milking or a combination of the two.

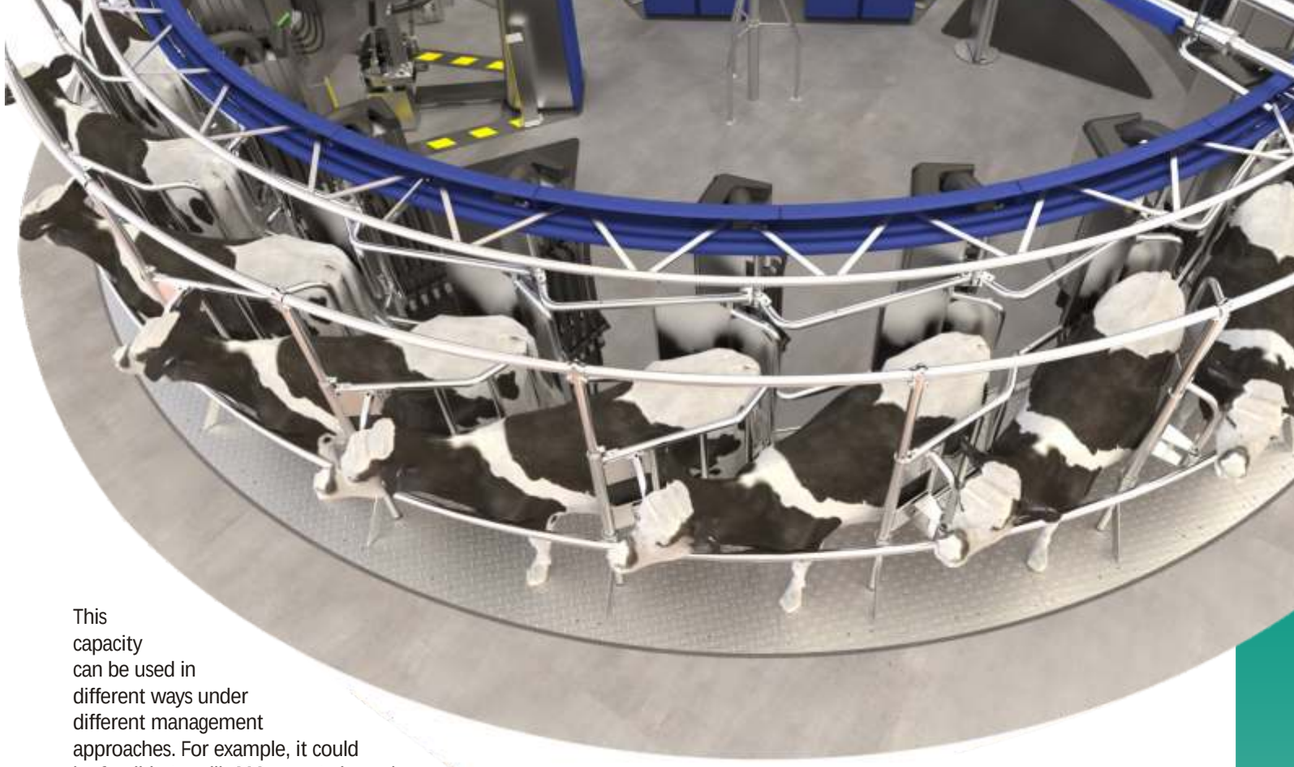
With a voluntary milking system, cows walk to the dairy on their own, so there is a small number of cows being milked throughout most of the day and night.

A batch milking system involves bringing the cows up in groups throughout the day. During milking the operator can leave the dairy and do other tasks.

It is not feasible to bring a whole herd (say 400 cows) to the yard and leave for automatic milking while the operator does other farm tasks. This is because the throughput rates of 50-90 cows per hour would involve cows waiting too long at the dairy yard.

Capacity

The first commercial robotic rotaries will be able to milk up to 90 cows per hour, depending on the number of robots installed.



This capacity can be used in different ways under different management approaches. For example, it could be feasible to milk 800 cows twice a day; or up to 540 cows three times a day.

The design allows for a modular approach, so capacity can be expanded as the dairy business grows.

For example, an initial installation could start with two robots – one for teat preparation and one for milking cup attachment – with the capacity to milk 50 cows per hour. Subsequent herd expansion could be accommodated by installing extra robots.

In contrast, the single box automatic milking units can milk only 6-10 cows per hour. This is because each robot is idle for almost the entire time the cow is being milked.

The moving platform on the robotic rotary frees the robots up as soon as the cups have been attached to the cow.

Commercial release

A limited commercial release is planned for 2011 under the system name DeLaval AMR™ (automatic milking rotary).

It will be marketed globally to farmers with herds of more than 300 cows. Although developed for Australian conditions, it is flexible enough to operate in a variety of dairy farming systems including grazing, free-stalls and loose-housing.

Innovation award

The DeLaval AMR™ received the 2010 Eurotier Gold Medal, a prestigious European award for agricultural innovation. It was presented at the EuroTier 2010 agricultural technology extravaganza in Germany on 16 November 2010.

Eurotier Medals are awarded by an independent innovations commission. Criteria include being a new concept, importance of product for practice, conformity with animal welfare, impact on farm and labour management and the environment and energy situation.

It is quite possible that a farm with a single box automatic milking unit could install a DeLaval AMR™ and run both technologies to accommodate herd expansion.

A recommended retail price for the DeLaval AMR™ has not been announced yet but it will be competitive in the automatic milking segment for larger herds.

It is likely to cost more than a conventional rotary with all the 'bells and whistles' but the running costs would be significantly lower because of reduced labour input.