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Automatic Milking Systems: Keeping Smaller Dairies in the Game

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Key Points:

- Various forms of robotic milking are helping to sustain small to medium sized farms amid a consolidating industry, and offering solutions to labor challenges and efficiency gains for some larger operations.
- The adoption of robotic elements in the milk production process will continue to grow at a rate of 20 to 30 percent annually in the years ahead. However, high costs and remaining uncertainties about useful life will slow the adoption rate among the country's producers and keep the share of the total U.S. herd milked by robots relatively small.
- Finances are typically not the primary driver of the decision to adopt robotics for smaller producers. Instead, these producers often cite less tangible benefits related to quality of life and making the farm more attractive to the next generation.
- As labor challenges mount and costs rise, tradeoffs will increasingly tilt in favor of robotic milking systems. This will happen first through box-style milking systems on small and medium sized farms in the Northeast and Upper Midwest, then on larger farms in the West and Southwest.
- Proximity to a dealership or service technician is critical, and areas with established networks of dealers have experienced broader adoption rates so far. The machines are generally very reliable, but any downtime quickly reduces profitability.

Summary

Automation and robotics have made their way into milking parlors across Europe, Canada, and most recently the U.S. These technologies are helping sustain small and medium sized farms and relieve some labor challenges and costs; but for now, they are not a clear financial home-run for most.

To this point, automated milking systems have mostly been a small-farm technology, though recently they have gained popularity among farms in the 500 to 1,000 cow range. For operations larger than that, the start-up cost and barn layout challenges associated with needing many standalone box-style milking systems are usually barriers to entry, but not always. The largest operations in the U.S. are in the range of 1,500 cows.

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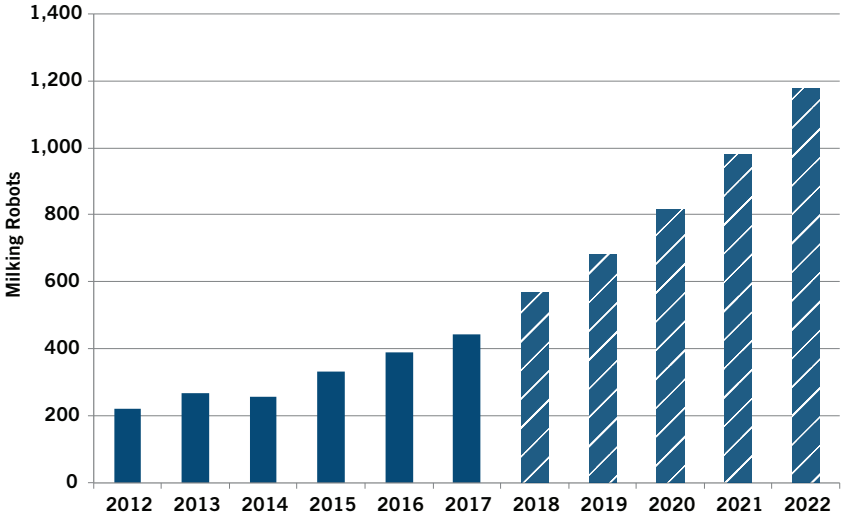
Exhibit 1: Milking Robot Sales in the U.S.



Source: Industry Estimates, CoBank

Incorporating robotics into the rotary milking systems that are common on very large farms will likely be the next frontier in milking technology, but for now automated milking systems represent only a small fraction of the national milk supply. Less than 5 percent of U.S. dairy farms currently use milking robots, but sales are projected to increase by 20 to 30 percent annually in the years ahead.[1] (*See Exhibit 1.*)

Introduction

Automated milking systems (AMS), also referred to as robotic or voluntary milking systems, take a variety of forms. Currently in the U.S., AMS are most commonly standalone "box" milking units in which cows take turns voluntarily walking into the station. Through a combination of scales and lasers, the AMS locates the teat before a robotic arm cleans it and attaches the cups for milking. Before entering the milking station, unique identifying tags on the cow are scanned, the AMS recognizes the cow, remembers when the cow was last milked, the location of the teats on the past several milkings, and prepares to collect the milk as well as about 100 data points specific to that cow. If a recently milked cow attempts to re-enter the machine too soon she is diverted out of the machine without being milked. Cows are enticed to enter the AMS with a customized supply of feed pellets available only in the machine. These pellets supplement the lower-energy partially mixed feed ration provided to the milking herd as a whole and they are distributed based on the individual cow's production levels and lactation stage.

Once the cows get a feel for the system, which for some cows can take a couple of days, and for a few may never happen, they fall into a pattern of taking turns entering the AMS from an open pen. The transition and training period for the entire herd typically takes a few weeks. Many large-scale robotic dairies operate a conventional barn on-site for cows that fail to adapt to the robotic environment.

Farmers who have converted to AMS from conventional operations are quick to point out that an AMS will not allow you to run your farm from your phone on your recliner. Quality of life is often one of the primary motivations of making such a conversion but the farmer must still be comfortable getting dirty and working with cows. To get the most efficiency gains out of an AMS system, it also helps to be technologically savvy and mechanically handy to be able to deal with repairs on the fly, as any downtime can quickly hurt the profitability of an AMS system.

AMS systems have been growing in popularity in the U.S. since the first unit was installed in 2000. Before reaching the U.S. they had been in use in Europe since 1992.[2] AMS can limit growth potential, or at least make incremental growth much more difficult without significant capital. This worked well in the EU where expansion was less of a goal and producers could automate profitably within the former EU milk quota system.

Up to 870 box robots were sold in North America last year, the majority of which were in Canada. Canada's dairy quota system can make the investment in robotics more clear-cut. In addition to box robots, about 300 robotic rotary units were sold in North America in the past year.[3]

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Aside from standalone milking units, there are a number of other automated components available that complement an AMS barn, or can be used as standalone technologies on a conventional farm. These include feed pushers, calf feeders and manure scrapers. As an alternative to standalone milking units, robotic, automated components of rotary parlors are gaining in popularity among larger producers.

U.S. Availability and Cost

Most manufacturers of robotic milking components and AMS originated in Europe, where the technology was first developed and made available. Most have now established a sales presence in the U.S. An important consideration for producers thinking about incorporating AMS is proximity to a dealer that can supply parts and service the machines quickly. Dealers are scattered throughout the major milksheds of the U.S., but the highest concentration is in the Upper Midwest through the Northeast.

The five major brands available in the U.S. are:

- **Lely:** A Dutch company with the flagship Astronaut line of robotic "box-style" milking systems. They also make a variety of other automated components including feed systems, feed pushers and calf feeders.
- **DeLaval:** Based in Sweden, is another leading provider of box style robotics, and the leading provider of traditional rotary parlors.
- **GEA:** A German-based company specializing in larger herds and fully robotic rotary parlors
- **BouMatic:** Based in the Netherlands, has differentiated itself through an innovative double-box milking robot that allows two cows to enter from opposite sides of the machine and be milked from behind (as opposed to from the side in the case of Lely and DeLaval) simultaneously, reducing cost per unit of milk.
- **AMS Galaxy:** A newer Dutch entrant into the U.S.

The cost of these units is dependent on a number of factors, but a new, single-box unit typically costs in the range of $200,000 plus an additional $15,000 to $20,000 for the housing.[4] Costs can be less per unit for larger purchases of multiple robots. On top of this, it is common to purchase a service and maintenance plan. The cost of a fully robotic rotary parlor can be more than three-times that of a conventional rotary parlor.

Key Metrics

The primary measurement of success and return on investment for an AMS is the amount of milk per robot. 4,500 pounds of milk per robot per day, or about 80 pounds per cow is a good minimum target for success. Each robot can optimally handle between 55-65 cows. This gives the cows the opportunity for two to three milkings per day. Cows are milked around the clock in most AMS and to operate at full efficiency the AMS should have minimal downtime.

The primary motivation for the adoption of AMS technology is labor cost and efficiency. One of the biggest benefits gained in incorporating AMS is an increase in labor efficiency. An efficient operation can have a labor cost as low as 75 cents per robot per hundredweight of milk, though up to $1.50 is reasonable and still slightly better than the 1.64 national average per hundredweight for hired labor in 2017. While labor costs may not be drastically less than a conventional operation in most cases, it can reduce the reliance on outside labor significantly, retaining only more specialized roles or relying primarily on family labor.

Major Advantages

Although labor efficiency is a benefit, there is not a clear financial advantage across the board for AMS. Adoption of AMS has many advantages revolving around quality of life, labor issues and efficiency that all point to being able to sustain smaller farms managed by aging generations.

Human workers are becoming harder to find and more expensive, while AMS are becoming more widely available, better, and in some cases cheaper over time.

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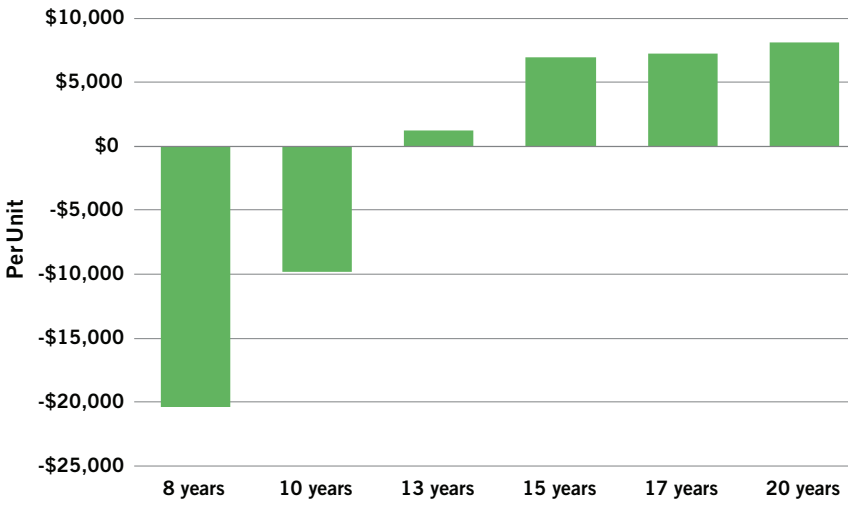
Exhibit 2: Net Annual Impact of AMS by Lifespan

Assumes no change in milk production compared to conventional milking.
See Salfer et. al. for other assumptions and more detail.



Source: Salfer et. al. 2017.

Getting rid of the headache of managing employees in an operation that so critically requires consistent and reliable workers is one of the most frequently discussed motivations of farmers. There may be additional stress associated with the additional maintenance of AMS, but the tradeoff is one that many dairy producers willingly accept.

Quality of life is a major motivation of small to medium sized producers, and while it may not mean remotely managing a farm from a smartphone on the beach, it could mean the ability to attend family events and even take the occasional weekend getaway. Many family farms find it challenging to entice the next generation to take over the farm. Incorporating AMS can be a step toward modernizing and appealing to the next generation with new technology and more data.

Larger operations with 1000+ cows are typically more focused on the financial and economic benefits of robotics. These operations can see significant reduction in labor costs and other efficiency benefits which can help offset the high capital cost of a larger scale operation.

Although there are many intangible benefits and quality of life advantages to robotics, there is still not a clear-cut financial advantage across the industry. This will prevent a major wave of adoption of robotics, but as labor challenges mount and technology improves, the tradeoffs will increasingly tilt in favor of robotics.

Uncertainty Remains

One of the key uncertainties that remains with AMS is the useful economic life of the units. Useful life estimates range from 7-15 years. A study from the University of Minnesota Extension found that an assumption of 13 years or longer was needed to have a consistently positive net financial impact.[5] (*See Exhibit 2.*)

A related uncertainty is the residual value and second-hand market for AMS units. While there have been some reports of second-hand transactions, they are rare so far in the U.S. Europe, meanwhile, has a comparatively more robust market for pre-owned robots which make up approximately 15 percent of installations. Lely has established a "Taurus" program through which they refurbish and certify pre-owned AMS systems which have often been traded-in for an upgrade.[6]

AMS systems typically lose about 25 percent of their value after the first year, but year-old units are extremely rare. More commonly, second-hand units appear on the market 5-7 years after the original purchase and sell for around half of the original value. After the initial drop of 25 percent, depreciation is generally a straight line age-life depreciation until a new model is released, at which point there is another drop of around 25 percent.

As with many advanced technologies in the early stages, it can be tempting to wait a few years to see if the technology makes significant advancements or if prices come down. Prices so far have remained relatively stable, though the technologies have improved. High research and development costs per unit will likely hold prices in a fairly stable range while the technology advances.

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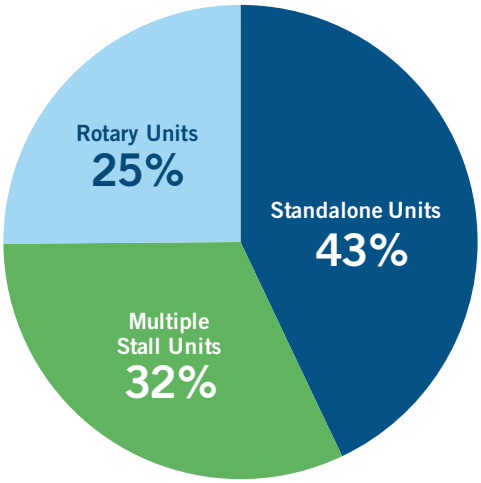
Exhibit 3: Global Share of Milking Robots by Type



Source: Business Wire

How AMS Will Change the Industry

The fact that AMS are attractive mostly to smaller and medium sized farms will limit their growth. As the industry consolidates, more of the milk supply in the U.S. is produced by large farms, which are adopting AMS at a much slower rate. However, AMS technology manufacturers are increasingly focusing on scalability and incorporating robotic elements into conventional large-scale milking infrastructure like rotary parlors.

In the absence of AMS technology, dairy farms would likely consolidate at a much faster rate. AMS technology is enabling many farms to continue operating and could entice the next generation to remain farming.

AMS eliminate the need for some farm labor, but develop opportunities for more specialized labor. Additionally, the new jobs are created for the sales, distribution and maintenance of AMS units. An increase in job opportunities for farm workers, combined with tighter immigration policy, could accelerate the adoption of AMS systems and the related labor shift.

Box-style AMS and multiple stall units still make up the largest share of robot installations. However, robotic components incorporated into rotary milking parlors will likely grow in popularity and help drive adoption of robotics into larger-scale operations.[7] (*See Exhibit 3.*) Meanwhile, broader adoption over time will open new opportunities to further develop a secondhand market for pre-owned AMS units.

Adoption of AMS and other robotic technology on dairy farms will continue to grow. While adoption may not be a financial home-run for every operation, many farms view adoption as a means to eliminate a number of labor and quality of life pressures which otherwise could lead to closing the operation. This trend will likely support a continued diverse base of milk producers across the country in the years to come and could be a factor in attracting the next generation to take over family operations. ■

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Sources:

[1]*Mulvany, Lydia. "Thanks to Trump, More U.S. Milk Will Be Coming From Robots." Bloomberg, January 30, 2018.*

[2]*Haan, Matthew, Diana Stuart, and Becky Schewe. "Challenges and Benefits of Adopting Robotic Milking on Michigan Dairy Farms." Michigan State University. 2012. https://msu.edu/~mdr/vol17no3/challenges.html (accessed January 5, 2018).*

[3]*Maxiner, Ed. "Worker Scarcity Prompts Rally in Robotic Milking." Agri-Pulse, 2018.*

[4]*Schulte, Kristen, and Larry Tranel. The Economics of Automatic Milking Systems. Iowa State University Extension, 2013.*

[5]*Salfer, J. A., K. Minegishi, W. Lazarus, E. Berning, and M. I. Endres. "Finances and Returns for Robotic Dairies." Journal of Dairy Science, 2017: 7739-7749.*

[6]*Mark, Oliver. "Top tips for buying a used milking robot." Farmers Weekly, June 23, 2015.*

[7]*Global Demand for Milking Robots, 2016. Business Wire, 2017.*

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