Robotic Milking Systems

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A Deal or No Deal For a Dairy?

IOWA STATE UNIVERSITY
Extension and Outreach

No Endorsement of Product Intended

How Do You Best Evaluate Technology?

How Do You Best Evaluate a New Technology for Your Farm?

Cash Flow-Ability	=	-$50,000 to +$20,000
Net Financial Impact	=	-$25,000 to +$35,000
Quality of Life	=	+$10,000 to +$25,000
Cash Flow-Ability	vs	Net Financial Impact & QofL
-$50,000	vs	+$25,000 + $25,000

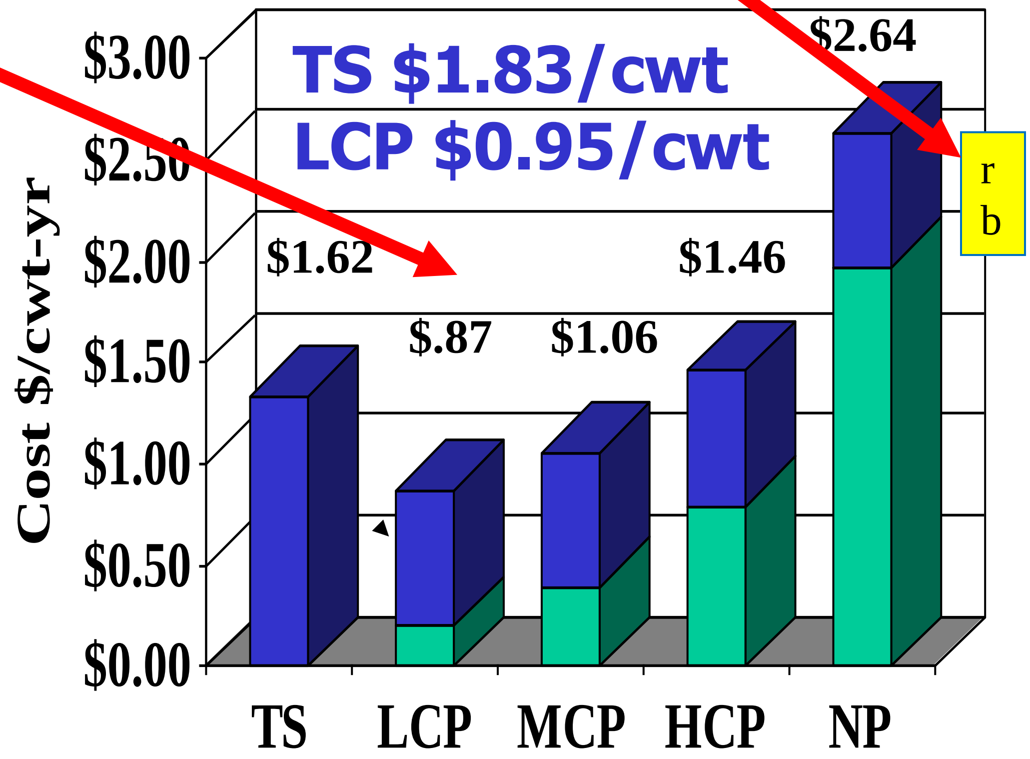
How do make the decision to put in a Robotic Milking System for 140 cows

Parlor Annual Capital and Labor Costs

120 cows 18,000 # $10/hr labor

- Tie Stall
  - $35,040/year labor
- Low Cost Remodeled Parlor
  - $25,000-capital ($4,250 annual)
  - $14,600/year labor
- Medium Cost Remodeled Parlor
  - $50,000-capital ($8,500 annual)
  - $14,600/year labor
- High Cost Remodeled Parlor
  - $100,000-capital ($17,000 annual)
  - $14,600/year labor
- New Parlor
  - $250,000 ($42,500 annual)
  - $14,600/year labor

Robot - $59,600 annual; Labor $9,855
= **Range = $1.77- $2.06 (10%^)**
(labor cost = $0.35/cwt)




GEA


LELY
LELY ASTRONAUT
www.lely.com


INSENTEC
Galaxy-Starline


DeLaval

Robot Types

Boumatic, GM Liberty, Fullwood, SAC

Robot Types II

Robot Growth

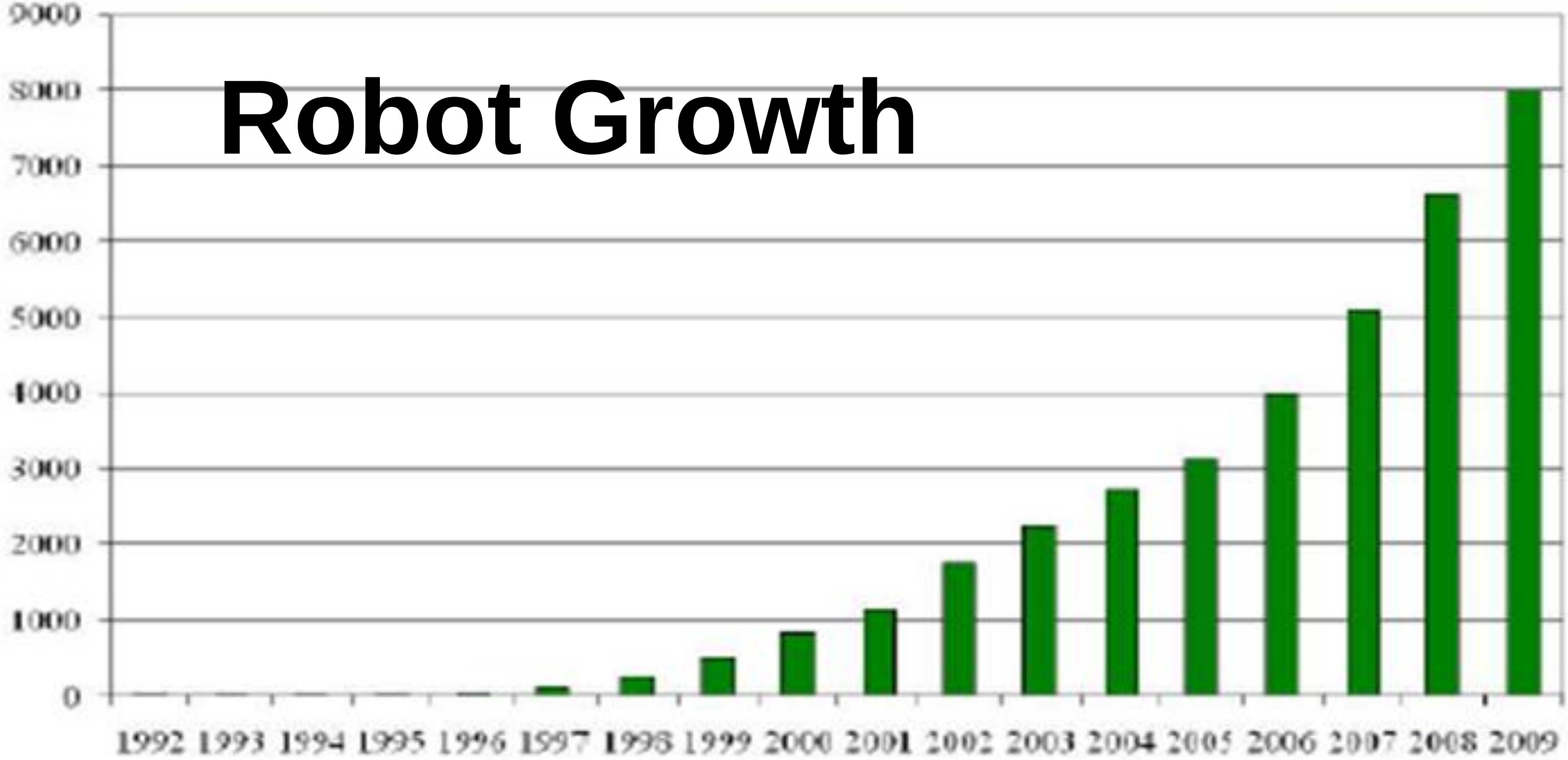


Figure 1. Development of the number of AM-farms world-wide since first introduction in 1992.

(Koning 2010)

Automatic milking systems

- > 11,000 units world-wide (2010) 14,000 now – 27% ^
- New concept integrating voluntary milking of individual cows with the automation of all steps of the milking process

Cleaning

Attachment

Milking

Disinfection

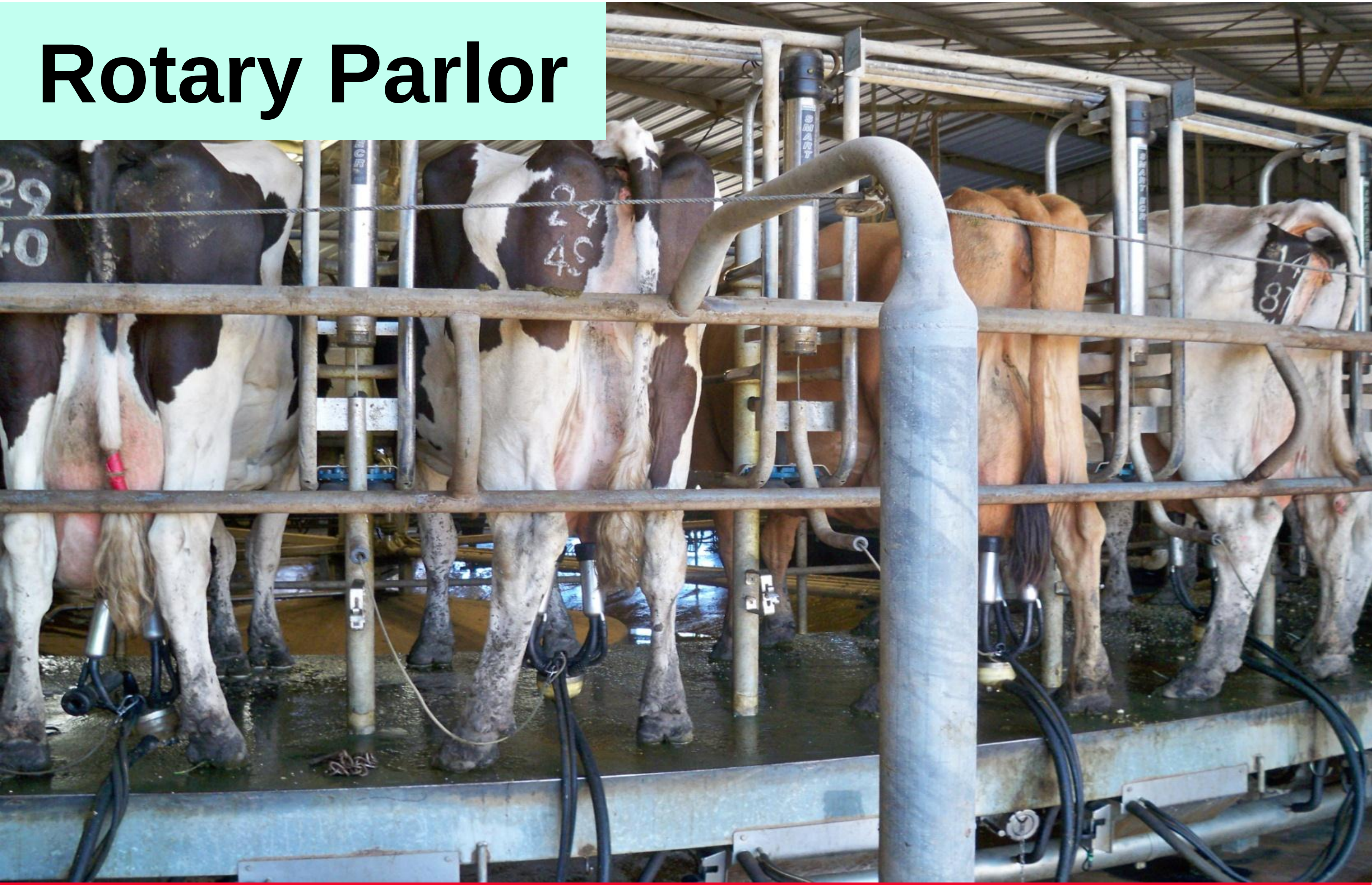
AMS Operation

Rotary Parlor

Manual Milking
Post Dip Arm
Pre-Dip Arm
Attach Arm
2 by 2
Invest in Stages?

24 Bale Rotary Parlor with Robots Attaching (up to 5)

Rotary Parlor



Australia: Lady milked 903 cows solo in 6 hrs

Herd and Financial Assumptions		Units	Instructions or Reference Value
Herd Size	140	no. cows	Enter herd size, lactating and dry
Milk Price	$17.00	$ per cwt milk	Typical range $13.00 - $19.00 / cwt
Estimated Cost per Robot	$210,000	$ per robot	Include building cost for housing robots
Estimated Annual Change in Milking System Repa	$10,600	$ per farm	Typical range from $5,000 - $9,000/robot
Number of Robots Needed	2	no. robots	Typical range of 55-65 milking cows/robo
Years of Useful Life	10	years	Typical rage is 7 -12 years
Value per Robot after Useful Life	$40,000	$ per robot	Typical range of 10-20% of purchase price
Interest Rate of Money	5.50	% interest rate	Value of own or borrowed money
Insurance Rate per $1,000 Value	0.50	%	Typical rate is 0.5% per 1,000 investment
Increased Insurance Value of Robot vs. Current	$350,000	$ per farm	Value of robot(s) over current system

Labor Changes

Current Hours of Milking Labor	6.5	hours per day	Include set-up and cleanup
Anticipated Hours of Milking Labor	1.5	hours per day	Include fetching cows and cleanup
Current Hours of Heat Detection	0.5	hours per day	Typical is 0.25 - .75 hours
Anticipated Hours of Heat Detection	0	hours per day	Typical is 0 - 0.5 hours
Labor Rate for Milking and Heat Detection	$15.00	$ per hour	Typical rate is $10 - $18 with benefits
Increased Hours for Records Management	0.25	hours per day	Include AMS management records
Reduced Hours for Labor Management	0.5	hours per day	Include hiring, training, overseeing, etc.
Labor Rate for Records and Labor Management	$20.00	$ per hour	Typical rate of $12 - $25

Milk Production and Quality Changes

Lbs of Milk per Cow per Day, Past Year	70	lbs/cow/day	Typcial range of 50 - 90 lbs
Projected Change in Milk Production	7	lbs/cow/day	Typical 3-15% more 2x; 0-9% less 3x
SCC Premium per 1,000 SCC Change	$0.003	$ per cwt	Typically $0.002 - $0.004/cwt
Current Annual Bulk Tank Average SCC	240,000	SCC per ml	Typical range of 100,000 - 400,000 SCC
Estimated Percent Change in SCC	-5.0	%	Typical range of -10 to +2%
Feed Costs and Intake Changes			
Lbs of TMR Dry Matter (DM) per lb of Milk	0.65	lb DM/lb Milk	Typical range of 0.55 - 0.8
Cost per lb of TMR Dry Matter	$0.105	$ per lb DM	Typical range of $0.8 - $0.14 in 2011
Estimated Change in cost/lb Dry Matter	-$0.001	$ per lb DM	Typical range of -$0.003 to +$0.003

Culling and Herd Replacement Changes

Cost of Replacement Heifer	$1,600	$ per heifer	Typical range of $1,300 - $2,200
Cull Price per Cow (or sold for milking purposes)	$850	$ per cow	Typcial range of $350 - $1,200
Expected Change in Annual Turnover Rate	-1	%	Typical change has been very small

Utilities and Supply Changes for Milking

Anticipated Change in Electricity cost	$8.25	$/cow/year	Typical increase of 0 - 150 kWh
Anticipated Change in Water cost	-$3.00	$/cow/year	Typical range of -$5 to +$5
Anticipated Change in Chemicals Cost	$1.50	$/cow/year	Typical range of -$2 to +$2

The authors have used their best judgement and shall not be liable for any use of this software decision-making aid.

Partial Budget Summary

Positive Impacts

Increased Incomes	
Increased Milk Production	$54,978
Increased Milk Premiums	$1,281
Increased Cull Cow Sales	-$1,190
Total Increased Incomes	**$55,069**

Decreased Expenses	
Reduced Heat Detection	$2,738
Reduced Labor	$27,375
Reduced Labor Management	$3,650
Total Decreased Expenses	**$33,763**

Total Positive Impacts	**$88,831**
Annual Value to Quality of Life =	**$10,000**
Annual Value of Herd Software =	**$3,000**

ISU Extension DAIRY TEAM

Negative Impacts

Increased Expenses	
Capital Recovery Cost of Robots (Dep & Int	$57,100
Increased Repair and Insurance Costs	$12,350
Increased Feed Costs	$19,760
Increased Cow Replacement Costs	-$2,240
Increased Utilities and Supplies	$945
Increased Records Management	$1,825
Total Increased Expenses	**$89,740**

Decreased Incomes Expected	
Total Decreased Incomes	**$0**

Total Negative Impacts	**$89,740**
NET ANNUAL FINANCIAL IMPACT =	**-$909**
with Quality of Life and Herd Software =	**$12,091**

Increase Value by 10 Percent		$ Change
Herd Size MP	➡	$3,661
Milk Price	➡	$5,498
Cost per AMS	➡	-$6,510
Change in Repair Cost	➡	-$1,060
Years of Life	➡	$3,091
Resale Value of AMS		$800
Interest Rate	➡	-$2,310
Insurance Rate/$1,000 Value		-$175
Increased Insurance Value		-$175
Current Hours of Milking Labor	➡	$3,559
Anticipated Hours of Milking Labor		-$821
Current Hours of Heat Detection		$274
Rate for Milking/Heat Detection	➡	$3,012
Increased Hours Records Mgt		-$182
Reduced Hours Labor Mgt		$365
Rate for Records/Labor Mgt		$183

Increase Value +10%	$ Change	% Change
Current Bulk Tank Average		$327
Projected Change in Milk Production	➡	$3,324
SCC Premium/1,000 SCC Change		$128
Current Bulk Tank SCC		$128
Estimated Percent Change in SCC*		$128
Lbs TMR Dry Matter/lb of Milk	➡	-$1,976
Cost/lb of TMR Dry Matter	➡	-$2,207
Change in cost/lb TMR Dry Matter*		$232
Cost of Replacement Heifer		$224
Cull Price per Cow		-$119
Change in Annual Turnover Rate*		$105
Change in Electricity cost		-$115
Change in Water cost*		$42
Change in Chemicals Cost		-$21

➡ > $1,000

Variable Sensitivity

AMS Loan Amortization 2 Robots

7	Years of Loan	Annual Interest	Principal Amount
12	Annual Payment(s)	Rate 5.50%	$400,000
84	Total Payments		

First Month	Interest	Prinicpal	Total Payment
Payment	$1,833	$3,915	$5,748

First Year	Interest	Prinicpal	Total Payment
Payment	$22,000	$46,976	$68,976

Net Cash Flow Analysis

				Totals
Net Annual Financial Impact from Partial Budget Analysis				**-$909**
Capital Recovery Cost of Robots			$57,100	
Annual Payment on Robot Investment			$68,976	
Cash Flow Difference of Capital Recovery vs Annual Payment				**-$11,876**
Cash Flow Adjustment for Unpaid Labor and Management				
Heat Detection & Milking Labor Saved			$30,113	
		Amount Hired	$20,000	**-$10,113**
Labor & Records Mgt Changes			$1,825	
		Amount Hired	$0	**-$1,825**
		Total Change in AMS Cash Flow		**-$24,722**

Pasture or Confinement

Transitioning to pastures

Putting The Pieces Together

- Reliance on equipment, buildings & facilities
- High feed cost/cow
- High production/cow

- Fewer cows per robot (60/robot)
- High milking frequency (> 3)
- High yield/milking (> 22 lb)

- **Optimize the occupation time per robot**
- **Maximize the milk flow per robot**

- Reliance on land use
- Low feed cost/cow
- High production/acre
- Lower production/cow

- More cows per robot (> 60/robot)
- Low milking frequency (< 3/d)
- Low yield/milking (< 22 lb)

Efficient year-around Automatic Milking requires strategic management plans to optimize voluntary milkings and milk flow per robot along the year

MICHIGAN STATE UNIVERSITY

The Kellogg Biological Station's Pasture & AMS Dairy

A research project on pasture-based dairy systems addressing current and future issues of profit, labor, land use and environmental impacts.

MICHIGAN STATE UNIVERSITY

The Kellogg Biological Station's Pasture & AMS Dairy

Gating Systems

The Lely Producer Survey

Lely Survey: 104 sent, 57 responses

Milk Yield

Milk Yield improved 6.3% over all herds

Milk Yield improved 11% for 2x herds w/o BST
Age and Type of barn did not have a significant impact

Reproduction and Longetivity:

Average days to first breeding: - 4 days
Average days to conception: -6 days
Calving Interval: -7 days

Cull Rates: No significant difference

--Farms with high cull rates significantly improved 1st yr.
--Cull rate for fertility and udder health decreased -6%, -5%

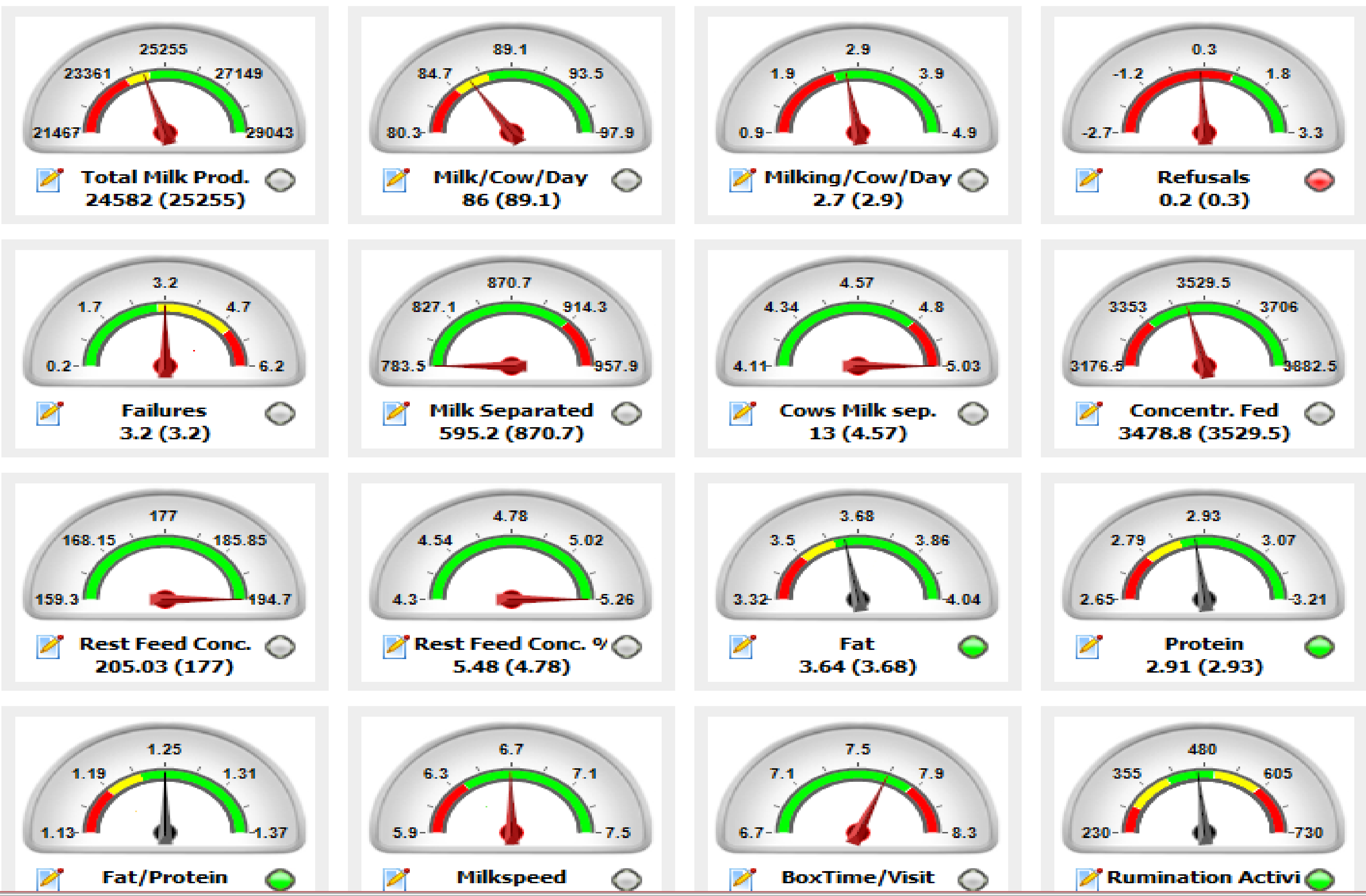
--Cull rate for slow milking and teat placement increased +4.1%, 6.5%

The Lely Producer Survey

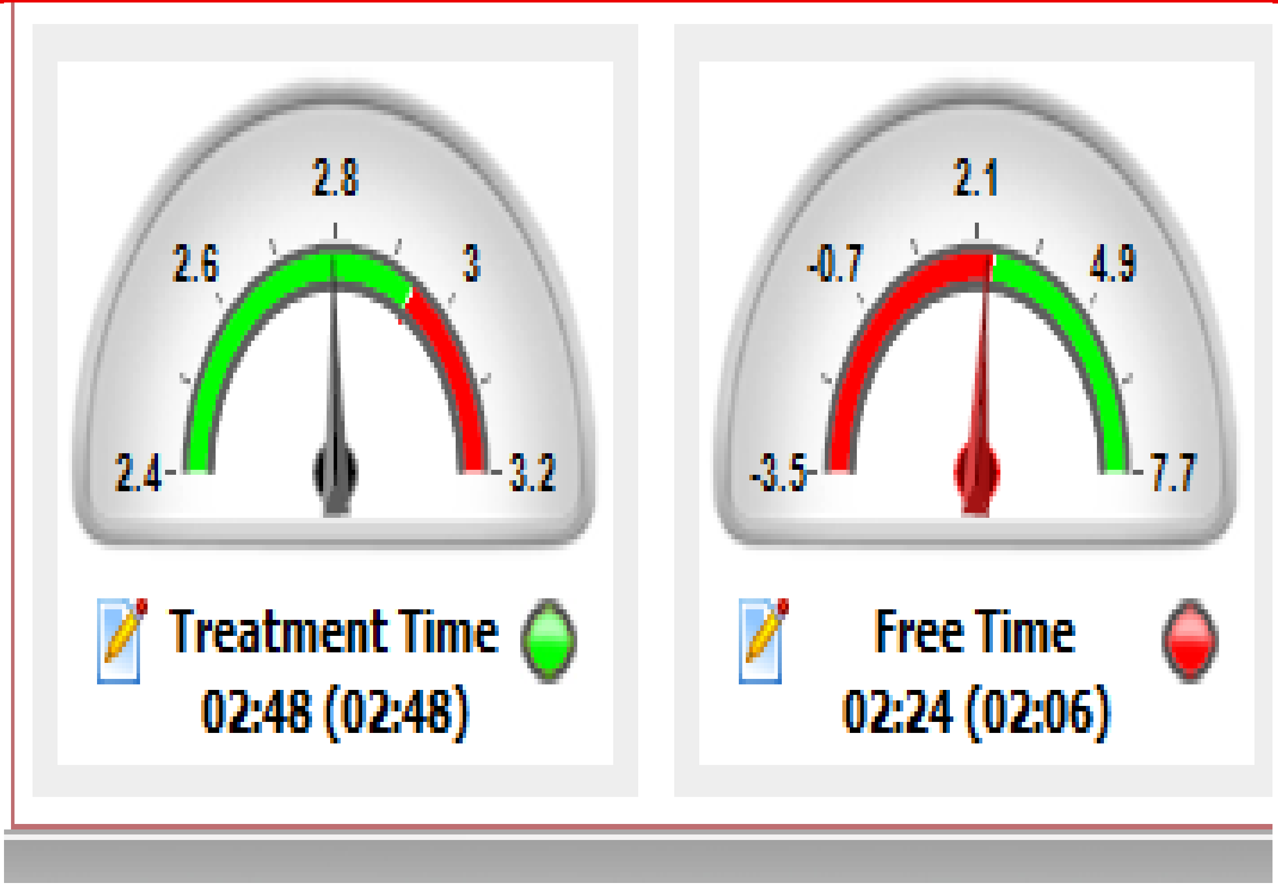
Other Significant Management Aspects Post AMS

Higher cow density showed an increase in SCC
Lower bunk space per cow showed an increase in SCC
Higher cow density showed more days open until 1st service

AMS sensors and information tools allow producers to be pro-active and to solve cow health problems before they become visible in the barn,



The Dashboard



To Get 5,000 – 6,000 pounds per robot daily
Need to continually look for ways to reduce free time

Optimize Robot Time

Robotic Milking Facts

For dairy herds in the 60-240 cow range, AMS may be competitive economically where labor costs or hired labor availability or frustrations are high.

Robots sold in 2000 are still supported and working effectively.

AMS systems can be “free flow” with unimpeded access or “guided flow” with one way gates to guide cows.

Robotic Milking Facts

AMS range from 140-190 milkings per 24 hour period or 2.4-3.0 milkings per cow/day. (Salfer)

AMS range from 4,000 – 5,500 pounds of milk/RMS/day (Salfer)

The AMS software assists in heat detection, rumination, scc levels, milk weights and individual grain feeding. These abilities need consideration for cost-benefit analysis.

They cannot discard milk from individual quarters.

Robotic Milking Facts

AMS have been successful in freestall, bedded pack and grazing operations.

Water and chemical use tends to be less than parlors, electricity higher but maybe related to increased electrical rates more than increased useage. (Rodenburg)

There may be increases in milk production (3 lbs per cow per day). With good management, expect production 3 to 5% higher than 2x parlor milking, but 6-9% lower than 3x milking.

(one IA producer went from around 60 pounds/cow/day to 86 pounds per cow/day or 43%^)

Equal or improved somatic cell counts, herd health and reproduction with increased management ability.

Considerations for increased AMS Effectiveness: (Salfer, 2011)

Many factors must be considered in barn design. Since cows need to be coerced into milking, anything that makes visiting the AMS easier will improve performance.

Here are some considerations in barn design:
Consider systems that minimize time interacting with cows in the pens. Most producers install automatic scrapers or slats to eliminate having to go in the pen to scrape.

Producers that did scrape manure indicated that it took very little extra time to scrape alleys compared to when they milked in a parlor.

Considerations for increased AMS Effectiveness: (Salfer, 2011)

Provide wide alleys and crossovers to facilitate easy cow movement within the pens.

Highly visible well lit areas around the robot are preferred. Providing amenities such as water near the entrance to the AMS are important to encourage cows to visit that area.

One producer has extra fans to provide cooling in the holding pen for the AMS.

The area around the robot needs to have an open feel with adequate space for cow movement, a holding area for fetch cows and an exit alley for submissive cows to leave the robot with being intimidated by boss cows.

Guarded Exit Area

Considerations for increased AMS Effectiveness: (Salfer, 2011)

Provide a large open area around the entrance to the AMS unit. This allows multiple cows to stand in the area and enter the AMS as other cows exit.

Provide protection at the exit of the milking unit. This prevents dominant cows from intimidating submissive cows as they exit the AMS.

Considerations for increased AMS Effectiveness: (Salfer, 2011)

Do not move cows between pens. This requires social adjustment and cows will decrease visits after moving.

Consider designing a barn where all robots are positioned so the cows enter them on their left or right side. Another alternative is to have both right and left entrance robots in the same pen.

One study showed that 10% of cows had a difficult time adjusting to entering on the opposite side entry (Rodenburg, 2007).

Nutrition and Feeding Management

(Feeding Strategies to Promote Good Cow Flow)

One of the most important factors in making AMS successful is ration balancing/nutrition management. **Cows are enticed to visit RMS because of feed, not because of udder pressure.** Feed presented in the RMS must be very palatable so that cows want to visit the robot.

A survey of 25 AMS herds in North America indicated that they fed an average of 65% forage in the diet.

Preliminary results indicate that most producers are feeding a minimum of 4 lb/cow/day to a maximum of about 19 lbs/cow/day through the AMS.

Nutrition and Feeding Management

When producers and nutritionists were surveyed regarding the key factors to getting good cow flow, all mentioned feeding a pelleted, highly palatable feed in AMS and limiting energy in the PMR. Many producers also mentioned feeding strategies that promoted cows to stay active also promoted good cow flow.

Methods that producers tried to accomplish this varied and included: feeding the PMR multiple times per day or pushing up on a regular basis, feeding for low refusals, keeping feeding times and forages consistent, feeding excellent quality forages and cleaning bunks on a regular basis. (Salfer, 2011)

AMS Challenges

Balancing the palatable pellet and the energy density of the PMR to promote both cow flow and milk production.

Lame or sick cows (including sub-acute rumen acidosis) do not visit the AMS.

Disruptions due to manure scraping, herd health checks, hoof trimming, etc. affect throughput.

Long udder hair, reverse tilted udders, touchy teats, dancing cows can delay attachment times.

AMS Challenges

Initially training cows to AMS can take 3 weeks to 3 months and would not be classified as a pleasant experience.

AMS can cost over $4,000 per cow just for the AMS unit so new setups could invest over $10,000 per cow.

Cash flow due to high investment and possibly high repairs after warranties expire can present challenges.

Maintenance costs and repairs—producers learn to make minor repairs. Parts of most concern are hydraulic arms and lasers after warranty because of their high replacement costs.

Rather than milking 2x or 3x, manager is on call 24-7.

People adapting is taking longer- accepting the fact that the robot is really doing it!

"different kind of work"

Mark and Sandra Erhardt, Monona, IA

Spend more time analyzing "Key Performance Indicators"

Learning how to interpret the reports daily, sometimes hourly;

Computer gives lots of data-have to be able to analyze it

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