Economics of Robotic Milking Systems

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No Endorsement of Product Intended

A Dairy Specialist's Vision of DC

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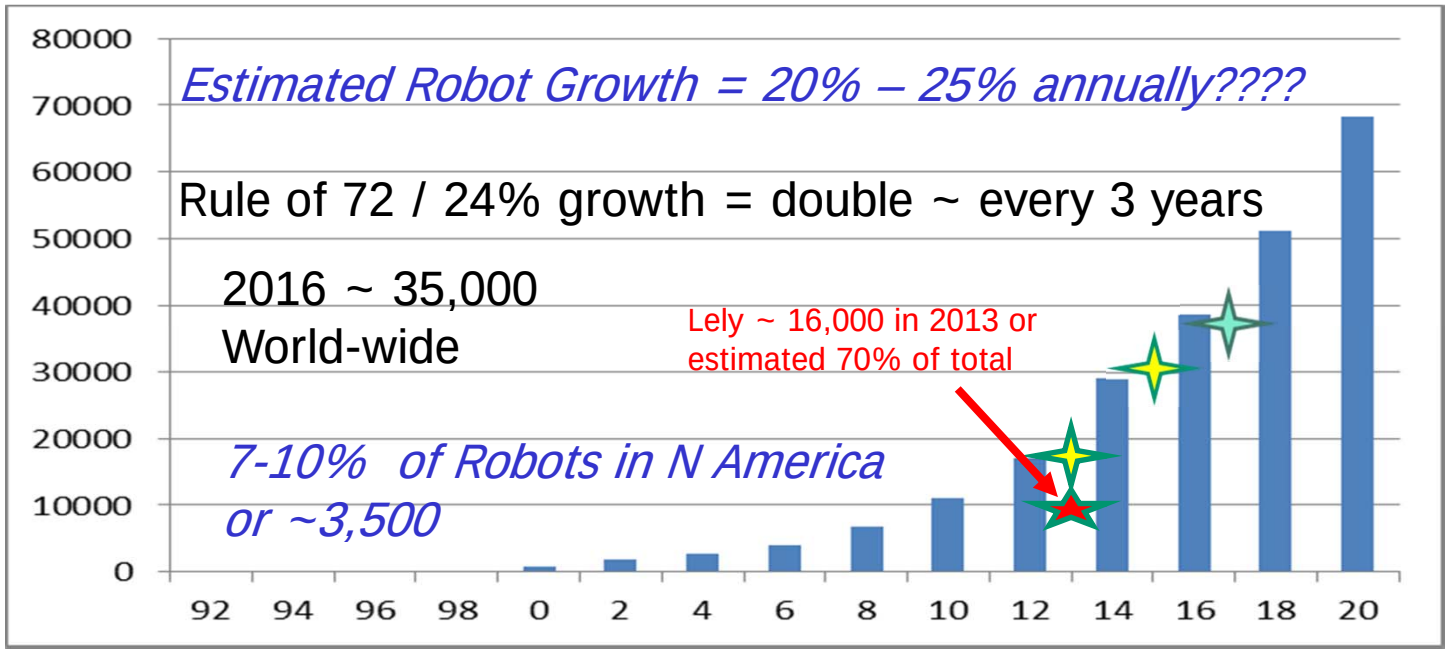
Milking robots are here to stay!

North American Data

- **>2500 AMS units**
- **>1000 farms**
- **>140,000 cows**
- **>381,000 milkings/day**
- **Avg 2.5 AMS units/farm**

Rodriguez, DeLaval, 2014
Jim Salfer, U Minn

End 2017 Estimated 40-43K Robots Worldwide



WI ~ 320; IA ~ 130 (46 farms); IL ~ 70 (26 farms)

3.5% - 5% of Farms in Midwest

Evaluating Robots Financially?

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 & Q of L

-$50,000 vs +$25,000 + $25,000

Evaluating Technology on the Farm

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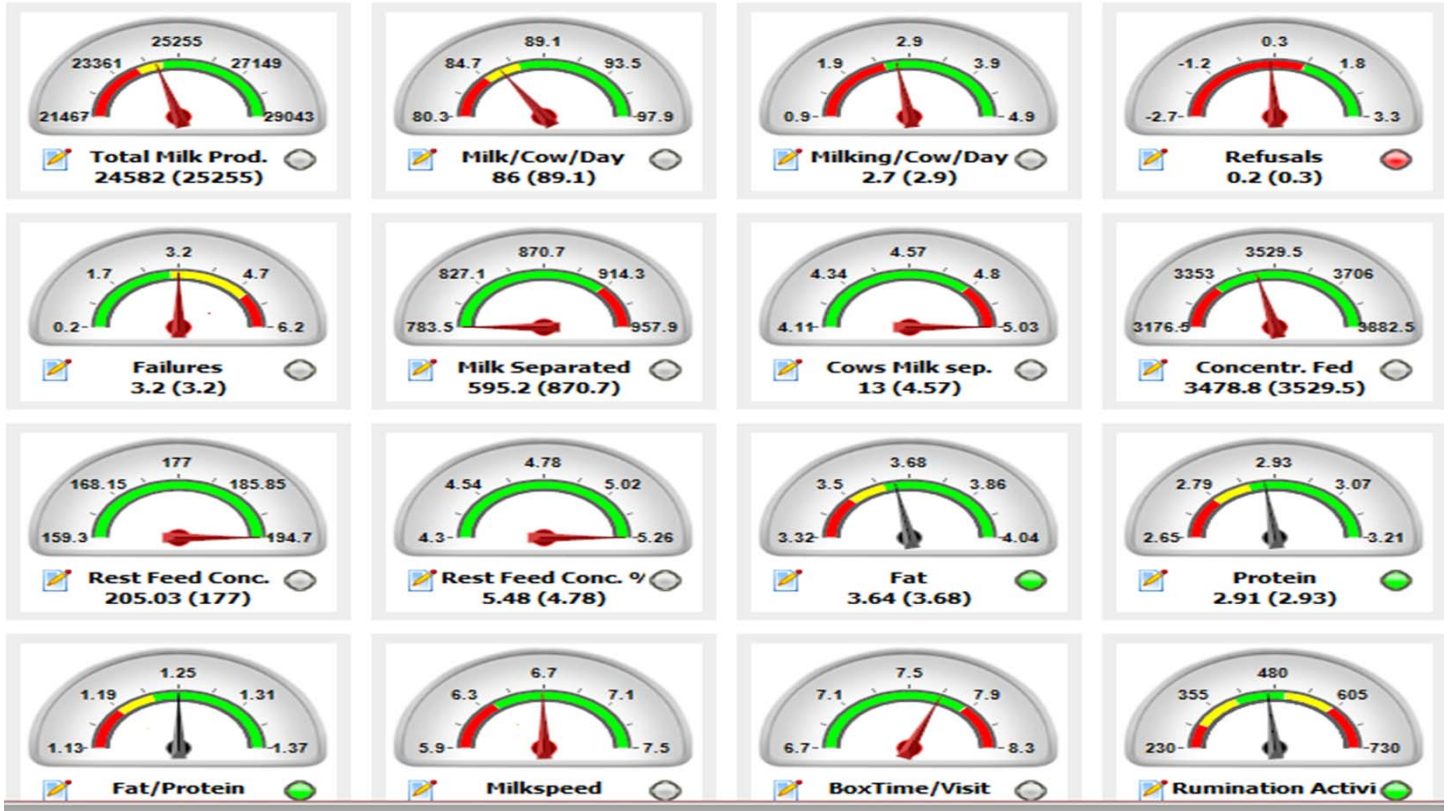
Why Invest in Robotic Milking—Even on Large Farms?

- Milking Is Labor intensive: (typically **40-50%** of total labor costs)
- Labor: **20-30%** Of Total Dairy expense
- Large parlor: **2—6 skilled workers, 3 shifts per day**
- Finding qualified workers 365/24/7: **Expensive, difficult**
- Managing labor is expensive and often frustrating
- Milking is a very repetitive task
- Milking requires very little decision making
- Cows thrive on consistency and predictability

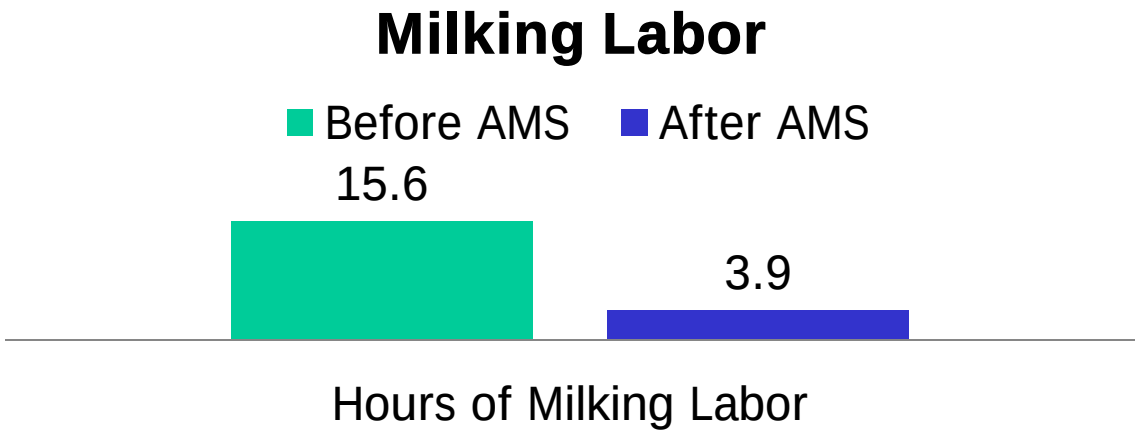
And, it provides data, 100 measurements/milking

Salfer, U of Minn

Robots Provide Data for Higher Mgt

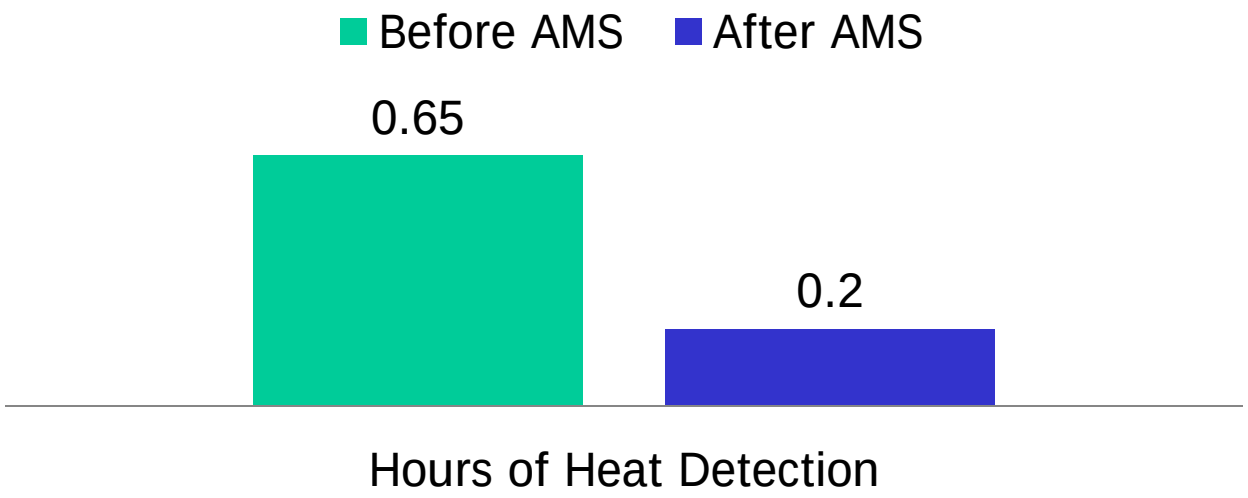


75% Decrease in Total Milking Labor



Labor is #1 Reason Producer Go Robotic!

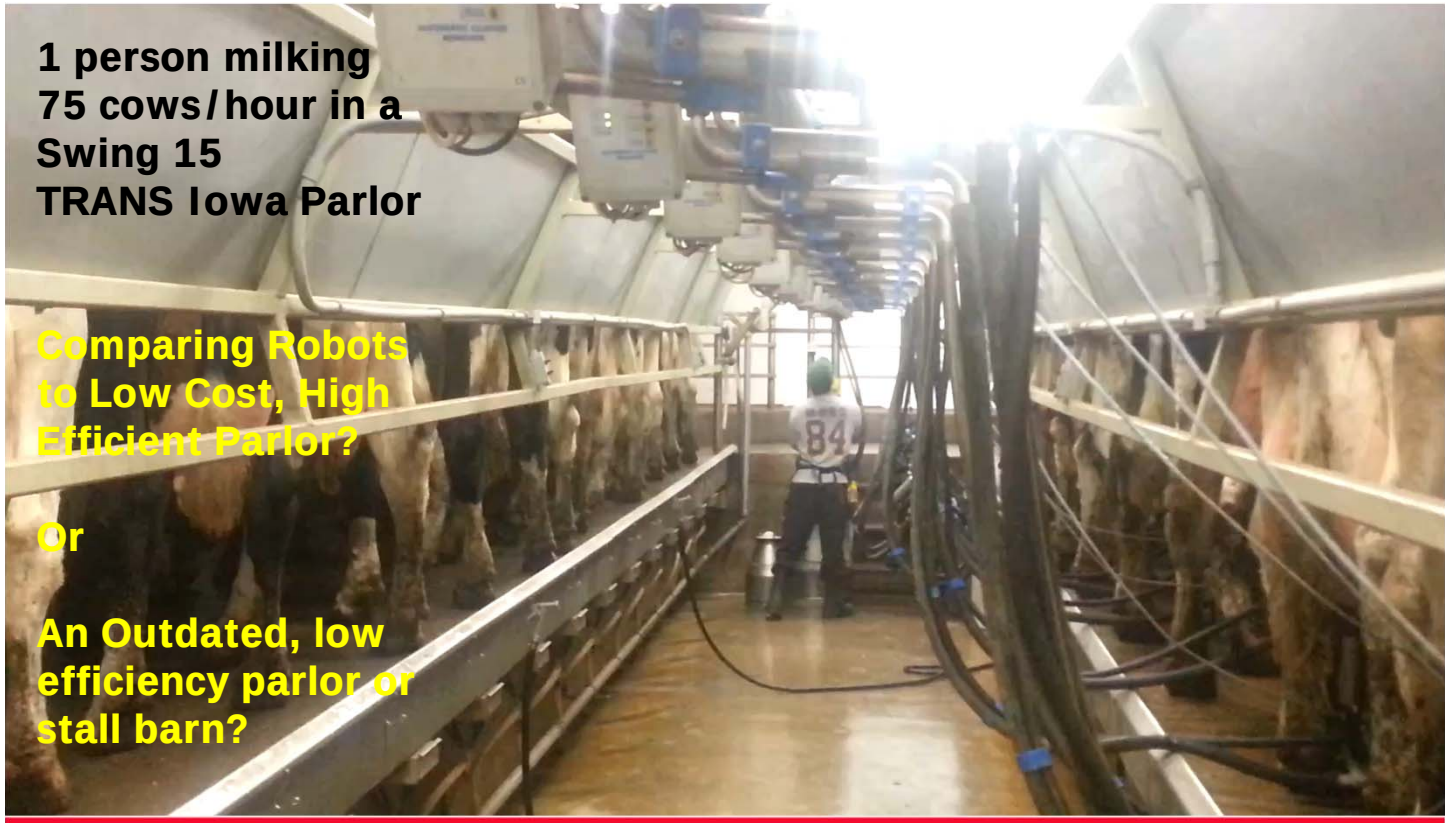
70% Decrease in Heat Detection



Labor Efficiency

- Primary goal when installing an AMS
  - Labor savings valued at $44,030/year
  - Hiring, training, and overseeing employees decreased (37 minutes/day)
  - Records Management labor increased minimally at $212 per year (37.8 minutes/day)
    - Information and records collected from AMS

Are Robots Profitable? Compared to What?

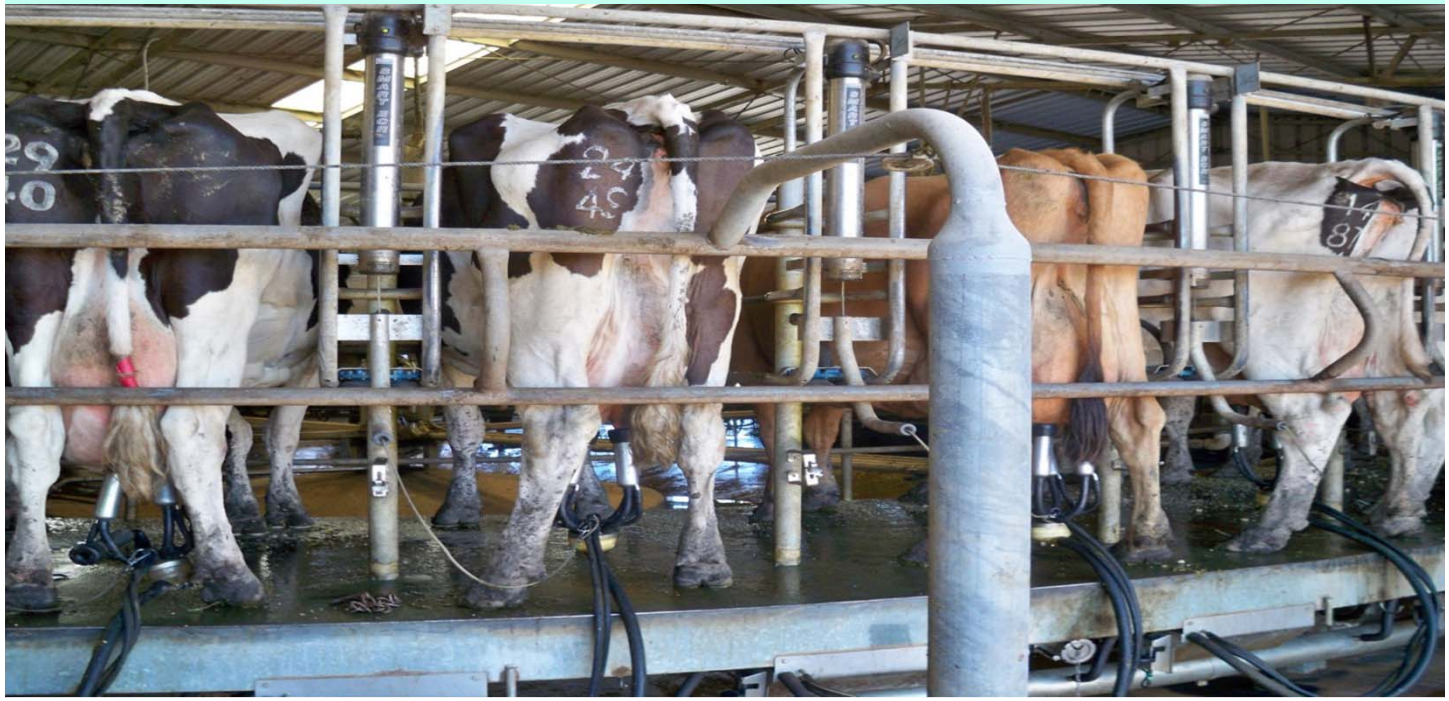


TRANS Iowa LCP vs Robotic Milking

Milking System Payback Periods

1-5 years for LCP	vs	6-15 years for AMS
64-75 cows/person/hour	vs	3,000-6,000 lbs/robot/day
<$1.00/cwt	vs	$1.75 to $3.00/cwt

Rotary Parlor with Human Robot



Australia: Lady milked 903 cows solo in 6 hrs

Herd and Financial Assumptions		Units	Instructions or Reference Value
Herd Size -- both milking and dry	144	no. of cows	Typical herd size of 66-74 cows/robot
Mailbox Milk Price	$17.50	$ per cwt.	Typical range $13.00 - $20.00 / cwt
Estimated Cost per Robot -- include robot housing	$220,000	$ per robot	Typical range of $185,000 - $230,000
Estimated Annual Change in Milking System Repa	$7,000	$ per robot	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 - 15 years
Value per Robot after Useful Life	$40,000	$ per robot	Typical range of 10-30% 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	$400,000	$ 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, Herd Health, Reproduction and Milk 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 5-15% more if 2x; 0-10% less if 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%
Reproduction and Herd Health Value of Software	$35.00	$ per cow/year	Estimated range of $20 - $60 per cow/yr
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	$0.125	$ per lb DM	Typical range of $0.8 - $0.15
Estimated Change in cost/lb Dry Matter	-$0.002	$ per lb DM	Typical range of -$0.005 to +$0.005

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)	$750	$ 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

Positive Impacts

Increased Incomes	
Increased Milk Production	$58,212
Increased Milk Premiums	$1,317
Increased Cull Cow Sales	-$1,080
Software Value to Herd Production	$5,040
Total Increased Incomes	$63,489

Decreased Expenses	
Reduced Heat Detection Labor	$2,190
Reduced Milking Labor	$32,850
Reduced Labor Management	$3,942
Total Decreased Expenses	$38,982

Total Positive Impacts	**$102,471**
Annual Value to Quality of Life =	**$9,000**

ISU Extension DAIRY TEAM

Negative Impacts

Increased Expenses	
Capital Recovery Cost of Robots (Dep & Int	$60,200
Increased Repair and Insurance Costs	$16,000
Increased Feed Costs	$22,270
Increased Cow Replacement Costs	-$2,304
Increased Utilities and Supplies	$972
Increased Records Management	$3,942
Total Increased Expenses	$101,080

Decreased Incomes Expected	
Total Decreased Incomes	$0

Total Negative Impacts	**$101,080**
NET ANNUAL FINANCIAL IMPACT =	**$1,391**
with Annual Value of Quality of Life =	**$10,391**

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AMS Loan Amortization for 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

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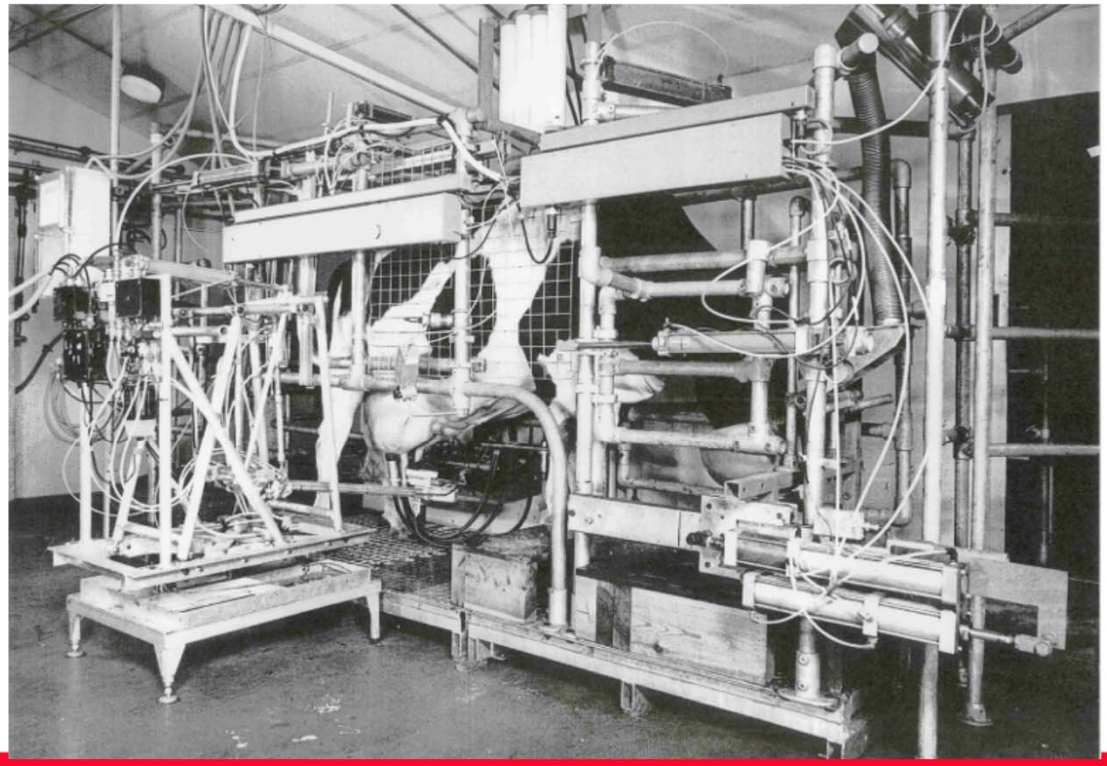
Net Cash Flow Analysis of AMS

			Totals
Net Annual Financial Impact from Partial Budget Analysis			**$1,391**
	Capital Recovery Cost of Robots	$60,200	
	Annual Payment on Robot Investment	$68,976	
Cash Flow Difference of Capital Recovery vs Annual Payment			**-$8,776**
Cash Flow Adjustment for Unpaid Labor and Management			
	Heat Detection & Milking Labor Saved	$35,040	
	Amount Hired	**$20,000**	**-$15,040**
	Labor & Records Mgt Changes	$0	
	Amount Hired	**$0**	**$0**
	Total Change in AMS Cash Flow		**-$22,425**

Where are You in Dairy Career?

First Robotic Milker (1981)



Robotic Milking Continues to Evolve……

Box systems

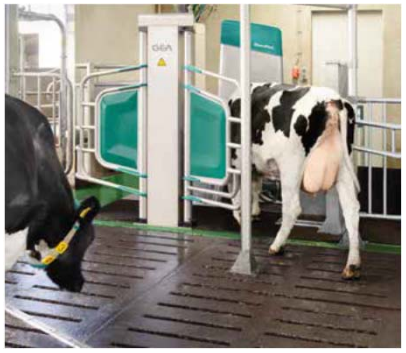
- Lely
- DeLaval
- GEA Farm Technologies
- AMS-Galaxy
- BouMatic Robotics

Parlor systems

- GEA Farm Technologies (Apollo Post Dip, Dairy Pro Q)
- DeLaval
- MiRobot
- BouMatic Robotics

Lely—Astronaut, A4, straight entry

DeLaval-VMS, side entry



GEA Dairy Pro Q Mono Box

Robot Types

Multi-Box Systems

~~GEA—M1~~

Insentec--Astrea

Boumatic-MR-S1, D2

Laproma Farm-Germany

”Batch milking”
Involuntary ”
cow traffic
with AMR™

Slide compliments
Mark Futcher, DeLaval

Dairy Pro Q Rotary Milking Parlor @ $70,000 per stall

1 person milking 400 cows per person/hour

Robotic Milking Continues to Evolve……

Robot performs **all pre—and post---milking activities**

- **One** operator
- For **new + existing stalls:** utilizes existing infrastructure
- **Portable Control unit:** Remote control/supervision
- Small, flexible, **cow---friendly?**
- Target user price: **$12,500** Per Stall (3 yr payback?)

Slide

MiRobot version 1.0 under cow model

Summary

- ***Labor is KEY Reason to install Robotic Milking!*** *Studies have shown AMS tend to be less profitable than parlors (Salfer) or other milking systems but dependent on variables:*

1) **Milk Production change** (MN=+9.3% AMS 23,532 vs 21,528 Parlor); (IA=12%)
   - > 5 lbs Retrofit (7% of 72 pound average)
   - >10 lbs new construction (14% of 72 pound average)
   - 3-5% gain to robot; 6-10% gain to new construction
2) **Labor Wages** (and future wage inflation)
3) **Labor Savings** for milking (~75%)
4) **Labor Efficiency** (2.2 mil/lbs/milk vs 1.5 mil/lbs/milk/FTE)
5) **Years of Useful Life** (10-13 years)
6) **Annual Repairs** (new range of $7,000-$15,000) *what's included?*