Is Robotic Milking Right for You?

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New Seat Belt law
This becomes effective Sept 1, 2015
The National Highway Safety Council has done extensive testing on a newly designed seat belt. Results show that accidents can be reduced by as much as 95% when the belt is properly installed.
First Robot Milker (1981)

Milking robots are here to stay! – North American Data

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

Rodriguez, 2014
Why robotic/automated milking?

- Improve lifestyle
- Labor management
- Human health
- Latest technology

Why Industries Invest in Robots

- Improved product quality and consistency
- Reduce direct and overhead cost
- Improved accuracy and repeatability (cows like consistency)
- Improved quality of work for employees (higher skilled workers)
- Improved workplace health and safety (take over unpleasant, arduous or health threatening tasks)
- Reduced waste and increased yield
- Reduced turnover and recruitment difficulty
Labor on a Dairy Farm

Conventional milking
- Business management 5-10%
- Reproduction & Health 5-15%
- Feeding 10-20%
- Milk harvesting 50-60% or managing labor

Automatic milking
- Milk harvesting 5-10%
- Reproduction & Health 5-15%
- Feeding 10-20%
- Business management 50-60%

Potential AMS Advantages

Provides Data
- Milk production etc
- Over 100 measurements at every milking
- Timely decision making

Other benefits:
- Consistent milking routine
- Higher skilled labor
- Never late for work
- Never needs training
- Doesn't need scheduling or holidays off
Potential challenges

- “Plug and play,” “Plug and pray,” or “Plug and pay”
- Low Return on Investment? (compared to what?)
- Obsolescence
- Repair costs

Adapted from Bewley, 2013

Automated/Robotic Milking Systems

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

Parlor systems
- GEA Farm Technologies
- DeLaval
- MiRobot
- BouMatic Robotics

What is the right fit for me?
Single Box Systems

Multiple-Box Systems
GEA Robot for Rotary Parlors

**DairyProQ**
Fully Automated
Industrial Milking
Slide compliments Greg Larson, GEA

GEA Apollo – semi automated milking

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DeLaval Rotary Parlor

Slide compliments Mark Futcher

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Keys to success with robots

You must like working with cows

• “Management makes milk – Robots only harvest it”  Doug Kastenschmidt – Ripon WI

• Cow management must still come first
Guidelines for Efficiency

Box robots
140-190 attaches/24 hrs
2.4-3.0 milkings/cow/day

Goals for milk per robot
• 4000-4500 lbs – OK
• 4500-5000 – Good
• >5000 - Excellent

Pounds of milk per robot

Average = 4,325
Number of milkings per day

Average = 2.6

Keys to success with robots

Excellent feed management

Survey results

- Feed management ranked 1st
- Pellet palatability and quality ranked 2nd

Nutritionist that like the challenge of robots
Goal of every feeding program

1. Meet nutritional needs of cows while maintaining cow health
2. Optimizing milk and components
3. Economical
4. Labor efficient and cost effective feed delivery system

Automatic milking system feeding

Additional AMS goal:
• Entice cows to visit the milking station regularly and frequently

Accomplished through:
• Partial mixed ration (PMR) at bunk
• Additional concentrate at the milking station
• Series of selection gates in a guided flow system
Feeding to meet the farmers goals

Balancing energy in AMS vs. bunk
- high forage/low energy TMR drives cows to robot – may limit milk production
- high energy TMR – increase late lactation "lazy" cows

How much concentrate to feed through AMS
- increase risk of acidosis and lameness
- off feed problems

Daily robot concentrate

<table>
<thead>
<tr>
<th></th>
<th>Free flow</th>
<th>Guided flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average, lbs</td>
<td>11.2</td>
<td>7.9</td>
</tr>
<tr>
<td>Minimum, lbs</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Maximum, lbs</td>
<td>25.0</td>
<td>18.0</td>
</tr>
</tbody>
</table>

Rodenburg, 2008
### PMR balance vs milk tank average

<table>
<thead>
<tr>
<th></th>
<th>Free flow</th>
<th>Guided flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>20.0</td>
<td>12.3</td>
</tr>
<tr>
<td>Minimum</td>
<td>10.0</td>
<td>9.0</td>
</tr>
<tr>
<td>Maximum</td>
<td>30.0</td>
<td>20.0</td>
</tr>
</tbody>
</table>

*Bulk tank average milk – PMR balanced milk*

---

### Voluntary and Involuntary milkings of cows fed at two concentrate levels

<table>
<thead>
<tr>
<th></th>
<th>6.6 lbs AMS pellet</th>
<th>17.6 lbs AMS pellet</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total milking/d</td>
<td>2.6</td>
<td>2.8</td>
<td>.13</td>
</tr>
<tr>
<td>Not fetch cows</td>
<td>2.4</td>
<td>2.7</td>
<td>&lt;.05</td>
</tr>
</tbody>
</table>

Bach, JDS 2007
Milking frequency of high starch vs. low starch pellets

High Starch Pellet
- Average: 3.39 visits 78 lbs
- 4%: 2 X
- 23%: 3 X
- 46%: 4 X
- 27%: 5 X

Low Starch Pellet
- Average: 3.31 visits 79 lbs
- 35%: 2 X
- 15%: 3 X
- 38%: 4 X
- 12%: 5 X

1 Avg consumption – 11.9 lbs of pellets. 249% starchy grain, 325% starchy grain. Halachmi, et al, JDS 2006

Pellets vs Meal

Pellet vs meal effect on visits

<table>
<thead>
<tr>
<th>Item</th>
<th>Meal1</th>
<th>Quality pellet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visits/cow/day</td>
<td>3.57</td>
<td>3.93</td>
</tr>
<tr>
<td>Milkings/cow/day</td>
<td>2.35</td>
<td>2.50</td>
</tr>
<tr>
<td>Milk/cow/day, lbs</td>
<td>53.6</td>
<td>57.2</td>
</tr>
</tbody>
</table>

1 49% distillers grains, 49% cracked corn, 2% molasses, 0.1% flavoring

Rodenberg, 2004
## High vs low quality pellet

**Pellet quality effect on visits**

<table>
<thead>
<tr>
<th>Item</th>
<th>Low Quality</th>
<th>High Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visits/cow/day</td>
<td>3.40</td>
<td>4.04</td>
</tr>
<tr>
<td>Milkings/cow/day</td>
<td>1.72</td>
<td>2.06</td>
</tr>
<tr>
<td>Fetched cows, %</td>
<td>16.0</td>
<td>7.1</td>
</tr>
<tr>
<td>Milk/cow/day, lbs</td>
<td>54.5</td>
<td>55.6</td>
</tr>
</tbody>
</table>

Rodenberg, 2002

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## Feed Costs of Robot vs. Conventional

<table>
<thead>
<tr>
<th></th>
<th>Total Feed Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parlor</td>
</tr>
<tr>
<td>120 lbs</td>
<td>$8.87</td>
</tr>
<tr>
<td>90 lbs</td>
<td>$7.53</td>
</tr>
<tr>
<td>70 lbs</td>
<td>$6.80</td>
</tr>
<tr>
<td>50 lbs</td>
<td>$5.63</td>
</tr>
<tr>
<td>AVG</td>
<td>$7.21</td>
</tr>
</tbody>
</table>

**Ration data from 5/1/12**

(CS-$50/ton, Hlg-$60/ton, HMSC-200/ton, SBM-$430/ton, Cottonseed-$300/ton)

Slide compliments – Chad Keifer
Keys to success with robots

Barn design

- Cow comfort
- Access to robots
- Minimize lameness
- Labor saving design

Free flow system
Free Cow Traffic
with split entry

Fetch Pen

Fetch cows

Resting Area

Automatic Milking System

Sort Pen

Feeding Area

http://www.dairylogix.com
/ http://vetvice.nl/

Slide courtesy D. Kammel
Directed Cow Traffic “Feed First”

Holding Pen → Selection Unit → Feeding Area

Automatic Milking System → Sort Pen → Resting Area

Guided flow - Milk first system

Photo courtesy Erica Kiestra, KIE Farms
Directed Cow Traffic
“Milk First”

Slide courtesy D. Kammel

Free Flow vs Guided Flow

<table>
<thead>
<tr>
<th>Item</th>
<th>Free Flow</th>
<th>Guided Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fetch rate (labor)</td>
<td>16%¹</td>
<td>8.5%¹</td>
</tr>
<tr>
<td>Initial investment</td>
<td>lower</td>
<td>higher</td>
</tr>
<tr>
<td>Level of mgmt complexity</td>
<td>lower</td>
<td>higher</td>
</tr>
<tr>
<td>Feeding complexity</td>
<td>higher</td>
<td>lower</td>
</tr>
</tbody>
</table>

¹Rodenburg, 2007
Other keys to for success

Cow Comfort

- Overcrowding limits cow movement
- Lameness decreases visits and increases fetch rates (Bach, 2007) (Borderas 2008)

Excellent ventilation and fly control to minimize bunching

Lameness prevalence

<table>
<thead>
<tr>
<th>Stall surface</th>
<th>Lameness</th>
<th>Severe Lameness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand (14)</td>
<td>22.5%</td>
<td>4.3%</td>
</tr>
<tr>
<td>Waterbed (7)</td>
<td>35.3%</td>
<td>10.2%</td>
</tr>
<tr>
<td>Mattress (22)</td>
<td>40.9%</td>
<td>8.5%</td>
</tr>
<tr>
<td>Mattress + pasture (5)</td>
<td>21.5%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Bedded pack (3)</td>
<td>19.0%</td>
<td>1.7%</td>
</tr>
</tbody>
</table>

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Labor savers - drovers lanes & split entry

Compliments David Kammel
Labor savers - headlocks

Special needs/treatment pen??
Where should the footbath go?

Pre-fresh feeder for heifers

Will this improve training of heifers
• Possibly improve visits of heifers
• Is it worth the cost?
• How much time to you spend training pre-fresh heifers
Labor comparison

• AMS dairies (all single box units)
  – 485 to 1410 lbs milk per man hour

• Parlor dairies
  – >500 cows, 772 to 922 lbs milk per man hour
  – 100-300 cows, 551 to 771 lbs milk per man hour

*Caution Preliminary survey results
  Unpublished, Piktaranta, 2014*

Stocking Rate

- In 13 herds with 34 to 71 cows/AMS, higher stocking densities were associated with lower milking frequency. *(Deming 2013)*

- When there are more than
  • 60 cows per AMS,
  • the number of fetch cows
  • Increases (free flow).
  • *(Rodenburg and Wheeler, 2002)*
Keys to success with robots

Enjoy technology

- Use the information available to optimize performance and cow health

Keys to success with robots

Focus on maintenance

- Equipment is expensive
- Downtime is more expensive
- Be prepared for higher repair costs
Keys to success with robots

Start up & Dealer support

- Use proven tactics at start up
- Successful start up minimizes financial stress
- Good dealer support is essential

Keys to success with robots

Requires excellent business and management skills

- Higher management than conventional system
- Mindset to maximize output/robot
Mindset Change

- Focus on milk per robot per day
- Maximize milk per minute of box time
  - Cow milking speed
  - Machine settings and maintenance
  - Minimize prep time and attach time
    - Cow cooperation
    - Teat placement and udder balance
    - Singe udders
  - Minimize percent free time
  - Optimize refusals
    - Each 5 seconds more/milking = one less cow

Milk per AMS

Biggest factors
- Percent idle time
- Milk flow rate per minute of robot use

Balance:
- Milk/cow/visit (milking permission)
- Milkings/cow/day
- Milk/cow/day
- Number of cows/robot
Cull Rate
Typically 0-3% (Rodenburg, 2002)

AMS cannot milk some udder conformations
- Crossed rear teats
- Real deep udder
- Severe reverse tilt

Cull for optimum robot performance
- optimum box time (milk per minute of box time)
- milking speed
- behavior
- attach time

<table>
<thead>
<tr>
<th>Milking time (minutes)</th>
<th>Milking speed (L/min)</th>
<th>Robot idle time (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>5.5</td>
<td>2.8</td>
</tr>
<tr>
<td>Minimum</td>
<td>4.5</td>
<td>2.3</td>
</tr>
<tr>
<td>Maximum</td>
<td>6.3</td>
<td>4.7</td>
</tr>
</tbody>
</table>

Reduce box time by 1 minute/cow increases capacity by 12%
Economics

Cost/Value
Expensive – compared to what???
Family dairy looking to expand
Trade offs
– labor (hired and family)
– capital investment
– lifestyle
Choices:
– low cost parlor – hired/family labor
– modern parlor – hired/family labor
– AMS – family labor
Inputs – Two robots

- 144 cows
- $200,000/robot
- $21,600 barn cost
- 5.0% opportunity cost
- 10 year’s of loan payments
- 15 year robot life
- $25,000 residual/robot
- Increase milk 5 lbs/c/d
- Decrease labor 5 hr/d
- Decrease SCC 10%
- $17.50/cwt milk price
## Outputs

**Robotic milking system economic analysis**

by William Lazarus and Jim Salfer

Most recently modified: 12/1/2013

### Farm Information

Dan Dairyman, 11/8/13

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### Partial budget analysis (before-tax)

<table>
<thead>
<tr>
<th>Positive Impacts</th>
<th>Negative Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased Incomes:</td>
<td>Decreased Incomes Expected:</td>
</tr>
<tr>
<td>Increased Milk Production</td>
<td>$41,580</td>
</tr>
<tr>
<td>Increased Milk Premiums</td>
<td>$2,737</td>
</tr>
<tr>
<td>Increased Cull Cow Slaught (minus = decrease)</td>
<td>$0</td>
</tr>
<tr>
<td>Software Value to Herd Production</td>
<td>$5,040</td>
</tr>
<tr>
<td>Total Increased Incomes</td>
<td>$49,357</td>
</tr>
<tr>
<td>Decreased Expenses:</td>
<td></td>
</tr>
<tr>
<td>Reduced Heat Detection</td>
<td>$2,190</td>
</tr>
<tr>
<td>Reduced Labor</td>
<td>$27,375</td>
</tr>
<tr>
<td>Reduced Labor Management</td>
<td>$0</td>
</tr>
<tr>
<td>Total Decreased Expenses</td>
<td>$78,955</td>
</tr>
<tr>
<td>Total Positive Impacts</td>
<td>$78,922</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
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</tbody>
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**Sensitivity Analysis**

**Projected Change in Milk lb/day**

![Graph](image)
Sensitivity Analysis

Projected Change in Milk lb/day

- $40,000
- $30,000
- $20,000
- $10,000
  $0
  $10,000
  $20,000

Impact

Years of useful life

NET ANNUAL IMPACT

Scenario’s

Enter scenario descriptions here =>
Increased investment
Less Pellets
New Barn ($12,000 stall)
No reduced labor
No reduced milk and no more milk

Enter input data for alternative scenarios to compare

<table>
<thead>
<tr>
<th>Scenario Description</th>
<th>Current</th>
<th>Last</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Cost per Robot</td>
<td>$200,000</td>
<td>$200,000</td>
<td>$220,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Related housing changes needed/cow</td>
<td>$150</td>
<td>$150</td>
<td>$500</td>
<td>$100</td>
<td>$7,222</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased Insurance Value of Robot &amp; Housing vs. Current</td>
<td>$400,000</td>
<td>$400,000</td>
<td>$440,000</td>
<td>$1,400,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticipated Change in Hours of Milking Labor</td>
<td>5</td>
<td>6</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced Hours for Labor Management</td>
<td>0</td>
<td>0.6</td>
<td>0</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lbs of Milk per Cow per Day, Past Year</td>
<td>75</td>
<td>75</td>
<td></td>
<td></td>
<td></td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Projected Change in Milk Production</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>16</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated Percent Change in SCC</td>
<td>-10</td>
<td>-5</td>
<td>-15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pellets Fed in Robot Booth</td>
<td>11</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Total investment for the robots and housing</td>
<td>$421,600</td>
<td>$512,000</td>
<td>$413,968</td>
<td>$421,600</td>
<td>$421,600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NET ANNUAL IMPACT</td>
<td>$4,063</td>
<td>$4,426</td>
<td>$16,405</td>
<td>-17,915</td>
<td>-23,456</td>
<td>-18,170</td>
<td></td>
</tr>
</tbody>
</table>
Summary

- Milking process fits well with robotic technology
- Most current users are satisfied with their decision
  - Dairies can expand w/o hiring labor
  - Producers can have more flexible schedule
- Whole system approach for best success
- Must make the cash flow work!
- What is the return on investment?
- Requires excellent management!

Summary

- Adoption rate in U.S. will depend on:
  - Availability of labor
  - Cost of labor
  - Cost of technology
Acknowledgements

• Dairy producers
• Lely & DeLaval for assistance with our project
• GEA & BouMatic
• David Kammel, UW-Madison
• Kelly Froelich
• Lucas Salfer, Tyler Evink, Michael Schmitt, Andrew Plumski, Nathan Bos

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