Finances and returns for robotic dairies

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Outline

- Comparing profitability of robotic systems to parlor systems
  - Herd size effect
  - Milk production effect
  - Labor effect

- Keys to optimizing robot efficiency
FinBin Data indicates that robot farms have higher costs, but greater milk production

<table>
<thead>
<tr>
<th>Item</th>
<th>Robot</th>
<th>Conv</th>
<th>Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk/cow, lb</td>
<td>23,532</td>
<td>21,526</td>
<td>+2006</td>
</tr>
<tr>
<td>Milk per FTE, lb</td>
<td>2,206,100</td>
<td>1,542,900</td>
<td>+663,200</td>
</tr>
<tr>
<td>Feed cost/cwt milk</td>
<td>$9.57</td>
<td>$10.25</td>
<td>-$0.68</td>
</tr>
<tr>
<td>Direct cost/cow/yr</td>
<td>$3,261</td>
<td>$3,189</td>
<td>+$72</td>
</tr>
<tr>
<td>Overhead cost/cow/yr</td>
<td>$898</td>
<td>$558</td>
<td>+$340</td>
</tr>
<tr>
<td>Net Return/cow/yr</td>
<td>$406</td>
<td>$483</td>
<td>-$77</td>
</tr>
<tr>
<td>Dep + Int/cow/yr</td>
<td>$547</td>
<td>$253</td>
<td>+$249</td>
</tr>
</tbody>
</table>

U of MN Finbin [www://finbin.umn.edu](http://finbin.umn.edu), data from 2011-2015
### Assumptions consistent across all scenarios

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chore labor rate</td>
<td>$16.00/hour</td>
</tr>
<tr>
<td>Management labor rate</td>
<td>$25.00/hour</td>
</tr>
<tr>
<td>Milk Price</td>
<td>$7.71/kg ($17.00/cwt)</td>
</tr>
<tr>
<td>Cost per kg/DM</td>
<td>$0.050/kg ($0.011/lb)</td>
</tr>
<tr>
<td>Loan interest rate</td>
<td>5%</td>
</tr>
<tr>
<td>Equity interest rate</td>
<td>5%</td>
</tr>
<tr>
<td>Weighted avg cost of capital</td>
<td>3%</td>
</tr>
<tr>
<td>Loan term on barn</td>
<td>20 year</td>
</tr>
<tr>
<td>Loan term on robot</td>
<td>10 year</td>
</tr>
</tbody>
</table>
240 cow scenario assumes 4 robots and D8 parlor

Investment¹

- Robot (4)  
  $2,400,000

- Parlor (D8)  
  $1,352,000

Milking Labor

- Robot (45 m/r/d)  
  2.5 hr/d

- Parlor (64 c/hr)  
  2X - 16 hr/d  
  3X – 24 hr/d

¹Includes new barn cost
Four robot system compared to D8 Parlor

$25,000

Net Annual Impact (Robot – Parlor)

$20,000

$15,000

$10,000

$5,000

$0

1% wage inflation

2% wage inflation

3% wage inflation

14589

17765

21328

5967

10987

16445

240 cows 2X milking

240 cows 3X milking

1 Robot milk per cow +5 lb/day for 2x milking and -2.0 lb/d for 3X milking
1500 cow scenario assumes 25 robots and D24 parlor.

Investment
- Robot (25) – $13,750,000
- Parlor (D24) – $6,786,000

Milking Labor
- Robot (45 m/RMS/d) 16.75 hr/d
- Parlor (200 c/hr) 81.2 hr/d
Net annual income for 1500 milking cow dairy - 25 robots compared to D24 parlor

Net Annual Impact (Robot – Parlor)

1% wage inflation
Robot -2.0 lb m/c/d
 -$162,672

Robot +0 lb m/c/d
 -$147,542

2% wage inflation
Robot -2.0 lb m/c/d
 -$111,210

Robot +0 lb m/c/d
 -$96,080

3% wage inflation
Robot -2.0 lb m/c/d
 -$130,571

Robot +0 lb m/c/d
 -$80,672

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Breakeven labor rate for 1500 milking cow dairy - 25 robots compared to D24 parlor

Breakeven labor $/hr

1% wage inflation
- Robot -2.0 lb m/c/d: $32.30
- Robot +0 m/c/d: $27.23

2% wage inflation
- Robot -2.0 lb m/c/d: $29.59
- Robot +0 m/c/d: $24.95

3% wage inflation
- Robot -2.0 lb m/c/d: $27.05
- Robot +0 m/c/d: $22.91
Milk production and wage inflation affect annual impact

25 robot system compared to D24 Parlor

1% wage inflation

- Robot +3.0 lb/m/c/d: -$34,017
- Robot +4.0 lb/m/c/d: -$8286
- Robot +5.0 lb/m/c/d: $17,445

3% wage inflation

- Robot +3.0 lb/m/c/d: -$3256
- Robot +4.0 lb/m/c/d: $22,433
- Robot +5.0 lb/m/c/d: $48,385
Milk per robot
Net Annual impact by milk yield per robot

Net Annual Impact compared to 4000 lb/robot/d

1Net annual impact per robot compared to 4000 lb/robot/d
High milk per robot is possible

<table>
<thead>
<tr>
<th>Device Name</th>
<th>Milk Yield last 24hrs</th>
<th>Avg Yield Per Day Last 7 days</th>
<th>Milk Yield To Tank Last 24hrs</th>
<th>Avg Yield To Tank Per Day Last 7 days</th>
<th>Avg. Yield / Milking Last 24h</th>
<th>Milkings Last 24hrs</th>
<th>Divert Milking Last 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMS 1</td>
<td>6778.9</td>
<td>6399.7</td>
<td>6778.9</td>
<td>6388.2</td>
<td>39.9</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>VMS 2</td>
<td>6148.9</td>
<td>5915.7</td>
<td>6148.9</td>
<td>5830.9</td>
<td>41.3</td>
<td>149</td>
<td></td>
</tr>
<tr>
<td>VMS 3</td>
<td>6492.4</td>
<td>6131.8</td>
<td>6492.4</td>
<td>6131.8</td>
<td>40.1</td>
<td>162</td>
<td></td>
</tr>
<tr>
<td>VMS 4</td>
<td>6871.5</td>
<td>6319.4</td>
<td>6871.5</td>
<td>6255.0</td>
<td>40.4</td>
<td>170</td>
<td></td>
</tr>
</tbody>
</table>
A major factor affecting high yield per robot is high yield per cow.

There is a significant correlation between yield per cow and yield per RMS ($r = 0.83$)

Salfer and Endres, unpublished
Visits per day, milking speed cows per robot and concentrate per cow is associated with more milk per robot.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milking visits per day</td>
<td>746.3</td>
</tr>
<tr>
<td>Milking speed</td>
<td>387.0</td>
</tr>
<tr>
<td>Cows per RMS unit</td>
<td>70.8</td>
</tr>
<tr>
<td>Concentrate per cow</td>
<td>92.8</td>
</tr>
</tbody>
</table>

Salfer and Endres, unpublished
## Milking time, speed, robot use

<table>
<thead>
<tr>
<th></th>
<th>Milking time (minutes)</th>
<th>Milking speed (L/min)</th>
<th>Robot idle time (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average</strong></td>
<td>5.5</td>
<td>2.8</td>
<td>19</td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
<td>4.5</td>
<td>2.3</td>
<td>8</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>6.3</td>
<td>4.7</td>
<td>66</td>
</tr>
</tbody>
</table>

Salfer and Endres, unpublished
Reduced box time per cow

- Select for cows that milk and attach fast
- Keep RMS equipment in top working condition
- Singe udders
- Trim tail switches
Residual feed, alley scraping and stall surface is associated with less milk per robot.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual feed per cow</td>
<td>-177.5</td>
</tr>
<tr>
<td>Alley scraping</td>
<td>-460.5</td>
</tr>
<tr>
<td>Stall surface</td>
<td>-394.6</td>
</tr>
</tbody>
</table>

Salfer and Endres, unpublished
Keys to increasing milk per robot

- High milk production per cow
  - Fetch early lactation cows more frequently to maximize lactation potential
  - Well balanced diets and excellent transition cow program
  - High reproductive efficiency
  - Excellent cow comfort
  - Low somatic cell count

- Minimize box time per cow
  - Cows that attached fast
  - Cows that milk fast
  - Carefully thought out milking permission settings

- Minimize free time
  - May increase the number of fetch cows in free flow systems
Milk per cow
Milkings per day, milking speed, concentrate and exit lane length is associated with more daily milk cow.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milking visits per day</td>
<td>14.8</td>
</tr>
<tr>
<td>Milking speed</td>
<td>7.5</td>
</tr>
<tr>
<td>Concentrate per cow</td>
<td>2.0</td>
</tr>
<tr>
<td>Length of exit lane</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Salfer and Endres, unpublished
Residual feed and failed milkings is associated with less daily milk per cow.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual feed per cow</td>
<td>-4.4</td>
</tr>
<tr>
<td>Failed milking visits/cow</td>
<td>-1.1</td>
</tr>
</tbody>
</table>

Salfer and Endres, unpublished
Fresh cow management

- Special observation of fresh cows
- Observe rumination, activity and manure daily
- Palatability of PMR as well as pellets is important
- Frequent fetching of fresh cows
- Multiple feeds through robot box allows flexibility
Feeding consistency

- Consistent PMR dry matter
- Consistent mixing and delivery
- Consistent feed push ups
- Consistent and frequent fetching
- Highly palatable PMR
- Highly palatable, consistent, high quality milking box feed
Summary

Main management factors affecting profitability include:

- Milk production per robot
- Milk production increases compared to other milking systems
  - Trading manual to more productive management labor
- Labor savings compared to other milking system option
Summary

Other factors include:
- Robot useful life
- Wage inflation
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Excuse me, I have a question.