Experiences with Robotics on Large Farms

February 2019
MREC-Minneapolis
Brandon Treichler, DVM
Future Of Dairy In A Volatile World: A Mid Atlantic Dairy Outlook

Brandon Treichler
5/30/2008
New Trends in Equipment

• **Robots “Will” be the future of milking!**
• Timeframe depends on immigration policies and price shifts.
• Currently technology is advancing rapidly and units quickly become obsolete.
• Many questions left to be answered in this area.
Robotics

• Currently this is an “emotional” purchase item.
• Sold on the premise of
  • Less Labor
  • More Consistency
  • Freedom from milking
• Many of these things are half truths presently
Where Is Robotics Headed?

• I believe that the future will be a robot arm adapted to a milking parlor scenario.
• One arm can now milk more cows. Spreads out investment.
• No requirement for facilities changes to adapt to robots
• Need only to bring cows to the parlor
• Could work particularly well on a Rotary parlor.
• Major companies are already investigating this option.
The Decision to Install Robots is still somewhat an Emotional Decision

• For Smaller Dairies
  • To improve lifestyle
    • Flexible daily schedule to attend kids’ activities or family events
  • To decrease labor
  • To milk more cows with family labor only

• For Larger Dairies
  • Concerns about available pool of employees
  • Do not want to manage more/any people
Why milking first

• Milking cows, like much of agriculture, is a very labor intensive process!
• Is a repetitive set of motions and steps
  • Apply Pre-Milking Sanitizer to the teat
  • Prime each teat (Forestripping) and check the milk
  • Clean each teat
  • Attach the teat cup or milking unit to each teat
  • Monitor the milk output to see when the cow is finished milking
  • Remove the milking unit or cluster
    • Shut off the vacuum and disconnect each teat cup from the teat
  • Apply post milking sanitizer to the teat
  • Return to step one and Repeat-Repeat-Repeat
Concerns over our labor force

- Political concerns have many dairies and dairy workers very scared
- Nearly full employment in most areas, so where is the pool of applicants
- Quality of applicants is “becoming lower”
  - I believe much of this issue is due to the difference in generations and the failure of owners and managers to transition to coaches and leaders
- People are inherently frustrating and will let you down
  - Will they show up? Will they show up sober? Do they care? Are they engaged?
- Most dairymen would rather manage cows than people!
- People struggle with consistency, which is what cows crave and robots excel at!
Lechería de Blanco: Vaca Procedimiento de Preparación

Primer técnico: aplicar la pre-inmersión sobre las tetas de todas las vacas

Técnico dos: limpiar agresivamente las tetinas de las primer 12 vacas

Conecte las máquinas a cada vaca

Primer técnico: limpiar agresivamente las tetinas de las últimas 12 vacas

Conecte las máquinas a cada vaca

Tercer técnico: 1) cargar el salón con las vacas, 2) eliminar las unidades en las vacas que se terminan y aplicar post sello.
Rocíe cada tetina con desinfectante

Limpie cada pezón en un movimiento de torsión

Asegúrese de limpiar completamente el extremo del pezón

Alinear la unidad de modo que esté cuadrada y nivelada con la ubre

Cuando la vaca haya terminado de ordeñar, pellizque la manguera y retire la unidad de ordeño

Aplicar la unidad a cada prueba

Aplicar post-inmersión a todas las pruebas
Economics of Dairy Labor in the US

• **Major Cost Center’s of Dairies**
  1. Feed Costs
  2. *Labor Costs*
  3. Replacement Heifer Costs

• **Rough Figures on Dairy Labor**
  • Roughly 1 FTE per 120-150 cows currently
  • Prevailing wage is $13-$16 per hour
  • Total Labor cost of between $350 and $500 per cow per year
    • Varies by region of the US
Economics of Robotic Milking

• Current Cost per “box” is between $150,000 and $180,000 USD
• 1 “box” can milk between 55-70 cows per day
• Current Cost per Stall (Milking Parlor) - $10,000-$15,000
  • 1 Stall can milk 4-5 cows per hour for 21-22 hours per day
    • 84 to 110 cow milkings per day
      • 2x/day milking capacity is 42-55 cows per stall per day
      • 3x/day milking capacity is 28 to 37 cows per stall per day
• In conventional milking parlors, we typically staff at a rate of 1 employee per 20 stalls
  • If using 3 shifts per day, each FTE will milk about 630 cows per shift
    • Assumes 4.5 turns/hr * 20 stalls per employee * 7 hours milking
• 1 Box essentially replace 0.1 FTE Employee
Economics of Robotic Milking on Large Dairies

• de Koning (2010) found that robotic herds had production increases of 5 to 10% compared to milking 2X, but **production decreased 5 to 10% compared to milking 3X**.
  • Box Robots average about 2.8 milkings per cow per day, so on average less than 3x milking in many large Midwestern dairies

• **At the wage inflation rate of 1% and a 2 lb lower milk production with the RMS, the breakeven labor rate is $32.30/hr.** If similar milk production levels are assumed with a 3% annual wage inflation, the breakeven wage rate drops to $22.91/hr.
Economic Returns of Robotic Milking on Large Dairies

Comparison of 2 systems

Conventional 2x30 Parallel Parlor
• 3x Milking
• 1890 cow capacity
• $600,000 investment in milking equipment
• 9 FTE @ $15/hr
• Labor Cost/year: $394,200
  • Labor difference/yr: +$372,300
  • Years to breakeven: 12.6 years

32 Box Style Milking Robots
• 2.8x Milking
• 1920 cow capacity
• $5.28 Million investment in milking equipment
  • $165K/Box
• 0.5 FTE @ $15/hr
• Labor Cost/Year: $21,900
  • Labor Difference/yr: -$372,300
  • Years to breakeven: 12.6 years
Considerations with Robots

- Costs of Maintenance
  - Cost of Ownership, Including Maintenance, is typically higher with robots
  - How much can the dairy perform on their own
  - How much parts inventory will the dairy have to stock?

- What is the physical/functional lifespan of the technology?
  - Robots are typically going to have less life than a parlor
  - Is the platform going to be supported/upgradable and for how long?
  - Who pays for the upgrades?
Diagnosis function number: 5
Diagnosis function name:
- Unknown
- Leakage out
- Speed in
- Friction in
- Speed out
- Friction out
- Leakage in
- Sensor

Start diagnosis (ARM WILL MOVE III)

Status: Ready
Result: 2TV
Classification:

Process Settings Test Indications Reports T&L System

LELY E-LINK Manager
Fire Engine Management?
Robotic Milking Units numbers are growing at roughly 20-25% per year globally!

• Approximately 25,000 units operating world-wide in 2015
  • [https://dairy.unl.edu/automatic-milking-systems-good-bad-and-unknown](https://dairy.unl.edu/automatic-milking-systems-good-bad-and-unknown)
• >2500 AMS units in North America in 2015
  • >1000 farms
  • >140,000 cows
  • >381,000 milkings/day
  • J. Salfer UMN 2015
• Approximately 40,000 to 43,000 units operating worldwide in 2018
  • Roughly 3,500 units operating in North America in 2016
WATCH
WHATEVER
WHENEVER.

With Sony's Betamax SL-6000 video recorder, you can see any TV show you want to see anytime you want to see it. Because Betamax, which plugs into any TV set and is easy to operate, can videotape a show up to three hours long with the L-250 videocassette while you're doing something else, even while you're out of the house, by setting the electronic timer. It can also videotape something off one channel while you're watching another channel.

And remember, Sony has more experience in video equipment than anyone (over 20 years). In fact, we've sold more videocassette recorders in broadcast and studio than any other consumer manufacturer. Even make your own tape. For years, you've watched TV shows at the time you've had to. Now you can watch them at the times you want to.

SONY BETAMAX
THE LEADER IN VIDEO RECORDINGS

© 1976Sony Corp. (Americas) SONY and Betamax are trademarks licensed to Sony

© 1976Sony Corp. (Americas) SONY and Betamax are trademarks licensed to Sony
Embracing the Robot Uprising: Producing High Quality Milk in Robotic Dairies

September 2018
AABP-Phoenix
Brandon Treichler, DVM
Tandem or Side Opener Parlors
Difference between robots and weigh jar/high line milking?
I do not think the key factors driving milk quality in robots are significantly different than conventional parlors.

I think of robots as very complex poorly plumbed side opener weigh jar parlors.
  - The milking and washing characteristics are very similar to these more “old-school” type parlors
  - Only with the bonus of less labor and more data
## What factors drive milk quality

### Udder Health

1. Clean Cows
2. Clean Teat Ends at Milking
3. Dry Bedding
4. Excellent Transition Cow Program
5. Excellent Teat Health
   - Teat Ends
   - Teat Skin
6. Management of Chronic Cows
7. Consistent ability to detect Clinical Mastitis
8. Robust Screening for Contagious Mastitis

### Bacteria Counts

1. Plenty of hot water
2. Plenty of hot water
3. Plenty of **SOFT** hot water
4. Clean cows and teat ends
5. Excellent Scheduled Maintenance
   - Seals, Gaskets, Valve Seats, Hosing
6. Lots of cooling capacity
7. Change milk filters every 4 hours maximum
8. Low levels of clinical or sub-clinical infections
   - Especially Streps
The State of Robotic Milking

“We often care more **THAT** the cows get milked than **HOW** the cows get milked”

- Technology... the knack of so arranging the world that we don’t have to experience it.
  - Max Frisch

- The real danger is not that computers will begin to think like men, but that men will begin to think like computers.
  - Sydney J. Harris

- Technology frightens me to death. It’s designed by engineers to impress other engineers. And they always come with instruction booklets that are written by engineers for other engineers”
  - John Cleese

**Translation:** We are often so happy that we no longer have to...

- **Live on a schedule**
- **Perform a repetitive job**
- **Learn to work with people**

...that we are willing to make compromises, forget some of what we knew about milking cows and pay more to do it!
What milk quality advantages do robots have?

• **Consistency!**
  • Cows respond to consistency in cow prep and milking experience
  • If you program in that a cow is a three teat, that cup never gets attached

• **Technology**
  • Quarter milk volume and take-off
  • Backflush units between cows
  • Conductivity allows us to find clinical cows
  • Weight?, rumination?, milk temperature? All help us find sick cows faster
    • This has both a direct and indirect effect on SCC
What milk quality advantages do robots have?

• **Timing**
  - Cows can milk when they want, and as often as their production will allow
    - This is a huge positive
    - Less cows leaking milk
  - There is no person moving cows through alleys area no areas of high cow density like holding areas
    - A significant part of the splash on bellies and udders occurs from people moving cows
      - People prefer to move faster than a cows normal pace
      - Transfer and exit lanes often have significant manure build-up that cows have to walk through
    - When cows are never in a the holding area, there are less slips that create splash
      - Also less opportunity for heat stress, as the holding area is one of the hottest places on the dairy.
What potential drawbacks do robots have?

• **Teat Cleaning**
  • No Employee ever cleans teats perfectly either though, so this might be a “wash”!
  • I prefer brushes for stimulation of milk letdown

• **Poor Post Dip Coverage**

• **Very Limited Liner Choices**

• **“Perceived” limited equipment settings options**

• **Complex Plumbing**
  • Multitude of valves
    • Backflush
    • Abnormal milk divert
    • Pre-Milk divert
    • Automatic tank valves
  • Hosing
    • Lots of small diameter milk hose and moves milk up hill
Teat Cleaning and Robot Milking

If you give them clean cows robots will give you clean teats!
Haan 2015

Traditional teat end swabbing is difficult with robots, so filter socks scoring is an attractive and valuable
Teat End Swabs
DeLaval VMS Teat Prep

• Utilizes a dedicated teat prep cup that is specially designed with a perforated sleeve
• A combination of vacuum and atmospheric air is applied to the sanitizing solution to create a vortex in the cup that provides mechanical cleaning
• Compressed air blows the teat dry as the cup is pulled down the teat
• Spraying teats with teat sanitizer before cleaning is optional
• Having a germicide in the wash solution is a settings option (Required in the US)

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Teat Cleaning</th>
<th>Fore-Stripping</th>
<th>Drying</th>
<th>Total Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra-Light</td>
<td>2.7s</td>
<td>1s</td>
<td>3.3s</td>
<td>7s</td>
</tr>
<tr>
<td>(per cow parameter)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>5.8s</td>
<td>1s</td>
<td>3.3s</td>
<td>10.1s</td>
</tr>
<tr>
<td>(per station parameter)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>7.8s</td>
<td>1s</td>
<td>3.3s</td>
<td>12.1s</td>
</tr>
<tr>
<td>(per station parameter)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>9.8s</td>
<td>1s</td>
<td>3.3s</td>
<td>14.1s</td>
</tr>
<tr>
<td>(per station parameter)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Double</td>
<td>The Teat Cleaner cup will attach to all teats twice. Both passes operate a full program cycle, including fore- stripping and drying</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(per cow parameter)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Default setting should result in about 1 liter of wash solution recovered per four teats prepped.

NOTE: If you are measuring the solution draining from the divert trap after an actual cow prep, then there will be more than 1 liter of fluid because of the first milk that is diverted.
Lely A4 Teat Prep

• Utilizes a pair of counter rotating air driven brushes to clean the teat
  • Traditional cow preparation is one brush pass for each teat
  • USA Teat Cleaning option makes the first cleaning pass of each teat, swings the brushes out to be sprayed with sanitizer, and then swings them back in for a second pass. A puff of compressed air will dry each teat end.
  • There is an option to add a pre-cleaning teat sanitizer spray
  • “X-Prep” Option allows for some lateral movement of the brushes
    • This helps to get additional contact with the teat ends
    • Multiple different settings within X-Prep to define how much lateral travel is desired. Within settings, several account for the tendency for front teats to be longer.
  • There is a brush height adjustment offset as well
    • Goal is to clean the teat and not necessarily the udder floor
    • If the brush rides too high it will “stall” out on the udder floor
Thoughts on the GEA Monobox and ProQ

- Performing all steps with a single connection per teat should lower box time per cow...*if the stimulation actually leads to good milk letdowns*
- Stimulation is provided simply by increasing the pulsation rate
GEA Teat Prep

• Teat Prep is performed in the same teat cup that is used for milking immediately after connection to the teat
  • Teat Prep Solution dispensed into the liner head
    • Programmable options include
      • Teat wash solution time
      • Pre-Dip Sanitizer time
      • Compressed Air Drying time
      • Atmospheric air drying or soak time
  • Pulsation is active during this phase (Higher Pulsation Rate and Lower Vacuum)
    • Distribute the cleaning solution to all teat surfaces
    • Loosen dirt and debris
    • Stimulate milk letdown
  • First milk is used to purge the lines before diverting back to receiver
    • Factory default is 3 seconds, US setting is 35 seconds
Where does the debris go?
Producer Considerations that drive quality

• Labor savings alone do not justify the additional investment in robots so producers justify the investment with other indirect benefits
  • Improved lifestyle
  • Less need for/frustration with hired labor

• These motivators are strong and drive producers to make decisions that justify this investment
  • In other words, we are so motivated to not have to milk cows we will spend more money and make other sacrifices to do it.

• How will I bed, groom and rake stalls?
  • Even with mattresses this is critical

• How will I handle manure?
  • If it is alley scrapers, there are ways to mitigate the negative effects

• Hot water capacity. Is there enough capacity?
If you plan to use alley scrapers consider designing your barns with a center drainage channel.
If you are committed to not doing deep beds, consider a bedding retainer instead of just a mat/mattress. Also try to make it easy to bed when you design the facility as this is critical to productive life and milk quality.
DeLaval Robotic Rotary

- https://www.youtube.com/watch?v=j_zBqUtJt6o
Teatwand Robotic Dip Sprayer

- https://www.youtube.com/watch?v=Ilff1xVW71w
Madero Max-1 Teat Sprayer

- https://www.youtube.com/watch?v=O6lxf2kNIM8
Questions?

Brandon Treichler DVM
Quality Control Veterinarian
Select Milk Producers

qmlkdoc@gmail.com