Cornell University

Quality Milk Production Services

Automatic Milk Installations for Management Benefits

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QMPS is a program within the Animal Health Diagnostic Center, a partnership between the NYS Department of Agriculture and Markets and the College of Veterinary Medicine at Cornell University.

Objectives

- Understand importance of monitoring robot function – routine maintenance and monitoring
- Understand importance of monitoring records at least twice daily
- Use the technology at your fingertips to reduce the risk of spreading mastitis causing organisms via the robot

Outline

- Robotic history to current status
- Why robotics
- Robot management
- Milk quality

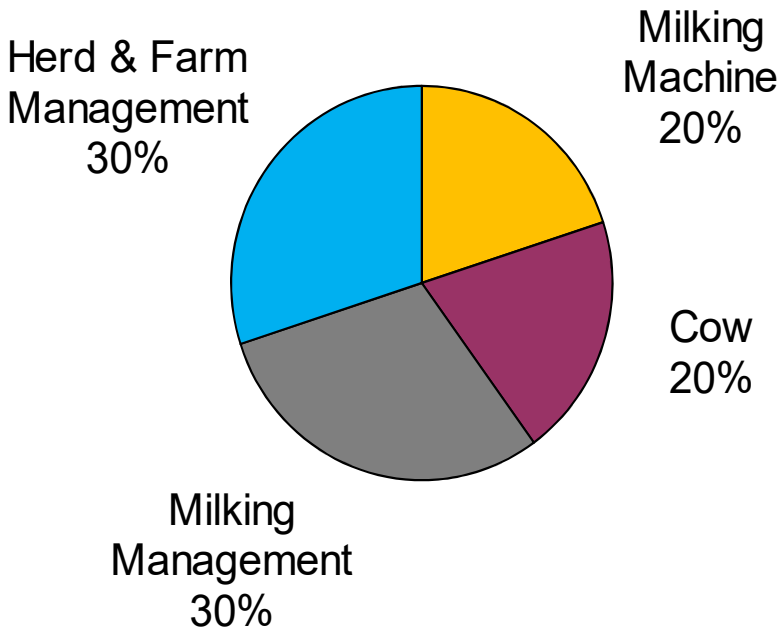
Current status

- 1992 first installation in Netherlands
- 1999 first robot in Canada
- 1999 first robot in US (on-farm) - Wisconsin
- > 25,000 robots world wide
- > 10,000 farms worldwide
- ~ 3,000 robots in North America
- 2013 US
  - 578 farms
  - 1415 robots
  - 2.45 robots/farm
  - 75,000 cows

Robotic trends

- Larger robotic installations
  - Western US starting to see larger robotic installations
    - ~20 installations slatted for install with 12 or more robots
  - Is this the future?
    - Even seeing economic analysis of large robotic dairies being completed by lenders
    - Large robotic dairies is where the labor savings are substantial
  - Largest in North America to be installed in MI – 24 robots - 2017
  - Largest in world in Chile – 64 robots to milk 4,500 cows - 2017
- Continue to see 2 – 4 robot installations as exit strategy for farm with no next generation to take over farm
  - Assumption is 40 – 50% salvage value of robot with this strategy
  - Price on used robots is $45,000 - $70,000
  - 20 – 30% salvage value

Potential Contribution to Mastitis



3-ways to cause mastitis from a machine

- Irregular vac fluctuations – liner slips: equipment
- Teat damage – overmilking: equipment
- Transfer of contagious organisms: equipment/milking management

G. Mein et. al, Storm in a Teatcup, NMC 2004

Milkings/robot

- Which has more milkings/milking unit…?
  - milking 120 cows 3 times daily with 2 robots
  - milking 4,500 cows 3 times daily with a 100 stall rotary

Mind-set for number of cows milked at each unit

- How does the number of milkings/robot compare to milkings per milking unit on a large dairy?
  - 120 cows – 2 robots 3 milkings/day = 180 milkings/robot or per milking unit
  - 120 cows – 2 robots 2.7 milkings/day = 162 milkings/robot or per milking unit
  - 100 cows – 2 robots 2.7 milkings/day = 135 milkings/robot or per milking unit
  - 100 stall rotary milking 4,500 cows 3x = 135 milkings/unit
  - 80 stall rotary milking 3,200 cows 3x = 120 milkings/unit
  - D-20 parlor milking 1,200 cows 3x = 90 milkings/unit
  - 80 cows - tie stall with 6 units milking 2x = 27 milkings/unit
- Minimize risk of robot being vector for transfer of mastitis causing organisms

Goal of milking with robot

- Harvest high quality milk in a clean and efficient manner while minimizing risks to the cow during the harvest of milk
- Minimize human to cow interaction for milking cows
- Maximize number of cows through a robot or pounds of milk harvested through a robot
- Read reports to identify cows at risk for health disorders
- Use technology within the robot to minimize the risk of spreading disease causing organisms within your herd

Why do producers choose robotics?

- Flexibility in schedule
  - Improved quality of life – more family time
  - Number one reason to switch to robotics
- Labor efficiency
  - Ability to work on other areas of the farm
  - Most robot farms have 2 robots or less so reducing labor may not be an option
    - If its family labor then even less of impact on reducing labor
  - Refocusing labor on reproduction, crops, calves or heifer management can be profitable
  - Labor efficiency/savings is real on large robotic dairies
- Information
  - Technology, cow management
  - Ability to manage cow sooner
    - Repro, metabolic, milk quality

Labor efficiency

Economist or financial institution

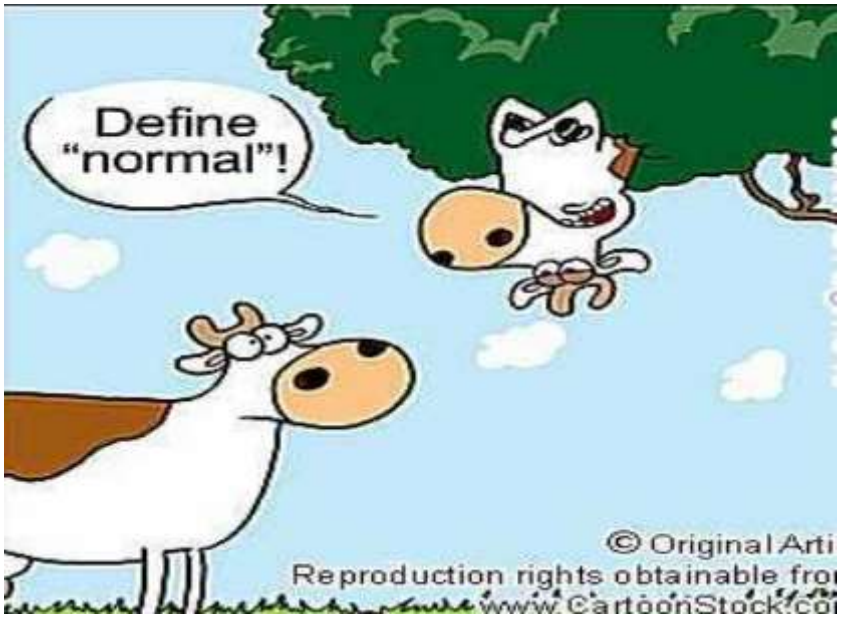
- 70 – 80% reduction in labor costs
- Labor costs
  - $1.81 – 1.93/cwt conventional
  - $0.35 - $0.54/cwt with robot
- Labor savings are seen when there are 4 or more robots
  - If you are milking 240 cows and they are 4 employees…
    - 2 family and 2 non-family
    - Can you complete all daily farm related tasks with 3 employees?
      - Feeding, cleaning, calves, repro, maintenance, accounting, etc..

Survey of dairy operations

- $2.22/cwt conventional
- $1.60/cwt robot
  - 28% reduction in labor costs

Robot management

- Barn design
  - Determined during design phase and fixed component
- Cow traffic
  - Determined during design phase
    - Physical layout is a fixed component
  - Impacted by human-to-cow interaction
- Robot settings
  - Number of milkings allowed, interval between milkings, maximum box time, etc..
- Daily monitoring
  - Cow reports
  - Robot – Equipment
- Proactive management



Management

- Manage mechanics of robot – routine tasks
  - Daily, weekly, monthly routine service
    - Pulsation, vacuum, camera, laser, greasing, manual cleaning, calibrating, etc..
  - Automation does not mean less manual tasks
    - Automated equipment require daily – monthly maintenance
- Manage records or reports
  - Cow and equipment
  - Monitor reports 2 – 3 times daily
- Manage the risk of the robot being a vector for the movement of mastitis causing organisms
  - Use the technology of the robot to minimize risks
    - Block animals with a known mastitis/aerobic culture history from milking on all robots
      - Allow them to milk at specified times
    - Multiple pens – move all high risk cows to one pen
  - Include an extra backflush, rinse after an at risk cow milks

Equipment monitoring

- Robot will inform you if there is a mechanical issue
- Robots will inform you of when you should change wear items
  - Liners and other rubber goods
- Robot reports
  - Daily milking reports can be a useful tool to monitor the mechanics of the robot
    - Box time, treatment time, compare milking time of front teats to front teats and rear teats to rear teats

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Type	Extra	Attention	Info
A4		Liner Attention	13709 Milkings
A4		Sleeve Attention	30069 Milkings
Feed	Pellets	Attention Level	Aug 11 2016 4:17AM Storage Attention

Attention List

Device	Type	Extra	Attention	Info	View
101	A4	LR	Increased milktime	+22 sec	View

Robot maintenance

- 8 hours/week
  - Daily, Weekly, Bi-weekly and Monthly tasks
- Cleaning lenses and area around laser
- Check that each liner is pulsating
  - Finger in liner – open and close
- Monitor for tears
  - Liners, hoses, gaskets
- Ocular irritation of liner from backflushing chemicals and steam
- Greasing, checking fluids, cylinders, air filters, gaskets, etc..
- Monthly – pulsators and claw vacuum
- Maintenance cost per robot cost $7,000 - $12,000 annually
  - $600/month to $1000/month
    - Hygiene and service = cost of ownership
- Service/repairs annually cost $2,000/robot

Equipment monitoring

- Monitor robot reports for equipment function
  - Front teats as compared to front teas should not differ by more than 20 seconds for milking time
  - Rear teats as compared to rear teas should not differ by more than 20 seconds for milking time
  - Multiple robots in same pen should have similar box times
- Teat in liner – low or fluctuating vacuum
- Pulsation – less B-phase, pulsator not pulsing at all, tear in pulsation hose, dirty air

Failed or incomplete milkings

- Failed or incomplete milking occur for what reason?
  - Equipment failure
  - Cow – fresh animal kicks unit off, can't attach teatcups because of udder hygiene, etc..
- Failed/incomplete milkings at one robot when there are multiple robots is an indication of a mechanical issue
- How much time does a failed/incomplete milking take up?
  - 4 – 5 minutes or more
  - Reduce failed or incomplete milkings by 2 per milking shift (between cleanings) and there is an extra 30 minutes of milking time each day
    - This doesn't include additional time required to fetch a cow if fetching is required after a failed milking

Cameras for monitoring

- Cameras, cameras, cameras
  - Install cameras to monitor….
    - Traffic patterns
    - Bottlenecks
      - Time of day, dominant cow, etc..
- Natural movement without human influence

- Why are cows bunching at entrance/exit area of robot?
  - Cooling, flies, etc..

Fetch and dominant cows

- What can you do to get fetch cows milked with limited human interaction?
  - Move fetch cows at the same time that stalls are cleaned each day
    - Multiple cow interaction tasks completed at once

Fetch and dominant cows

- Subordinate cows may need to be fetched
  - Fetch cow moved to pen and dominant cow is ready to load next
- Separate pens or you may have to move subordinate cow directly into robot – not ideal

Milking time parameters/robot – 60 cows

Item	Target	Action
Milk Yield/milking (lbs.)	30	25
Milkings/robot/day	180	165
Milkings/cow/day	3	2.7
Yield/robot/day (lbs.)	5,000	4,500
Percent of cows fetched (%)	$\leq 2\%$	$\geq 5\%$
Total cows fetched	2	≥ 3
Percent time robot is milking (%)	85	80
Percent time robot is idle (%)	10	15
Time robot is cleaning (minutes)	80	> 120

Milk quality

- How do we determine if a cow has mastitis when milking in a tie stall barn or parlor?
  - Clots/flakes – abnormal milk
  - Bloody or watery milk – abnormal milk
  - Swollen or hard quarter – inflammation
  - Decreased milk production
  - Down cow – systemic mastitis
  - CMT
- Don’t out guess the biology of the cow because there is robotic technology involved

Milk quality - Robot

- How does a robot indicate if a cow may have mastitis?
  - Color sensor - Bloody milk
  - Temperature of milk - Swollen or hard quarter
  - Milk deviation - Decreased milk production
  - Milking time – short or long milking time at quarter level
  - Conductivity – CMT
- Not much has changed in how we determine if there is mastitis
  - Still have to evaluate the cow to determine what caused the health alert/attention
  - Cow evaluation and/or treatment should not take place in robot
    - Evaluation/treatment in robot may be a negative experience for cow
    - Negative experience may lead to cow not willingly visiting robot

Cow as her control

- Real-time values at the level of the quarter with the cow as its control
  - Multiple repeated measurements at the level of the teat, within cow and multiple times/day
  - Monitor changes at the level of the teat within cow
  - Software compares the cow to itself when determining if she is at risk
  - Very sensitive method of indicating that something is wrong with the cow

What data can we get from a robot

- Quarter level – milking
  - Milk yield
  - Average milk flow
  - Milking time
  - Conductivity
  - SCC
  - Color
- Quarter level – mechanics
  - Teat position
  - Attachment attempts
  - Pre-milking prep time
- Udder Level
  - Milk yield
  - Fat
  - Protein
  - Lactose
  - Average milk flow
  - Milk temperature
- Cow level
  - Activity
  - Rumination
- Box level
  - Box time
  - Treatment time
  - Visit data

Proactive management

- Conductivity, color and temperature of milk are indicators of an immune response
  - Management is responding to an immune function
  - Gather data multiple times/day at the quarter level thus the sensitivity of the parameters is high
    - Small change may be indicative of an udder issue
- Proactive not preventive management
- Management comes in the form of rapid intervention
  - Provide supportive therapy to prevent mild case of mastitis from becoming a moderate or systemic case of mastitis
  - Aerobic culture of at risk quarter to identify organisms that is the cause of milk quality issue

Managing milk quality

- Managing milk quality is the same in a robot as it is in any other milking center
- Management requires managing the causative agent or organism
  - One cannot manage conductivity, color, temperature, etc.
    - Manage what causes changes in conductivity, color, temperature
      - Aerobic culture and treat or no treat
- Don't use robot to guess what organism caused the udder health alert
  - Robots cannot determine if the causative agent was E. coli, Staph aureus or Strep uberis
    - Acute change in conductivity, milking time or milk yield are not indicative of a mastitis causing organism
  - Aerobic culture is needed to management causative agent

Milk quality - robot

- Technology requires monitoring reports
- The key to milk quality in a robot is monitoring udder health reports at least twice daily
  - 12 hours apart
  - Cows monitored in AM also monitored again in PM
  - All cows on list monitored at least twice in 24 hour period even if cow did not show up on report 12 hours later

Key reports to monitor

- Milk deviation
- Abnormal milk, separated milk
  - SCC, color, conductivity
- Fetch/Collect cows
  - Long interval and low milkings/day
- Slow or long milking time
- Fetch cows or average milkings/day
- Failed milkings
- Activity
- Rumination

- Reports
  - Collect/Fetch Cows
  - Udder health Work
  - Failed/Incomplete milkings
  - Udder health report
  - Robot performance/daily milkings
  - Alerts from robot on main screen

Robot management failures

- Not performing routine maintenance/service on the robot
  - Daily to monthly tasks
  - Significant impact on box time
- Not monitoring reports two to three times daily
- Barn design
  - Design that requires unnecessary human-to-cow contact
  - Dirty cows
  - Don't cut corners when it comes to installing a robot
    - A retrofitted barn is not always the best decision
    - No matter what method of cow flow you use the idea is the cow freely chooses when to go to the robot
      - Tie stalls were not designed for free flow of cattle – therefore retrofitting a tie stall for a robot is not suggested
      - Retrofitting a free stall can also be a challenge depending upon where the robots are installed
  - The main reason that people choose robots is for more free time
    - Collecting more fetch cows does not lead to more free time

Robot success

- Perform daily, weekly and monthly maintenance tasks as recommended by the manufacturer
- Monitoring reports at least 3 times daily
  - Cow level
  - Robot diagnostics (equipment)
- Cows will adapt quicker than people
  - Do not interfere with the flow of cattle to and from the robot
  - It's ok if a cow hasn't visited the robot in 10 hours
    - Give her a chance to visit on her own before getting her up and moving her to the robot
  - Go check her visually and if all looks well then give her a chance to move to the robot
  - Once you start moving cows to the robot it is hard to break the habit
- Evaluation/treatment area to monitor cow – not in robot
- Observe cows with limited cow to human interaction
- Barn design
- Feed

Discussion ?

- Why hasn't Joe monitored reports today? I better fetch Joe!!!