



Maximizing profit and labor efficiency with robots.



UNIVERSITY
OF MINNESOTA
Driven to Discover™

Marcia Endres

University of Minnesota
Extension, St. Paul

Jim Salfer

University of Minnesota Extension
St. Cloud



1

Outline

- Goals of installing robots
- Real farm profitability
- Comparing profitability of robotic systems to parlor systems
 - Herd size effect
 - Milk production effect
 - Labor inflation effect
- Keys to optimizing robot efficiency



4

What are your goals for installing robots

- Maximum productivity per cow and robot?
- Improve efficiencies (labor) and increase productivity
- Maximize lifestyle benefit?
- Expand with minimal hired labor?
- Expand the potential labor pool?



Goals will help prioritize investments, labor structure and expectations on the farm

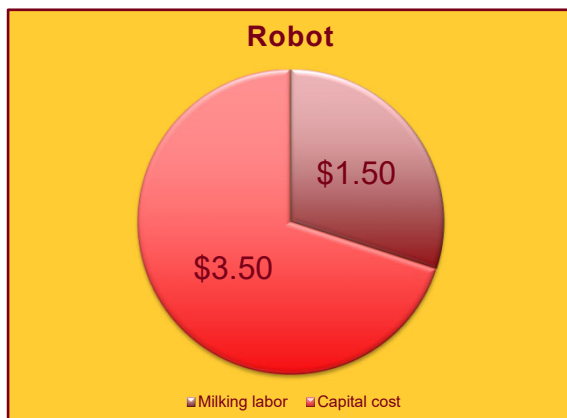


UNIVERSITY OF MINNESOTA EXTENSION

© 2023 Regents of the University of Minnesota. All rights reserved.

8

Robotic milking systems trade higher capital costs for reduced labor expense



UNIVERSITY OF MINNESOTA EXTENSION

© 2023 Regents of the University of Minnesota. All rights reserved.

9

Potential future US domestic workforce is shrinking



UNIVERSITY OF MINNESOTA EXTENSION

United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2024. © 2023 Regents of the University of Minnesota. All rights reserved.

10

FinBin Data indicates that robot farms produce more milk per cow and FTE with less labor per cow.

Item	Robot	Conv	Difference
No cows	200	180	+20
CFP/cow	1873	1712	+161
ECM/cow	27,884	25,531	+2353
Est labor hrs/cow	28.8	39.0	-10.2
Milk price, \$/CWT	\$20.33	\$20.39	-\$0.06
Net return over lbr mgmt./\$ COW	\$214.92	\$269.78	-\$54.86



UNIVERSITY OF MINNESOTA EXTENSION

U of MN FINBIN [www://finbin.umn.edu](http://finbin.umn.edu), data from 2020-2024

© 2023 Regents of the University of Minnesota. All rights reserved.

17

Cost of production

	per cwt		
	Conv	AMS	
	Avg	Avg	Top 40%
Direct only	\$15.78	\$15.93	\$14.99
Direct + overhead	\$19.06	\$19.23	\$17.62



UNIVERSITY OF MINNESOTA EXTENSION

U of MN Finbin [www://finbin.umn.edu](http://finbin.umn.edu), data from 2024

© 2023 Regents of the University of Minnesota. All rights reserved.

19

Overhead costs

	per cow			per cwt		
	Conv	AMS		Conv	AMS	
	Avg	Avg	Top 40%	Avg	Avg	Top 40%
Interest	\$108	\$165	\$136	\$0.44	\$0.62	\$0.50
Depreciation	\$191	\$310	\$328	\$0.78	\$1.16	\$1.19
Hired labor	\$409	\$233	\$197	\$0.99	\$0.29	\$0.31
Total labor	\$680	\$462	\$450	\$1.80	\$1.15	\$0.68



UNIVERSITY OF MINNESOTA EXTENSION

U of MN Finbin [www://finbin.umn.edu](http://finbin.umn.edu), data from 2023

© 2023 Regents of the University of Minnesota. All rights reserved.

20

Net return over labor and mgmt. per cow is more variable on robot farms.

Item	Avg	Bottom 20%	20 to 40%	40 to 60%	60 to 80%	Top 20%
	Profit Cohort – Net return per cow					
Robot, \$/c	\$279	-\$864	-\$293	\$161	\$684	\$1232
Conv, \$/c	\$305	-\$686	-\$87	\$273	\$604	\$1231
Diff, \$/c	-\$26	-\$178	-\$206	-\$112	+\$80	\$1



21

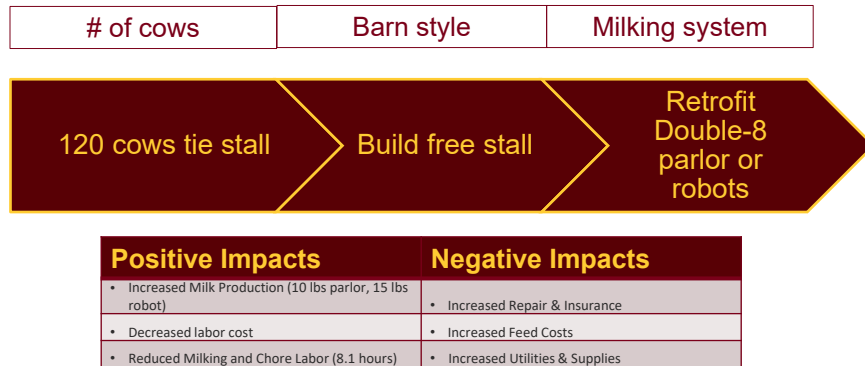
Economics

Partial budget spreadsheet model



23

Free stall and retrofit parlor vs 2 robots

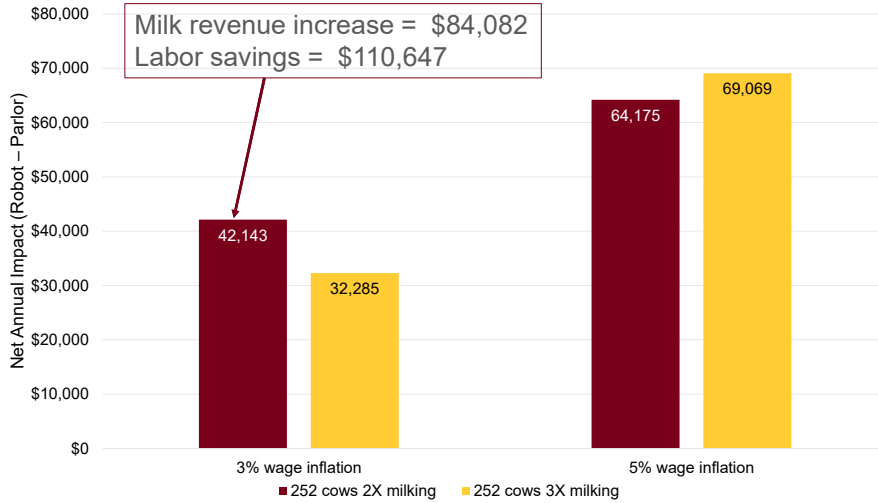


Assumptions consistent across all scenarios

Item	Value
Chore labor rate	\$17.00/hour
Cows per robot	63
Milk Price	\$8.62/kg (\$19.00/cwt)
Cost per kg/DM	\$0.054/kg (\$.12/lb)
Loan interest rate	5%
Equity interest rate	3%
Weighted cost of capital	3%
Loan term on barn	30 years
Loan term on robot	15 years
Useful life of robot	15 years



Difference in net annual income of a four-robot system compared to D8 Parlor¹



¹Milk per cow in robot +5.0 lb/day for 2x milking and - 2.0 lb/d for 3X milking

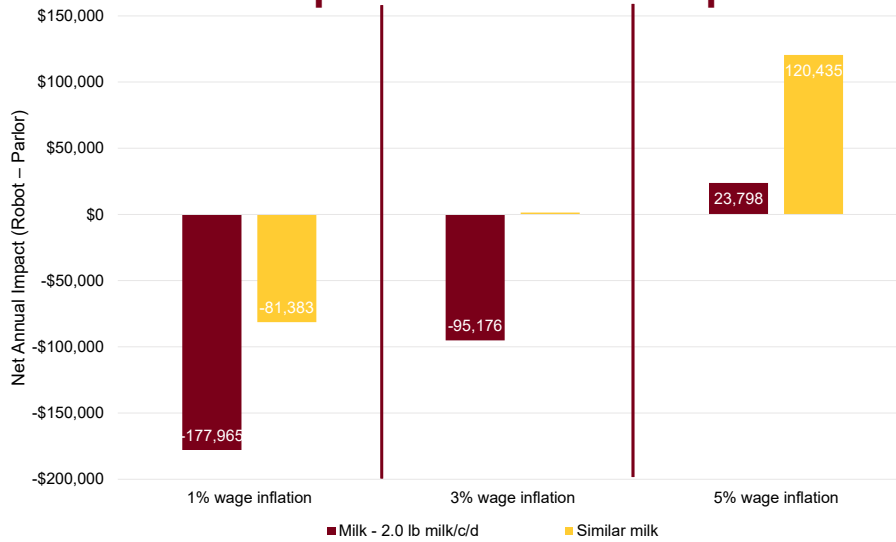


UNIVERSITY OF MINNESOTA EXTENSION

© 2023 Regents of the University of Minnesota. All rights reserved.

30

Difference in net annual income for 1575 milking cow dairy - 25 robots compared to double-24 parlor

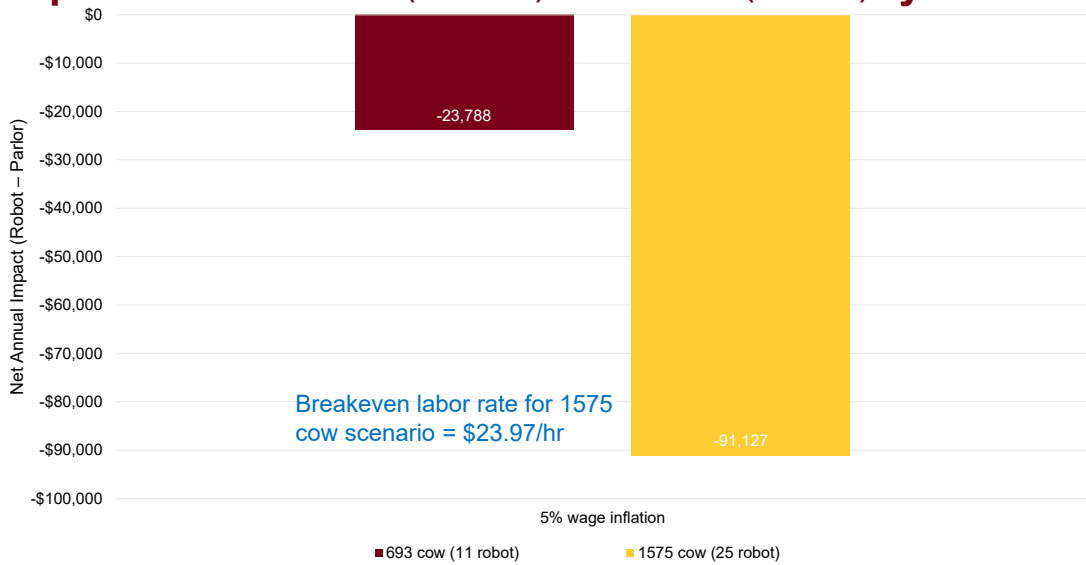


UNIVERSITY OF MINNESOTA EXTENSION

© 2023 Regents of the University of Minnesota. All rights reserved.

32

Difference in net annual income for 50-stall rotary parlor compared to 693 cow (11 robots) and 1575 (25 robot) system

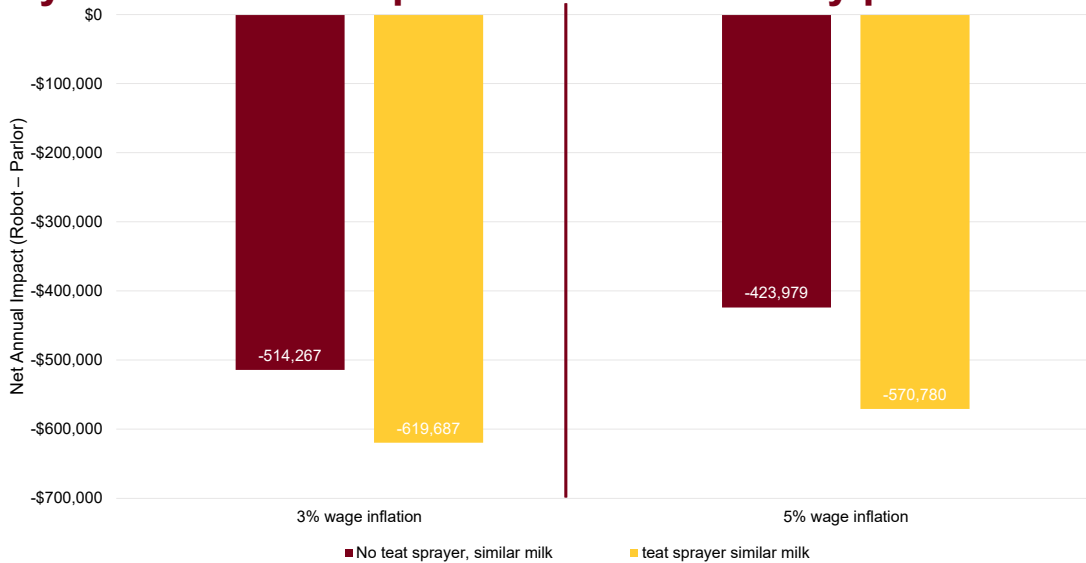


UNIVERSITY OF MINNESOTA EXTENSION

© 2023 Regents of the University of Minnesota. All rights reserved.

35

Difference in net annual income for 3528 milking cow dairy - 56 robots compared to 80-stall rotary parlor



UNIVERSITY OF MINNESOTA EXTENSION

© 2023 Regents of the University of Minnesota. All rights reserved.

37

Labor savings affects profitability

252 cow dairy – 4 robots at 3% wage inflation

Saving 15 minutes of labor/robot/day and similar milk

- **Net annual impact + \$5,532**
- **Can afford to invest an additional +\$152,177 in building costs to breakeven**



UNIVERSITY OF MINNESOTA EXTENSION

© 2023 Regents of the University of Minnesota. All rights reserved.

39

Milk production affects profitability

1575 cow dairy – 25 robots at 3% wage inflation

15 min more labor/robot/day and +0.45 kg/milk/cow/day

- **Net annual impact + \$13,741**
- **Can afford to pay milking labor employee's \$6.76/hr more and break even**

Same labor/robot/day and +0.45 kg/milk/cow/day

- **Can afford to pay milking labor employees about +\$7.06/hr more and break even**
- **Net annual impact +\$48,349**



UNIVERSITY OF MINNESOTA EXTENSION

© 2023 Regents of the University of Minnesota. All rights reserved.

40

What about hybrid systems

Advantages

- Maximize advantage of both systems
- Maximize robot capacity
- Minimize risk while learning new system
- Increased operational flexibility

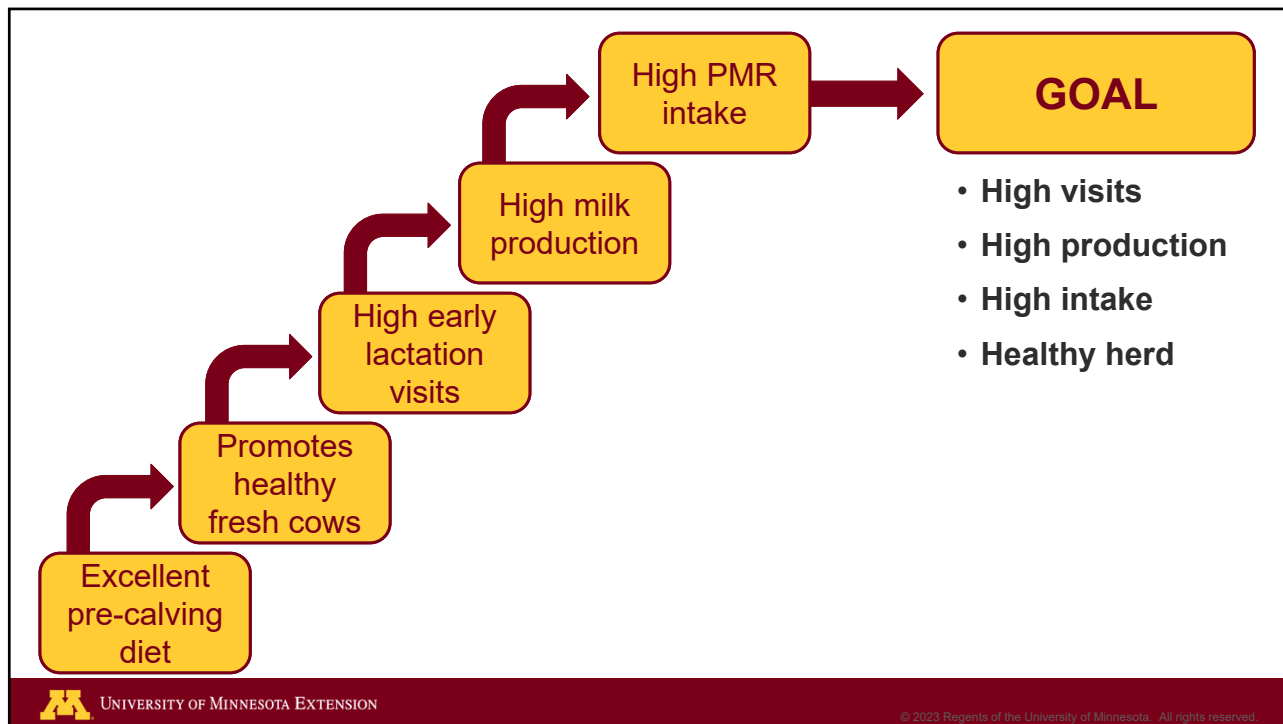


What about hybrid systems

Disadvantages

- Operating two systems
- Potentially less lifestyle improvement





53

Design barn for labor efficiency

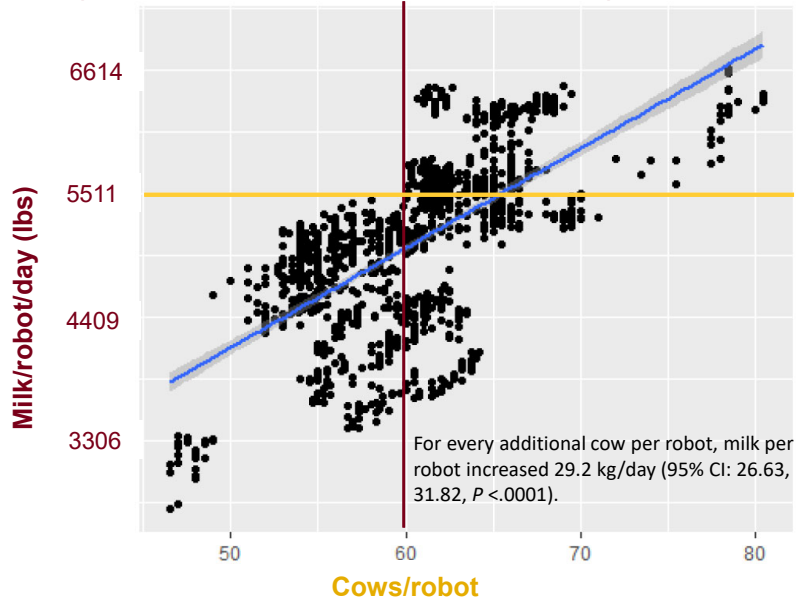
- Fresh cow management – how and where
- Separation pens
- Headlocks
- Drivers lanes
- Split entry to robot
- Strategically placed gates
- Well designed commitment pens for guided flow barns
- Foot bath location and design

UNIVERSITY OF MINNESOTA EXTENSION

© 2023 Regents of the University of Minnesota. All rights reserved.

61

As cows/robot increased milk/robot increased



UNIVERSITY OF MINNESOTA EXTENSION

Gednalske, MS thesis, 2021

© 2023 Regents of the University of Minnesota. All rights reserved.

70

Get fresh cows off to a good start

Train heifers: Practice the behavior you want in early lactation

– High visits early = high visits late = high milk

- First 2-3 days – teach them about the entire pen
- Fetch morning evening – and 1 or 2 times between
- Move slow
- “Guide” don’t “Chase” them to the robot
 - Chasing can lead to chronic fetching
 - Guide them in the direction of the robot



UNIVERSITY OF MINNESOTA EXTENSION

© 2023 Regents of the University of Minnesota. All rights reserved.

83

Robot items to consider

- Alarms are a pain
- Maintenance is expensive
 - Very important for maximum performance
- Light quarters
- Different manager/employee skill set

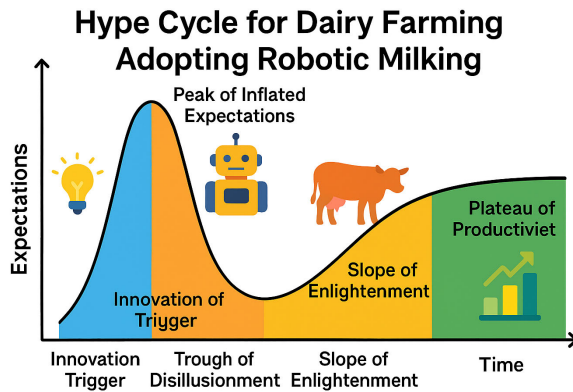


Have realistic expectations

- Higher repair costs
- Labor saved is often not as high as expected
- If family labor is saved – can't make robot payments
- Feed cost is higher
- Advantages – expand in stages
- More inconsistent performance than a parlor (changes in visits)
- Have realistic expectations



Where are you? – where are we as an industry?



- Innovation Trigger: Early excitement about automation and labor savings
- Peak of Inflated Expectations: High hopes for efficiency and cost reduction
- Trough of Disillusionment: Challenges with cost, maintenance, and training
- Slope of Enlightenment: Realistic benefits like improved animal welfare
- Plateau of Productivity: Widespread adoption with proven ROI



UNIVERSITY OF MINNESOTA EXTENSION

© 2023 Regents of the University of Minnesota. All rights reserved.

94

Summary

- **Labor cost and availability will continue to be a challenge**
- **Requires excellent management!**
- **Excellent transition program and high-quality forage**
- **Help the robot succeed**
 - Feed and milk access tables
 - Correct employees
 - Correct mindset/management
 - Best barn design
 - Robot Maintenance/cleanliness
 - Select right kind of cows
- **Whole system approach for best success**
- **Must make the cash flow work!**



UNIVERSITY OF MINNESOTA EXTENSION

© 2023 Regents of the University of Minnesota. All rights reserved.

104

Jim Salfer
salfe001@umn.edu

Excuse me,
I have a question.

A big thanks to:
Robot companies for their cooperation
Farmers that have cooperated on our projects
Students for collecting and summarizing data

 UNIVERSITY OF MINNESOTA EXTENSION