Time for Technology

The Cost Benefit of Automation for Feeding the Dairy Herd

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At the recent Progressive Dairy Operators Conference in Toronto, I was asked to speak on the cost benefit of precision technologies. I began my talk with a warning that any discussion of what things cost and what they are worth involves wading into a minefield of unknowns and misassumptions. The "process" of assessing cost benefit is simple enough. All that is needed is a "partial budget" in which you start with your current income and expenses and then look at the change in the bottom line, by summing up all the ways income and expenses change because of the new technology. But even on an individual case, coming up with an accurate prediction of expenses such as maintenance costs and depreciation for new technology is little more than a guessing game. Coming up with accurate values for benefits of adopting new technology is even harder. I often see "increased milk production" valued at $0.70 per liter but unless you have offsetting expenses for the extra feed and labour and quota ownership cost in the equation, that over values the benefit by at least $0.40 cents. Direct "hard" benefits like the reduced cash expenses for drugs when you switch from synchronized breeding to pedometers are the easiest to predict. Benefits from reduced labour can also be quantified quite easily and if it is paid labour that you can eliminate by reducing the number of employees, it has a direct pay back. If you reduce unpaid family labour, life gets better, but unless you spend that time making money some other way, it does not do much for your partial budget. "Soft" benefits like improvement in health, higher conception and more milk can all have a huge impact on the bottom line, but are much harder to put a dollar value on.

Generalizing about cost benefit across all dairy farms is an even bigger minefield, because for this, the logical assumptions will be the industry average or norm, which may be quite different from the numbers for individual farms. Nevertheless it can be a useful exercise to assess the overall potential of new technology. In Ontario, unattended robotic milking seems to have become mainstream in 2013, and it looks like the number of robotic milking units operating here could double this year. Milking is estimated to be the biggest single chore representing about 40% of the in- barn labour, so putting robots to work on this task addresses the biggest area of labour demand. But handling and delivering feed is also a large task and I predict that particularly robotic milking dairies will be looking to adopt robotic feeding systems in the next decade.

In 2010, members of the Progressive Dairy Operators (PDO) reported on the time and labour they used for preparing feed on their dairy farms, as part of the labour and wage survey they complete once every three years. This data, summarized in Table 1, is useful in assessing the potential cost benefit of automatic feeding systems. I have used these numbers before to demonstrate that equipment that pushes up feed, a task which takes 25 minutes per day on the average PDO dairy, comes within a dollar per day of breaking even on labour savings alone, if the person pushing feed is paid $17.69 per hour. I use this number here because it is the average wages and benefits, that PDO herds reported in 2013 for employees responsible for feeding. Add to that the soft benefits of more frequent push up, especially in the middle of the night, and this technology starts to make sense for the majority of freestall herds.

The potential for automating other aspects of feeding can also be explored using the averages reported in table 1. For example I know of several herds that have installed systems to automatically "prebatch" grains and other small ingredients. Based on the information in table 1, on the average survey farm adding these ingredients to the mixer takes 9.7 minutes per batch or 34 minutes per day. At the above wage that is worth $3660 in labour saving. In the partial budget this equipment does not lead to other changes in cost or other benefits. Using a figure of 11% per year for interest, depreciation and insurance the typical farm can invest $33,000 in a prebatching system and break even.

Automatic systems for filling track mounted mixers, or stationary mixers with belt feeders, from bins and tower silos have been around for many years, but for herds with bunker silos, most of these systems do not offer a good way to keep silage fresh. With these technologies, feeding is still a daily task, although the labour component would be reduced to "adding forage". This takes an estimated 44 minutes per day for the average PDO herd. If the delivery system also pushes up feed, feeding labour is reduced to just 44 minutes per day. Recently two companies have introduced automatic feeding systems that use block cutters to place feed from bunker silos in a "kitchen" from where it is automatically loaded into a TMR mixer. Both of these systems have been discussed in previous columns. Troliet uses a kitchen that moves the silage block forward and slices off an appropriate amount for the batch being mixed. The Lely Vector uses silage blocks placed on the kitchen floor that are loaded by a "grabber" mounted on moving rails above the feed storage area. Estimated capital costs for both of these systems is roughly $280,000. In the case of the Vector this breaks out as $210,000 for the equipment itself, $40,000 for the kitchen building, and $20,000 for a good block cutter. There is currently one Vector system running in Ontario on a farm milking 175 cows. The owner reports that keeping the kitchen tidy takes ten minutes per day and it takes 135 minutes twice a week to fill the kitchen. So the net labour saving compared to the average PDO herd, which just happens to be the same size, is 801 minutes per week or

694 hours per year worth $12277. Table 2 illustrates how these systems might compare financially to conventional TMR feeding. Of course both conventional and robotic feeding have their own set of soft benefits as well. For example the tractor you are writing off as "dedicated to making feed" can still be used elsewhere in a pinch, but a robotic system means no dirt and dust is coming in on tractor wheels. new barns designed for feeding robots will be a little cheaper to build because these systems operate in narrower alleys than conventional equipment. Of course the biggest soft benefit of robotic feed delivery will be feeding fresh feed 8 to 10 times per day, vs the 1.7 times reported by PDO herds with conventional technology. Although the research on feeding frequency is limited, work at the University of British Columbia reported that feeding four times per day reduced sorting and led to more uniform feeding behaviour throughout the day. Subordinate cows were not displaced from the feed bunk as frequently, and all cows spent more time at the feed bunk when they were fed more often. Resting times were the same as with once daily feeding.

It is noteworthy that with the assumptions made in table 2., for the average Ontario freestall herd, robotic feeding has a similar bottom line as conventional TMR technology. But these assumptions are based on the labour experiences of one owner, and no real experience at all with maintenance costs and other variables. The real cost benefit of these systems and where they will fit in the dairy farms of the future should become clearer as we gain more experience across a variety of situations in the next decade.

Herd Size Catagory (no. milking cows)	All herds	< 100	100 -199	200-299	≥ 300
No. of milking cows	174	77	141	238	415
No. of batches of TMR made per week	24.8	20.5	23	29.8	36.0
For Milking Cows, No. of times/day: Fed fresh feed	1.7	2.0	1.7	1.6	1.1
Feed is pushed up (time in min. /push in brackets)	4.2 (6.0)	3.7 (6.1)	4.1 (5.4)	5.2 (5.6)	4.0 (8.4)
For all batches of TMR, time (min./batch) to: Park the mixer	3.0	2.0	1.7	1.8	5.7
Add forages	12.3	13.5	12.7	11.1	10.6
Add grain	5.3	6.1	5.3	4.4	6.0
Add other ingredients	4.4	4.3	4.7	3.7	5.2
Mix and deliver	11.6	11.5	10.8	10.8	12.6
Total time per batch	36.4	37.8	36.2	32.6	39.7
Total time (min./day) for: Making and delivering TMR	129	111	119	142	204
Cleaning the manger	8.8	9.0	7.3	8.8	12.2
Pushing up feed	25.2	22.6	22.1	29.1	33.6
Total of all feeding activity	163	143	148	180	250
Total of all feeding activity per milking cow	0.94	1.86	1.04	0.76	0.60

Table 1: 2010 Progressive Dairy Operators Feeding Labour Survey Results

	Robotic	Conventional
Labour, 295 vs 986 hours @ $17.69	$5218	$17442
Depreciation, interest and insurance calculated at 11% per year on a robotic system worth $280,000 vs a dedicated tractor and mixer worth $160,000	$30,800	$17600
Maintenance	$7,000	$3,000
Fuel and Electricity	$2800	$7700
Total annual cost of feed handling	$45818	$45742

Table 2: Estimated annual cost of handling feed for a 175 cow dairy using Robotic or Conventional TMR technology