

An economic evaluation of automatic cluster removers as a labour saving device for dairy farm businesses

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Abstract. Automatic cluster removers (ACRs) are a popular device used for reducing labour requirements and improving conditions for workers and cows in the milking shed. An economic analysis was conducted on a range of milking sheds and herd sizes to determine whether the costs associated with the installation of ACRs can be justified on the value of the saved labour alone.

The analysis suggested that the technology could be a good investment in many Australian dairies, with a nominal internal rate of return (IRR) of up to 75%. The performance of the investment was dependant on being able to remove labour from the dairy after the installation of the devices. As the potential to make labour savings generally increases with shed and herd size, returns on investment also increased with these two factors.

While the cash labour savings are a major attraction to the adoption of new technologies, there are a number of costs and benefits that are difficult to quantify, but are important when considering an investment. These include herd health, occupational health and safety, worker comfort, and managerial control of the dairy shed.

Keywords: Cost Benefit Analysis, Partial Budget, Dairy Technology, Automatic Cluster Remover

Introduction

The labour associated with dairy farms in Australia is substantial. After feed costs, labour is the next largest expense on most Australian dairy farms, often up to 50% of overhead costs (Gilmour et al. 2010). Attracting and retaining quality labour is also often identified as a significant issue (Gilmour et al. 2010). One major requirement for labour is milk harvesting, which takes more than six hours per day on many dairy farms, and often requires more than one person (Moran 2002). The difficulty attracting and retaining skilled labour for milk harvesting is particularly challenging as the tasks rarely take place during normal business hours. Hence, there has been strong interest in labour saving devices for the milking shed. One such device is the automatic cup (or cluster) remover (ACR).

An ACR is an attachment on the normal milking cluster that measures the flow rate of milk from each cow in the milking shed. When the flow rate falls below a preset level, the ACR switches the vacuum off, and lifts the cluster into position to be reattached to the next animal (Stewart et al. 2002). These devices allow the clusters to be removed automatically without compromising the quality or quantity of milk harvested (Clark et al. 2004).

Automatic cluster removers are a popular labour saving technology in Australian dairies. A survey of Victorian dairy farmers found that almost 30% currently had ACRs, with the majority of those being in double-up herringbone dairies (Watson 2009). Of farmers planning on automating parts of their sheds, ACRs were the most popular first instalment, suggesting that farmers recognise the potential value of the technology.

Despite this apparent popularity, there is little economic analysis on the value of installing the technology. This paper describes an economic analysis of the installation of ACRs into the three most common milking sheds – the double-up herringbone, swing-over herringbone, and the rotary dairy.

Method

The value of installing ACR technology in a range of dairy sheds was tested. Swing-over dairies with 15 and 25 clusters were analysed, milking either 150 or 300 cows. Three double-up dairies, with 16, 28, or 50 clusters were tested. The smaller two sheds were analysed using either 150 or 300 cow herds, while the 50 unit dairy was tested with 300, 500 and 600 cow herds. A 50 unit rotary dairy was analysed using herds of 300, 400 and 600 cows. The labour requirements, time taken to milk, and potential savings for each dairy are listed in Table 1.

A partial budget projecting the discounted net cash flow over a 10 year period was used to analyse all systems. The method used the economic assessment of farm management changes described in Malcolm et al. (2005). This was a modified version of an economic analysis of other labour saving devices by Armstrong and Ho (2009). The nominal internal rate of return (IRR), the years to break even and the net present value (NPV) were used as the key economic measures.

A nominal IRR of greater than 10% was used as the criteria for judging the investment as worthwhile on economic grounds alone. A return of between 5% and 10% would require additional benefits for it to be considered a reasonable investment. Any returns below 5% per year were not considered sufficient to meet the opportunity costs of the expenditure.

It may not be possible to achieve these labour savings on all properties – so the sensitivity of the returns to labour savings was also tested.

Assumptions

The assumptions made in the economic analysis were made with the assistance of scientists and extension officers at DPI Ellinbank. All assumptions have been validated by a steering committee of farmers, consultants, scientists and economists in the Northern Irrigation Region of Victoria. The key assumptions are outlined below.

- Labour was costed at $25/hour
- It was assumed that ACRs would not reduce the time taken to milk, but would reduce the labour requirement during that time.
- Labour requirements and savings were recorded as an annual figure. For example, 1.5 labour units means two labour units were required for half of lactation, and a single labour unit milks for the rest of lactation.
- All cows have a 300 day lactation, and are milked twice per day.
- Milking time is a function of herd size, shed type and shed size.
- ACRs cost $1,700 per cluster, with $15 maintenance cost per cluster per year. Maintenance costs did not change with herd size.
- An automatic teat spray unit was included (at a cost of $6,000 per shed), and used the same chemicals as a hand spray.

Results and Discussion

Swing-over dairy

Automatic cluster removers could be justified by the value of labour saved alone in the 25 cluster shed, at both herd sizes (Table 2). The IRR ranged between 26 and 75%, with a strongly positive NPV. The technology allowed the shed to be run by one person for the majority of the year, saving almost a whole labour unit. The second person would be required only during peak periods.

The investment remained attractive (nominal IRR of 29%) if half of the expected labour savings could be made with the 300 cow herd. Intangible benefits would have to be valued by the operator to justify the investment with lower labour savings and a 150 cow herd (7% nominal IRR).

Similarly, the smaller 15 cluster shed required the larger herd size to justify the investment (nominal IRR of 13%). Labour savings were more difficult to find in this situation, as the shed can generally be milked by one labour unit without automated technology such as ACRs. The investment earned negative returns with both herd sizes when only half the expected labour savings could be achieved. Despite this, the investment may still be of value if other factors, such as worker comfort and fatigue are important.

Rotary dairy

Using the assumptions of this analysis, the installation of ACRs is a good investment in a 50-unit rotary dairy irrespective of herd size (Table 3). The savings were achieved by effectively turning a 'two person' shed into a 'one person' shed for the majority of the year (Table 1).

The return on investment increased with herd size, from an IRR of 20% with 300 cows to 59% with 600 cows. Both scenarios had the same initial set-up and annual repairs and maintenance costs. Milking the larger herd would take over two hours longer per day compared with milking the smaller herd. As labour savings were based on an hourly rate, a longer milking time would always result in higher cash savings, further diluting the cost of the investment, and increasing returns.

The sensitivity of the results to labour savings was tested (Table 3). Only the largest herd size tested (600 cows) continued to justify the investment on economic grounds alone when labour savings were halved, earning a nominal IRR of 21%. A nominal IRR of 9% when milking 400 cows was close to justifying the investment, and would probably require only minor intangible benefits for ACR installation to be worthwhile.

If a labour unit could only be removed from the milking shed for half the year, then the IRR dropped to a point where the investment could no longer be justified when milking 300 cows (IRR of 3%). Non-economic benefits would be required to justify automation when milking 600 cows (IRR of 9%).

Double-up dairy

The 8 cluster per side dairy was assumed to be operated with one labour unit for the majority of the year, allowing for few labour savings through automation. The other extreme was the 50 unit 'double-up', with 25 clusters per side, where a whole labour unit could be removed from the shed by installing ACRs.

The investment of ACRs appeared attractive in the majority of scenarios analysed (Table 4). The only option that did not justify automation on labour savings alone was the 16 unit dairy with the smaller herd size. The longer milking time of 300 cows was required to generate sufficient labour savings to offset the cost of the investment.

In the larger dairies (28 and 50 clusters), the installation of ACRs could be justified for all herd sizes analysed, as their installation meant that a labour unit could be removed from the milking shed for at least half the year. This would be a substantial cash and management saving to a dairy business.

Herd size became a more important determinant when only half the expected labour savings were achieved (Table 4). Installation of ACRs in a 28 unit dairy may be worthwhile when milking 300 cows, but not a smaller herd size. To justify the 50 unit double-up, milking more than 400 cows was required to justify on labour savings alone. With a 300 cow herd, intangible benefits of value to the owner-operator may be sufficient to justify the investment with half of the expected labour savings. It was not possible to generate sufficient cash savings with the 16 unit double-up dairy.

Intangible costs and benefits

Herd health *The effect of ACRs on herd health is debatable, and depends heavily on shed design and quality of staff. Automatic cluster removers do have the potential to reduce mastitis associated with over-milking, by stopping the vacuum when milk flow falls (Klindworth* et al*, 2003). There is a wide variety of ACR systems available, from the basic to the technologically advanced. For example, some ACR systems can detect flow per quarter, and shut down the vacuum one teat at a time – eliminating over-milking in a given quarter. When combined with electronic ID, the more advanced ACRs compare milk yield with yield for the same cow at previous milkings. An alert is raised if there is a substantial difference, for example, if the cups have been kicked off, leaving a cow only partially milked. It is important, when selecting an ACR system, to understand the costs and benefits of each of these options to find a system to best meet the needs of the farm in question.*

The important concern regarding herd health is more acute in rotary dairies. By removing the person at 'cups-off', the opportunity to detect inflamed or damaged teats is removed, making the early detection of mastitis more difficult. Picking up these diseases and problems early can be invaluable in maintaining a healthy herd and a low bulk milk cell count. In a herringbone shed, there is the opportunity to glance over the udders before cows are released, potentially identifying damage early. Some more advanced ACRs contain technology to identify and alert the milker to the symptoms of mastitis. However, these are significantly more expensive than the ones used in this analysis.

The change from manual to automatic teat spraying may also have an effect on herd health, depending on the way teats are currently treated after milking, and the efficacy of the automatic teat spray unit chosen.

In his 1984 survey of Western Australian dairy farmers, Olney found no significant difference in the somatic cell counts of farms before and after the installation of automatic cluster removers.

Increase managerial control of milking shed This is a point of real value for farm managers who regularly use relief milkers, or have trouble finding reliable staff. By using ACRs, a manager can ensure that cows are not over or under milked. By altering the cut-off point for the ACRs, the manager is able to find the optimal balance between time spent milking and the residual volume of milk in the udder. Once this level is set, the manager knows that the cows will be milked to the same level at every milking, irrespective of the staff member employed. Olney (1984) found that over half made greater use of relief milkers after the installation of the technology. For single calving herds, the ACR cut-off level can be altered to match stage of lactation.

The flow meters are inclined to drift over time in ACRs. It is recommended that the recorded and the vat milk volume are compared regularly. If there is a large difference, then the ACRs might require recalibration.

Improve worker comfort (lifestyle) Automation can make the task of milking easier, by removing some of the more laborious tasks, such as cup removal. In turn, labour can be better streamlined and tasks completed less strenuously. Klindworth (2003) recommends ACRs as a technology to reduce the stress or pressure placed on workers during milking. Automation can also allow an owner or manager to allocate more time to other aspects of the business.

It is noted that ACRs will do little to improve working conditions for employees if the shed is poorly designed or maintained.

Occupational health and safety (OH&S) During a typical milking in a non-automated shed, one labour unit often lifts and moves an accumulated weight of over 1 tonne. This is a significant OH&S issue that can be almost halved through the installation of ACRs

(Cowtime, 2006). Depending on the placement of the cups after removal, bending, reaching, and lifting can be minimised. This is of significant benefit to staff in terms of enhanced comfort and reduced fatigue. The farmers interviewed by Olney (1984) reported that making milking easier was just as important as saving labour.

On the other hand, there are some OH&S concerns when converting a shed to a single labour unit set up. If there is only one labour unit, then injuries may go unnoticed or unreported, or, if the injury is serious, there is no one present to render assistance.

Flexibility and risk management While ACRs can be used to reduce labour requirements, they can also be used to improve the productivity and flexibility of the available workforce. If an employee is ill, it is possible for the shed to be managed by a reduced number of people. It also allows managers to gear operations to the tasks that must be completed. When the milking shed is busy, such as during calving or as heifers are introduced, it can be geared up with more labour units. When milking is less busy, then staff can be assigned to other tasks around the farm.

Conclusion

Installing ACRs is an attractive investment for a number of herd sizes and shed designs and sizes (cluster numbers), if the labour savings used in this analysis can be achieved. However, the economic performance is very sensitive to labour savings. When only half of the potential labour savings can be achieved, attractive returns from investing in ACRs are limited to the larger herd sizes and respective shed sizes.

Whilst this is an economic analysis, on-farm decisions are often also based on a range of factors that are difficult to quantify. Technology such as ACRs may be installed in sheds where they might not provide a high return on the capital, but where they provide some other benefits in the management of staff, herd health, or lifestyle. These reasons may be as persuasive as the economics, and so should be analysed and considered on an individual basis.

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Appendix

Table 1. Dairy size, efficiency and labour requirement by shed-type

	Swing-over		Double-up		Rotary	
Cluster Number	15	25	16	28	50	50
Cows/Cluster/Hour	7	7	5	5	5	6
Installation Cost	$31,500	$48,500	$33,200	$53,600	$91,000	$91,000
Annual Maintenance (per year)	$150	$250	$160	$280	$500	$500
Labour to Milk before ACRs (FTE)	1.1	2	1.1	2	3	2.5
Labour to Milk with ACRs (FTE)	1	1.25	1	1.5	2	1.5

Table 2. Labour savings and economic returns from ACR installation in a 'swing-over' dairy, with sensitivity to labour savings

'Swing-over'	Full potential labour savings				Half potential labour savings			
Cluster number	15	15	25	25	15	15	25	25
Herd size (cows)	150	300	150	300	150	300	150	300
Milking time (Hours)	1.5	3.0	0.9	1.8	1.5	3.0	0.9	1.8
Labour savings ($,thousands/year)	2.2	4.5	10.1	20.2	1.1	2.2	5.4	10.7
Years to break even *	>10	7	4	2	>10	>10	9	4
Net Present Value+ ($,thousands)	-16	0.0	24	96	-22	-13	-5	38
Nominal Internal Rate of Return (%)	-1	13	26	75	-9	-1	7	29

* Before Interest, +At 10% discount rate

Table 3. Labour savings and economic returns from ACR installation in a 'rotary' dairy, with sensitivity to labour savings

'Rotary'	Full potential labour savings			Half potential labour savings		
Cluster number	50	50	50	50	50	50
Herd size (cows)	300	400	600	300	400	600
Milking time (Hours)	1.1	1.5	2.2	1.1	1.5	2.2
Labour savings ($,thousands/year)	16.4	21.8	32.7	8.2	10.9	16.3
Years to break even *	5	4	2	10	8	5
Net Present Value+ ($,thousands)	26	64	144	-34	-3	41
Nominal Internal Rate of Return (%)	20	32	59	3	9	21

* Before Interest, +At 10% discount rate

Table 4. Labour savings and economic returns from ACR installation in a 'double-up' dairy

'Double-up'	Full potential labour savings						
Cluster number	16	16	28	28	50	50	50
Herd size (cows)	150	300	150	300	300	400	600
Milking time (Hours)	1.9	3.9	1.1	2.2	1.3	1.7	2.5
Labour savings ($,thousands/year)	2.9	5.9	8.4	16.7	18.7	25.0	37.5
Years to break even *	>10	5	6	3	5	3	2
Net Present Value+ ($,thousands)	-12	9	6	67	43	88	179
Nominal Internal Rate of Return (%)	3	20	16	48	25	39	73

* Before Interest, +At 10% discount rate