WORKING SMARTER NOT HARDER IN THE DAIRY SHED

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Introduction

In September 1897 John Blake moved from Lincoln in Canterbury to a new farm in Taranaki. It was his wife’s job to milk their 20 cows by hand, however, she contracted milk eczema and could not do it anymore. They had two options: either Blake had to do the milking himself; or buy one of the new-fangled milking machines that were coming onto the market.

In 2007, a similar situation is developing on many New Zealand dairy farms, only this time it’s not milk eczema forcing farmers to look for alternative methods for carrying out manual jobs, but a worldwide shortage of skilled people.

Milking accounts for a significant portion of the total labour input on dairy farms and is the task that has a major influence on work patterns, hours of work, work conditions and lifestyle opportunities for dairy farmers and their employees. In addition to streamlining work routines, there are well established locally and internationally sourced technologies available to ease the situation. Many are available ‘off the shelf’ while others will require development to meet the specific requirements of New Zealand farming conditions. Both however, will require a mindset change by farmers with respect to the value of automation technology and a willingness to work smarter and not harder, if they are to be widely and successfully adopted.

This paper:
• assesses the reasons labour has become an issue for farms, considering national and international labour projections
• provides tools for benchmarking the milking operation and outlines what options are available to improve milking management

Notes:
• takes a look at how one farmer is using technology to achieve labour and performance targets, and
• describes what the milking and animal management systems may look like in the future.

**Why is labour becoming a major issue for the dairy industry?**

In the OECD in the next 25 years 70 million people will retire. They will be replaced by 5 million workers. In the past 25 years 45 million pensioners were replaced by 120 million baby boomers. The numbers are startling and seem far removed from the issues relating to staffing farms, however, the larger picture of world demographic change clearly shows that the dairy industry is not alone in facing labour shortages.

New Zealand is experiencing record low unemployment (3.6%) and record high workforce participation. This means that fewer people are looking for work, resulting in intense competition for good staff and increasing labour costs. Labour force and population projections indicate that the workforce is ageing and becoming more ethnicity diverse.

On dairy farms the total labour requirement (effective full-time equivalents - FTE) is relatively stable at 25,000 to 30,000. What has changed significantly is who is doing the work, with a dramatic increase in paid labour (up 118% from 0.54 FTE to 1.18 FTE/farm over the 9 years to 2005).

The labour forecasts suggest that to achieve the productivity targets set by the industry farm owners will have to:
• do more of the work themselves and/or
• redesign work tasks to be more attractive and competitive to staff and/or
• find ways to achieve greater output with less time input.

**Labour productivity and milk harvesting**

Labour productivity is the ratio of some measure of output to labour input, in hours:

\[
\text{Labour Productivity} = \frac{\text{Outputs}}{\text{Inputs (hrs)}}
\]

There are a number of measures of labour productivity on dairy farms, each reflecting a different aspect or emphasis. For example, labour cost/kgMS is a financial measure and hours worked/kgMS is a measure of sustainability. Table 1 shows that over the past decade there have been positive gains in labour productivity as measured by cows/FTE, kgMS/FTE and labour cost/kgMS.
Table 1: Farm demographics and measures of labour productivity (Cows/FTE, kgMS/FTE and labour cost ($/kgMS) from 1994/95 through 2004/05 (Dexcel ProfitWatch)

<table>
<thead>
<tr>
<th>Year</th>
<th>Herd size</th>
<th>FTE¹</th>
<th>Production (kg MS)</th>
<th>Total Labour cost ($/farm ²)</th>
<th>Cows /FTE</th>
<th>Kg MS/FTE</th>
<th>Labour cost ($/kg MS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994/95</td>
<td>297</td>
<td>1.84</td>
<td>53,286</td>
<td>66,041</td>
<td>99</td>
<td>28,960</td>
<td>1.24</td>
</tr>
<tr>
<td>1995/96</td>
<td>199</td>
<td>1.87</td>
<td>55,015</td>
<td>67,809</td>
<td>98</td>
<td>29,420</td>
<td>1.23</td>
</tr>
<tr>
<td>1996/97</td>
<td>208</td>
<td>1.87</td>
<td>58,906</td>
<td>67,134</td>
<td>102</td>
<td>31,501</td>
<td>1.14</td>
</tr>
<tr>
<td>1997/98</td>
<td>220</td>
<td>1.95</td>
<td>59,026</td>
<td>64,241</td>
<td>102</td>
<td>30,270</td>
<td>1.09</td>
</tr>
<tr>
<td>1998/99</td>
<td>229</td>
<td>1.92</td>
<td>61,792</td>
<td>69,870</td>
<td>116</td>
<td>32,183</td>
<td>1.13</td>
</tr>
<tr>
<td>1999/00</td>
<td>236</td>
<td>1.87</td>
<td>68,789</td>
<td>74,883</td>
<td>121</td>
<td>36,786</td>
<td>1.09</td>
</tr>
<tr>
<td>2000/01</td>
<td>251</td>
<td>2.10</td>
<td>79,857</td>
<td>85,143</td>
<td>120</td>
<td>38,027</td>
<td>1.07</td>
</tr>
<tr>
<td>2001/02</td>
<td>271</td>
<td>2.02</td>
<td>77,370</td>
<td>86,135</td>
<td>119</td>
<td>38,302</td>
<td>1.11</td>
</tr>
<tr>
<td>2002/03</td>
<td>285</td>
<td>2.17</td>
<td>89,463</td>
<td>94,678</td>
<td>124</td>
<td>41,227</td>
<td>1.06</td>
</tr>
<tr>
<td>2003/04</td>
<td>302</td>
<td>2.44</td>
<td>100,122</td>
<td>103,233</td>
<td>119</td>
<td>41,034</td>
<td>1.03</td>
</tr>
<tr>
<td>2004/05</td>
<td>315</td>
<td>2.35</td>
<td>97,573</td>
<td>102,349</td>
<td>126</td>
<td>41,520</td>
<td>1.05</td>
</tr>
</tbody>
</table>

¹Full time equivalent (FTE). Includes paid and family labour (based on 2400 h/yr/FTE).
²Includes management wage for family labour input.

The efficiency of a farm’s milking operation will have a significant influence on overall labour productivity. It is a major, labour intensive undertaking and a routine that has a significant influence on work patterns, hours of work, work conditions and lifestyle opportunities for dairy farmers and their employees. There is little data on the contribution that milking makes to the labour needs on dairy farms. In recent workshops farmers indicated that milking accounted for 50-70% of labour required on their farms (Ohnstad and Jago, 2007).

**Benchmarking milk harvesting labour productivity**

We cannot manage what we cannot measure.

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Notes:
The first step in identifying opportunities for change is to assess current performance against a benchmark. The following are useful calculations for gauging milk harvesting, labour productivity:

- cows/operator/hour (from cups on to cups off)
- litres/operator/hour (from cups on to cups off)
- clusters per operator
- cows per cluster per hour
- litres per operator per hour

Data from a large number of Australian farms have been collected to produce industry benchmarks for each of the measures and these are available on the Australian Milk Harvesting Centre website (www.cowtime.com.au). For example, benchmark data for the measure cows per operator per hour (cups on to cups off) indicate a maximum throughput achieved for the rotary dairy was 245 (50% percentile = 110, 75% percentile = 125) and for the herringbone/swingover dairy 160 cows/operator/hr (50% percentile = 65, 75% percentile =80).

There are no equivalent data for New Zealand farms. Clearly this is an area that requires effort to provide farmers with meaningful standards with which to benchmark their milking operation.

A small study carried out in 2006 observed the milking operations on 10 Waikato farms for 4 milkings (two AM and two PM) in mid/late lactation. The work tasks of all staff involved in the milking operation were recorded and data used to calculate efficiency measures and gain estimates of where time was spent. Milking was divided into three key tasks as described in Table 2. The observations showed that on average 17% of the time was spent fetching cows and preparing the shed for milking; 62% on milking tasks and 21% on clean-up tasks and shutting cows away (Ohnstad and Jago, 2007).

**Table 2**: The three major tasks involved in milking and percentage of time spent on each task by 10 study farms observed over 4 milking in Feb/March 2006.

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>% of Time (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>Fetching cows, setting shed up.</td>
<td>17.3% (12-22)</td>
</tr>
<tr>
<td>Milk Harvesting</td>
<td>Attaching &amp; removing cups, activities associated with getting cows onto and off the platform or row, teat spraying, washing between cows, fixing equipment such as hoses, detecting unwell cows or abnormal milk and attending to health herd.</td>
<td>Total: 61.1% (55-65) Cupping: 28.0% (22-39)</td>
</tr>
<tr>
<td>Clean-up</td>
<td>Cleaning the plant and yard and shutting the cows away.</td>
<td>21.6% (12-29)</td>
</tr>
</tbody>
</table>
Table 3 provides a further breakdown of each task for six of the larger observed farms as these are most relevant to South Island dairy operations. The total time is an average for the two days and gives the total amount of time spent (including all staff) each day on all activities associated with milking (e.g. 2 people spending 3 hours each milking equals 12 hours total time per day to harvest milk).

Notes:
Table 3: Summary data from four observations of milk harvesting (2xAM and 2xPM) on six Waikato dairy farms undertaken in February 2006 (mid/late lactation). Time (hours:minutes) spent on each activity is for a 24 hour period and includes all person hours (from Ohnstad and Jago, 2007).

<table>
<thead>
<tr>
<th>Farm</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows</td>
<td>553</td>
<td>404</td>
<td>468</td>
<td>653</td>
<td>545</td>
<td>767</td>
</tr>
<tr>
<td>Dairy (type:no. clusters)</td>
<td>HB:36</td>
<td>HB:30</td>
<td>ROT:24</td>
<td>ROT:60</td>
<td>ROT:50</td>
<td>ROT:50</td>
</tr>
<tr>
<td>Herds</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Breed</td>
<td>F/UXJ</td>
<td>J</td>
<td>F</td>
<td>F/UXJ</td>
<td>F/UXJ</td>
<td>F/UXJ</td>
</tr>
<tr>
<td>Automation¹</td>
<td>Nil</td>
<td>Nil</td>
<td>ACR/TS</td>
<td>TS</td>
<td>ACR</td>
<td>ACR/TS</td>
</tr>
<tr>
<td>People</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Yield (L/d)</td>
<td>7,374</td>
<td>5,013</td>
<td>5,267</td>
<td>9,768</td>
<td>9,000</td>
<td>13,155</td>
</tr>
<tr>
<td>Activity</td>
<td>Preparation</td>
<td>3:02</td>
<td>1:52</td>
<td>1:07</td>
<td>2:37</td>
<td>2:22</td>
</tr>
<tr>
<td></td>
<td>Cups off</td>
<td>N/A*</td>
<td>N/A*</td>
<td>-</td>
<td>2:24</td>
<td>0:07</td>
</tr>
<tr>
<td></td>
<td>Teat spraying</td>
<td>0:50</td>
<td>0:34</td>
<td>-</td>
<td>-</td>
<td>0:55</td>
</tr>
<tr>
<td></td>
<td>Herd health</td>
<td>0:50</td>
<td>0:06</td>
<td>0:29</td>
<td>1:55</td>
<td>0:41</td>
</tr>
<tr>
<td></td>
<td>Other³</td>
<td>5:20</td>
<td>2:47</td>
<td>1:14</td>
<td>2:30</td>
<td>2:57</td>
</tr>
<tr>
<td></td>
<td>TOTAL (cups on-cups off)</td>
<td>10:43</td>
<td>6:02</td>
<td>4:06</td>
<td>10:11</td>
<td>6:51</td>
</tr>
<tr>
<td></td>
<td>TOTAL (all hh:mm)</td>
<td>16:49</td>
<td>9:15</td>
<td>6:20</td>
<td>15:56</td>
<td>11:29</td>
</tr>
<tr>
<td></td>
<td>Rotation speed</td>
<td>N/A</td>
<td>N/A</td>
<td>6:23</td>
<td>9:26</td>
<td>7:13</td>
</tr>
<tr>
<td></td>
<td>Cows/h</td>
<td>103</td>
<td>133</td>
<td>205</td>
<td>128</td>
<td>159</td>
</tr>
<tr>
<td></td>
<td>L/h</td>
<td>687</td>
<td>829</td>
<td>1283</td>
<td>957</td>
<td>1312</td>
</tr>
<tr>
<td></td>
<td>Time/cow/d</td>
<td>1:10</td>
<td>0:54</td>
<td>0:32</td>
<td>0:56</td>
<td>0:45</td>
</tr>
</tbody>
</table>

¹ ACR - automatic cup remover; TS – automatic teat sprayer
² Includes taking cups off one cow and putting them on the next for Herringbone dairies
³ Includes maintaining cow flow, fixing equipment, hosing during milking, putting cups back on, putting chains up.
The data show that milking takes a significant amount of time on some dairy farms (close to 17 operator hours in 24hr to milk 553 cows twice a day on one farm and almost 16hr to milk 653 cows twice a day on another). There was a two-fold difference across the farms in the number of cows milked per hour (from 103 to 217 cows per hour) including all labour required from time the first cups went on until the last cups came off.

The data collected were on a very small scale and during mid/late lactation, however it clearly demonstrated that room exists for improvement on some of the farms observed. Technology has a pivotal role to play in increasing labour productivity, which is evident when the differences between Farms 3 and 6 are investigated. Farm 6 had installed automatic cup removers (ACR) and a teat sprayer whereas Farm 3 did not have ACR but did have an automatic teat sprayer. Farm 6 achieved 220 cows/hr compared with Farm 3 at just 120 cows/hr. Overall, Farm 3 spent an additional 1207h (assuming 270 days milking) harvesting milk than Farm 6, 39% longer to milk fewer cows.

**Options for improving milking efficiency**

Successful milking is achieved through a partnership between cows, people and technology. All three need attention if maximum performance is to be achieved.

*Think ‘cow’*

Good cow flow has nothing to do with how old the dairy is. It is all to do with the cow being happy and comfortable (Jan Fox, 1994). Milking should be a pleasant experience for cows. They have excellent memories for people and places so interactions with people need to be calm and positive. Put away the alkathene pipe, lay off the backing gate and keep the loud and sudden noises down. Heifers and new cows need to be trained before the start of the season. They are the new recruits in your team and need to be familiarised with their work environment just as new staff do. Take care to minimise the chance of teat damage and mastitis. Any women who have breastfed their babies and endured cracked teats, mastitis and poor attachment knows what this feels like, and will leave you in no doubt that it is very painful and not conducive to good milk letdown.

Notes:
Think 'people

“What is the most important thing? It is the people, it is the people, it is the people”. Work conditions have a major impact on people’s attitudes and ability to get the job done effectively and efficiently. Generally the changes required are small but have a big impact. Examples include correct lighting (makes it easier to identify mastitis and cows on heat), rubber mats or grating to reduce soreness in the legs and back, warm water hand-washing hose, step-up rail on side of pit (makes reading ear tags/tail paint easier, means a greater range of people can do the job and because it is easier it is more likely to get done!). There are many more ideas on the Dexcel website (look under “People and Farms”).

Taking the time to make sure all staff receive the appropriate training for the numerous tasks they are required to carry out during milking and in particular for any new technology is critical.

Think ‘dairy design and technology

The design of the dairy and work routines have a major influence on the milking performance of both cows and people. Improvement in dairy design has produced quantum advances in milking efficiency over the past 50 years. The introduction of the herringbone increased cow throughput from 30 cows/operator/hour to around 100 cows/operator /hour and some rotary installation operators are now achieving well over 300 cows/operator/hour.

The herringbone is still the most common type of dairy in New Zealand but the number of rotary installations is increasing rapidly (Figure 1). Overall the proportion of the national herd milked through a rotary had risen to 34% in 2005, up from 18% in 1995. Larger herds tend to be milked through a rotary and in 2005 the average size of herds milked in herringbone and rotary dairies was 289 and 537, respectively.
Figure 1: (a) Distribution (%) of dairy shed type in New Zealand (1973/74 to 2004/05); (b) Total cow and herd numbers and herd size in New Zealand for 1974/75 to 2004/05.

Automation

Once the number of milking units is no longer the barrier to improved throughput, further improvement can only be achieved by removing elements of the operator work routine from the milking process. The job can be made more efficient and less physically demanding through the use of automation.

Each hour contains 3600 seconds. If all the tasks associated with the successful milking of one animal takes 30 seconds, then the maximum number of animals per hour the operator can milk is 120 cows. Unless progress can be made to reduce the time associated with elements of the work routine, there is little potential gain in efficiency to be obtained by installing larger dairies with more milking units. Further gains in productivity need to be obtained either by examining the milking routine or substituting labour with automation.

When a higher level of technology is implemented a more rigorous repair and maintenance program is necessary. This is important, because to get full benefit from the investment, equipment must be given the chance to perform through regular servicing.

Notes:
Think ‘teamwork’

Having considered options for change in each of the three key areas, an assessment of the overall functioning of the cow/people/technology partnership is important. Teamwork refers to the combined efforts of the cows, the people and the technology. Problems in one will affect the others. For example, if cows are fearful during milking because of poor liner choice or milking machine settings causing teat damage or painful milking, they will not be willing to enter the dairy unassisted, they will be unsettled during milking causing a slower milk let down response and much more. This irritates staff, cows take longer to milk, and there is more muck to clean up so the whole milking process takes longer. People are then less motivated and have less energy to complete other farm work.

Lessons from a farmer seeking milking efficiency gains

Farm Profile:

<table>
<thead>
<tr>
<th>Ownership structure</th>
<th>50:50 Equity Partnership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land area</td>
<td>245 ha (220 effective)</td>
</tr>
<tr>
<td>Cows</td>
<td>650</td>
</tr>
<tr>
<td>Staff</td>
<td>3FTE (made up of owner/manager, 2 farm assistants, relief milker, calf rearer)</td>
</tr>
<tr>
<td>Hours of work</td>
<td>48 wks worked, 45h/wk, 103 days not worked, every second weekend off</td>
</tr>
<tr>
<td>Dairy</td>
<td>54 bail rotary, WestfaliaSurge</td>
</tr>
<tr>
<td>Automation</td>
<td>EID, auto-drafting, milk flow rate and volume meters, teat sprayer, pedometers (heat detection), milk conductivity measuring, auto-start cups, cow retaining arms</td>
</tr>
</tbody>
</table>

Labour productivity measures

| Cows/FTE          | 227 |
| MS/FTE            | 83,300 |
| Hrs worked/kgMS   | 1.6 |
| Hrs worked/cow    | 10.0 |

In 2003 Andrew and Jenny Calder made major changes to their farm dairy. This coincided with the purchase of a new property and a desire to lift its productivity and efficiency. After researching a number of options they decided to invest in a 54 bail rotary with as much automation as their budget could afford. A realisation in the decision was that you cannot automate partially. The following is an account of the impact the technology has had on the farm and importantly the people.
Automation technologies that have had the most impact in the dairy

Electronic ID

Without the ability to identify the cow correctly, and her position in the shed, no other feature would be as much use. Collars were chosen over ear tags as they offered a higher degree of accuracy. A small difference in accuracy makes a big difference operationally and it would drive staff mad having the lower accuracy. On the whole, if the system is asked to draft out 10 cows it is those cows that are in the drafting pen and this flows through to all the processes for which EID is used.

Drafting

This is perhaps the most obvious feature in the shed. The shed operator can draft a cow by pressing a button at the bail, very useful when mastitis is seen at cupping. The operator can easily ask the system to draft a particular cow seen to be lame whilst walking to the shed. The system can draft cows on predetermined dates as defined by the farmer, e.g. cull cows going to the works or CIDR cows to be treated. The system will draft based on criteria selected, e.g. cows on heat or cows losing weight or two year olds.

Feeding

Automation of the farm system now includes supplementary feeding in the cowshed. Because there is less labour on farm then there is also less labour available for other jobs, such as feeding silage. With the ability to feed individual cows different amounts of feed, or types of feeds, the aim is to increase feed efficiency and also help match cow energy/nutrition requirements better. For example, an empty fat cow will receive a different level of supplement than a high producing cow losing weight.

Notes:
Milk metering

Each cow’s milk production is recorded at every milking. Based on the premise that milk production will change with illness or heat etc this is a very valuable piece of information. As well as total volume, the rate of flow is recorded, which has proved helpful in detecting cows on heat.

Information gathering and interpretation

The herd management software gathers a lot of data and the analysis of that data is very useful in driving profitability, easing management and also increasing personal interest in the herd and overall farming operation. If the data and technology are not utilised it is a bit like owning a Ferrari and only driving in second gear!

The amount of data recorded daily is huge. The big benefit is that the manager sees the changes in the data, so mastitis is detected earlier and lame cows are treated earlier. Ideally, the goal is to become a proactive manager of the cows rather than reactive. For example, lower milk production from lame cows and the ease with which cows can be drafted results in the cow being treated on day 1-3 of lameness instead of on day 7 when she is severely lame.

Impact on staff rosters, hours of work and time off

The aim is to have a weekly work load of 45 hours averaged over the year and at least 120 days not worked, things that on an annual basis are more attractive than most jobs in town. The automation technology has meant that it has been very easy to include the four week annual leave legislation without further cost to the business. The general roster has one person getting to work at 04:15-04:30 beginning milking at 05:15, finishing that herd at 06:45 then heading home for breakfast after working for 2 ½- 3 hours. The second person starts at 05:30 collecting and milking the second herd, finishing around 08:00. On the weekends relief milkers are employed to do all the cupping, enabling the permanent staff member working to bring cows to the shed and not only monitor cow and grass positions, but also allowing time during milking to put up fences, shift irrigators etc. The technology allows:

- shorter periods of work, ie, 3-4 hour stints
- more productivity per hour 350-400 cows milked/h/labour unit with supplement fed
- the milking itself is very easy and so can appeal to a wider range of people
- less stress; the technology looks after the cow on the platform so it is no problem to stop for a rest
- the manager to access valuable and accurate data on the herd without having to milk.

Barriers to getting the most from investment in technology
Initially the greatest barrier was the operators’ (managers/owners) own paradigms. It is important to work hard at thinking differently about how the farm could operate. Other barriers include:

- time to learn the capabilities of the software that is used to manage the shed and the data generated.
- staff buy-in to the technology. If the data are not analysed and used then it is a waste of money.
- fully automating the system, not partial, eg, installing ACR but still having a staff member teat spray.

**Time savings seen from the investment**

At mating, milking and AI are easily completed with 2 staff, which is estimated to save 1-1.5 labour hours/day.

Auto drafting saves at least 3 hours per week, given drafting of cows is necessary most weeks, and to draft manually would take 1 person for the whole milking.

Live weight data is used to make the sorting of freshly calved cows easier. All calvers are brought to the shed, and any cow where there is uncertainty over having calved or not, is weighed to identify a weight change. DNA profiling is also carried out so that the matching of dams and calves is not necessary. These technologies save 1-2 hours/day in August and September. The DNA testing is equivalent to the cost of a calving supervisor but means less people are needed.

Feeding in-shed saves 2-3 hours labour per day.

Milk metering and conductivity testing (looking for mastitis) identify problems cows, saving the need to strip the whole herd, equivalent to about 3 hours every time herd stripping would be required.

The software in the shed can provide customised reports thereby reducing office hours determining ‘good’ or ‘bad’ cows.

In addition to time savings, the lowering of staff stress levels is very significant. Being able to draft cows at the touch of a button, and the high level of accuracy in that drafting means this

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Notes:
work task is achieved more easily and faster than manually. This also can be said of mating where the auto gates provide a relaxed way (for humans and cows) to separate cows for AI.

**What would be changed in the dairy if we did it all again?**

Having the owner very closely involved in the project planning and implementation means that the builders and contractors build what is intended and not their interpretation. This means that very little would change. If money was not a constraint further additions would include:

- a shower in the toilet area
- automated vat wash
- more self generated energy and efficiency systems, e.g. solar/wind heating

**Future developments to advance milking practices**

**Automatic Milking**

Cup attachment remains the only aspect of the milk harvesting process that is not currently automated on any commercial farms in New Zealand. While New Zealand was an early adopter of the first machine milking technology, the industry is one of the last to adopt fully automated milking systems (AMS) which have been in use internationally since 1992. There have been a number of reasons for this:

- all automated milking systems are manufactured overseas (in England, The Netherlands, Sweden, Denmark and Germany) and manufacturers to date have not been prepared to sell into New Zealand. This is partly because of the need to provide 24 hour technical support for the systems and a minimum number of AMS are required for this to be viable for the companies (a real chicken and egg situation)
- there has not been the demand. New Zealand has developed very efficient batch milking systems – often described as the world’s best at this practice
- the use of AMS in pastoral farming systems has been relatively untested. Farms where AMS have been combined with grazing have still fed up to 70% of intake through concentrates and silage/mixed rations. For AMS to be successful on a large scale in New Zealand, diets of 90-95% pasture intake and high pasture utilisation rates must be achieved
- there has been a perception that the technology has been developed for housed dairying systems and that the capital cost is prohibitive.

In 2007 there are a number of changes taking place which will see automatic milking systems available and viable in New Zealand:
• the demand is increasing. Farmers are now facing labour shortages and the pressure is on, not only to reduce labour input but also to change the work environment and hours of work for people on dairy farms
• the AMS technology has developed significantly over the past 5 years such that cup attachment times of less than 20 sec are now possible and fewer cows are not suited due to poor udder conformation
• the international uptake of automated systems is accelerating exponentially such that demand is close to exceeding supply, with the technology now firmly established as a viable milk harvesting option
• research carried out at the Greenfield project has shown that cows are unlikely to be the limiting factor for adoption in New Zealand. Walking distances of close to 1000 m do not pose a problem; the system can operate with approximately 95% of the cows’ diet grazed pasture; milking is achieved for 20 of the 24 hr when cows are allowed to volunteer for milking. Pasture, rather than being a problem in the system, has been shown to be the main driver for cow traffic and the solution lies in managing the timing and availability of pasture
• the major suppliers of AMS are now seriously looking at selling into New Zealand
• the cost of equivalent automation on conventional rotary systems has increased, reducing the difference between conventional and automatic systems

These changes mean that automatic milking is inevitable.

What will the farm look like?

Notes:
Figure 2: Potential farm layout for a 450-500 cow farm with 5 to 6 automatic milking systems in a centralised dairy (Tanker). Cow traffic controlled by two remote selection units ( ). Grazing areas indicated by dotted lines.

The farm layouts will be many and varied, but may look something like that in Figure 2. The farm system will be system 2 or higher with some feed imported (Hedley et al., 2006). The dairy, housing a bank of robots, will be centrally positioned minimising walking distances. The raceway and cow selection infrastructure will allow for three areas of pasture to be made available to the herd in a 24hr period. There should be a cow selection system for stimulating cow movement, restricting access to the AMS and sending cows back to graze pasture to correct residuals. It is likely that 1 AMS per 90 cows will be required. Managers may oversee several farms each of approximately 450-500 cows, utilising the ability to remotely monitor the operations of each farm. Each farm would employ an operational manager with assistance during calving and mating. Hours of work would typically be 7am to 4pm. The out-of-hours support for all farms would be shared between managers and farm assistants.

**Automatic cup attachment in existing dairy designs**

Automating cup attachment within existing dairy designs is often talked of as the next logical step in milk harvesting development. Few people are aware that the combination of a robotic arm to attach teat cups to cows in a rotary platform has been considered regularly by OEM (Original Equipment Manufacturers), new technology companies and research teams since 1982. However, in 20 years of development no OEM or new technology developer has produced a robotic arm/rotary platform combination, and no mainstream developer has ever tried to do so.
There are a number of technically challenging obstacles that must be overcome.

Commercial robotic milking arms are fixed in location and overcome movement challenges of the arm itself and the cow when movement occurs in any of three dimensions. The robot/rotary has been rejected because the platform moves in another dimension and time, adding several extra factors of difficulty in control and engineering. The options are to attach when the platform is moving (4D movement issues) or when the platform is stationary. Stationary multibox AMS systems with a tracking robot (Gascoigne/Vikon/Prolion/Liberty) have failed because the robot/box registration was too difficult, moving the robot repeatedly and getting precise location relative to the cow-box. With a rotary it would mean moving the cow to a static robot. In a robot/rotary combination the platform may have to be stationary for up to 60 seconds for attachment, giving a maximum throughput of 60 cows per hour irrespective of platform size. Alternatively multiple robotic arms would be required, introducing an extra magnitude of engineering complexity and cost.

All commercial robotic milking systems milk from in front of the rear legs. The discontinued Westphalia Leonardo was located in the floor under the cow. The first robotic system developed by Gascoigne in 1982 through 1987 milked through the rear legs. This system was never developed beyond a prototype. Any robot/rotary has to milk through the rear legs to maintain throughput rates.

The initial approach by Gascoigne was rejected in part because:

- the distance between the rear legs is too narrow to pass a robotic arm with a cluster, except perhaps a single teat cup arm. The Gascoigne system widened the rear leg gap by opening the floor to make the cow widen her stance. This led to behavioural problems resulting in poor cow attendance, stress on the pelvic girdle resulting in leg lameness and increased loading on the outer claws resulting in increased foot lameness; unacceptable cow welfare.

- fouling of milk lines occurs in narrow gaps creating attachment difficulties for teats 3 and 4 and problems in individual teat cup detachment

- teat cup attachment requires ‘sight’ of all teats. This is not readily possible from behind the cow, and why milkers in parallel parlours attach to front teats largely by touch location

Notes:
• any systems passing through the rear legs can become heavily soiled creating hygiene and milk quality problems.

If the problems of the robot/cow registration can be overcome, if a teat location system can be developed to attach all teat cups in 10 seconds, if registration problems, and if stopping and starting the platform can be overcome, then the cow problems remain substantial. There is widespread agreement that any development of automatic cup attachment technology will not be to retrofit the technology into existing dairy designs. The most probable route will see a completely new design, which may involve approaching cup attachment from the side of the cow which will significantly slow throughput.

At least two companies are continuing to pursue development of robots on a rotary. Any successful robot/rotary combination is considered by experts in the field to be at least 10 years away, if ever possible.

**Other technology**

An area that is only just beginning to be recognised as having potential to improve farm performance is the use of individual cow monitoring and data collection to make better decisions. Because more data on each cow are now available farmers will be able to make decisions based on actual costs and profit per cow. Historically all feeding and management decisions have been made at the herd level and for the average cow. With individual monitoring and feeding technology this opens a new area for exploitation.

Information needs to become simple and cheap, if large gains are to be realised. This will require the co-operation of milking and animal breeding companies.

Other technologies that are likely to be common on farms in the next 10-15 years include:

• real time information. e.g. herd test data on protein and somatic cell count

• a ‘gun’ device to point at cows so that on cow can be identified and drafted without seeing her number.

• milk contents monitored and pick-ups scheduled for more efficient transporting, but also timed to avoid to collection when setting up to milk

• rumen activity monitoring for health/feed efficiency

• multi-system communication devices which will replace staff radios/timesheets/data entry for drafting etc/fuel purchases at garage
References and further useful sources of information

CowTime (www.cowtime.com.au)

Fox J. 1994. NZ Dairy Farmers’ 111 Ideas to Improve Milking (see Dexcel website).


Neild J. 2006. The supply side: what people and skills will we have available to the dairy industry, Report to Dairy Industry People Capability Review.


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