CRF Colac Otway, Y-Cutter Review

- **Occupational Health and Safety evaluation**
- **Economic Analysis of the benefits of Installation**

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EXECUTIVE SUMMARY

This report reviews the occupational health and safety evaluation and an economic analysis of the benefits of the installation of the Y-Cutter at the CRF (Colac Otway) Lamb processing plant in Colac Victoria.

The Health and safety issues have significantly improved with no injuries or accidents reported for the associated tasks since the machine was initially installed in January 2005 compared to an average of $30,000 per year costs under the old, 3 person manual Y-Cut process. In addition to this the bacterial counts as a result of contamination from the opening up process, have reduced with the machine system compared to the conventional manual system. The tests conducted prove that the bacterial load is less however any benefits that this may bring through longer shelf life or less rework downstream in the process could not be quantified due to downstream manual processes currently taking away any advantage currently obtained by the automation process. It is anticipated in future years as additional automated solutions are installed, food safety benefits will be enormous.

The System has delivered a benefit based on its capital, operating and injury related costs such that it has a payback period of approximately 1.7 years for an installation running 2 shifts as CRF is doing. Thereafter it returns a net benefit of Approx. $160,000 per year. The payback on smaller plants is not so attractive because:-

- The additional 2 units of labour for the second shift is not contributing to the savings. The additional cost of running the Y-Cut machine for the extra shift is negligible in comparison.
- The Extra assumed capital cost since subsequent installations are unlikely to be done under a 50:50 shared arrangement and full capital cost would be paid for the installation.

INTRODUCTION

CRF Colac Otway (CRF) have installed a robotic Y-Cutter into their plant in Colac. The Y-Cutter is a robotic device that makes the first incisions, a “Y” shaped cut, on the lamb or sheep carcase to begin the opening up process so as to remove the pelt from the carcase. In the inverted dressing system, the lamb is hanging upside down with the 4 hocks restrained in a clamp. The cut starts initially at the front foreleg hock and moves down to the breast or sternum area and then the same is done to the other side. The final cut is to form the vertical leg of the “Y” and cut from the breast bone down to the underside of the neck.

The Y-Cut has traditionally been done by 3 people on the processing chain with each person making 1 of the 3 cuts that, as the name suggests, defines the “Y” Cut.

CRF have had concerns regarding the number of injuries that were being sustained from this opening up operation and looked around to find an alternative. In 2004, CRF was paying on average $30,000 a year in costs as a result of injuries sustained from this operation.

The Y Cutter has been under development since 1991 and was initially developed by Industrial Research Limited of New Zealand with funding from Meat New Zealand. The Y-Cutter is now being commercialised and marketed by IRL's commercialising arm, Device Works.

Device Works is using Machinery Automation and Robotics (MAR) in Australia as their agent. MAR are also agents for the Kuka Robot which is the support robot to which the cutting head of the Y-Cutter attaches.

BACKGROUND

CRF are a major modern Lamb processor who have grown considerably since they started production in 2000.

They currently have a production of approximately 5,500 lambs per day on their 2 production shifts. They process approximately 1,500,000 lamb and sheep per year.

CRF is an Australian leading Lamb processor and has a close relationship with and supplies to a major Australian Supermarket. As a result CRF are proactive in seeking better ways to operate and drive costs out of the supply chain. On top of this there is a shortage of available and suitably qualified labour and this coupled with the high turnover of staff within the industry generally encouraged the uptake of the technology.

CRF is also a very responsible company and is keen to improve the welfare of their employees. The ability to reduce the risks to their workforce from the manual methods of opening up the carcase was another major factor in the decision to adopt the Y-Cutter as part of their core production process.

The Y-Cutting machines have been installed in New Zealand for some time and had been trialled in one other Australian lamb processor.

The new Zealand industry is a very different lamb production industry when compared to Australia.

In the New Zealand industry:-

- lambs are predominantly Romney based compared to the merino base of Australia
- lambs are killed at a much younger age with an average carcase weight of 18 Kgs, compared to Australian Lambs which are generally at an age nearing a hogget and are approx. 25 Kgs average weight.
- lambs are washed down prior to processing whereas this process is outlawed in Australia
- producers are encouraged under codes of practice to have their lambs shorn at a predetermined time before processing in an effort to achieve a consistent wool length at time of processing.
- The New Zealand lambs are much cleaner than the Australian Lambs as a result of the wetter and grassier environment where they are raised.

These factors have meant that the performance of the machine was different from the performance that had been experienced when it was installed on trial at the Rakaia River Meats plant in New Zealand where the final development was completed. Device works now have these machines installed at CRF Colac in Australia and at Alliance's Lornville Plant in Invercargill in New Zealand.

DESCRIPTION OF THE MACHINE

The Y-Cut is the cut that begins the release of the pelt form the carcase. The Y-Cutter consists of a skin or pelt "Cutting" and piercing head which is attached to a Robot Arm. The Robot arm is programmed to follow a set path based on the normal size of the lambs being processed and to pierce the skin at the Breast plate.

The Cutting head starts at the bottom of the front hocks of the animal and slices the pelt, separating the pelt form the carcase as it cuts down toward the breast bone. After the cut has reached the sternum, the robot extracts the cutting head, the tool is sterilised and the other side of the lamb is processed in the same way. The second cut does not stop at the breast bone area but continues down to stop at the neck near the underside of the jaw. After completion the tool is sterilised with a shot of steam and the Y-Cut is ready to process the next lamb.

To assist in the Y-Cut machine initiating the cut a "Sock Ringer" is used to cut the skin in a horizontal line from around the hocks, at a set distance away from the foot restraint device.

The Sock Ringer consist of a rotary knife that is spring loaded so that it cuts some way around the foreleg enabling an area of cut skin for the Y-Cut cutting head to initiate the cut more easily and consistently.

Any figures that are reported relating to the successful completion of the Y-Cut also include the Sock cutter as well. Whilst the sock cutter does not give major problems, some lambs have their forelegs vibrated from their restraint as a result of its cutting action against the bone. This sometimes results in the Y-Cut machine being unable to correctly process the lamb.

It is unfortunate that the statistics have not kept separate the two processes so that improvements could be focussed on the piece of equipment causing the problem.

The Robot used to hold and manipulate the cutting head is a commercially available Kuka Brand of 6 axis robot. Any similar brand could have been chosen to do the same task. The robot arm is designed to carry the head along the correct tool path to follow the inside front leg of the lamb being processed. The tool path has the ability to be varied to suit the different leg and frame sizes of the lamb. CRF have expressed concern that the Y-Cutter does not work as well on Merino sheep compared with Lambs.

OCCUPATIONAL HEALTH AND SAFETY ISSUES

The traditional way that the Y-Cut has been made was a source of injuries and the action taken in cutting through the pelt and opening up the carcase was prone to allowing contamination onto the surface of the lamb carcase surface.

INJURIES

The action of opening up the carcase meant that the process operator would “pinch” a small portion of the skin and make an initial cut before inserting the knife under the surface of the skin at the breast bone and move it along the line of the inside leg to the hock. To accomplish this, the leg was generally held with the other hand for balance. This means that the other hand was a prime target for knife cuts, as was the face and limbs, should the knife slip and come outside the carcase. It was even more difficult if a naturally left handed person was undertaking the right hand side leg and vice versa.

The lower and final cut of the Y-Cut was made by inserting the knife under the skin and moving it along to the brisket stopping at the underside of the neck. Should the knife become dislodged from contact with the carcase in this action, the knife was potentially going to stab the process operator in the stomach area or other limb. There was also potential to injure a co-worker with the close proximity of each operation to the next.

This potential for injury was increased as:-

- The knife lost its edge and was not re-sharpened
- The animals skin was tougher than normal
- The process operator became tired.

This was the experience of CRF and the majority of their injuries were as a result of cuts to their employees. This was despite rigorous attempts to prevent injury by wearing appropriate protective equipment and recurrent training.

The Y-Cut machine relocates almost all of the resources from this dangerous task that were being used to perform the Y-Cut operation. The Y-Cut machine has sufficient speed to be able to relocate the 3 slaughtermen required to perform the task manually. Whilst this is the case, CRF have maintained one resource up stream of the Y-Cutter whose role it is to:-

- Handle exceptions from the Y-Cut machine such as incomplete cuts or where the knife blades did not follow the skin sufficiently and an incomplete cut was made
- Replace carcases that have come adrift from the Hoof clamps, an action that occurs as a result of the ring cutter vibrating the hock out of the clamp
- Inspect the Y-Cut for completeness
- Check the animals mouth to ensure it meets the age dentition specifications

This last point is a task that used to be carried out by another person in conjunction with other jobs and is considered only ¼ of a full task.

The repetitive nature of the manual Y-Cut task is also a prime candidate for a repetitive Strain Injury or RSI. The processing rate at CRF is approximately 11 carcases per minute so that over the course of a shift a process operator will have done exactly the same Y-Cut task over 2,000 times.

With the Y-Cut machine in place the single operator now does a variety of different tasks and often has little to do on each lamb except inspect for dentition compliance. A great improvement indeed!

No issues or injuries have been reported as a result of the work undertaken by the single process operator upstream from the machine, or as a result of the Y-Cut machine and robot, since the machine commenced operation in January 2005.

Food Safety

The main issue with food safety during the Y-Cut operation is from contamination from other parts of the carcase or pelt, or cross contamination from another carcase. During the process of the pelt being opened up in preparation for removal, there is the great possibility of having contamination from the pelt to come in contact with the carcase surface below. This seems to be worse in Australia compared to New Zealand because of the longer wool length in Australia, and the greater ease that folds or flaps of the skin can fall and the wool comes in contact with the carcase surface.

The Y-Cutter has an advantage in this respect since it can cut faster than a man and the size of the cutting blades is less than the length of a slaughtering knife. This means that there is less disturbance of the pelt surface during the generation of the Y-Cut.

The other potential is for cross contamination from one carcase to the next. Process operators working on this process are supposed to sterilise their knife in-between each cut. This operation is normally a 3 person task and therefore each “cut” basically means each carcase. Should a Process operator fail to sterilise the knife between carcases then any contamination from one carcase can be transferred to the next.

The Y-Cutting machine is programmed to sterilise the cutting tool and those parts of the head that come in contact withy the carcase or pelt after every operation.

ECONOMIC ISSUES

Labour

Whilst the occupational health and safety issues were a big driver to replace the manual work with a machine, the opportunity of relocating the valuable labour component to value-adding areas was also a keen driver to introduce the technology. This was particularly so since CRF are located in a regional centre and sourcing and keeping a trained labour force is always an issue.

CRF have been able to relocate their 3 resources used to undertake this task to 1. This equates to 4 labour units per day since CRF are normally operating on a 2 shift basis. This one person also, as part of the current task, undertakes the inspection of dentition to ensure compliance with customer specification. The new task is used to re-do any part of the automated task that was not undertaken properly. This job requires the process operator to rework approximately 10% or less of the carcases. The variation in % is as a result of the poorer performance of the system with older sheep and more particularly with Merino lambs. CRF processes for its major lamb customer less than 10% of Merino lambs.

Occupational Health and Safety Benefits

The main benefit from a Workplace health and Safety aspect has been the reduction in the number of injuries. This has amounted to $30,000 in 2004 when the analysis was done. The Y-Cut machine was originally planned for introduction in 2004.

There are still manual operations involved with the 1 resource per shift that is allocated to the final inspection task but the number of knife cuts that need to be made are significantly reduced. Down to 10% or less of what it was before or 3% if this is factored over the 3 resources which were used in the manual process. Added to this, a large % of the knife cuts being made now are to repair inconsistencies' in the Y-Cut machines action. Often these do not require initiating a cut but finishing one that has been started and completing it. This means that a knife tool with a conical point rather than a sharp knife point, can be used to slip under the skin and finish the cut. It negates the need for a pointed blade and as a result any stabbing injury is likely to be less invasive and cause less injury.

The other benefit that impacts safety comes from the reduction in contamination. CRF have measured the bacterial load on a carcase before and after the Y-Cut machine operation. It was found that the Y-Cut machine was introducing lower bacterial load onto the carcase than was the manual method of carrying out the Y-Cut. Swabs were taken of a number of carcases pre and post installation and the bacterial counts measured. 4 points on the carcase were swabbed with these positions being common for all tested carcases.

Whilst this reduction in bacterial count is good news and is a benefit, the benefit is not thought to be quantifiable. The benefit from reduced bacterial and contamination count comes from:-

- Reduced workload further down the chain in not as many carcases are entering the detain and require rework because of identified contaminants such as hair or dirt etc.
- Potential increase in shelf life as a result of reduced bacterial counts.

Nether of these are easy to quantify and the benefit achieved does not warrant the time spent quantifying the benefit.

Pelt Improvements

The automated Y-Cut machine has improved the quality of the sheep and lamb pelts. This is a result of less damage occurring from random knife cuts as a result of problems during the Y-Cut operation.

This has been quantified by CRF to be around $0.03 cents per pelt.

Success Rates

CRF have found that they are achieving upwards of 95% successful Y-Cuts on lambs irrespective of breed. Although this is somewhat lower than the 98% target as specified in the contract CRF have accepted this and the resource they have attached to the Y-Cut operation is able to handle the 5% of unsuccessful Y-Cuts as well as the dentition inspection function.

On the Sheep i.e. mutton type products, the success rate is not as high. 73% of CRF product is sent to a major Supermarket chain and of these less than 3% would be Sheep. Of their service kill customers, less than 8 % is made up of sheep product.

However of these total sheep numbers, approximately 50% are merinos and of those animals the Machine is unsuccessful approximately 50% of the time.

The reasons that the machine is less successful on the sheep are multi-fold:-

- The animals are bigger and more varied in shape. Just as humans change in shape as they get older so do sheep. As a result the robot has trouble defining a constant path to cut
- Range in fatness is much greater than the lambs and they are less like “peas in a pod.”
- The animals are older and often fatter which causes larger rolls of skin and fat to form in the Dew Lap area and with the coverage of wool this tends to “bunch up” more than in the younger lambs
- The skin is older, thicker and tougher and therefore is more difficult to penetrate and cut.
- The animals often have longer wool to save the producer paying for a shearer on an animal that does not have a high value

The contract for the Y-Cutter was for the application on lambs and not on sheep. As a consequence the negative impact on sheep will not be considered in this study as it does not reflect the intent of the contract. Deviceworks are planning on further developments and are now hopeful of selling systems into Alliance in New Zealand. If this eventuates, further development work will likely be undertaken to suit the sheep product since these make a significant percentage of Alliance’s kill numbers. If a Y-Cut machine is installed permanently it will be expected to work on 100% of animals processed and not just lambs.

This will hopefully bring about improvements that can be applied to the CRF machine and improve the performance percentages.

MAINTENANCE

The new Y-Cut machine will require ongoing maintenance, a cost that is not applicable to a manual Y-Cut operation save from the supply and repair of knives. CRF have kept good records of all costs associated with the repair and maintenance of the Y-Cut machine since January 2007. These records have been reviewed and adjusted to remove any obvious costs that should have been allocated to the capital cost of installation or modifications.

As well as this MAR had a service contract with CRF and funded 50% by CRF to be available for repair and maintenance of the system in the initial months of operation. The costs associated with this contract have been ignored as part of this study since the work being undertaken is not considered “maintenance” but is more developmental support.

Some of the aims of this contact with MAR were to:-

- improve the performance of the machine so as to achieve the 98% success rate, a target as explained above that was never reached, even on lambs,
- “to ensure the system meets its full potential providing a benefit to the industry “which again is not a maintenance costs but one of development to increase the machine’s performance and therefore its attractiveness to the Australian Industry.

These are considered more of a development nature and are not included in the analysis. Any other plant that purchases a Y-Cut machine in Australia would not need these same services.

ECONOMIC BENEFITS

The economic benefit seeks to compare the costs before the installation and compare to the costs associated with the machine on an ongoing basis after the installation. They have been broken down into the topics below.

CURRENT SYSTEM COSTINGS

Labour

The following additional labour costs are associated with the manual Y-Cut.

Item	Rate
Rate Per hour- assume $20.50 per hour	$20.50
Hours Per Day	8
Days per week	5
Weeks Per year	52
Sub Total - cost per annum	$42,640
Oncost – Includes Work Cover Payroll tax, Superannuation, cleaning, protective clothing at 26%	$11,086
Sub Total	$53,726
For 2 shifts by 2 process operators	$214,906

Occupational Health and Safety Costs

The following are the reductions in occupational health and safety costs as a result of installing the Y-Cut machine:-

Item	Rate
Costs associated with Injuries from Y-Cut operation as prepared in 2004	$30,000
Increase in Costs associated with inflation and increased Medical costs to 2008 Year= 3.2% x 4 years	$34,028

Pelt Improvement

The following are the estimated costs of increased sales as a result of less pelt damage:-

Item	Value
Animals Processed per year = 5,500/ day x 5 x 52	1,430,000
Average Pelt Sell Price	$10.00
Savings per pelt as a %	0.32%
Total Savings	$45,760

Y-CUTER COSTING

The following costs are for the installation and operation of a Y-Cut system that is a fully working system and is optimised for Australian Sheep and lamb.

Capital Costs

The Capital Costs have been broken down into 2 methods, The Capital Costs for CRF and the Capital costs for a plant purchasing a brand new unit.

CRF Colac		New Meat Processing Plant	
Item	Cost	Item	Cost
CRF Total capital Costs	$367,400	New Plant Capital cost	$573,000
Additional Cutting Head	$28,000	Installation cost Allowance	$85,000
		Additional Cutting Head	$28,000
Initial Essential Spare parts held at Colac	$10,000	Initial Essential Spare parts	$10,000
Total	$405,400	Total	$686,000

Operating Costs

Maintenance

CRF have kept detail records of the total costs associated with the maintenance of the Y-Cut machine. An analysis of these figures reveals the following

Year	Cost	Annualised Cost
2005	$4835	$4835
2006	$12393	$12,393
2007	$34364	$34364
2008 (7 Months)	$9,206	$15,781

The costs suggest that the maintenance costs, peaked some time after it was installed. CRF Personnel revealed that the machine was installed in May 2005. A review of the maintenance costs revealed that much of the work that was undertaken in 2005 was aimed at making modifications to the system or finishing of installation on items that were not originally thought about. For this reason all of 2005 costs will be excluded from this calculation. The modifications were still ongoing in 2006 and it is also not reflective of a machine under straight maintenance.

In 2007 there were several instances where MAR had undertaken some major work and modifications and these costs were captured against the maintenance costs. These items were removed from the costs as reported in the figures above.

It is therefore considered that the most appropriate path forward to calculate the operating costs associated with Maintenance is to average the annualised figures for 2007 and 2008,

This gives a value for maintenance of $25,072 per annum.

On top of this the following must be allowed:-

Item	Cost	Life	Annual Cost
Cutting head overhaul	$6,000	1 Year	$6,000
Robot Overhaul	$3,000	5 years	$600

Cleaning

After each days use, the Y-Cut machine must be cleaned and washed. This was not necessary for a manual Y-Cut process. A half hour was the estimate tome needed to clean the system, over and above normal cleaning

Item	Cost per Annum
Cleaning – Based on 30 Minutes per day plus chemicals- estimated at $15 per day = 15 x 5 x 52 =	$3,900

Power Usage

Extra power is needed to drive the cutter and the robot as well as to supply the heat to sterilise the Cutting head. There are no records available to determine what this usage might be, however it is considered to be a relatively low amount. It was thought that the costs associated with clothing 2 process operators per day and providing the personal protective clothing would be roughly the equivalent of the power costs and the two one would nullify the other. No extra power costs have been allowed as a result.

COST BENEFIT

In order to develop a reasonable cost benefit certain assumptions need to be made. The following assumptions apply in this analysis

CRF COLAC

Capital Assumptions

Capital Cost	$405,400
Interest Rate	9.00%
Pay Back time in Years	5.0

All other costs and benefits are as per the text above.

Additional Costs of Operating a Y-Cut machine

Interest and Principal amount payable Per annum	$99,083
Maintenance	$25,072
Cleaning	$3,900
Sub Total	$128,055

Savings of Operating a Y-Cut machine

	Savings Per Annum
Labour Reduction	$214,906
Reduction in Occupational Health and safety Costs	$34,028
Increased Sales from Pelts	$45,760
Sub Total	$294,694
Net benefit	**$166,639**

This demonstrates that with an investment horizon for a pay back period of 5 years, the net benefit per year, excluding inflation and other issues is $166,639. The figures indicate that there is a return on vestment of approximately 1.7 years.

Single Shift, New Installation Plant.

By Comparison, if a new system was installed in a single shift, Lamb processing plant where everything was scaled down as appropriate for a single shift operation the following would apply:--

Capital Assumptions

Capital Cost	$676,000
Interest Rate	9.00%
Pay Back time in Years	5.0

All other costs and benefits are as per the text above.

Additional Costs of Operating a Y-Cut machine

Interest and Principal amount payable Per annum	$134,315
Maintenance	$12,536
Cleaning	$3,900
Sub Total	$150,751

Savings of Operating a Y-Cut machine

	Savings Per Annum
Labour Reduction	$107,453
Reduction in Occupational Health and safety Costs	$17,014
Increased Sales from Pelts	$22,880
Sub Total	$147,347

Net benefit **($3,404)**

This suggests that there is a net cost of owning and operating a Y-Cutter machine at these prices.

The biggest consideration is the capital cost and the reduced savings since, in this example, the plant is only being operated over a single shift and therefore does not reap the savings of labour on the second shift that makes such an investment in a machine such as this more attractive.