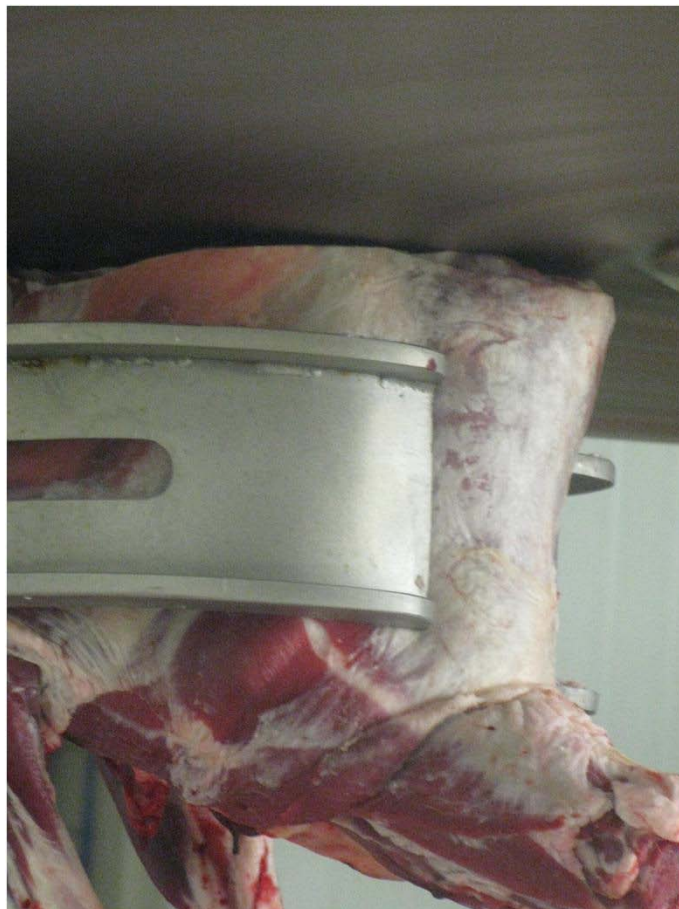




## Value Benefit of Automated lamb primal cutting using Robotic Ovine Cutter 450 (ROC450)



Prepared by Greenleaf Enterprises: Wednesday, 25 August 2010

# Value benefit analysis – ROC450

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## Contents Page

<b>1</b>	<b>EXECUTIVE SUMMARY</b> .....	<b>3</b>
<b>2</b>	<b>BACKGROUND INFORMATION</b> .....	<b>4</b>
<b>3</b>	<b>OBJECTIVES</b> .....	<b>4</b>
<b>4</b>	<b>METHODS</b> .....	<b>5</b>
4.1	TRIAL WORK CONDUCTED AT PLANTS .....	5
4.2	SALES PRICES FOR COSTING YIELD LOSSES AND CUTTING INACCURACIES.....	6
4.3	LOIN WEIGHT USED FOR COSTING .....	7
4.4	DATA COLLECTION .....	7
<b>5</b>	<b>RESULTS AND DISCUSSION</b> .....	<b>8</b>
5.1	MODEL DRIVERS .....	8
5.2	ACCURACY OF CUT LOCATION: 1 <sup>ST</sup> CUT (CUT BETWEEN FOREQUARTER AND LOIN) .....	12
5.2.1	<i>Method for measuring forequarter</i> .....	12
5.2.2	<i>Correct number of ribs</i> .....	12
5.2.3	<i>Angle of cut relative to the rib</i> .....	14
5.3	ACCURACY OF CUT LOCATION: 2 <sup>ND</sup> CUT (CUT BETWEEN RACK AND SHORT LOIN PAIR).....	16
5.4	ACCURACY OF CUT LOCATION: 3 <sup>RD</sup> CUT (CUT BETWEEN LOIN AND CHUMP).....	16
5.5	ACCURACY OF CUT LOCATION: 4 <sup>TH</sup> CUT (CUT BETWEEN LEG AND CHUMP, OR CHUMP AND LOIN).....	16
5.6	CUTTING TECHNIQUE: BAND SAW DUST.....	18
5.6.1	<i>Cutting Technique: Improved shelf life</i> .....	19
5.7	INCREASED PRODUCTIVITY.....	21
5.8	OH&S SAVINGS .....	22
5.9	LABOUR SAVINGS .....	23
5.10	COSTS.....	23
5.10.1	<i>Capital costs</i> .....	23
5.10.2	<i>Floor space requirement</i> .....	24
5.10.3	<i>Operational, Maintenance &amp; Training Costs</i> .....	24
<b>6</b>	<b>COST BENEFIT SUMMARY</b> .....	<b>26</b>
<b>7</b>	<b>APPENDICES</b> .....	<b>29</b>
7.1.1	<i>List of Tables</i> .....	29
7.1.2	<i>List of Figures</i> .....	30

# Value benefit analysis – ROC450

## 1 Executive Summary

The following report provides a review of automated lamb primal cutting equipment which has been developed by an Australian lamb processing plant in conjunction with Meat & Livestock Australia (MLA).

The benefits of the automation system were broken into two main areas including value achieved through influences on both product and yield gains, and secondly through savings achieved in benefits to the processing system such as increased efficiency of existing labour, OH&S savings and actual labour savings.

Costs associated with the equipment included the capital costs, maintenance, and operation, and costs associated with the risk of mechanical failure.

Based on capital costs supplied by the manufacturer, break even analysis using the net present value calculation (10 yrs & discount rate 7%) shows that a plant would need to be processing at least 120 000 head per annum for this equipment to provide a positive return to the plant. At a maximum processing rate of 5hd/minute for 4 four cuts (8hr/day 250 day/ annum) an annual net return of approximately \$700,000 is estimated, or a net present value of \$4.7M (AUD) over the estimated 10 year life expectancy of the equipment.

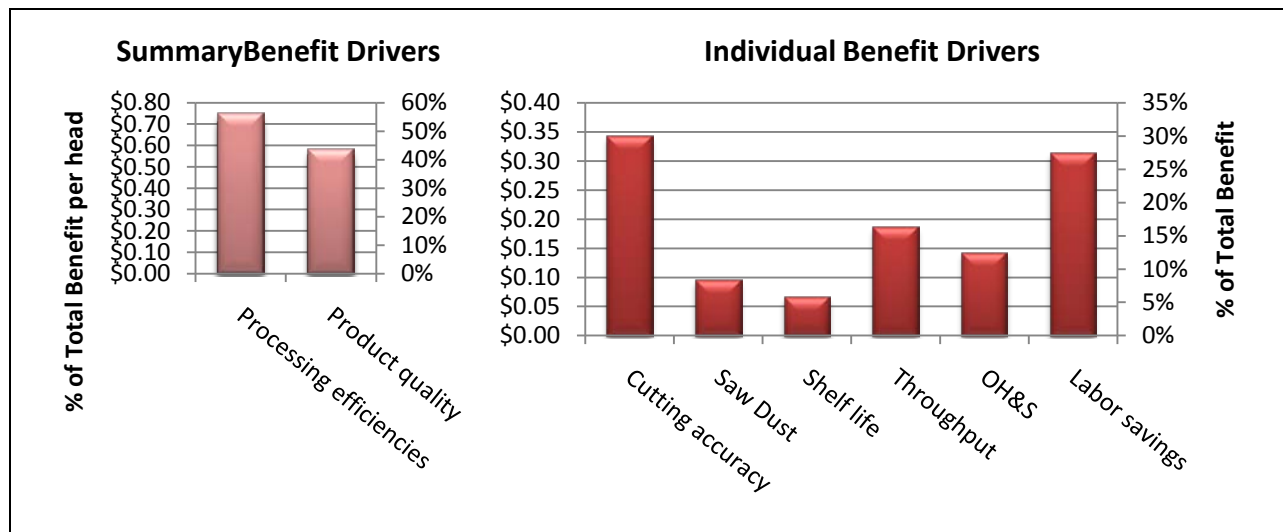


Figure 1: Contribution of summary benefits and individual benefits to overall estimated gross value return on ROC450 equipment of \$1.32 / hd

## 2 Background information

The majority of lamb carcasses processed in Australia are currently broken down into major primals with the use of a band saw under manual operation. The dependency on manual operators for this task has been under review for some time by industry due to the high OH&S risk associated with the task, inconsistencies that can occur in cut frequency, accuracy with manual operators, and the need to shift the industry away from the high dependency on manual operation.

With the involvement of MLA, this has led to development of an automated primal cutter which can be used for the breakdown of lamb carcasses into forequarter, loin and hindquarter primal sections. Proposed benefits of the equipment include reduced labour, reduced OH&S risks, increased accuracy of the cut on the carcass anatomical location, possible yield benefits, improved consistency in the speed at which carcasses are processed through the room, reduced dependency on a limited number of highly trained bandsaw operators to keep the room operational, and improvements in product quality through reduced bone dust.

## 3 Objectives

1. To establish a modelling tool that allows plants to quickly assess the amount and cost of yield loss due to inaccuracy of cutting between primals (also in conjunction with another associated MLA project);
2. To establish current level of inaccuracy in plants currently operating with manual cutting systems and the associated cost of the inaccuracy;
3. To review ROC 450 equipment and determine what level of yield improvement can be achieved through increased accuracy and the cutting technique of the equipment; AND
4. Provide an estimate of the value proposition for install of ROC450 equipment in a plant currently operating with manual primal cutting systems.

## 4 Methods

### 4.1 Trial work conducted at plants

As stated in the objectives, the work initially focused on establishing a bench mark for the value opportunity that exists in a lamb processing plants currently cutting primals with manually operated bandsaws. This work was conducted at an Australian lamb processing plant currently operating with a bandsaw under manual operation for primal cutting. Trial work was conducted to establish the current level of accuracy for the proposed cuts shown in Figure 2.

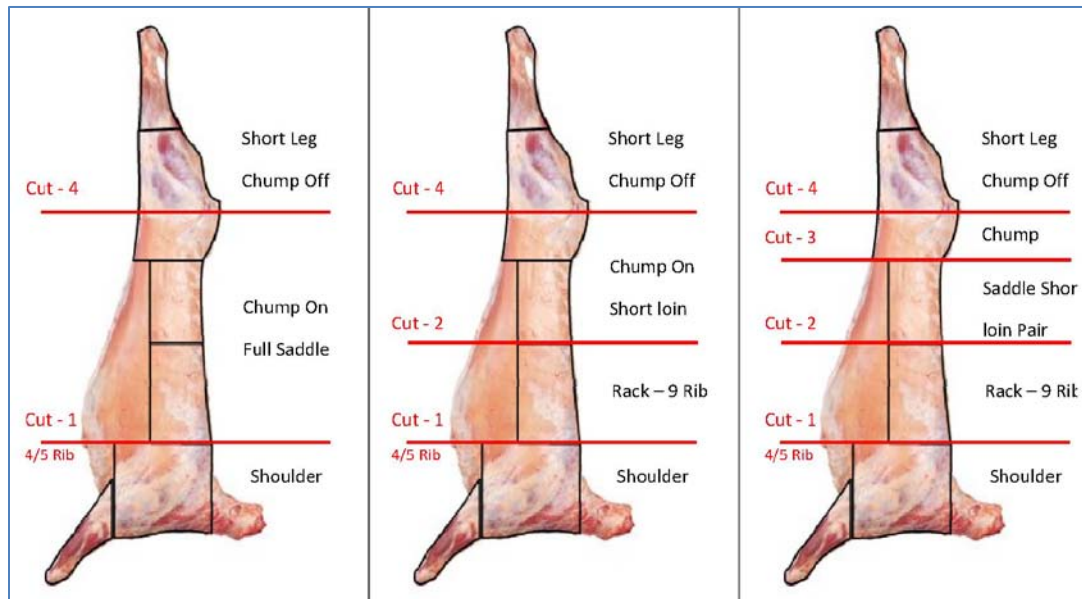


Figure 2: Proposed cutting line for ROC450 system \*\*Source MAR Promotional literature 2010, provided by Stuart Shaw.

Establishing the accuracy of the forequarter cut occurred primarily by counting the number of ribs on the forequarter. The angle of the cut was observed by measuring how parallel the cut was to the length of the 4<sup>th</sup> rib, measured in millimetres from the dorsal end of the 4<sup>th</sup> rib and the ventral end of the 4<sup>th</sup> rib. As the angle of the ribs can vary significantly (as measured perpendicular to the backbone), tipping of ribs regularly occurs during manual bandsaw processing. If ribs are tipped too short, product may have to be discounted if tail length is too short to meet market specification.

# Value benefit analysis – ROC450

**Table 1:** Measurement points for determining cost of inaccurate cutting between primals in lamb processing

Cuts, Cranial to Caudal	Impact on Primal either side		Resulting Loss
<b>Cut 1</b>	Shoulder Short	Rack Long	Possible shoulder loin that is trimmed off 8 rib rack, discounted racks that don't meet market spec
	Shoulder Long	Rack Short	Loin rack achieves lower value as shoulder rack, Discounted racks if not able to meet market specs
<b>Cut 2</b>	Rack Short	Loin Long	Ribs cut short, discount because didn't achieve 8 rib rack for export
	Rack Long	Loin Short	Extra backstrap on rack, may need to be trimmed so lost value Backstrap discounted because they are short Loss of Tenderloin
<b>Cut 3</b>	Loin Long	Leg Short	Leg muscles remaining loin lost to trim, Aitch bone needs to be trimmed from loin
	Loin Short	HQ long	Loss of backstrap and TDR to aitch bone and trimming or leg muscle depending cutting specification
<b>CUT 4</b>			This cut currently not available on existing equipment. No observations made.

## 4.2 Sales prices for costing yield losses and cutting inaccuracies

All costings relating to the value of the product presented in the results section are based on the values shown in Table 2. Table 2: Sales prices used for costing inaccuracies and yield loss/gains

Average discount level		20%
Cut	\$/kg	Discount Value
Shoulder Rack	\$8.60	\$6.88
8 Rib Rack	\$22.00	\$17.60
7 Rib Rack (discount)	\$17.00	\$13.60
Back strap	\$22.00	\$17.60
Discount (Short) Back strap	\$18.00	\$14.40
Trim 65CL	\$2.70	\$2.16
Leg price	\$8.99	\$7.19
Whole lamb retail price	\$7.50	
Rendering	\$0.16	

# Value benefit analysis – ROC450

## 4.3 Loin weight used for costing

Table 3: Data used for loin and bone loss calculations

#	Total	fat	meat	nonbone	(total)	Bone	Sum	% nonbone
1	0.061	0.016	0.027	0.043	0.042	0.023	0.065	0.646
2	0.060	0.010	0.028	0.038	0.037	0.022	0.059	0.627
3	0.073	0.016	0.036	0.052	0.052	0.020	0.072	0.722
4	0.069	0.012	0.037	0.049	0.048	0.017	0.065	0.738
5	0.083	0.026	0.037	0.063	0.063	0.020	0.083	0.759
6	0.079	0.022	0.040	0.062	0.060	0.020	0.080	0.750
7	0.080	0.021	0.040	0.061	0.062	0.018	0.080	0.775
8	0.044	0.006	0.024	0.030	0.030	0.015	0.045	0.667
9	0.045	0.007	0.020	0.027	0.027	0.017	0.044	0.614
sum	<b>0.594</b>	<b>0.136</b>	<b>0.289</b>	<b>0.425</b>	<b>0.421</b>	<b>0.172</b>	<b>0.593</b>	
Avg	<b>0.066</b>	<b>0.015</b>	<b>0.032</b>	<b>0.047</b>	<b>0.047</b>	<b>0.019</b>	<b>0.066</b>	<b>69.98%</b>
StDev	<b>0.015</b>	<b>0.007</b>	<b>0.007</b>	<b>0.014</b>	<b>0.014</b>	<b>0.003</b>	<b>0.015</b>	<b>6.16%</b>

## 4.4 Data collection

For ease of readability the data collection method for costs and benefits of the primal cutting equipment is presented with each benefit in the results section.

# Value benefit analysis – ROC450

## 5 Results and Discussion

Calculation of existing costs associated with manual production has all been calculated on per head basis.

The following results and discussion sections follows the frame work presented in the cost benefit analysis. However consideration is also given to some other related automation issues.

### 5.1 Model Drivers

Calculation of the actual value of each benefit was based on the production figures seen in Table 4.

Table 4: Non adjustable drivers used to calculate the value per head for each of the 9 identified benefits.

Existing number of head	
hd/min	3.2
hd/hr	192
Hrs/day	8
hd/day	1536
days operation	245
hd/yr	376320

The following drivers shown in red are adjustable and can be used to customize the model to a different processing plant.

Table 5: Adjustable drivers

Processing room operation speeds		
	CURRENT hd/min	NEW hd/min
Current Saw speed / min	<b>3.60</b>	<b>6.68</b>
Saw speed / hr	216	400.80
Room speed	216	401
Shifts / day	1	1
Hrs / shift 1	8.00	8.00
Hrs / shift 2	0.00	0.00
No hd processed / day	1728	3206
Annual days	250	250
Annual # of hd processed	<b>432,000</b>	<b>801,600</b>

## Value benefit analysis – ROC450

As the ROC450 cutting system has one blade mounted on a robotic arm, increasing the number of cuts required will result in increased cycle time, and a reduction in the total processing capacity. Table 6 illustrates the number of cuts that the equipment is performing on a carcass and corresponding processing capacity. Unless a specific processing speed has been chosen in the model, the new processing rate (hd/min) shown in Table 5 will adjust automatically to represent the required the number of cuts. Reducing the number of cuts will also reduce some benefits such as labour savings, and saw dust savings.

**Table 6: Number of cuts required and the impact on processing speed\***

Number of cuts	Number of pieces	Max rate /min	Rate / hr
2	3	10.00	450
3	4	6.00	360
4	5	5.00	300
<b>Number of cuts required with cutting primal cutter</b>			<b>3</b>

\*Note: Existing equipment in commercial operation has the capacity to operate at 6.83 hd/min. However equipment manufacturers have advised developments are currently in place to upgrade to an operational capacity of 10 hd/min (operating at two cuts).

Table 7 shows other drivers that can be adjusted to customize the results of the model, they also show the settings that were used to calculate the summary results presented in this report. See Table 8 for a description of model drivers

**Table 7: Plant Specific Drivers\***

PLANT SPECIFIC DRIVERS	
Finance	
Discount rate	7.00%
Include Cap ex as expenses in first year?	YES
Life expectancy (yrs)	10
Cost of investment	<b>\$950,000.00</b>
Infrastructure costs for robot install	<b>\$100,000.00</b>
Total investment	\$1,050,000

## Value benefit analysis – ROC450

Cutting system	
Existing cutting system	Band Saw
No of stations	1
No of band saw operators saved	1.80
No of bone scrapers saved	1.20
Increase in Labor efficiency	4.00%
Product quality	
Retail Discounting	4.00%
Reduction in discount because of new cut system	10.00%
New portion of production discounted	3.60%
Average price of discount	20%
Average Carcasses weight	21.88
Product quality	
% of Annual production requiring 3rd cut	30.00%

\*Note: Although it is possible to change the current number of head processed in the model drivers on the front page, the reported savings per head are calculated independent to this number. This means it is possible to adjust the current number of head being processed on the summary page of the model without changes occurring to the calculated dollar value per head.

\*\*Note: An increase in throughput associated with installation of the equipment would require additional capital investment in plant infrastructure. No number has been supplied for this and should be considered when making any comparative analysis on return on investment.

## Value benefit analysis – ROC450

Table 8: Driver explanations

TITLE	Input message
Current Processing Speed	Select the existing processing speed of the boning room
New Processing Speed	Select anticipated operation speed once automated primal cutter and any required upgrades are complete
Discount rate	A firm's weighted average cost of capital (after tax) is often used, but it is also appropriate to use a higher discount rates to adjust for risk or other factors
Include cap ex in NPV?	NPV calculations for equipment investments should include the cost of the capital in the first year of the investment. Select YES to include cost of capital in the first year.
Life Expectancy of the investment	Select the number of years that the equipment is expected to be in operation for. This value is used to calculate annual cost of capital (straight line depreciation) and the number of years used in the calculation of NPV
Capital Cost of equipment	Enter price quoted from manufacture
Site install costs	Enter the capital to required for site specific changes to install the automated primal cutting equipment.
Total Capital cost of automating primal cutting	Calculation: do not change value
Cutting System	
Existing cutting system	Bandsaw base line data only available for this model (circular saw not functional, needs further work)
No of stations	Select current number of manual primal cutting stations
Increase in Labor efficiency	Eliminating fluctuations in the processing speed reduces pressure on critical limiting factors, and eliminates the number of stop-start during processing room operation, hence increase the efficiency of existing labor
Bandsaw operators	Select the estimated number of band saw operators that will be saved (also check band saw operator hourly rate on benefit calculations page)
Labor Bone Scraping	Select the estimated number of FTE bone scrapers that will be saved (also check bone scraper hourly rate on benefit calculations page)
Increased Labor efficiency through automation	Eliminating fluctuations in the processing speed reduces pressure on critical limiting factors, and eliminates the number of stop-start during processing room operation, hence increase the efficiency of existing labor
Product quality	
Retail Discounting	Select current estimated level of discounting of product that occurs at the retail level
Reduction in retail discounting	Select the amount by which current retail discounting will reduce. (Reduced discounts are assumed through increased sales (no visual appearance), and increased shelf life (reduced bacterial loading)

# Value benefit analysis – ROC450

TITLE	Input message
Amount by which product is discounted	Select the average discount rate applied to discounted product (major retailers will often start discounting at 20%)
Average carcass weight	Select the average weight of carcasses processed at the plant
Production utilizing the 3 <sup>rd</sup> cut	Select the % of total production that will be processed using the 3 <sup>rd</sup> cut

## 5.2 Accuracy of cut location: 1<sup>st</sup> cut (cut between forequarter and loin)

### 5.2.1 Method for measuring forequarter

Figure 3 shows a forequarter cut with the ROC450 primal cutting system. This product meets the market specification with the required 4 ribs on both the left and right side.

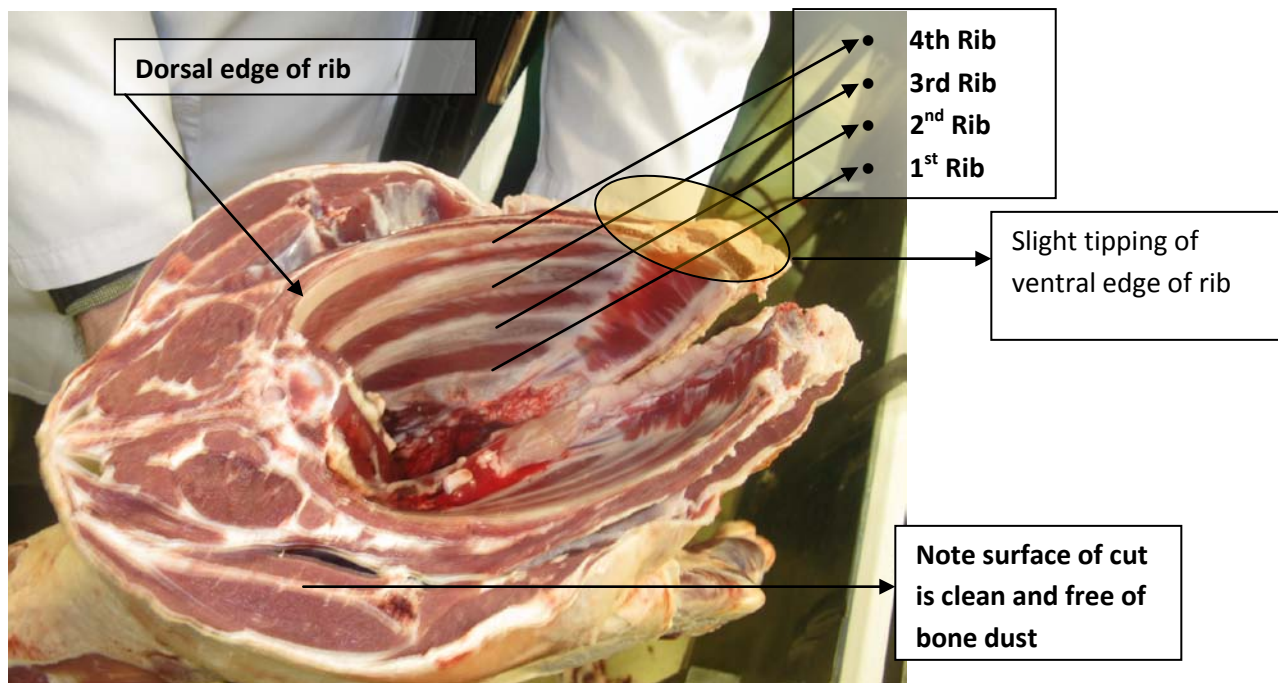


Figure 3: Forequarter processed using the ROC450 equipment.

### 5.2.2 Correct number of ribs

Figure 4 shows the differences observed in accuracy of the cuts on the forequarter relative to the required number of ribs. The ROC450 system was 16.5% more accurate at achieving the required number of ribs as compared to manual bandsaw cutting. This is based on 296 observations under manual cutting and 442 observations for automated cutting.

## Value benefit analysis – ROC450

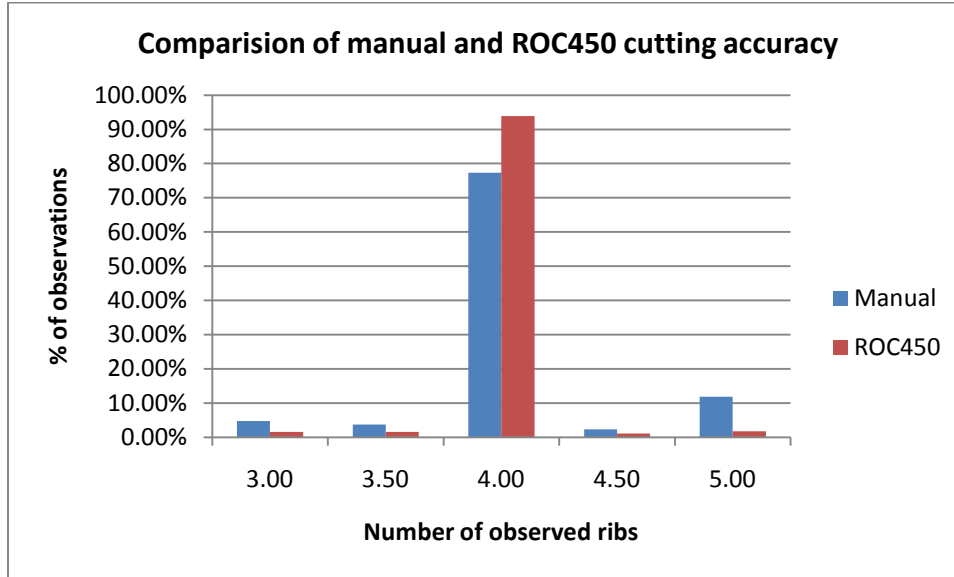


Figure 4: Current manual cutting accuracy of forequarter, compared to cutting accuracy observed at processing plant using ROC450 equipment

Table 9 shows the costing of cutting inaccuracies in the shoulder. A 5 rib shoulder rack has been costed at the price difference of the extra 5<sup>th</sup> rib cutlet achieving rack prices versus shoulder rack prices. This cost was \$0.94, and based on a 10% improvement across the production for the whole day this related to a saving of \$0.19 per head.

It could be argued that forequarter cuts made at the third rib would actually create an increase in value; however this was not the case for cutting specifications on the day when data was being collected. Shorter shoulders still produced racks with the required 8 ribs, however the extra rib ended up being on the short loin pair. The market specification for short loin was 1 rib only, so the 12<sup>th</sup> rib was removed and achieved only rendering value as opposed to rack value. Furthermore, three rib forequarters can also result in discounting depending on customer requirements.

## Value benefit analysis – ROC450

**Table 9: Results of manual forequarter cutting accuracy as measured by the number of ribs, compared to ROC450 observations (costing calculation based on 1,536 hd/day).**

RIB ACCURACY							
	Manual		ROC450				
Rib	# Obs	% Occurrence	# Obs	% Occurrence	Difference	Cost of occurrence	Cost per day
3.00	14.00	4.73%	7.00	1.58%	3.15%		
3.50	11.00	3.72%	7.00	1.58%	2.13%		
4.00	229.00	77.36%	415.00	93.89%	-16.53%		
4.50	7.00	2.36%	5.00	1.13%	1.23%		
5.00	35.00	11.82%	8.00	1.81%	10.01%	\$0.94	\$144.28
<b>Total</b>	<b>296.00</b>	<b>1.00</b>	<b>442.00</b>	<b>1.00</b>		<b>Per side</b>	<b>\$0.09</b>
						<b>Per head</b>	<b>\$0.19</b>

### 5.2.3 Angle of cut relative to the rib

The following Table 10 and Figure 5 compare the difference between manual and automated systems and their ability to cut parallel along the edge of the rib. These results show the number of mm that the cut occurred beyond, or before the dorsal (back bone end) edge of the rib. The accuracy of this cut is important because it impacts on the value of other cuts. The closer this forequarter cut occurs toward the cranial edge of the 5<sup>th</sup> rib, the greater the amount of loin lost from the rack to shoulder. The main point to note from Figure 5 is that there is a 17% increase in the number of cuts that occurred on the surface of the caudal edge of the 4<sup>th</sup> rib. This not only results in improved product quality, but also yield gains.

# Value benefit analysis – ROC450

Table 10: Distribution of observed forequarter cuts that occurred caudally or cranially to the 4<sup>th</sup> rib.

Number of mm + or - caudal edge of the 4th rib					Difference
mm from target	Manual		ROC450		
	#	%	#	%	
-30	0	0.00%	0	0.00%	0.00%
-25	0	0.00%	0	0.00%	0.00%
-20	1	0.34%	3	0.68%	-0.34%
-15	1	0.34%	0	0.00%	0.34%
-10	5	1.69%	2	0.45%	1.24%
-5	28	9.49%	4	0.91%	8.58%
0	139	47.12%	287	65.08%	-17.96%
5	44	14.92%	65	14.74%	0.18%
10	35	11.86%	50	11.34%	0.53%
15	3	1.02%	3	0.68%	0.34%
20	37	12.54%	23	5.22%	7.33%
25	1	0.34%	0	0.00%	0.34%
30	1	0.34%	4	0.91%	-0.57%
<b>TOTAL</b>	<b>295</b>	<b>100%</b>	<b>441</b>	<b>100%</b>	

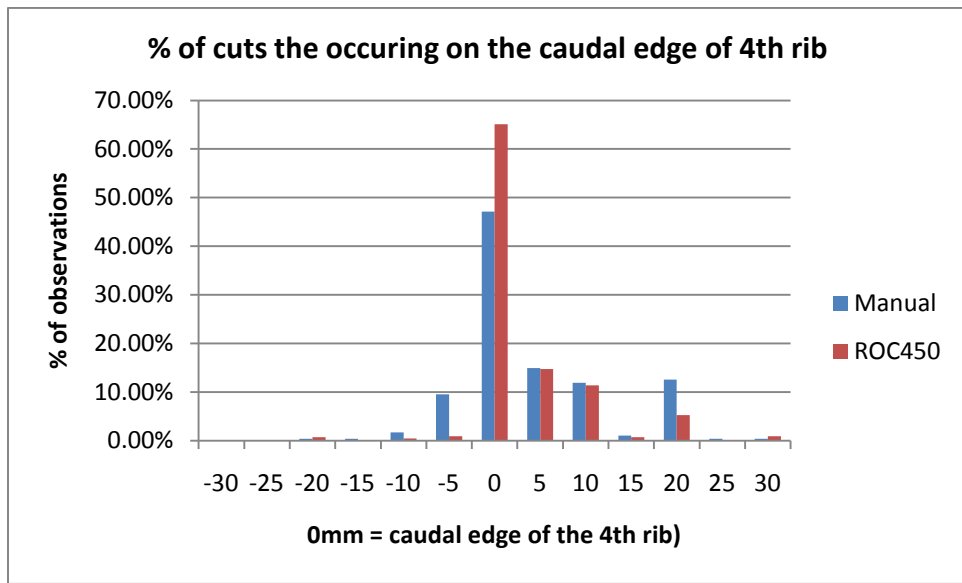


Figure 5: Consistency of the robot to cut along the caudal edge of the selected forequarter rib

## Value benefit analysis – ROC450

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### 5.3 Accuracy of cut location: 2<sup>nd</sup> Cut (cut between Rack and Short loin pair)

One of the cuts required by the manual processing plant was the cut between the Rack and the Short Loin pair (see 2<sup>nd</sup> cut in Figure 2). This cut was not available on the equipment reviewed in operation; however the cutting accuracy was assessed under manual cutting conditions to establish the value opportunity that exists for automating this cut. The inaccuracies shown in Table 11 are costed using the sale data shown in Table 2. The discount rate is applied to a rack that has 2 ribs less than market specification, -1 rib was costed at the value of bone lost to rendering when removed from the short loin pair. It is important to note the \$0.16/hd identified here is the full value opportunity. Accuracy has not been referenced against operational equipment but is expected to be less than 100% of the identified opportunity.

Table 11: Level of MANUAL cutting accuracy on racks as measured by the required number of ribs (0 = correct)

Number of ribs incorrect	Number observations	% Incorrect	Cost of inaccuracy	Daily occurrence	Cost
-2	1	0.63%	\$2.02	9.6	\$19.42
-1	29	18.13%	\$0.83	278.4	\$231.05
0	110	68.75%	\$0.00	1056	\$0.00
1	20	12.50%	\$0.00	192	\$0.00
2	0	0.00%	\$0.00	0	\$0.00
<b>Total</b>	<b>160</b>	<b>100.00%</b>		<b>1536</b>	<b>\$250.47</b>
				<b>Cost per hd</b>	<b>\$0.16</b>

### 5.4 Accuracy of cut location: (Cut between Loin and Chump)

Accuracy of this 3<sup>rd</sup> cut was not assessed during the manual trial work as the cutting specification required the chump to remain on the loin. Also this cut was not performed during observations taken on the ROC450 equipment during operation. No results are therefore presented for this cut, however analysis work will be conducted for this cut during the post installation review provided the cut is operational on the ROC450 equipment.

### 5.5 Accuracy of cut location: 3<sup>rd</sup> Cut (cut between Leg and Chump, or Chump and Loin)

The accuracy of the 3<sup>rd</sup> cut performed by the ROC450 equipment was assessed under commercial operation due to a change in cutting specification.

Accuracy was assessed in millimetres that the cut occurred away from the targeted cut across the top of ilium bone. Figure 6 shows a selection of aitch bones removed randomly from the belt that were cut using the ROC450.

## Value benefit analysis – ROC450



**Figure 6: Random Selection of aitch bones showing the accuracy of the 3<sup>rd</sup> cut.**

No manual comparison data was collected to assess the value of increased accuracy for this cut, as the larger volume of lamb processed at the plant did not utilize this cut (the chump was left on the loin). The \$/ value per head is shown below for this cut is only applicable to carcasses that are processed using this cut.

**Table 12: Cutting accuracy of the ROC450 equipment for the 3<sup>rd</sup> cut, as measured by the cut relative to the ilium bone.**

Accuracy (mm)	NO MANUAL DATA WAS OBTAINED FOR THIS PLANT, ESTIMATION ONLY	No Obs 4 ROC	ROC450 Leg Cut	Difference	Cost of occurrence	Daily Cost
-30	0.00%	0	0.00%	0.00%	\$0.00	\$0.00
-25	0.00%	0	0.00%	0.00%	\$0.00	\$0.00
-20	0.00%	0	0.00%	0.00%	\$0.00	\$0.00
-15	4.00%	0	0.00%	4.00%	\$0.00	\$0.00
-10	7.00%	0	0.00%	7.00%	\$0.00	\$0.00
-5	22.00%	1	0.47%	21.53%	\$0.00	\$0.00
0	24.00%	145	68.72%	-44.72%	\$0.00	\$0.00
5	34.00%	60	28.44%	5.56%	\$0.29	\$24.94
10	2.50%	2	0.95%	1.55%	\$0.75	\$17.95
15	2.00%	1	0.47%	1.53%	\$0.62	\$14.50
20	2.00%	2	0.95%	1.05%	\$1.18	\$19.06
25	1.00%	0	0.00%	1.00%	\$1.60	\$24.60
30	1.50%	0	0.00%	1.50%	\$1.60	\$36.90
<b>Total</b>	<b>100.00%</b>	<b>211</b>	<b>100.00%</b>		<b>Daily Cost</b>	<b>\$137.96</b>
					<b>Annual Cost</b>	<b>\$33,800.20</b>
					<b>Cost per head</b>	<b>\$0.09</b>

## 5.6 Cutting Technique: Band Saw Dust

Separate to accuracy of the cutting lines, the cutting technique of the ROC450 equipment resulted in reduced sawdust. This delivered two significant benefits including increased yield and also improved visual appearance of cut meat surfaces, and increased shelf life.

Table 13 shows that the primal cutting of 1500 head resulted in a recovering of 30.59 kg of saw dust. The total amount of bandsaw dust counted as a benefit in the model was reduced by 30% because the rack saddle was also being split in halves on this bandsaw but the current version of the ROC450 equipment does not include this cut. A benefit of 10c per head or \$37 000 per annum is identified in reduced bandsaw dust due to the ROC450 improved cutting technique.

When comparing between manual bandsaw cutting, and the circular saw action of the robotic equipment, the number of cuts that the robot is performing will have an impact on the amount of saw dust that is saved. The following Table 13 estimates the yield savings through reduced saw dust based on the number of cuts that the robotic equipment is going to perform.

Bandsaw dust collected with 1500/hd being processed returned 30.59 kg. It also important to note the amount of saw dust collected does not include saw dust remaining on the surfaces of the processing equipment and meat products. Other manual cuts were also occurring on this bandsaw so only 70% of the total bandsaw dust is attributed as a potential saving to the automated cutting system. This resulted in 20kg of bandsaw dust that was attributed to primal cutting. The primal cuts occurring on the day the bandsaw dust was collected included the 1<sup>st</sup> cut (forequarter and loin), 2<sup>nd</sup> cut (Rack: Short Loin Pair), and the 4<sup>th</sup> cut (Chump: Hindquarter). The assumption is made that the 20kg of collected bandsaw dust comes evenly from all 3 bandsaw cuts, this results in 7.14kg from each for the 1536 head. Depending on the number of cuts that the automated system is going to perform, the respective saving is factored in the cost benefit calculation.

## Value benefit analysis – ROC450

**Table 13: Potential savings achieved through reduced bandsaw dust.**

Number of head for collection		1536
Weight (kg)	Tub weight	Dust weight
11.70	1.92	9.78
4.17	1.92	2.25
15.83	1.92	13.91
6.40	1.75	4.65
Total dust weight		30.59
Dust from cut splitting chime bone		30.00%
Total dust that could be saved using equipment (kg)		21.41
Saw dust per cut (from 1500 hd)		7.14
Band saw dust / cut / hd (kg)		0.0046
Value of saw dust (retail value of whole lamb carcass)		\$7.50
Cost / hd	Weight (kg)	Value /hd
2 Cuts	0.009	\$0.07
3 Cuts	0.014	\$0.10
4 Cuts	0.019	\$0.14

### 5.6.1 Cutting Technique: Improved shelf life

The following table shows the estimated impact of reduced mark downs through reduced biological load and improved visual appearance. Reduced biological load is achieved through:

- No exposure to water on bandsaw table for primal cuts
- Reduced human handling
- Eliminating bone dust from surface of primal cuts

The main driver for increased visual appearance is based on eliminating bone dust from the surface of the product. Figure 3 shows the clean cut surface of a forequarter cut with the ROC450 primal cutting system. Visual appearance is particularly important.

## Value benefit analysis – ROC450

Table 14: Reduced discounting (improved visual appearance) \*\*

Increased Shelf Life (reduced level of discounting)			
	Shoulder (Boneless square cut shoulder)	Loin (Rack Standard)	Leg (Boneless leg chump on)
Average primal weight (kg)	2.57	2.80	5.20
Number of items in 1 year	752,640		
Current level of discounting	4.00%		
Number of items discounted	30,106	30,106	30,106
Weight of discounted (kg)	77,371	84,296	156,549
True Value	\$665,394	\$1,601,618	\$1,407,377
Discount Value	\$532,315	\$1,281,294	\$1,125,901
Current cost of discounting	\$133,079	\$320,324	\$281,475
Reduction in level of discounting	10.00%		
New level of discounting	3.60%		
New number of items discounted	27,095	27,095	27,095
New quantity (kg)	69,634	75,866	140,894
New True value	\$598,855	\$1,441,456	\$1,266,639
New Discount Value	\$479,084	\$1,153,165	\$1,013,311
New cost	\$119,771	\$288,291	\$253,328
SAVING	\$13,307.88	\$32,032.36	\$28,147.53
Saving per head (leg reduced discounting)	\$0.04	\$0.09	\$0.07
	2 Cuts	\$0.06	
	3 Cuts	\$0.13	
	4 Cuts	\$0.20	
Total Saving /hd	Total	\$0.20	

\* Average primal weights are based on results from industry bone out trials of 121 lamb carcasses (average carcasses weight 24.58 kg)

\* Assumptions are based around communication with a quality assurance meat supervisor from one of the major Australian retail supermarkets.

## Value benefit analysis – ROC450

### 5.7 Increased productivity

One of the main advantages achieved by automating a manual process is creating consistency in both the quality of the task and the processing speed at which the task occurs. One of the main logistical disadvantages with using manual bandsaw operators for primal cutting is the processing speed of the entire room is then set by the manual bandsaw operators. Usually bandsaw operators will work on a rotation cycle with a target number of head to be processed for each rotation cycle. This process often creates large fluctuations in the processing speed, even across short periods of time. This makes it difficult for operators further down the processing line to establish a regular work rhythm. The disadvantages of irregular product flow are also exacerbated where certain tasks or equipment process are critical limiting factors in the overall process. This creates ‘bottlenecks’ and may require production to be stopped in order to clear product. This creates down time and inefficiencies for all other labour units and equipment in the process resulting in higher unit cost of production.

The following Table 15 shows the current processing costs per kg. The loading value is included to show real cost of labour with inclusion of other costs such as holidays and workers compensation. It is expected that introduction of the equipment will increase level of productivity per person, largely due to a regular product flow. Based on the costs provided, the savings identified in Table 16 are expected based on an improved efficiency of 4% per person resulting in a saving of \$0.21/hd.

**Table 15: Current processing room staffing numbers**

Task	Number labor units				Loading 25.00%		
		hr Rate	Cost per hr	Cost per day	WW Loading	Cost /hr	Cost / day
Supervisor	1	\$35.00	\$35.00	\$280.00	\$43.75	\$43.75	\$350.00
QA	1	\$31.00	\$31.00	\$248.00	\$38.75	\$38.75	\$310.00
Admin	2	\$24.00	\$36.00	\$288.00	\$30.00	\$45.00	\$360.00
Band Saw operator	3	\$26.00	\$78.00	\$624.00	\$32.50	\$97.50	\$780.00
Ticketing	2	\$23.00	\$46.00	\$368.00	\$28.75	\$57.50	\$460.00
Knife hand	8	\$23.00	\$184.00	\$1,472.00	\$28.75	\$230.00	\$1,840.00
Trimmers	7	\$23.00	\$161.00	\$1,288.00	\$28.75	\$201.25	\$1,610.00
Packer	4	\$23.00	\$92.00	\$736.00	\$28.75	\$115.00	\$920.00
General Labor	6	\$23.00	\$138.00	\$1,104.00	\$28.75	\$172.50	\$1,380.00
Maintenance	1	\$19.00	\$19.00	\$152.00	\$23.75	\$23.75	\$190.00
<b>Total</b>	<b>33.5</b>		<b>\$820.00</b>	<b>\$6,560.00</b>		<b>\$1,025.00</b>	<b>\$8,200.00</b>

## Value benefit analysis – ROC450

**Table 16: Estimated saving of increasing existing plant processing efficiencies with automation**

Increased throughput through the room	
Average daily hd	1536.00
Average kg	21.88
Average Kg boned per day	33,608
Boning room cost / day	\$8,303.20
Labor cost \ per kg to bone	\$0.25
Labor cost \ per hd to bone	\$5.41
New kg boned per day	34,952
New Labor cost \ per kg to bone	\$0.24
New Labor cost \ per hd to bone	\$5.20
Saving per head	\$0.21

### 5.8 OH&S Savings

One of the main drivers for automation of lamb primal cutting is to progressively eliminate the use of bandsaws in the boning due to risk of operator injury.

Some retail customers are also now requiring as part of their due diligence that operators reduce use of bandsaws where other technologies are available to do the same job.

The two main areas where the automated equipment provides OH&S benefits include reduced sprain and strain injuries from lifting of carcasses, and also reduced risk of operator injury on the bandsaw.

The assumptions shown in Table 17 are based on discussions with the onsite workplace health and safety office at the site where survey data was collected.

**Table 17: OH&S savings**

OH&S			
Band Saw cutting		Sprain and Strain from lifting	
Risk of Limb Loss over 5 year period	80%	Number of occurrences per year	4
Premium Cost	\$120,000.00	Cost of light duties claim, loss of operator	\$10,000.00
Annual Cost	\$19,200.00	Annual Cost	\$40,000.00
Annual Saving per head	\$0.05	Annual Saving per head	\$0.11
TOTAL OH&S Benefit			\$0.16

# Value benefit analysis – ROC450

## 5.9 Labour Savings

One of the obvious savings and main drivers for automation is a reduced labour requirement. It is envisaged that introduction of the ROC450 equipment would reduce the labour requirements for bandsaw operation by approximately 1.8 labour units. Another significant saving as discussed previously is reduction in the amount of band saw dust. This also provides a labour benefit. Often up to 3 full time labour units can be used to scrape bone dust from the number of head being considered. As bandsaws will still be required for other primal cuts, not all bone scrapping will be eliminated. It is assumed 1.6 labour units are saved for the following analysis.

**Table 18: Assumptions for labour savings with the installation of ROC450 equipment (based on communication with CEO of the plant)**

Labor	Hd / annum	376,320
Number band saw labor units saved		1.8
Hourly cost		\$26.00
Plus overheads (35%)		\$9.10
Total hourly rate		\$32.00
Annual		\$119,808.00
Saving in bone scrapers		1.2
Hourly cost		\$23.0
Plus overheads (35%)		\$8.1
Total hourly rate		\$31.1
Annual cost of Bone Scraper		\$64,584.00
\$ Saved bone scraping		\$77,500.80
Total		\$197,308.80
Number of cuts required	2	\$0.17
	3	\$0.35
	4	\$0.52
Saving per head		\$0.52

## 5.10 Costs

### 5.10.1 Capital costs

The capital cost of the equipment is costed at the commercial value. A site specific infrastructure costs is also included. This amount will vary significantly from plant to plant depending on existing layouts and available space and should not be considered generically for a ROC450 installation. The useful working life of the equipment has been estimated at 10 years by the manufacturer. The annual capital cost is calculated using straight line depreciation across the 10 years; no provision is made for the opportunity cost of the capital.

## Value benefit analysis – ROC450

**Table 19: Capital costs of the equipment**

Based on annual product of		376320	801600
CAPITAL COSTS			
Item	Price	Price	
Equipment purchase	\$950,000.00		
Infrastructure upgrade	\$100,000.00		
Total	\$1,050,000.00		
Annual Deprecation	\$105,000.00		
Cost per head	\$0.28	\$0.13	

### 5.10.2 Floor space requirement

Installation of the ROC450 system requires floor space of a 4 metre by 5 metre area (20m<sup>2</sup>). Depending on available space this should allow for the system to be installed into most plants; however infrastructure changes may be required.

### 5.10.3 Operational, Maintenance & Training Costs

Some extra operational costs are also associated with the installation of the equipment. The following costs presented in Table 20 are provided by the manufacturer, with the exception of down time which is calculated as shown in Table 22. Hourly labour rate of the processing room is based on calculations shown in Table 15.

**Table 20: Operational, Maintenance and Training costs**

	Based on annual # hd		376320	720,000
	Item	Cost / yr	Cost / hd	
Operational	Cleaning	\$2,500.00	\$0.01	\$0.00
	Power	\$5,300.00	\$0.01	\$0.01
	Additional MAR support	\$5,000.00	\$0.01	\$0.01
	Ongoing Training	\$1,500.00	\$0.00	\$0.00
	Risk of down time	\$12,300.00	\$0.03	\$0.02
Sub Total		\$26,600.00	\$0.07	\$0.04
Maintenance	Blades	\$10,000.00	\$0.03	\$0.01
	Maintenance	\$4,850.00	\$0.01	\$0.01
	Materials	\$2,000.00	\$0.01	\$0.00
Sub Total		\$16,850.00	\$0.04	\$0.02
Total		\$43,450.00	\$0.12	\$0.06

## Value benefit analysis – ROC450

Table 21: Risk of down time caused by the automation equipment

Risk of down time	
Total plant down / week	0.25
Hourly labor cost for boning room	1,025.00
Weekly Cost	256.25
Annual Cost	12,300.00
Cost per head	0.03

While \$1500 is allowed for training of the plant staff, the day-to-day operation of the equipment is straight forward. Figure 7 shows the operator interface for the automation system is simple and robust, allowing the daily operation of the equipment to occur with minimal training and interruption to exiting operations in the plant.



Figure 7: Operators panel used to operate the equipment.

Some damage was observed to a small percentage of forequarters to the 4th rib. In all cases the product still met market specification and the issue was being addressed with adjustments to the equipment used to hold the carcasses during cutting.

## Value benefit analysis – ROC450

### 6 Cost Benefit Summary

Table 23 shows the contribution of individual costs and benefits to the total annual return that the automated primal cutting equipment provides to the plant on an annual basis. This calculation is shown for both production at the current capacity, and also production at the expected increase in processing capacity once upgrades have been installed.

Table 22: Cost Benefit analysis summary

COST - BENEFIT ANALYSIS OF ROBOTIC PRIMAL CUTTING EQUIPMENT						
Benefit summary		\$/hd	Total plant		Increased plant throughput (total per annum)	
			432000		720,000	hd/yr
1.1 Accuracy	Cut 1	\$0.19	\$81,160	\$0.19	\$135,266	
	Cut 2	\$0.16	\$70,445	\$0.16	\$117,408	
	Cut 3	\$0.00	\$0	\$0.00	\$0	
	Cut 4	\$0.03	\$11,640	\$0.03	\$19,401	
1.2 Cutting Technique	Reduced saw dust	\$0.10	\$45,168	\$0.10	\$75,280	
	Increased shelf life	\$0.13	\$55,678	\$0.13	\$92,797	
<b>2. Increase in throughput</b>		\$0.21	\$88,702	\$0.21	\$147,837	
<b>3. OH&amp;S savings</b>		\$0.16	\$67,959	\$0.16	\$113,265	
<b>4. Labor savings</b>		\$0.35	\$149,492	\$0.35	\$249,153	
<b>\$ Benefit per head</b>		<b>\$1.32</b>	<b>\$570,244</b>	<b>\$1.32</b>	<b>\$950,406</b>	
Capital cost		\$0.28	\$120,536	\$0.15	\$105,000	
Maintenance		\$0.04	\$19,343	\$0.04	\$32,239	
Operation		\$0.07	\$30,536	\$0.07	\$50,893	
Risk of mechanical failure		\$0.03	\$14,120	\$0.03	\$23,533	
<b>Total cost per head</b>		<b>\$0.43</b>	<b>\$184,534</b>	<b>\$0.29</b>	<b>\$188,131</b>	
<b>Total net \$ benefit per head</b>		<b>\$0.89</b>	<b>\$385,709.43</b>	<b>\$1.03</b>	<b>\$950,406.16</b>	

## Value benefit analysis – ROC450

Table 24 considers the net annual benefit of the project. The final row of the table considers the net present value of the investment at a discount rate of 7% if the equipment had a life span of 10 years. Both discount rate, and life span of the equipment are adjustable drivers in the model.

**Table 23: Summary performance measures**

SUMMARY PERFORMANCE MEASURES			
		Hd/ annum 432,000	Hd/ annum 720,000
%increase in production with new equipment installed			<b>66.67%</b>
Capital cost (payment option, upfront)		<b>\$1,050,000</b>	<b>\$1,050,000</b>
Gross return Per head		<b>\$1.32</b>	<b>\$1.32</b>
Total costs Per head		<b>\$0.43</b>	<b>\$0.29</b>
Net Benefit Per head		<b>\$0.89</b>	<b>\$1.03</b>
Annual Net Benefit for the plant		<b>\$385,709</b>	<b>\$950,406</b>
Annual Net Benefit for the ex cap cost		<b>\$506,245</b>	<b>\$843,742</b>
Pay back (years - months)		<b>2.07</b> <b>24.89</b>	<b>1.24</b> <b>14.93</b>
Net Present Value of investment		\$2,574,346	\$4,944,782

Figure 8 illustrates the contribution of individual benefits to overall benefit identified with installation of the automated primal cutting equipment. Labour saving is the most important driver identified at 37%, and product benefit achieved through cutting accuracy is calculated to contribute 24% of the total benefit. Benefits achieved through cutting accuracy obviously depend on cutting specifications. In the current analysis no benefit is attributed to accuracy of the cut between the hind leg and the loin as the plant’s cutting specifications did not include this cut. However, in the situation where a boneless loin is being produced, significant increases in value can be achieved through greater loin recovery from the pelvic bone.

Occupational Health and Safety benefits contribute only 10% to the overall increase in value. However, it is also important to consider the value of this benefit from a social and corporate accountability perspective where adoption of the equipment will likely result in reduced limb loss, and long-term sprain and strain injuries.

# Value benefit analysis – ROC450

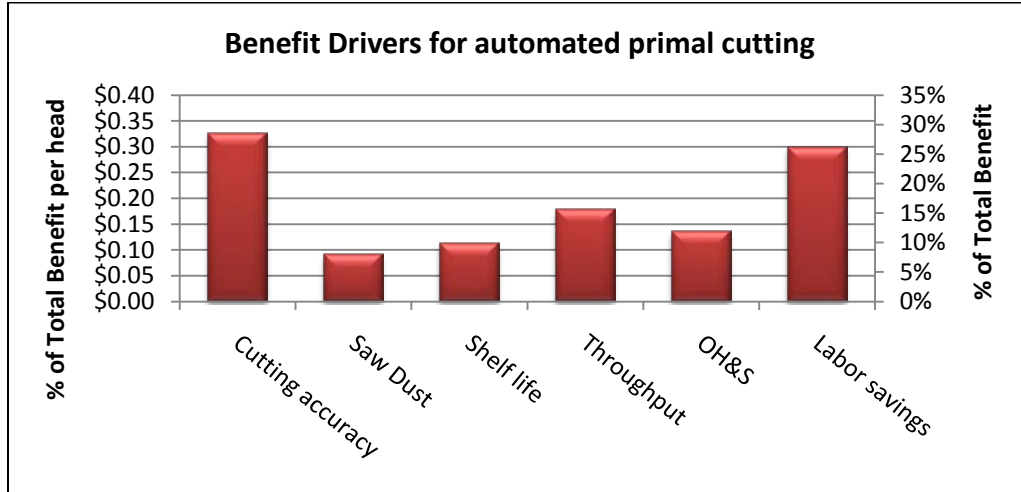


Figure 8: Contribution of individual benefits to overall benefit.

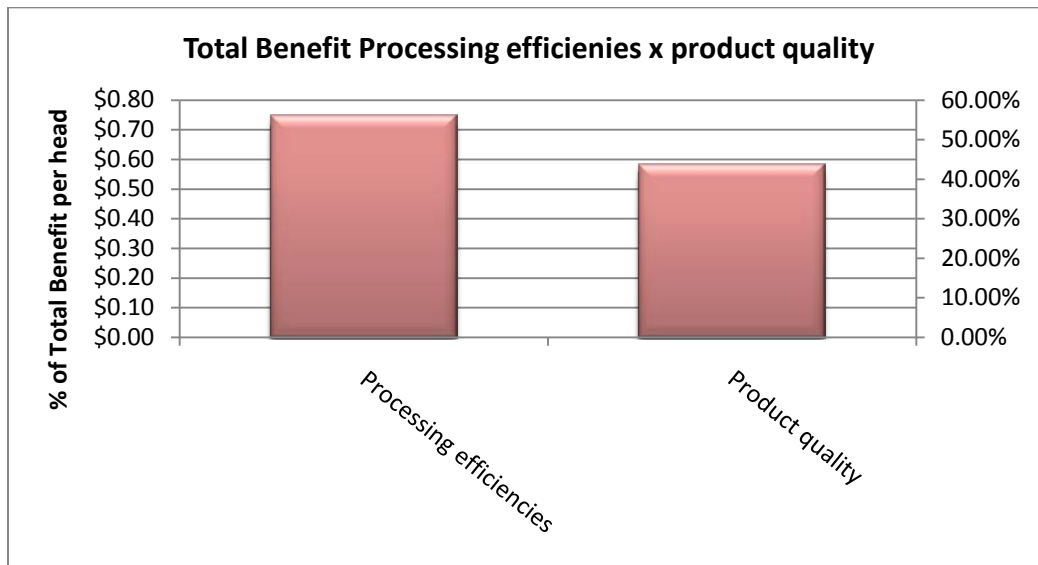


Figure 9: Portion of total benefits providing value to production system compared to actual increases in product quality.

## 7 Appendices

### 7.1.1 List of Tables

Table 1: Measurement points for determining cost of inaccurate cutting between primals in lamb processing .....	6
All costings relating to the value of the product presented in the results section are based on the values shown in Table 2. Table 2: Sales prices used for costing inaccuracies and yield loss/gains.....	6
Table 3: Data used for loin and bone loss calculations.....	7
Table 4: Non adjustable drivers used to calculate the value per head for each of the 9 identified benefits. ....	8
Table 5: Adjustable drivers.....	8
Table 6: Number of cuts required and the impact on processing speed*.....	9
Table 7: Plant Specific Drivers* .....	9
Table 8: Driver explanations .....	11
Table 9: Results of manual forequarter cutting accuracy as measured by the number of ribs, compared to ROC450 observations (costing calculation based on 1,536 hd/day).....	14
Table 10: Distribution of observed forequarter cuts that occurred caudally or cranially to the 4 <sup>th</sup> rib. ...	15
Table 11: Level of MANUAL cutting accuracy on racks as measured by the required number of ribs (0 = correct).....	16
Table 12: Cutting accuracy of the ROC450 equipment for the 3 <sup>rd</sup> cut, as measured by the cut relative to the ilium bone. ....	17
Table 13: Potential savings achieved through reduced bandsaw dust.....	19
Table 14: Reduced discounting (improved visual appearance) ** .....	20
Table 15: Current processing room staffing numbers .....	21
Table 16: Estimated saving of increasing existing plant processing efficiencies with automation .....	22
Table 17: OH&S savings .....	22
Table 18: Assumptions for labour savings with the installation of ROC450 equipment (based on communication with CEO of the plant) .....	23
Table 19: Capital costs of the equipment .....	24
Some extra operational costs are should also be associated with the installation of the equipment. The following costs presented in Table 20 are provided by the manufacturer, with the exception of down time which is calculated as shown in Table 22. Hourly labour rate of the processing room is based on calculations shown in Table 15.	
Table 20: Operational and Maintenance costs associated with the use of the ROC450 equipment. ....	24
Table 21: Operational, Maintenance and Training costs .....	24
Table 22: Risk of down time caused by the automation equipment.....	25
Table 23: Cost Benefit analysis summary .....	26
Table 24: Summary performance measures.....	27

## 7.1.2 List of Figures

Figure 1: Contribution of summary benefits and individual benefits to overall estimated gross value return on ROC450 equipment of \$1.32 / hd.....	3
Figure 2: Proposed cutting line for ROC450 system **Source MAR Promotional literature 2010, provided by Stuart Shaw. ....	5
Figure 3: Forequarter processed using the ROC450 equipment. ....	12
Figure 4: Current manual cutting accuracy of forequarter, compared to cutting accuracy observed at processing plant using ROC450 equipment.....	13
Figure 5: Consistency of the robot to cut along the caudal edge of the selected forequarter rib.....	15
Figure 6: Random Selection of aitch bones showing the accuracy of the 3 <sup>rd</sup> cut. ....	17
Figure 7: Operators panel used to operate the equipment.....	25
Figure 8: Contribution of individual benefits to overall benefit of \$1.57/hd. ....	28
Figure 9: Portion of total benefits providing value to production system compared to actual increases in product quality.....	28