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ALC X-Ray Primal System

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Abstract

The first successful LEAP III ovine primal cutter (including x-ray) was installed in late 2011 by Scott at the Australian Lamb Company (ALC). Since installation the ALC system has processed over 350,000 head in the first five months with less than four hours of downtime. The x-ray primal system is the first part in the Scott vision of a fully automated lamb room. It is likely that ALC and Scott will now install a fully automated middle system following on from the success of the x-ray primal system. At the time of report development the forecasted gross benefit of $2.49 per carcase benefit was being independently evaluated, however ALC believe that they have more than achieved this return from their investment.

Executive Summary

The first successful LEAP III ovine primal cutter (including x-ray) was installed in late 2011 by Scott at the Australian Lamb Company (ALC). Since installation the ALC system has processed over 350,000 head in the first five months with less than four hours of downtime. The x-ray primal system is the first part in the Scott vision of a fully automated lamb room, which is depicted in Figure 1.

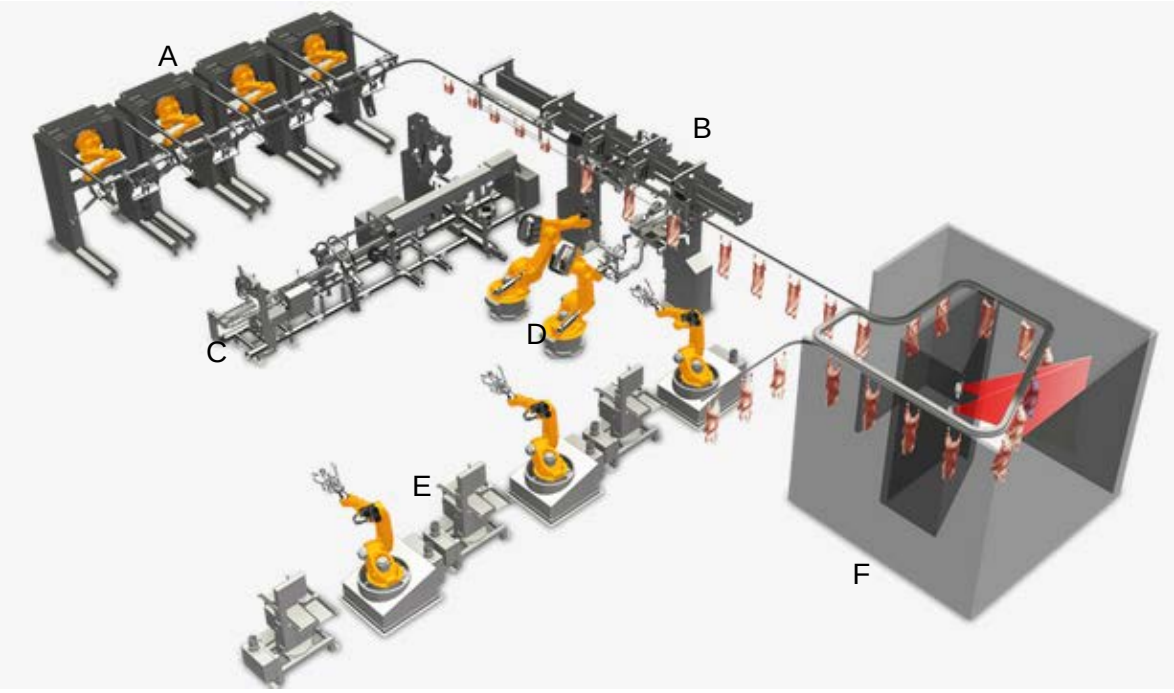


Figure 1: Scott Vision (now realised) of a fully automated bone-in lamb processing facility (Legend: A: hindquarter, B: Primal, C: middle, D: integration robots, E: forequarter, and F: x-ray system)

Note: ALC was the first company in the world to have the latest revision of the X-ray primal system, both systems being substantially changed from previous installations in New Zealand. Moving forward the ALC design has been cemented as the commercial standard for x-ray primal systems by Scott.

The functional purpose of the primal system (B) is to utilise x-ray information (F) of individual carcases and cut the carcase into forequarter, middle and hindquarter sections. ALC's installation also cuts the middle further into a rack and loin when operating at less than 7 carcases per minute (which is the maximum current ALC room throughput).

An independent pre-installation evaluation from Greenleaf Enterprises forecasted a gross per head benefit to ALC of $2.49 per carcase from the x-ray primal installation.

Contents

Background

Over the past eight years Scott Technology and Meat and Livestock Australia have been working together to develop an automated lamb boning room. The first component of this vision is an x-ray system and primal cutting system that separates the lamb carcase into forequarter, middle and hindquarter sections

Australian Lamb Company (ALC) and Scott Technology (STL) since November 2009 have been developing a design of the RTL X-ray Primal system to suit ALC's needs. As of the start of April 2010, the design and resulting budget was developed and approved by all required parties for execution.

The X-ray Primal solution for ALC utilised a newly developed dual x-ray system (to reduce space), a 10 carcase per minute primal de-tuned to 6 carcase per minute enabling a third cut to be incorporated into the towers (rack/loin cut) and finally a 'swing away' Primal second tower carcase clamp that allows the x-ray system to operate whilst the primal system is off-line.

Aim

The aim of the research was to:

- 10 carcases per minute at 2 carcase cuts (Forequarter – Middle separation and Middle – Hindquarter separation).
- 6 carcases per minute at 3 carcase cuts (as the 10 cpm configuration with the addition of a Rack – Loin separation)
- A solution that can purge the x-ray primal of carcases on the request from an operator, removing the need for operational staff to physically remove any more than two carcases from the system on malfunction.
- A two station x-ray system with reduced footprint compared with the current design single station x-ray system.

Introduction

Note: A significant proportion of the information contained in this section has been extracted from the Greenleaf Enterprises report.

The benefits of the system are:

- Yield →Increase return on carcase purchase by ensuring the forequarter, middle and hindquarters only contain forequarter, middle and hindquarter meat respectively,
- Yield → using rotary knives compared to bandsaw reduces meat lost as 'sawdust',
- Yield → extending the loin meat length by performing a 'scallop' cut
- Safety → lifting and moving of carcases
- Safety → humans removed from bandsaw interactions
- Productivity → increased room utilisation due to steady flow of product entering room as set by the x-ray primal machine compared to a human operator using a bandsaw.
- Labour → reduced labour required for the same throughput.

Greenleaf calculated the benefits to ALC to be as follows:

Table 1: ALC X-Ray Primal befits (taken from Greenleaf Enterprises report)

COST - BENEFIT ANALYSIS OF X-RAY PRIMAL CUTTING EQUIPMENT			
		Plant 1	
Benefit summary		$/hd	Total /annum
1. Increase in yield (kg/head)			
1.1 Accuracy of cut location	Inaccuracy of cut FQ : loin	$0.25	$135,214
	Inaccuracy of cut Rack : SLP	$0.14	$73,043
	Inaccuracy of cut Loin : HQ	$0.17	$90,870
1.2 Cutting Technique	Scallop cut	$1.20	$648,202
	Saw dust yield loss	$0.05	$26,753
	Shelf life	$0.14	$75,460
2. Increased efficiency through consistent product flow		$0.18	$97,397
3. OH&S savings		$0.14	$76,800
4. Labor savings		$0.22	$119,808
$ Benefit per head (Gross)		**$2.49**	**$1,343,547**

1.1 CUTTING ACCURACY

The following depicts the various cutting accuracy gains (or pre-installation current losses).

Table 2: Measurement Points for determining cost of inaccurate cutting between primal in lamb processing

Cuts, Cranial to Caudal	Impact on Primals either side		Resulting Loss
Cut 1	Shoulder Short	Rack Long	Possible shoulder loin that ends being trimmed off 8 rib rack, discounted racks that don't market specs
	Shoulder Long	Rack Short	Rack loin achieves lower value as shoulder rack Discounted racks if not able to meet market specs
Cut 2	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 lost to trimmed Backstrap discounted because they are short Loss of Tenderloin
Cut 3	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 back-strap and TDR to aitch bone and trimming or leg muscle depending cutting specification

1.1.1 Forequarter/Middle Cutting Inaccuracies

Figure 2: Correct cutting line between forequarter and loin for a four rib shoulder rack

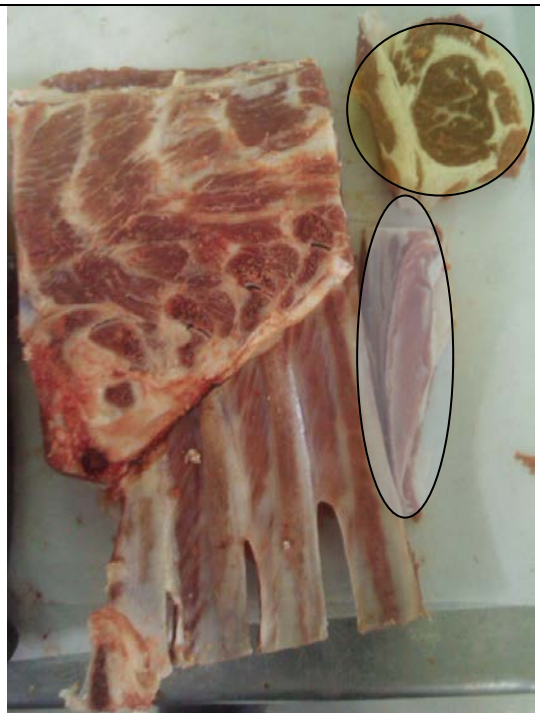


Figure 3: Cutting line long for a four rib shoulder rack. Highlighted items represent value lost (Loin lost to trim and part rib lost to render).

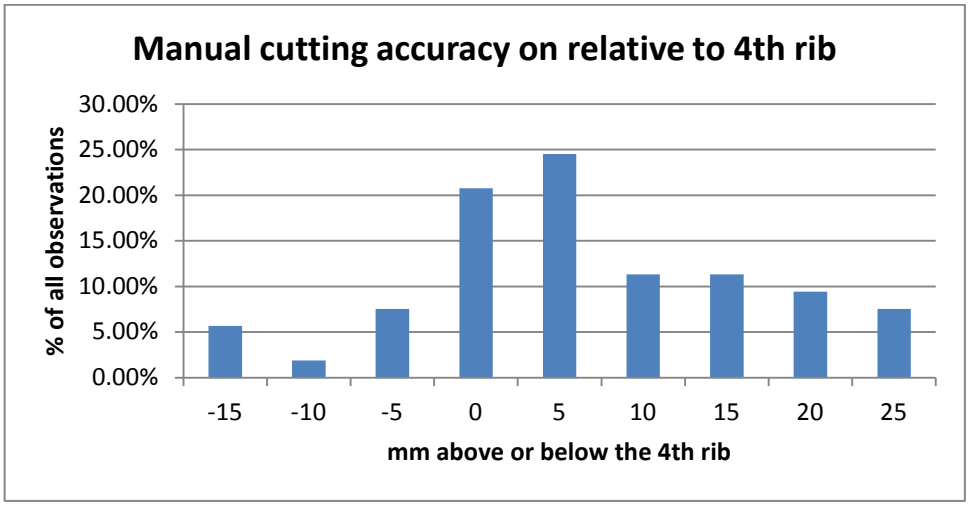


Figure 4: Manual cutting lines relative to the 4th rib on a 4 rib shoulder cut.

Table 3: Accuracy observations for both manual and NZ X-ray cutting systems

	Manual		X-Ray	
FQ - Mid	No Obs	%	No Obs	%
-2	0	0.00%	1	0.35%
-1	19	8.33%	17	5.90%
0	185	81.14%	249	86.46%
1	25	10.96%	18	6.25%
2	0	0.00%	3	1.04%
Number of observations	229	100%	288	100.00%

1.1.2 Middle/Hindquarter Cutting Inaccuracies

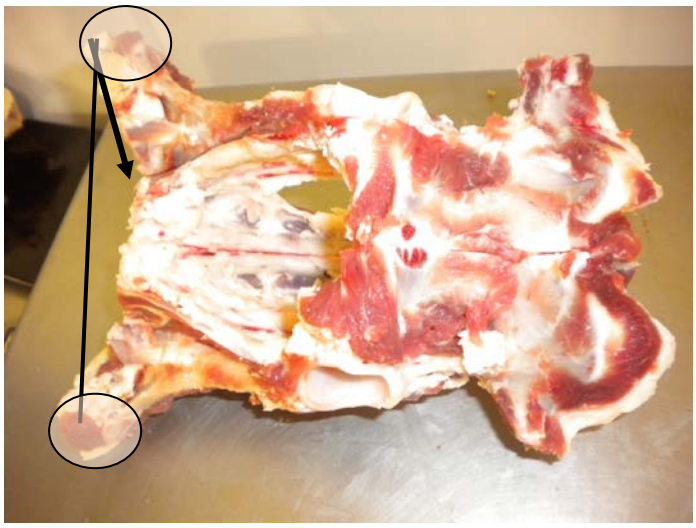


Figure 5: Correct cutting line between hindquarter and loin.

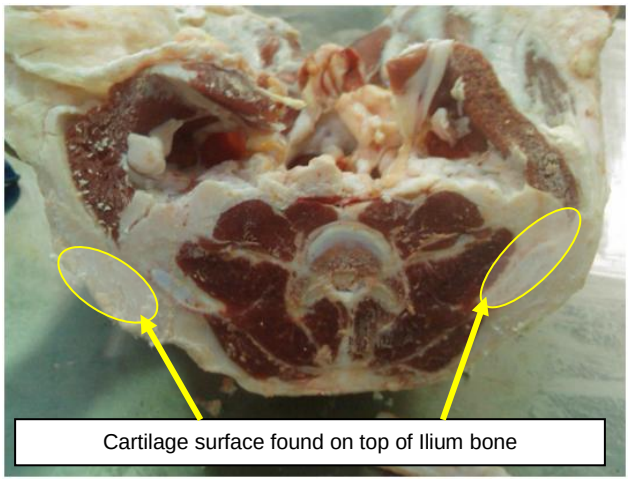


Figure 6: 100% accurate cutting line: Un-boned hindquarter with bone still remaining

Figure 7: Aitch bone showing cut where leg is long, and loin would be short, knife edge marks correct cutting line

Figure 8: Same aitch bone with trim removed

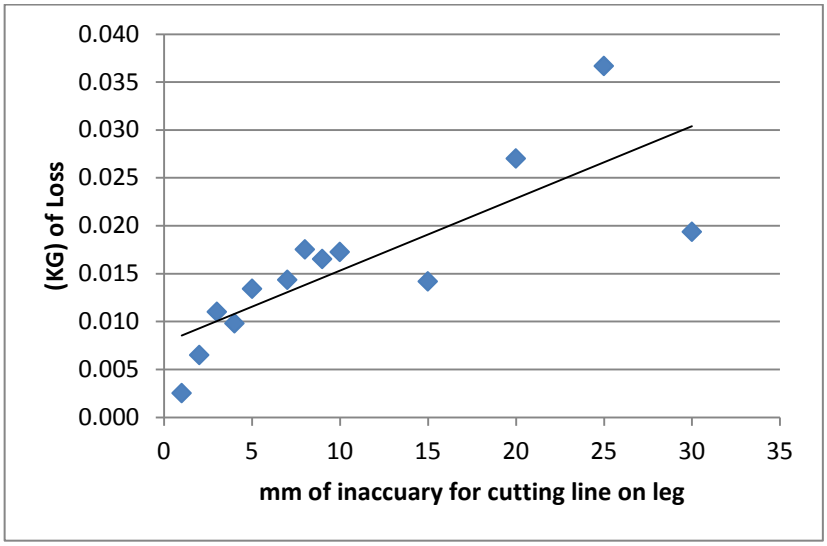


Figure 9: Average weight of loin recovered from aitch bone based on mm of cutting line inaccuracy

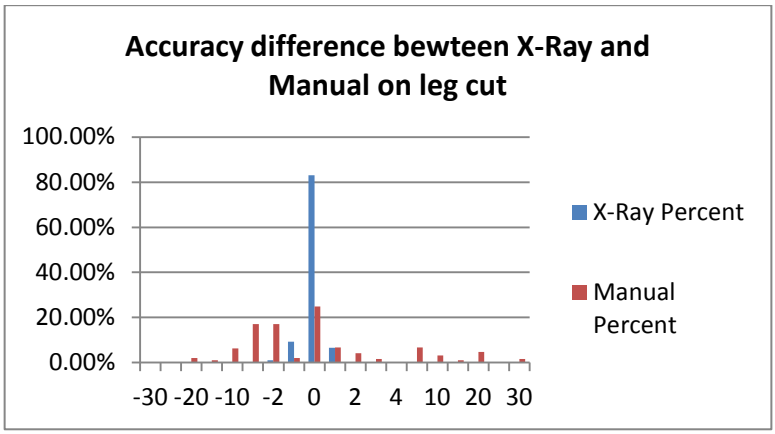


Figure 10: Survey results showing level of cutting accuracy for Loin – Leg cut under manual band saw operating conditions

1.2 SCALLOP CUTTING BENEFITS

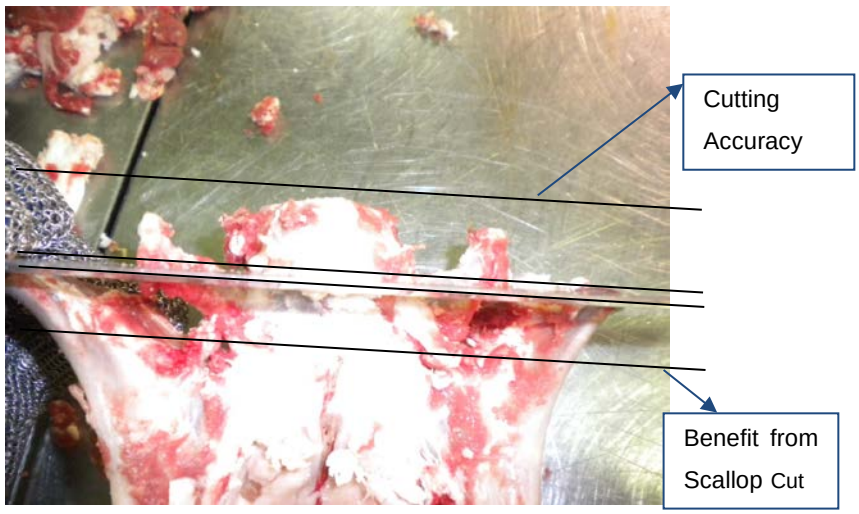


Figure 11: Aitch bone showing value opportunity for increased accuracy in cutting lines, and also value opportunity technical advantageous achievable with the scallop cut.

Figure 12: Shape of scallop cut, note greater loin recovery from aitch bone.

Figure 13: Difference between standard cut (far left), and Scallop cut (right). Note the increased visible loin remaining on standard hindquarter cut.

The cost benefit of the scallop cut was established by removing remaining loin from aitchbones cut using the standard cutting method. Recovery averaged 74 grams per aitch bone. Aitch bones were than assessed during the scallop cut and any remaining loin was removed. The average amount of loin remaining the aitch bones was 20 grams. Note the large amount of muscle remaining on the aitch bone on the left hand side of Figure 13 cut with a horizontal cut relative to amount of muscle left on the aitch bone seen on the right hand side of the image.

1.3 INCREASED EFFICIENCIES ON EXISTING LABOUR

The main assumption behind increased efficiencies for existing labour is a consistent throughput of product through the boning room. Currently the bandsaw operator is responsible for setting the speed at which the lamb carcasses enter the processing belt. While each rotation currently processed the specified number of carcasses in a given time period, large variations in the processing speed can occur during the rotation. This can lead to labours either operating at less than optimum speeds, or build-up of product where operators are not able to keep up.

One of the main advantageous of the automated primal cutting equipment identified by the boning room supervisor where the equipment was running commercially was the consistency of throughput through the room. The comment was made that product flow the room is now much more consistent, and has resulted in increased boning capacity of

the room using the same labour and infrastructure as previously used. The main driver for the reduced labour cost per kg shown in Table 4 is the assumption in the model drivers that consistency in product flow will result in an increased labour efficiency of 4%.

Table 4: Increase in existing labour due consistent product flow through the boning room.

Increased labor efficiency (consistency of product flow)			
Task	Number	Rate (plus costs)	Daily cost
Bonners	4	$31.00	$992.00
Slicers	6	$28.00	$1,344.00
Labor	40	$25.00	$8,000.00
Total			**$10,336.00**
Current kg of processing			52800
Current cost per kg			$0.20
New processing capacity with existing labor			54912
New Cost per kg			$0.19
Saving/ kg			$0.01
Saving per head			$0.18
Annual saving			$97,396.92

1.4 REDUCED BANDSAW DUST

The use of bandsaws for cutting lamb results in bandsaw dust. This has two negative impacts; a) yield loss from the carcass and b) negative visual impact from the residual saw dust left on the surface of the product. The amount of bandsaw dust was collected from the main bandsaw where lamb carcases were being broken into primals was 17.1

Table 5: Value of band sawdust lost during manual cutting

Band Saw Dust benefits	
Number of head processed	2200
Time	Net amount
8:40	1.027
10:20	3.959
12:15	3.996
14:30	8.147
TOTAL (kg)	**17.129**
% reduction with automated	85.00%
% reduction with automated (Kg)	14.55965
Retail value of carcasses	$7.50
Value of recovered. saw dust that was salable	$109.20
Value per hd	$0.05
Value per annum	$26,753.36

1.5 INCREASED SHELF LIFE

Increases in shelf life are expected with the use of the X-Ray primal cutting equipment. This is largely due to;

a) Eliminating of oxidized bone dust causing browning of meat surface. (Natural process of oxymyoblobin converting to metmyoblobin and causing browning will still occur.
b) Reduced biological loading
    a. Removal of bone dust from meat surface (see figure
    b. Eliminating the use of water on bandsaw tables current used during the cutting process
    c. Reduced human handling of meat

Figure 14: Lamb hindquarter cut with the leap3 X-Ray primal cutting system, note cut meat surface and lack of bone dust present.

Based on the assumptions the following reductions in discounts are estimated due improved visual appearance of the product and increased shelf life.

1.6 OH&S SAVINGS

Two main areas are identified where the automated primal cutting system will provide OH&S benefits. These are reduced sprain and strain injuries through eliminating the need for bandsaw operators to be lifting carcass off the rail for cutting, and eliminating the need for any operator interaction with a saw blade for the cutting of lamb primals. Based on these assumptions the following frame work in is presented to show OH&S Benefits.

Table 6: OH&S Benefits of automated X-Ray Lamb primal cutting

OH&S		
Band Saw cutting	Risk of Limb Loss over 5 year period	80%
	Premium Cost	$180,000.00
	Annual Cost	$28,800.00
	Annual Saving per head	$0.05
Sprain and Strain from lifting	Number of occurrences per year	4
	(real) Cost of light duties claim, loss of operator	$12,000.00
	Annual Cost	$48,000.00
	Annual Saving per head	$0.09
TOTAL OH&S Benefit		$0.14

1.7 LABOUR SAVINGS

The number of labour units saved with introduction of the equipment is estimated at 1.8 FTE labour units. This results in a saving of $0.22/hd.

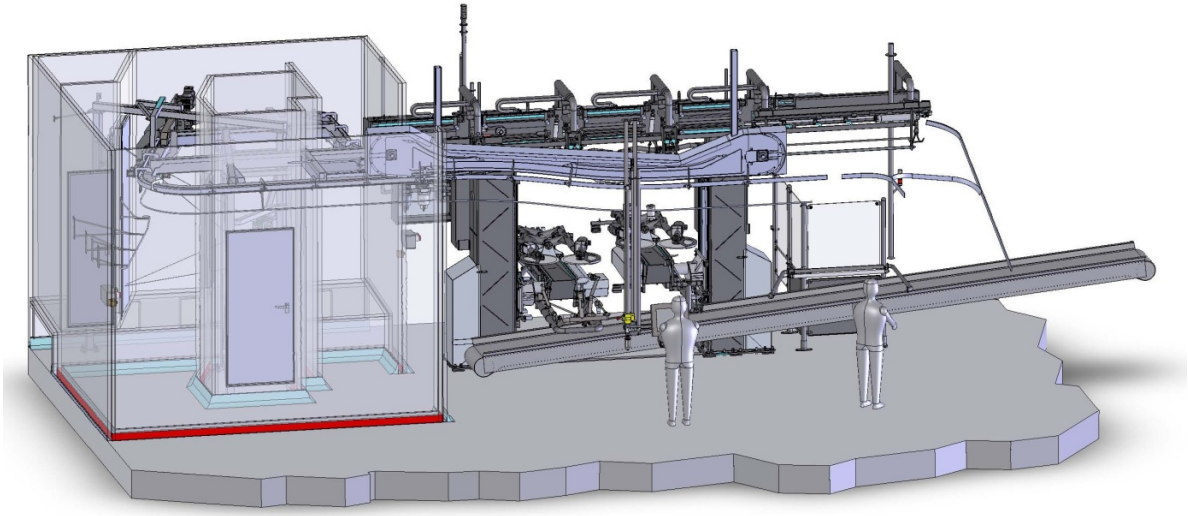
Table 7: Labour savings achieved with automated X-Ray Primal cutting equipment

Labor Savings	
Rate	$32.00
Annual Cost	$66,560.00
Band saw operator	1.8
Annual Cost	$119,808.00
Saving per head	$0.22

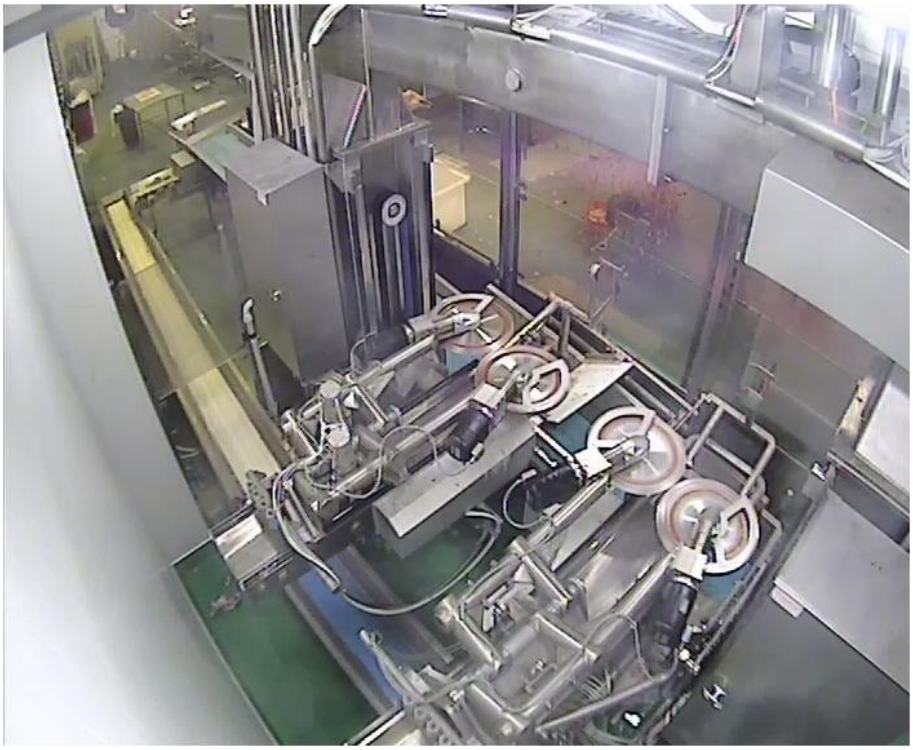
Results

The system depicted below was successfully installed at ALC, meeting all of the required objectives of the project. At the time of report writing Greenleaf was undertaking an independent review on behalf of MLA of the resulting gains achieved by ALC. The Greenleaf report will supplement this report in the future from a production benefit perspective.

1.8 MODEL



1.9 ACTUAL SYSTEM



Discussion

The ALC system has now become the standard for which Scott offers x-ray primal systems.

Recommendations and Conclusions

Scott is now actively targeting other Australian processors for commercial installations of the x-ray primal system and ALC for the installation of a middle system to complement their x-ray primal system.