





Cost Benefit Analysis – Automated Scribing System Non-Confidential

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Executive Summary

The Intelligent Robotics (IR) automated scribing system operating at AMG plant was reviewed over several days comparing the manual scribing accuracy to the automated scribing system for all carcases and specifications processed during the period. The cut value prices applied in the modelling are industry averages. The accuracy of the IR automated scribing system has an improved cutting accuracy over manual operators for all cutting lines. As can be seen in Table 1 the IR scribing system provides a payback of between 1.97 and 2.18 years based on the ex-work capital cost and between 3.69 and 3.72 years for the overall AMPC project. The benefits are based on the actual system accuracy of the cutting lines shown in Table 2, with an overall gross benefit of between $5.25 and $5.83/carcase when including the ongoing maintainence costs of the system. Maintenance costs are excluded from the second scenario as they were included in the AMPC project. The cube-strip separation was not validated as this cut is not currently undertaken at AMG.

Table 1: Summary of performance measures

SUMMARY PERFORMANCE MEASURES				
	Automated - Ex-Works		Automated - Overall Project Cost	
Hd / annum	239,892		239,892	
	From	To	From	To
Capital cost (pmt option, upfront)	$2,750,000		$5,020,315	
Gross return Per head	$5.66	$6.23	$5.66	$5.70
Total costs Per head	$0.98		$1.07	
Net Benefit Per head	$4.68	$5.25	$4.58	$4.62
Annual Net Benefit for the plant	$ 1,122,548	$ 1,260,312	$ 1,099,032	$ 1,108,801
Annual Net Benefit for the ex cap	$ 1,260,048	$ 1,397,812	$ 1,350,048	$ 1,359,817
Pay back (years)	2.18	1.97	3.72	3.69
Net Present Value of investment	$11,624,359	$13,083,836	$9,354,044	$9,457,534

Table 2: Overall plant benefit

TOTAL BENEFIT					
		Automated - Ex-Works		Automated - Overall Project Cost	
Benefit summary		$/hd From	$/hd To	$/hd From	$/hd To
Accuracy	Cube-strip separation	$0.00	$0.00	$0.00	$0.00
	Cube-chuck separation	$4.29	$4.65	$4.29	$4.65
	Vertical Scribes	$0.83	$1.05	$0.83	$1.05
Labour benefit		$0.53	$0.53	$0.53	$0.00
Equipment costs	**Maintenance**	-$0.38	-$0.38	$0.00	$0.00
	Operation	-$0.03	-$0.03	-$0.03	-$0.03
	Risk of failure	$0.00	$0.00	$0.00	$0.00
	$ Benefit per head	**$5.25**	**$5.83**	**$5.63**	**$5.67**
$ Annual Benefit overall plant		**$1,260,048**	**$1,260,048**	**$1,350,048**	**$1,350,048**

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2 Introduction

Beef scribes, known as the cutdown saw under manual operation, are the first cuts on a side of beef upon entry or just prior to the boning room. During the scribing process, two vertical and two horizontal cuts are performed, being four cuts in total, as shown in Figure 1. The location and orientation of these cuts are pivotal for the boning process, setting the boundary of all products adjacent to these cuts. The accuracy of these scribe/saw cuts, in part drives primal cut yield and commercial value from the saleable meat yield. Therefore, only highly trained and experienced operators are allocated to this manual operation to ensure optimised saleable meat yield of the higher value cuts.

The processing plant is highly dependent on manual saw operators. This dependence has created issues including:

- Staffing
    - Finding suitable candidates for skilled roles
    - Retaining operators once skilled in the position
    - The cost of training and recruiting operators
    - Increased labour costs
- Consistency of cutting lines
    - Across a whole shift, from start to finish
    - Between shifts (operators)
    - Between the left and right side of the carcass
    - Between changes in carcase specifications
- WHS risks associated with cutting;
    - Strain related injury
    - Laceration from scribing saw
    - Noise greater than 85db

Automated solutions are being developed to address the challenges of this highly skilled task. The following report assesses the current value opportunity that exists for automation within the constraints of existing manual system and estimates the value automation achieves.

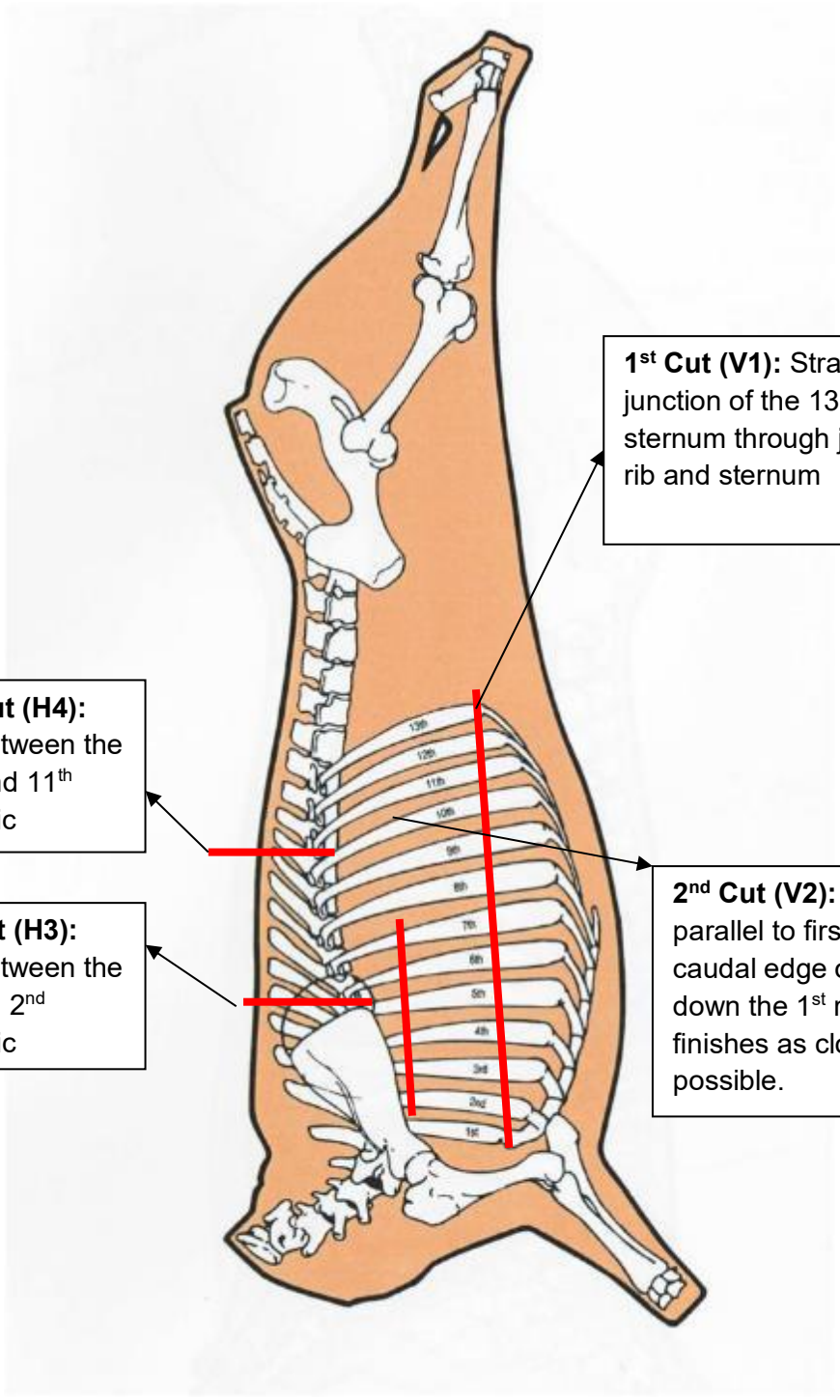


Figure 1: Right hand side of split beef carcass showing location of 4 cutting lines applied by a beef scriber

Source: Greenleaf Enterprises

3 Objectives

The objective of this work was to review the manual processing performance against the estimated automation accuracy from the new development of the automated beef boning solution and its impact at the AMG plant including:

- Quantify variance in accuracy of cutting lines completed by the manual operator on each boning chain and shift.
- Quantify the value benefit of the proposed automated system.
- Provide a detailed value benefit and main drivers of return on investment over manual performance, post-automated solution.

4 Methodology

The value created through the installation of an automation systems can be categorised into either processing improvements or increased product value. The processing improvements provides benefits such as increased throughput, WHS cost reductions, labour savings and generally an increased equipment cost. The increasing product value is created by an improvement in accuracy of the location of the cutting line. This improvement tends to provide the highest benefit for the implementation of automation in primary processing areas. The following provides an explanation of the measurements collected during the site visit at AMG's Cootamundra plant.

4.1 Cut accuracy data collection methods

The cutting line accuracy analysis was developed by Greenleaf Enterprises over the last 10 years. The following outlines the process used to compare millimetre (mm) accuracy to saleable yield of meat on specific cutting lines.

- Development of the cut weight standards: these are a set standard Greenleaf use to determine the accuracy across different carcase types. The following process was used for the development of these standards.
    - Cut weight standards require strips of primal cut to be segmented at 5, 10 and 15 mm increments each side of the cutting line. This facilitates calculating the density of meat either side of the cutting line.
    - The proposed measurements are recorded on this product and aligned with the cut standards to develop regression equations for product weight.
    - The final equation for each cut depends on the variables included in the final accuracy calculation.
- Review of the cut specifications, through discussions with plant staff during the site visit.
    - The customer specification for each cut impacted by automation is reviewed to ensure the anatomical location of measurement aligns with the customer specification.
- Measurements collected to compare accuracy between automation and manual operations to calculate the yield benefit either side of the cutting lines.
    - Standards of measurement are developed. However, measurements collected on the chain may not include all necessary data. Measurements may be refined to ensure data accuracy is maintained.

- The measurements include:
  - Millimetres from an anatomical structure
  - Degrees of cut variation
  - Squareness of cutting lines
  - Area of a cut face

4.1.1 Cube-strip and Cube-chuck separation measurements.

The accuracy of the cube-strip and cube-chuck separation identified the millimetres accuracy from the cranial edge of the 13th rib (1 rib strip) and the caudal edge of the 5th rib (5 rib chuck), as can be seen in Figure 2. Noting that when plants are processing 0 and 3 rib striploins, the location of the measurement changes to reflect the product specification. AMG are currently not automating the cube-strip separation as the cut is being completed on the slaughter floor to enable the grading cut to be completed in the chiller. There is the potential for this cut to be completed on the slaughter floor in the future to obtain the additional value from automating this cutting line. The measurements completed on these two cutting lines are as follows:

- Width of the total intercostal left between the cutting line and the edge of the rib.
- Width of the remaining intercostal and the rib on the other side of the cutting line.

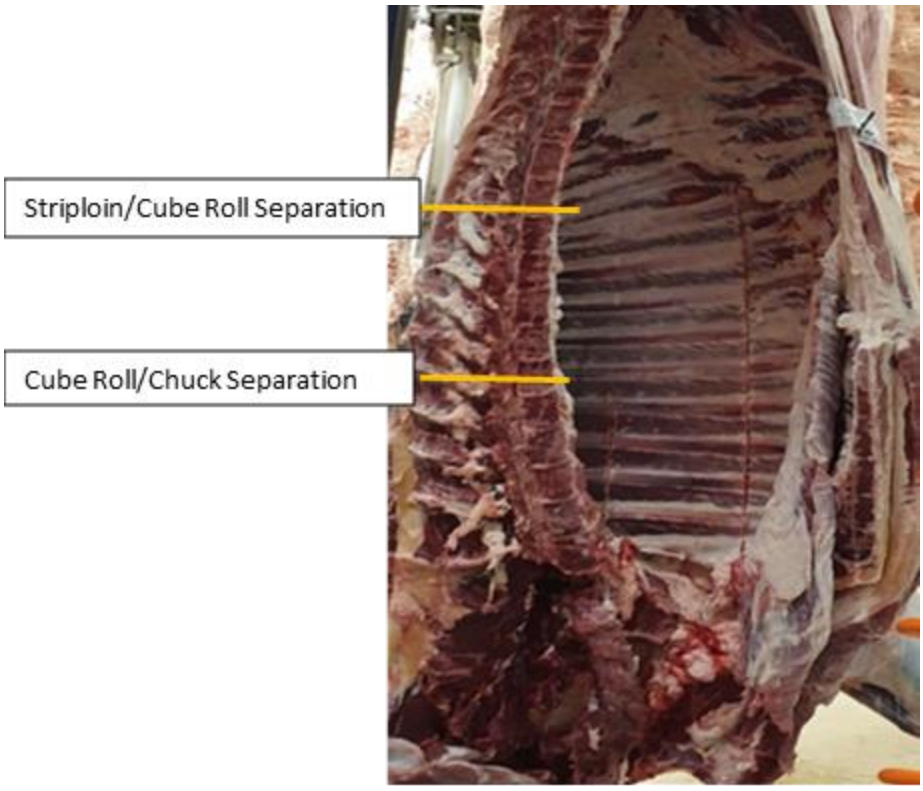


Figure 2: Horizontal and vertical cut accuracy locations

Source: Greenleaf Enterprises

4.1.2 Vertical scribes

The accuracy of the two vertical scribes on the carcases impacts on cuts either side of the cutting line and is a more complete calculation. The model has been developed to treat the cap, bone and intercostals on all 13 ribs as a separate entity to ensure the range in product specifications can be calculated for different animal types. The key measurements completed on these cutting lines are as follows:

1. Measurements completed at 1st and 2nd ribs
    a. Distance from brisket scribe to 1st rib-costal arch joint (Figure 3, red arrow)
    b. Distance from chuck/short-rib scribe to edge of vertebrae (Figure 3, green arrow)
    c. Width of chuck rib at 2nd rib (Figure 3, blue arrow)
2. Measurements completed at the 7th rib
    a. Width of brisket (Figure 3, red arrow)
    b. Width of short ribs (Figure 3, blue arrow)
    c. Distance from short ribs to edge of carcases on vertebrae side (Figure 3, green arrow)

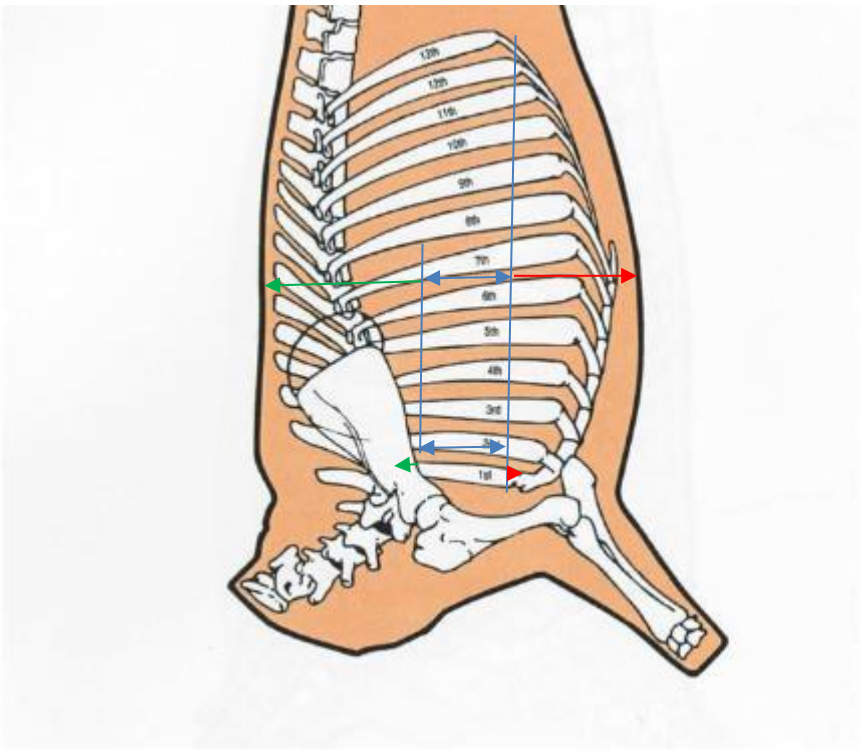


Figure 3: Measurements completed to calculate the accuracy of the vertical scribe cutting lines

Source: Greenleaf Enterprises

4.2 Cut pricing

The value of cuts either side of the cutting lines drive the value created by increased cutting accuracy. The cut prices change over time, but the prices shown in Table 3 have been used in the modelling for each animal type.

Table 3: Average cut value for each product impacted by the automated cutting system

Cut Prices ($/kg)	
Primal	Average price ($/kg)
Brisket bones	$ 2.50
Brisket fingers	$ 14.50
NE brisket	$ 8.50
PE Brisket	$ 12.00
Deckle- 65CL	$ 6.50
Rib blade meat	$ 7.50
Rib end meat- 65CL	$ 6.50
65cl	$ 6.50
Chuck rib	$ 13.50
Short rib	$ 21.50
Intercostals	$ 16.00
Chuck eye roll	$ 13.50
Chuck tail flap	$ 17.00
Spareribs	$ 5.50
Cube Roll	$ 35.00
OP rib	$ 29.46
Striploin	$ 20.00

4.3 Labour savings

The labour savings associated with the automation system is attributed to removing scribing saw operators from the process, completing their job with the scribing system. Table 4 shows the standard hourly costs for labour obtained from the industry award, utilising the level 4 hourly rate in the modelling, with 1 FTE per shift saving for the business.

Table 4: Meat Industry award labour rates used in the modelling obtained from the industry award (MA000059).

Classification	Hourly Rate
Level 1	$ 24.28
Level 2	$ 25.09
Level 3	$ 25.40
Level 4	$ 25.99
Level 5	$ 26.45
Level 6	$ 26.99
Level 7	$ 28.12

4.4 WHS costs

At the time of writing this report there had been no WHS savings included in the benefits. It is anticipated that there would be reduction in strains and sprain injuries and major incidences as part of this project but could not be quantified.

4.5 Fixed model drivers

The benefits achieved by the installation of an automation system is directly linked to the number of animals processed annually through the system. The total weekly volume of 1,000 head per day with 240 weeks production per year was used in the analysis. Table 5 shows the total volume of animals processed for each scenario modelled. There is no increase in throughput rate achieved by the installation as the boning room is chain driven.

Table 5: Production figures used for determining production volume base line

Operation speeds			
	Manual	Automated - Ex-Works	Automated - Overall Project Cost
Carcases / min	1.10	1.10	1.10
Carcases / Statn./hr	66	66	66
Carcases / day	1000	1000	1000
Annual days	240	240	240
Annual # of hd	239,892	239,892	239,892

5 Results

The following outlines the results from the cost benefit analysis from the automated IR-scribing system at the AMG plant.

5.1 Cutting line accuracy – Automated vs Manual – Ex-post results

The automated IR-scribing system has improved the accuracy of all cutting lines. The following outlines the average benefits for AMG because of the overall accuracy improvement. This section of the report outlines the accuracies achieved through the installation of the automated solution. It is important to note that while there is a cube-strip separation shown in Table 6, its benefit remains at zero due to AMG not automating the cut. The following outlines the benefits shown Table 6:

- Cube-stripe benefit is between 4.29 and 4.65/head, for details please see section 5.1.1
- Vertical scribe benefits are between 0.58 and 0.80/head, for details please see section 5.1.2
- The maintenance and operational costs shown are the result of the annual upkeep costs provided by IR on the upkeep of the IR-Scribing systems.

Table 6: Benefit per head averaged across the three carcase types processed at AMG, which have been pro-rated for the three animal type's production volumes

TOTAL BENEFIT					
		Automated - Ex-Works		Automated - Overall Project Cost	
Benefit summary		$/hd From	$/hd To	$/hd From	$/hd To
Accuracy	Cube-strip separation	$0.00	$0.00	$0.00	$0.00
	Cube-chuck separation	$4.29	$4.65	$4.29	$4.65
	Vertical Scribes	$0.58	$0.80	$0.58	$0.80
Labour benefit		$0.53	$0.53	$0.53	$0.00
Equipment costs	**Maintenance**	-$0.38	-$0.38	$0.00	$0.00
	Operation	-$0.03	-$0.03	-$0.03	-$0.03
	Risk of failure	$0.00	$0.00	$0.00	$0.00
	$ Benefit per head	**$5.00**	**$5.58**	**$5.37**	**$5.42**
$ Annual Benefit overall plant		**$1,199,266**	**$1,199,266**	**$1,289,266**	**$1,289,266**

The benefits that have been presented are the result of the accuracy of the automated cutting system. The automated cutting system provides a line for the boners to follow and does not complete the cut. The plant needs to ensure that the boners are utilising the scribe line to maximise the value of the cuts produced from the more accurate marks.

5.1.1 Cube roll-chuck separation

The primary intent of the system is to cut as close to the top of rib 5 as closely as possible to maximise the length of the cube roll. It must also be cut such that a knife can be used to open the cut and separate the cube from the loin. Overcut into the muscle must be minimised.

The accuracy of the cube chuck separation utilising an industry average dataset is shown in Figure 4. As can be seen the Automation system has significantly improve the accuracy of the cutting line between the cube chuck separations. In order to convert the millimetres accuracy Greenleaf has developed a standard model that calculates the grams of meat per millimetre (see Figure 5 for details). Table 7 then shows the calculation logic used for each of the measurements collected, this table outlines the average benefit by the variation in accuracy shown in Figure 4 has results in a benefit of between $4.29 and $4.65/carcase.

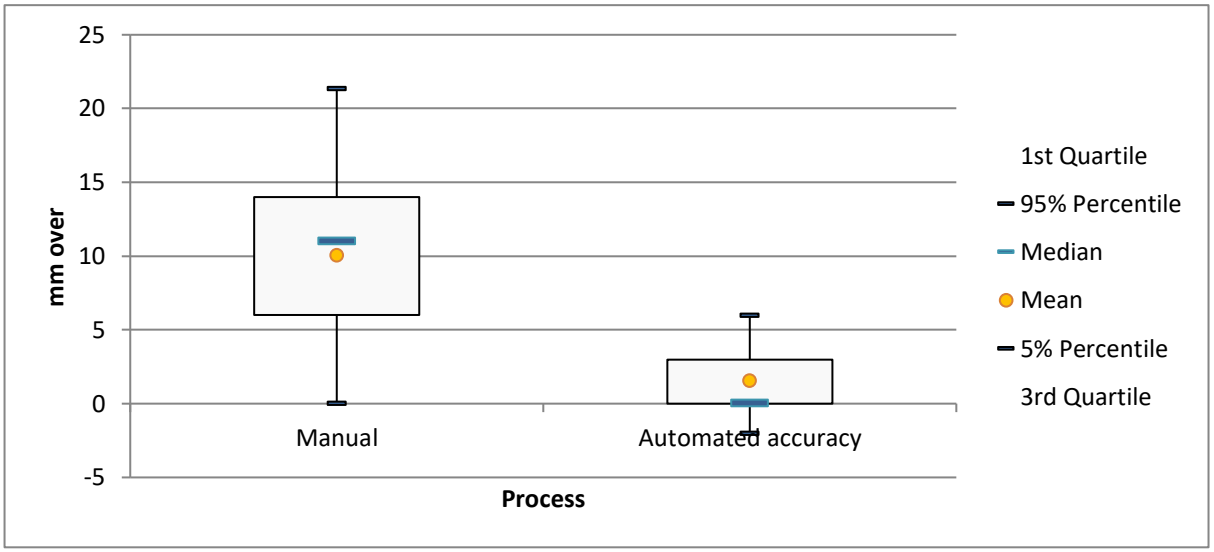


Figure 4: Variation in cutting accuracy for the cube-chuck separation of the automated and manual cutting lines

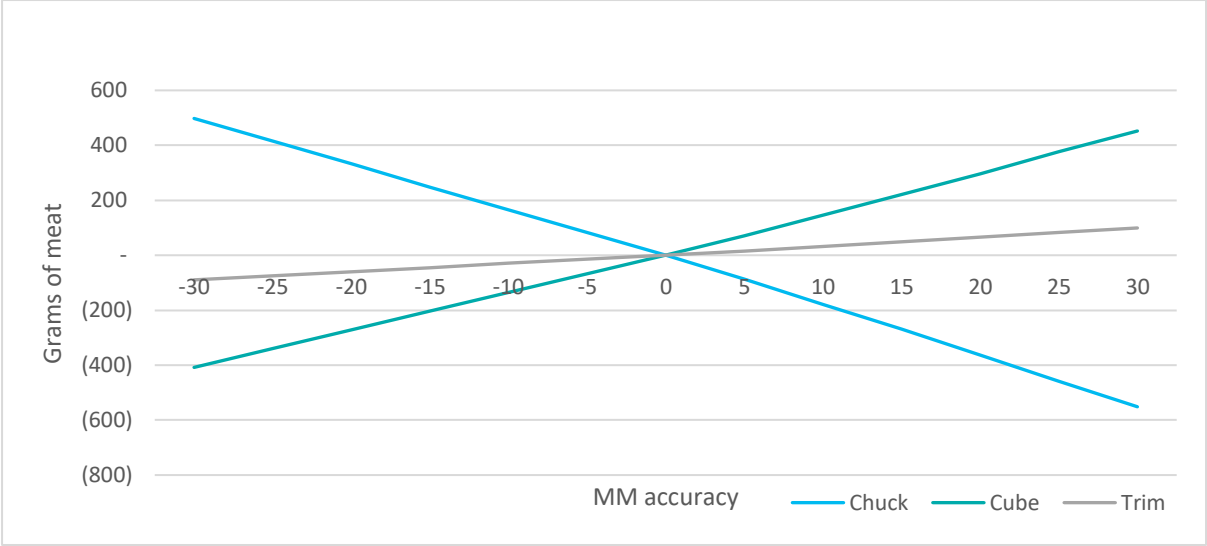


Figure 5: Equation used to calculate the different yields of cube roll, chuck & trim with different levels of inaccuracy

Table 7: Benefit calculations from the cube-chuck separation

Cube roll to Chuck roll separation	
Variable	**Mean**
Cube roll value	$ 35.00
Chuck roll value	$ 13.50
Cube roll cap value (65 CL trim used)	$ 6.50
Cube-chuck	$ 21.50
Cube roll cap - Chuck	-$ 7.00
Cube cap portion	23%
Weight per mm	13.1
Sides per carcases	2.0
Manual mean (mm)	10.07
Automation mean (mm)	1.54
Cube roll yield	8.53
Cube weight	0.22
Cap-weight	0.05
Benefit per head ($)	$ 4.47
Cube roll	$ 4.82
Cube roll cap	-$ 0.35
Number of head processed	239,892
Benefit per animal type	$ 1,071,962
Total Annual benefit	$ 1,071,962
Overall benefit per head	**$ 4.47**

5.1.2 Vertical scribe accuracy

Three vertical scribe settings that can be utilised on the IR scribing system are shown in Figure 6. The first image (image 6.1) is the full scribe on the on the ventral and a part scribe on the dorsal. Image 6.2 on the right is a full scribe on the ventral and the dorsal. Third image (6.3) is a full scribe on the ventral and no scribe on the dorsal. The ventral scribing line isn't changed currently being changed however the dorsal scribe is altered depending on the cuts being produced. For tomahawks there is no dorsal scribe undertaken. The system is currently not set up to auto select carcases for OP ribs or tomahawks.

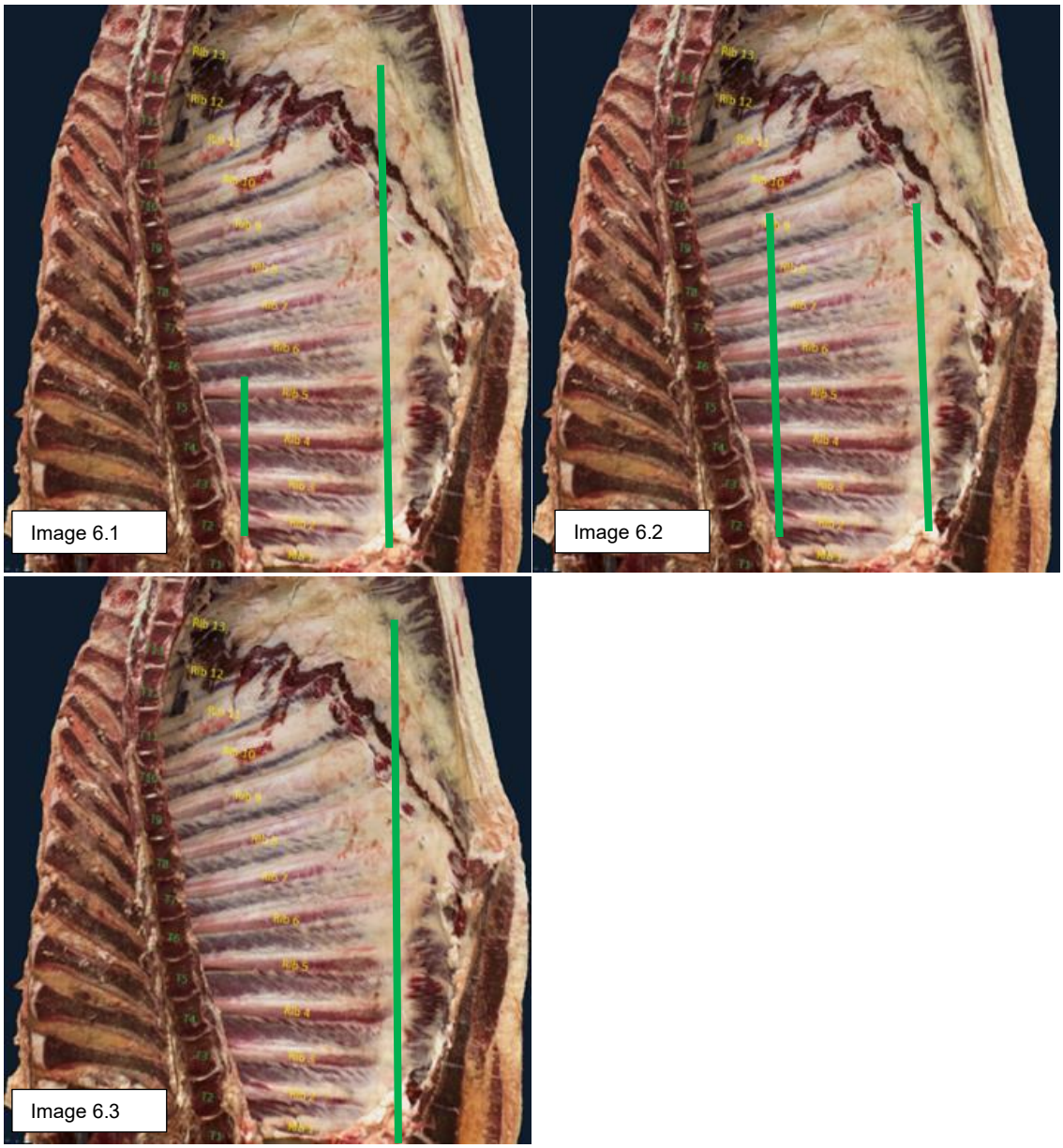


Figure 6: Scribing line options

Source Intelligent Robotics

5.1.2.1 Standard Development

The standards developed on the two vertical scribing lines has been completed, resulting from the yield gains either side of the chuck and short rib sections. The following outlines the variation in products and weights included within these standards. The standards were developed by removing a 10mm slice from either side of the cutting lines and separating the different products.

- Chuck rib section of the forequarter, see Figure 7. The following are the separation of products between the chucks and other products on the cranial end of the forequarter
    - Dorsal cutting line (shown by line A1 & A2 in figure 13) is from Chuck ribs to rib bones, intercoastal or trim and chuck flap tail. The A1 line shows where the cutting line would have been historically placed with the manual operation, However, with the automated scribing saw the scribe is now positioned closer to the vertebrae as shown in A2.
    - The Ventral cutting line (shown by B in figure 13) goes from Chuck ribs to intercostals, point-end brisket and bones.

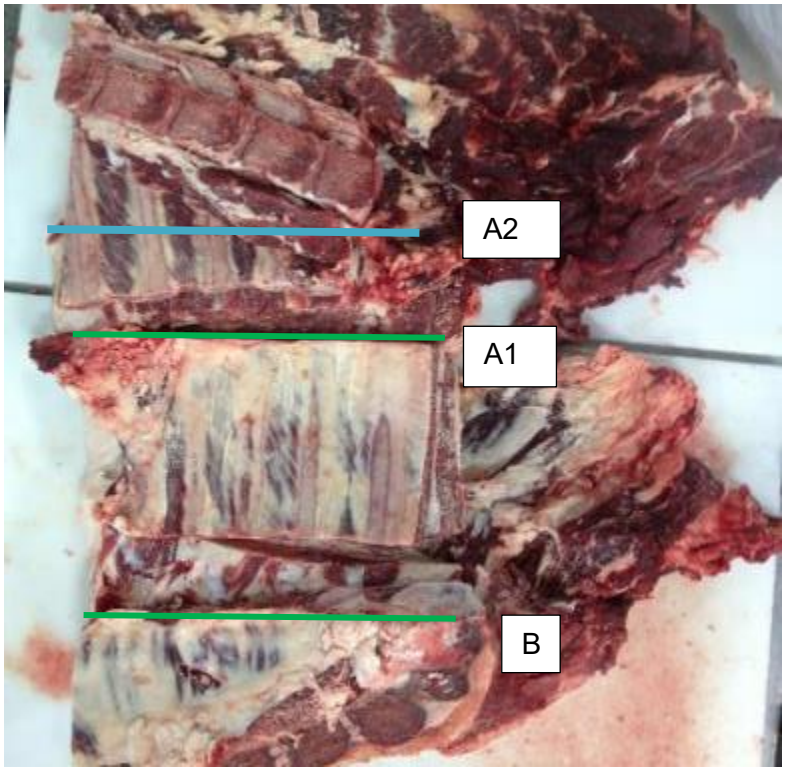


Figure 7: Chuck end of the forequarter breakdown

Source: Greenleaf Enterprises

Line A in Figure 7 represents the Dorsal scribe with the Manual system but the blue line (A2, shows the new position of the scribing line through the installation of the automated system. Line B showing the Ventral scribing line.

- Short rib section of the forequarter, see Figure 8. The following is the split of products from the scribing lines on the caudal end of the forequarter.
    - Dorsal cutting line (see line A on Figure 14) is from short ribs and trim to Trim, intercostals and bone, or back ribs rather than intercostals and bone. This cut is not completed when they are production OP ribs or tomahawk.
    - The ventral cutting line (shown by the cutting line B on Figure 14 is from short ribs and trim to navel end brisket, rib bones and intercostals.

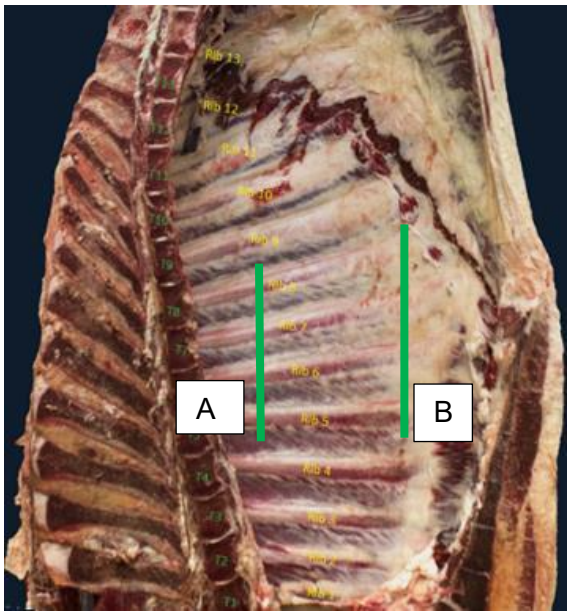


Figure 8: Cutting lines on the caudal end of the forequarter

Source Intelligent Robotics

5.1.2.2 Cut Accuracy

The accuracy of the vertical scribes by the automated solution has improved the overall accuracy of the cutting lines.

Figure 10 shows the accuracy of cutting line through the joint between the first rib and the breastbone and Figure 12 show the accuracy or the short/chuck rib scribe at the first rib.

- Brisket scribe
    - This has always been one of the harder cuts to get accurate but as can be seen in Figure 9 the system has been developed with a high degree of accuracy.
    - The negative shown on for the automate system is being completed by the automated system to maximise the width of the chuck and short-rib section. Noting that this will be removing yield from the brisket section but selling it at a higher value on the chuck and short ribs.
- Chuck-short rib scribe
    - The scribes were not being completed on Long-fed carcases due to them being packed as Tomahawks, thus were excluded from the calculations and results shown in Figure 12.
    - The system has been designed to enable the end affecter to be rotated to allow the scribing saw to get as close to the vertebrae bone as possible. This, in addition, to the ability to see the vertebrae bone very clearly on carcases has enable IR to accurately identify this point and cut closer to this point that a manual operator, which is shown in Figure 12.
- Width of the chuck and spareribs
    - Figure 13, shows the accuracy of the overall width of the chuck and short ribs produced through each of the systems. As can be see the automated system is maximising the width of this section, with the manual AMG data being much more accurate that the industry average dataset.



Figure 9: Ideal cutting line point for the brisket scribe through the join on the end of the first rib

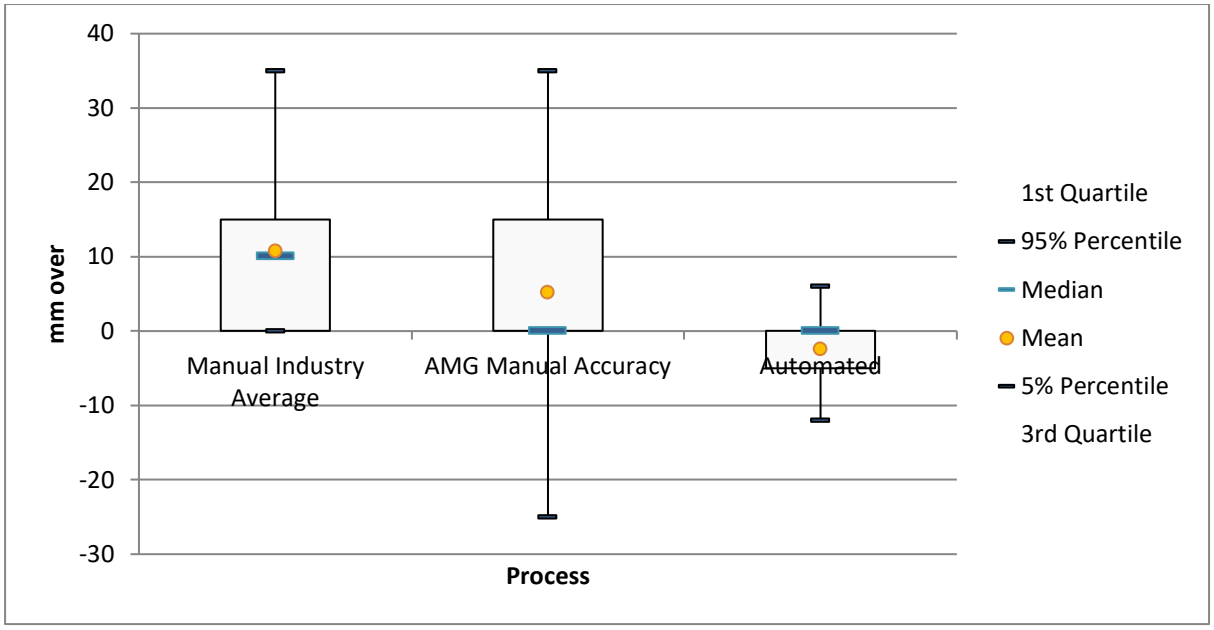


Figure 10: Variation in cutting accuracy for the vertical brisket scribe, based on the joint of the 1st rib



Figure 11: Ideal cutting location of the dorsal scribe of the ribcage

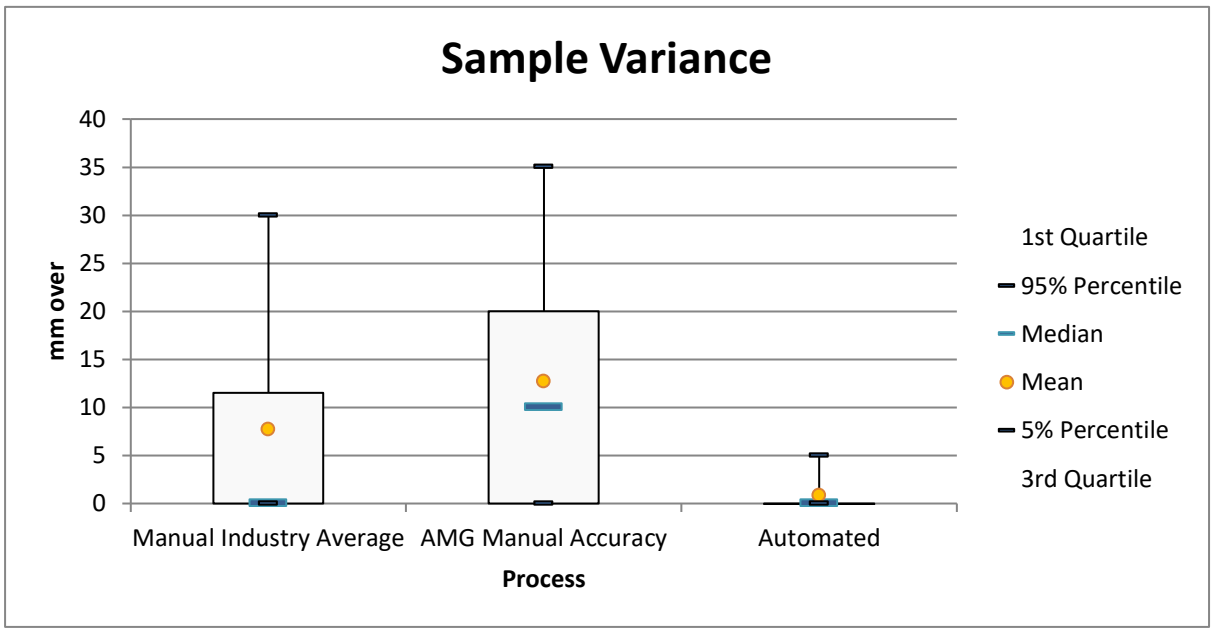


Figure 12: Variation in cutting accuracy for the chuck and short rib scribe, based on the point of the vertebrae

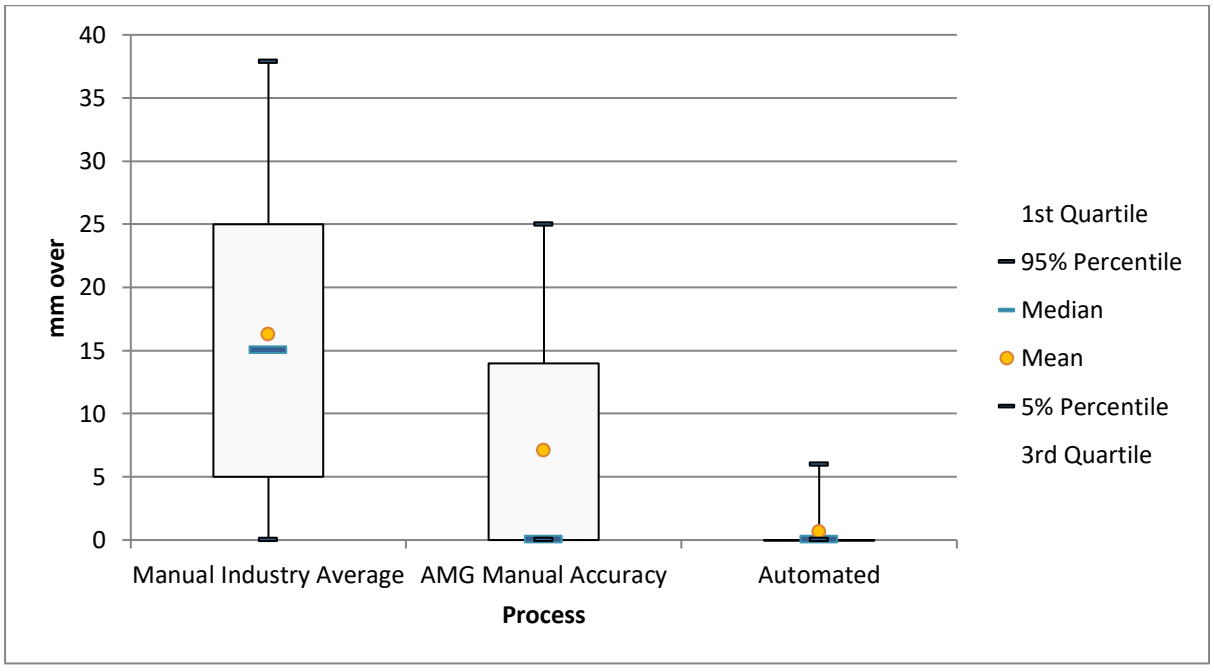


Figure 13: Variation in width of the chuck and short ribs from the ideal specification, comparing an industry average variation, with the AMG and Automated accuracies.

5.1.2.3 *Financial Benefits*

The financial benefits for each of the carcase types are provided based on the improvement of accuracy from the IR scribing system. As can be seen in Figure 15 the benefit per head for each carcase type is between $0.58 and $0.80. The weight gains and losses of individual products shown in Figure 14 are calculated individually. The value of each individual product and the gain/loss of each individual product is then used to calculate the benefit per head.

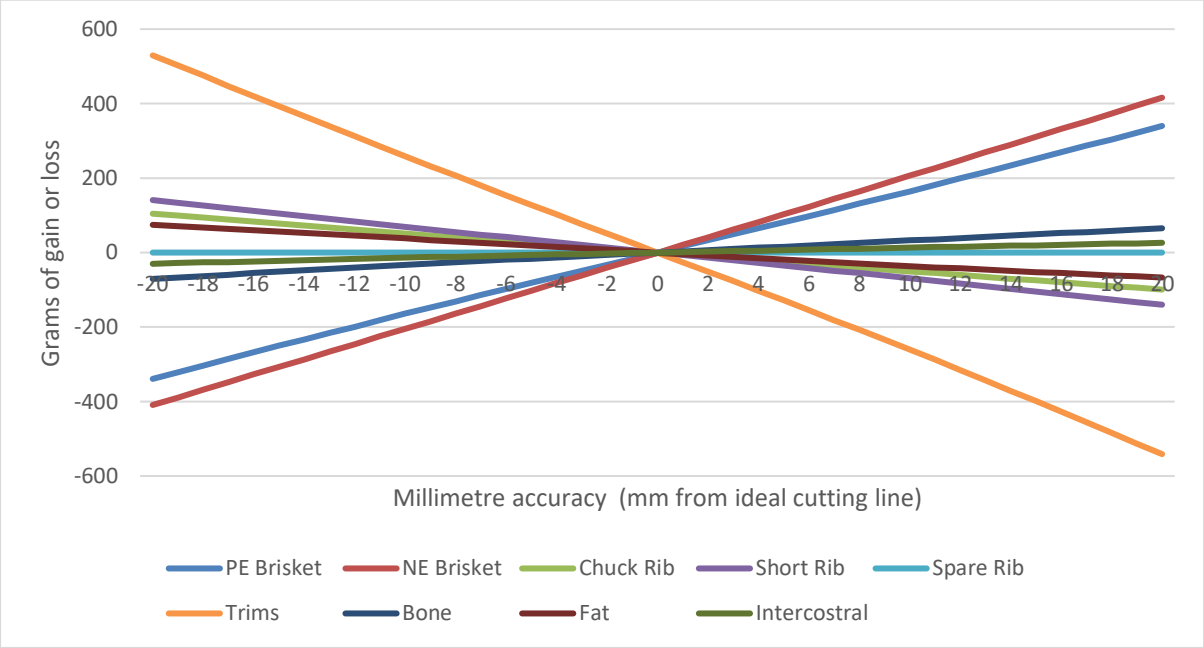


Figure 14: Millimetre accuracy to grams conversion of each primal impacted by the 2 vertical scribes

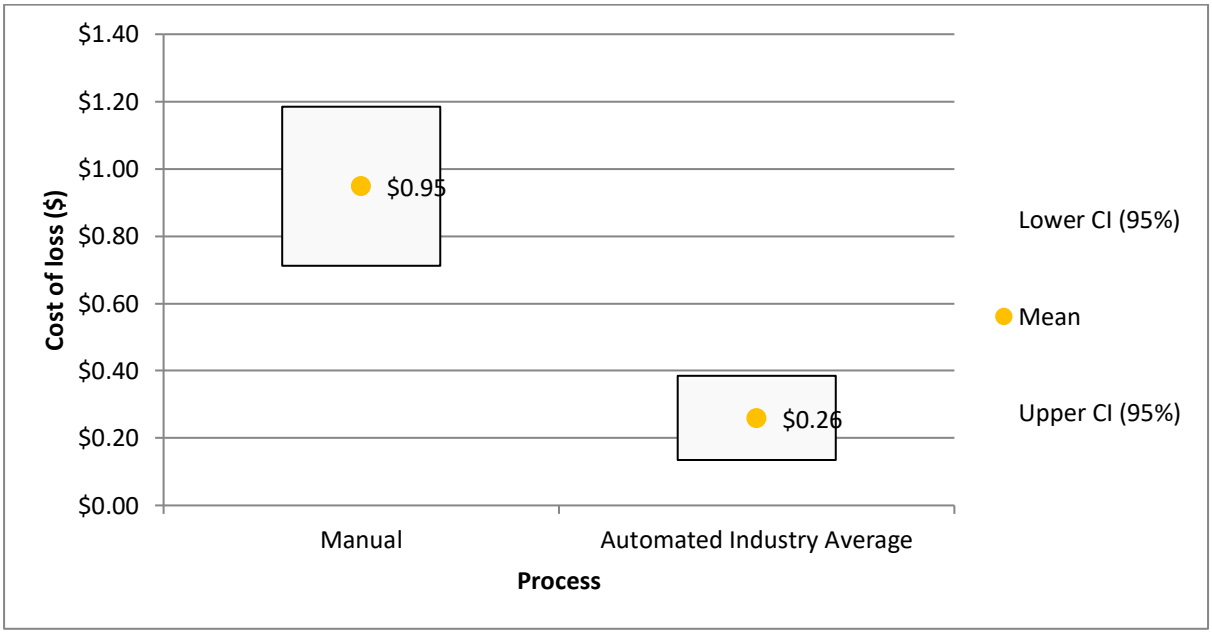


Figure 15: Average benefits from the improvement in accuracy of the ventral rib scribe

5.2 Equipment costs

The ex-works capital cost of the automated scribing system was $2.75 million which is the estimated ex-works price provided as an estimate by Intelligent Robotics. It is expected that the actual cost of the systems installed would be higher due the footprint of the system, however, will be plant specific. The return on investment is based on these costs.

It is also expected that the upkeep cost of the system will initially be $514,268 per year for 4 years and the around $96,000 per year for the maintenance service contract and a $6,730/year increase in electricity costs. The breakdown of these costs can be seen in Table 8. The actual capital costs will vary between plant to plant as a result of the ability to fit the system into the plant. The electricity usage for the automated system is 8.46KW which is based off the actual system usage tested by the plant. The manual usage is based off utilising 1 manual scribing saws.

Table 8: Estimated capital and operating costs of the IR Scribing system

Capital Cost	Manual		Automated - Ex-Works		Automated - Overall Project Cost	
	Cost	Life span	Cost	Life span	Cost	Life span
Capital Cost of the equipment			$ 2,750,000	20	$ 5,020,315	20
Essential and insurance spares				20		20
Other Capital install				20		20
Total			**$2,750,000**		**$5,020,315**	
Service maintenance	Manual		Automated - Ex-Works		Automated - Overall Project	
	Units	Cost	Units	Cost	Units	Cost
Estimated - COSTS						
Electricity			8.46 KW	$0.22 /KWH	8.46 KW	$0.22 /KWH
Maintenance labour (Daily)		0.00 /Yr		0.00 /Yr		0.00 /Yr
Maintenance labour (Preventative)		0.00 /Yr		0.00 /Yr		0.00 /Yr
Maintenance labour (Breakdown)		0.00 /Yr		96000.00 /Yr		0.00 /Yr
Maintenance labour (Training)		0.00 /Yr		0.00 /Yr		0.00 /Yr
Operational		**$0**		**$6,790**		**$6,790**
Maintenance		**$0**		**$96,000**		**$0**
Annual Sub Total (excluding major overhaul costs)		**$0**		**$102,790**		**$6,790**

5.3 Cost benefit analysis results

System benefits produce income by an increase in saleable meat yield due to less trimming. Table 9 summarises each scenario benefit and the return on investment the system provides the processing plant. The ROI for the installation of the automated scribing system is outlined below:

- Utilising the Ex-works price from IR the payback is estimated at between 1.98 and 2.19 years. This scenario provides an understanding of the return that would be expected a processing plant. Noting that the actual capital cost of the installed system would be higher due to capital works required to support and house the system.
- Scenario 2 demonstrate the ROI for the overall AMPC project cost completed at AMG Cootamundra, which provides an ROI of between 3.69 and 3.72 on the overall capital cost of $5.02million

Table 9: Summary of benefits for the vertical scribing system

SUMMARY PERFORMANCE MEASURES				
	Automated - Ex-Works		Automated - Overall Project Cost	
Hd / annum	239,892		239,892	
	From	To	From	To
Capital cost (pmt option, upfront)	$2,750,000		$5,020,315	
Gross return Per head	$5.66	$6.23	$5.66	$5.70
Total costs Per head	$1.00		$1.07	
Net Benefit Per head	$4.65	$5.23	$4.58	$4.62
Annual Net Benefit for the plant	$ 1,116,548	$ 1,254,312	$ 1,099,032	$ 1,108,801
Annual Net Benefit for the ex cap	$ 1,254,048	$ 1,391,812	$ 1,350,048	$ 1,359,817
Pay back (years)	2.19	1.98	3.72	3.69
Net Present Value of investment	$11,624,359	$13,083,836	$9,354,044	$9,457,534

The benefits identified can be broadly summarised as driven by increases in product value as shown in Table 10; there is little benefit due to improved processing efficiency. Table 10 shows how product value drives benefit for each scenario. Because processing costs are assumed to be fixed (labour and equipment are shown to be standard across each scenario), product value determines the variation in benefit derived from the scribing system. The greatest value for the current installation is the benefits associated with the Cube-chuck separation. These benefits are bases on an industry average manual dataset from Greenleaf and the actual automate accuracy from the IR Cootamundra installation.

Table 10: Breakdown of benefits and costs by area expected as a result of the installation of the system

TOTAL BENEFIT					
		Automated - Ex-Works		Automated - Overall Project Cost	
Benefit summary		$/hd From	$/hd To	$/hd From	$/hd To
Accuracy	Cube-strip separation	$0.00	$0.00	$0.00	$0.00
	Cube-chuck separation	$4.29	$4.65	$4.29	$4.65
	Vertical Scribes	$0.83	$1.05	$0.83	$1.05
Labour benefit		$0.53	$0.53	$0.53	$0.00
Equipment costs	**Maintenance**	-$0.40	-$0.40	$0.00	$0.00
	Operation	-$0.03	-$0.03	-$0.03	-$0.03
	Risk of failure	$0.00	$0.00	$0.00	$0.00
	$ Benefit per head	**$5.23**	**$5.80**	**$5.63**	**$5.67**
$ Annual Benefit overall plant		**$1,254,048**	**$1,254,048**	**$1,350,048**	**$1,350,048**

A summary of the range in costs and benefits for each scenario is included in Table 11.

Table 11: Ex-post costs and benefits breakdown for the current throughput

COST - BENEFIT ANALYSIS OF SYSTEM				
	Automated - Ex-Works		Automated - Overall Project	
Benefit summary	$/hd		$/hd	
	From	To	From	To
$ Accuracy Benefit per head	$4.87	$5.45	$4.87	$5.45
$ Technique Benefit per head	$0.00	$0.00	$0.00	$0.00
$ Labour Benefit per head	$0.53	$0.53	$0.53	$0.00
$ Overall Benefit per head	**$5.40**	**$5.98**	**$5.40**	**$5.45**

** Cost is reported as the inaccuracy from target specification OR as the difference between Manual vs. Auto costs*

COST ASSOCIATED WITH OPERATING SYSTEM		
	$/hd	$/hd
Capital cost	$0.57	$1.05
Maintenance	$0.38	$0.00
Operation	$0.03	$0.03
Risk of mechanical failure	$0.00	$0.00
Total cost per head	$0.98	$1.07
Total cost per head (EX CAP)	$0.40	$0.03

6 Key Findings

The IR automated scribing system are the first cuts on the carcase to guide the removal of the primals. The accuracy of these cuts can increase the weight of the primals with higher value and reduce the trimming required. The scribing system has been developed to cut through the vertebrae to support the boners in providing guidance and in reducing the effort required. The IR scribing system has improved accuracy when compared to a manual operator with a payback period of less than 2.19 years when based on the Ex-works capital costs or under 3.72 years for the overall AMPC project cost. The following outlines some key observations and benefits of the IR scribing system at Cootamundra:

- Less manual labour for beef scribing / saw operators reducing repetitive strain injury and the dangerous task of saw operation.
- Improved accuracy particularly for the chuck and short rib scribe over manual operators.
- Payback period <3 years which is required by processing sector to invest in new technologies.
- Accurate vertical scribes – equidistant between the scribes

Discussions during the project highlighted the need for plants to consider the future growth capacity requirements when designing and implementing these systems. The system installed at Cootamundra is starting the limit the throughput through the boning room due to its maximum capacity. The capacity was identified by all parties as the required throughput but highlights the need for companies when considering these systems to ensure that any future growth is considered within the design.