



# final report

Project code: P.PSH.0519  
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Date submitted: July 2011  
Date published: July 2011  
ISBN: [Request through Publications  
Database]

PUBLISHED BY  
Meat & Livestock Australia Limited  
Locked Bag 991  
NORTH SYDNEY NSW 2059

## **Automated Lamb Bone-in Middle Processing System – Stage 1**

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

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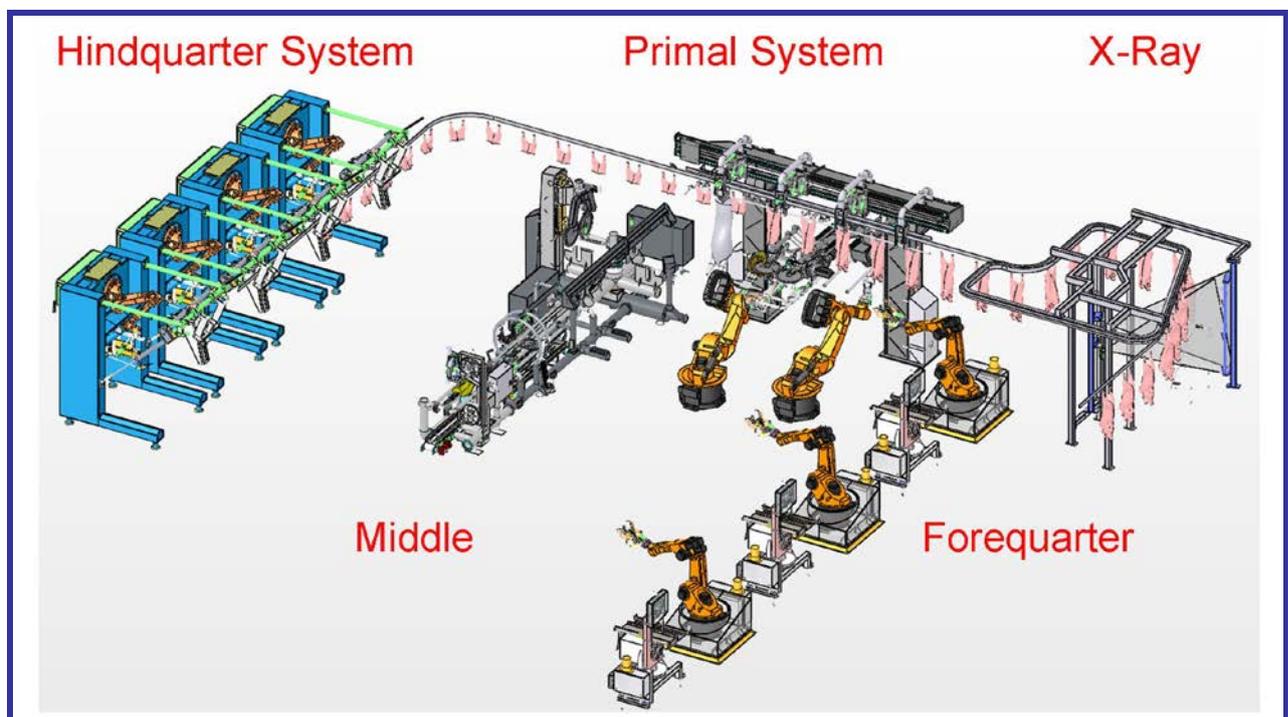
**Abstract**

Attracting and retaining labour, ensuring safe operational environments and focusing on maximising the conversion percentage of raw material to the highest value cuts possible (i.e maximising yield) are all key drivers and foci of the meat processing factor. Robotic Technologies Ltd and Meat and Livestock Australia are developing a fully automated lamb bone-in automation room to assist processors in addressing these three significant issues. This project successfully developed a pre-production automated middle system, that provides a solid platform for the pending future project that will develop a production prototype ready for commercial sale within Australia.

## Executive summary

Robotic Technologies Limited (RTL), a joint venture between Scott Technology Ltd and Silver Fern Farms has had a vision to fully automate the lamb boning process. This vision was developed in 2001 and proposed initially to fully automate all bone-in process, eradicating the need for any human operator to interact with a bandsaw, in addition to providing significant yield improvement and other beneficial processing outcomes.

The components of this vision are: (1) primal cutting, (2) forequarter processing, (3) middle processing and (4) hindquarter processing. All of these technologies are informed via various vision and sensing solutions including RTL's patented full carcass lamb x-ray system.



This project aimed to, and successfully developed and demonstrated, a middle processing system, via development of a lab prototype.

The project provided the RTL Board, Meat and Livestock Australia (MLA) Donor Company Board and the Australian Smallstock Steering committee to support the further development of the lab prototype into a production prototype.

The current project has been a success meeting all objectives, deliverables. It was delivered below budget and within the initial project contracted time frame.

Throughout the project monthly status reports (including videos and photos) have been provided to MLA and every six months the Australian Steering committee was presented to. Half the time these presentations were conducted in New Zealand to enable the committee to witness and comment first hand on the developments. The other times the committee met in Australia and were provided with a PowerPoint (including photos and videos) update. At all times Silver Fern Farms provided support via Wayne Rollinson to ensure that RTL could respond to meat processing product specification questions in addition to engineering development questions.

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## 1 Background

Since 2003 MLA has been supporting RTL to develop its vision of a fully automated boning room. This has included the following modules and is depicted in Figure 1:

1. Developing the Primal System (~2003-2005)
2. Developing the X-Ray System (~2006-2007)
3. Developing the Forequarter System and integration robot (2009-2011)
4. Developing the Middle System and integration robot (2009-2011)

In addition RTL has also developed two other key modules to realise the automated boning room vision.

5. Development of aitchboning and knuckle tipping

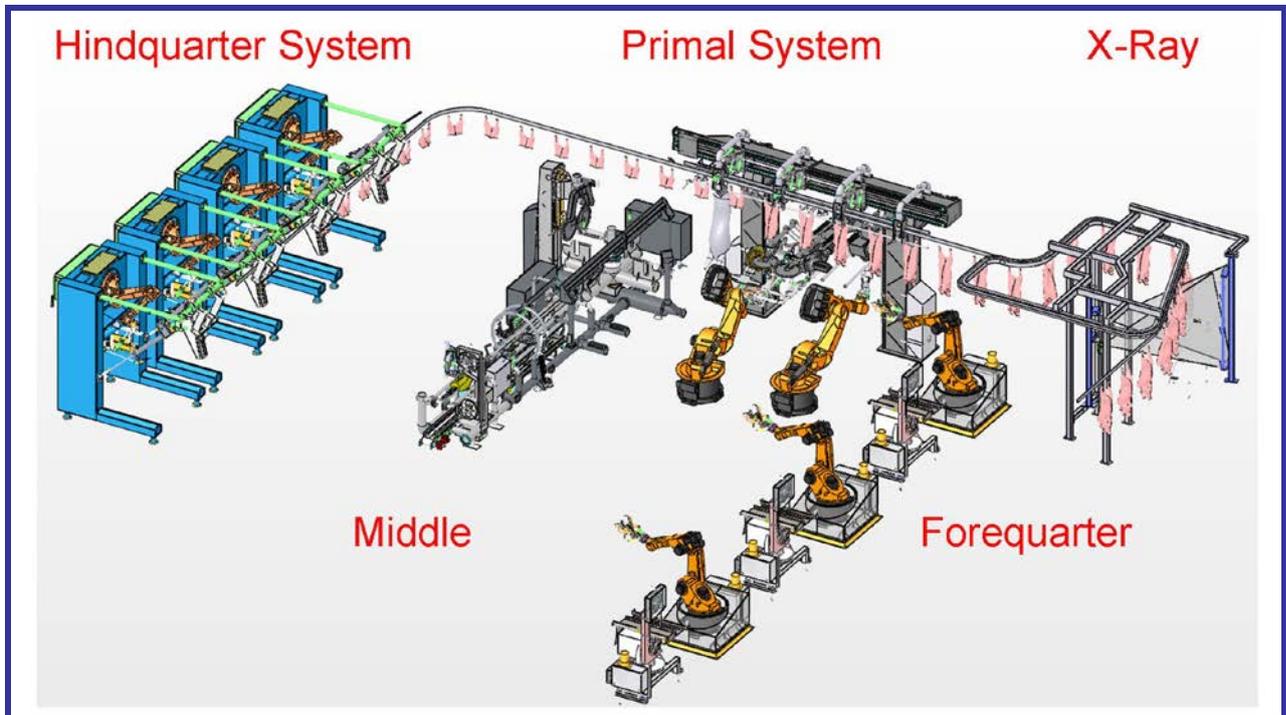


Figure 1: RTL Fully Automated Bone-In lamb Boning Solution

By the end of February 2011, RTL has completed working prototypes of (1) an x-ray system, (2) a primal system operating at 10 carcasses per minute (cpm), (3) hindquarter deboning machines that can match this speed, although need value engineering, (4) a middle machine early prototype at 10 cpm and (5) a forequarter prototype at 2-4 cpm.

## 2 Project objectives

The current primal system has been designed to automatically cut lamb carcasses into hindquarter, middle and forequarter sections. The objective of this project was to develop a Middle Processing solution that will be fed with lamb middle sections from the primal cutting operation. The system was to process all bone-in cuts.

A preliminary proof of concept Middle System was designed and built under P.PSH.0190. During this project RTL proved the potential of the concept by testing ways of separating the rack from the loin, removing the flaps and splitting the middle section along the centre line of the spine (vertebrae splitting).

Project P.PSH.0519 was aimed to progress the initial concept to a working prototype.

The objective was to design and build a working prototype capable of processing the main bone-in cuts of the carcass middle as follows:

1. Rack and Loin separation
2. Flap removal
3. Spinal cord removal
4. Vertebrae splitting

Contractually the objective was stated as the development of:

***A middle system capable of performing spinal cord removal, rack/loin split, brisket tip removal, flap removal and splitting, albeit at a significantly reduced speed. Included in this deliverable is the integration robot to 'pass' product from the primal system to the middle system. The system will have been demonstrated at Scott's Dunedin workshop on product, however will not have had significant quantum of product processed to 'iron out' production specification issues resulting in varying animals being processed.***

All objectives have been met at the conclusion of the project.

### 3 (Methodology) - Section

The methodology was:

1. Evaluate the need and opportunity for an automated bone-in middle processing system.
2. Design, build and evaluate a pre-production prototype.

#### 3.1 Australian Steering Committee

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To ensure that the Australian industry was (a) involved in the development and hence incorporated Australian processing specifications and (b) could be ensured that MLA and the wider industry obtained value for money, and was kept abreast of developments, the following two initiatives were instigated:

1. An Australian Steering committee was formed. This committee was open to any Australian lamb processing company, however typically each meeting comprised of:
  - a. WAMMCO
  - b. T&R Pastoral (minimal participation)
  - c. ALC
  - d. CRF
  - e. G M Scott (partial participation)
  - f. Castricums
  - g. JBS Swift

This committee formally met approximately every six months with some meetings held in New Zealand to visually assess the progress and comment on current and required developments.

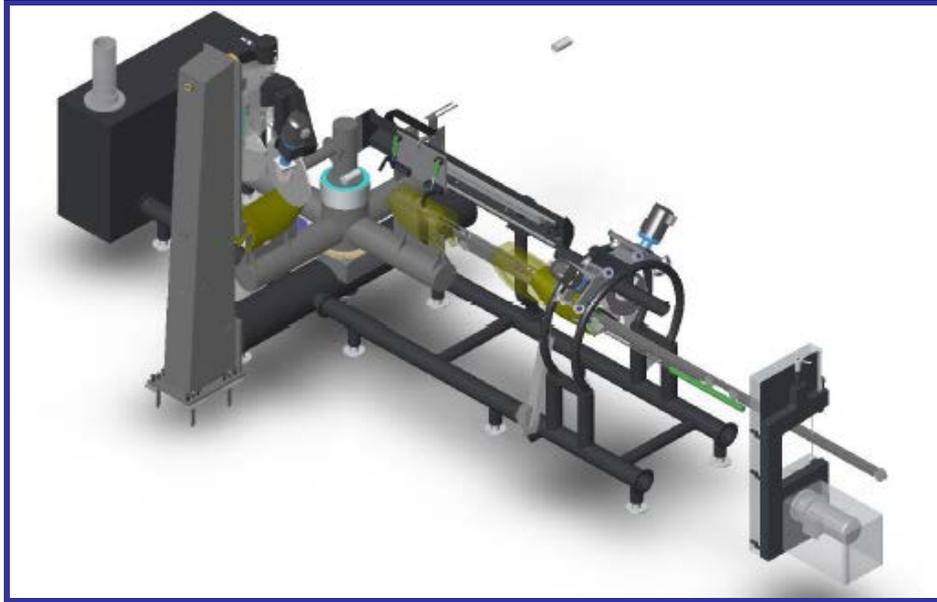
2. Octa Associated was engaged as an independent financial and project progress auditor and reporter. Octa assisted in assessing risks, minimise negative impact and maximise chances of successful project delivery. Octa has a successful history with the developments of RTL and has been an independent adviser to Silver Fern Farms during their development of the RTL systems since 2001 and an advisor to Silver Fern Farms prior to that period of other multi-faceted programs.

## 4 (Results and discussion) - Section

### 4.1 System Schematic and Realisation

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Figure 2 depicts the initial schematic of the proposed system with Figure 3 a photograph of the final system installed within the RTL development room.



**Figure 2: Middle System proposed concept**



**Figure 3: Middle System installed in R&D production room**

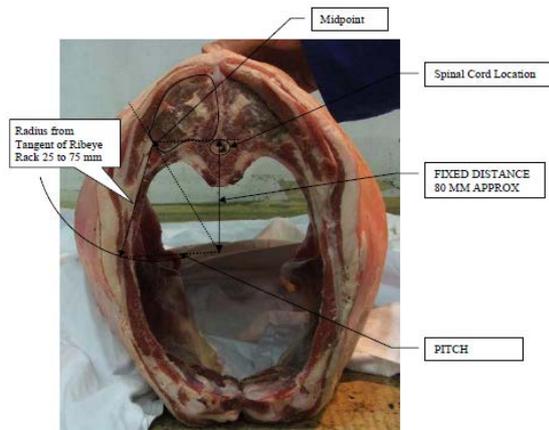
## 4.2 Middle System Operating Principles / Process



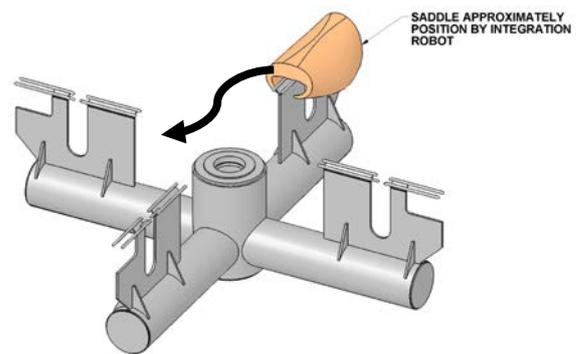
Step 1 – Primal system (Tower 2) removes middle/saddle from carcase (after forequarter has been removed in the first primal tower)



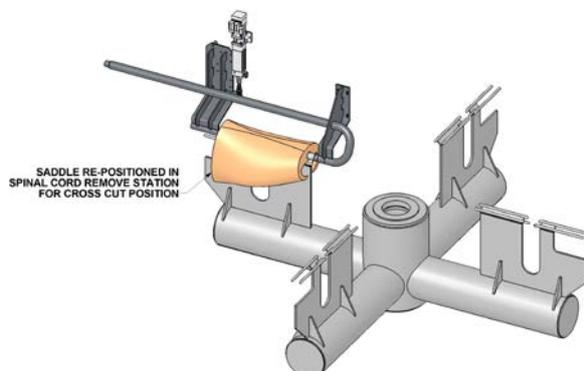
Step 2 – Integration robot transfers the middle section to the middle system loading fixture on the middle system carousel



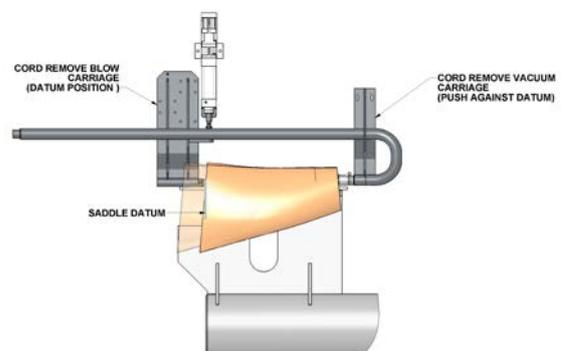
Step 3 – In addition to the original x-ray image of the carcass 'camera' vision of both ends of the saddle are taken to determine eye muscle area/location and flap cutting locations.



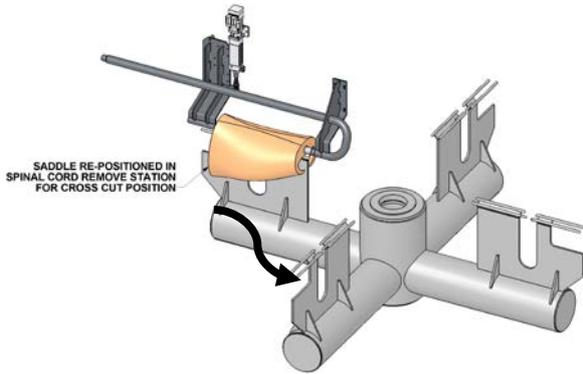
Step 4 – Carousel indexes 90° to carousel position two.



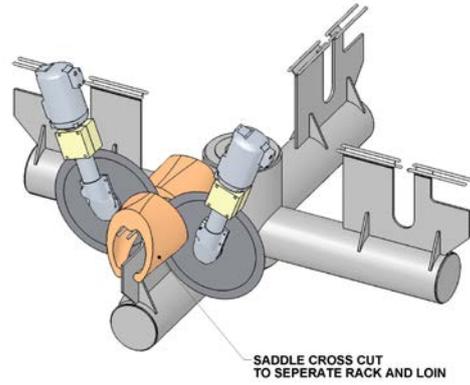
Step 5 – Using the original x-ray image the middle is position to the required datum point



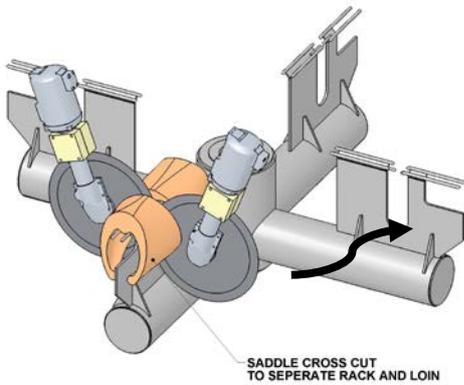
Step 6 – Spinal cavity is removed



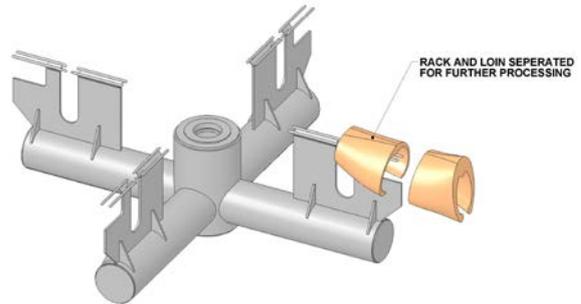
Step 7 – Saddle indexes to carousel position 3



Step 8 – the rack and loin are split (if the specification requires it)



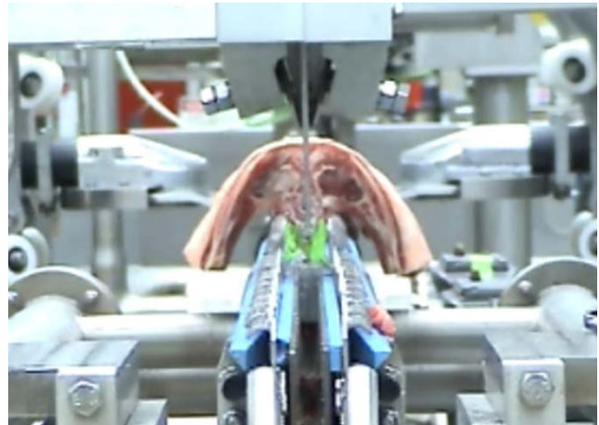
Step 9 – Carousel indexes to position 4



Step 10 – Either the complete middle section is pushed onto the 'straight processing section' of the equipment. Or the rack is pushed off first followed by the loin with a gap between the two.



Step 11 – Flaps are removed at the required specification



Step 12 – middle section is split along the vertebrae.

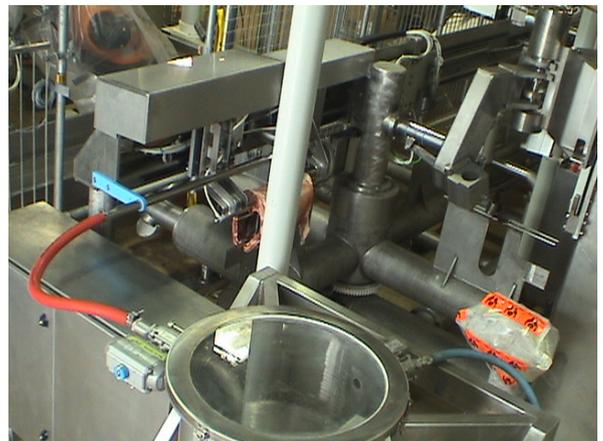
### 4.3 Resulting Product Presentation

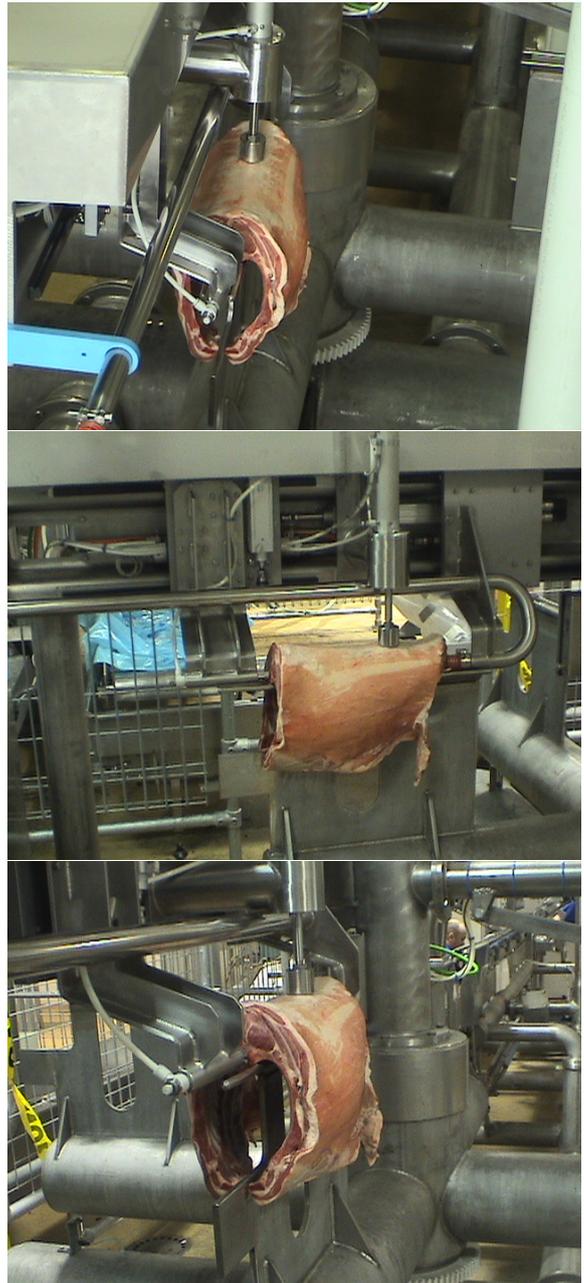
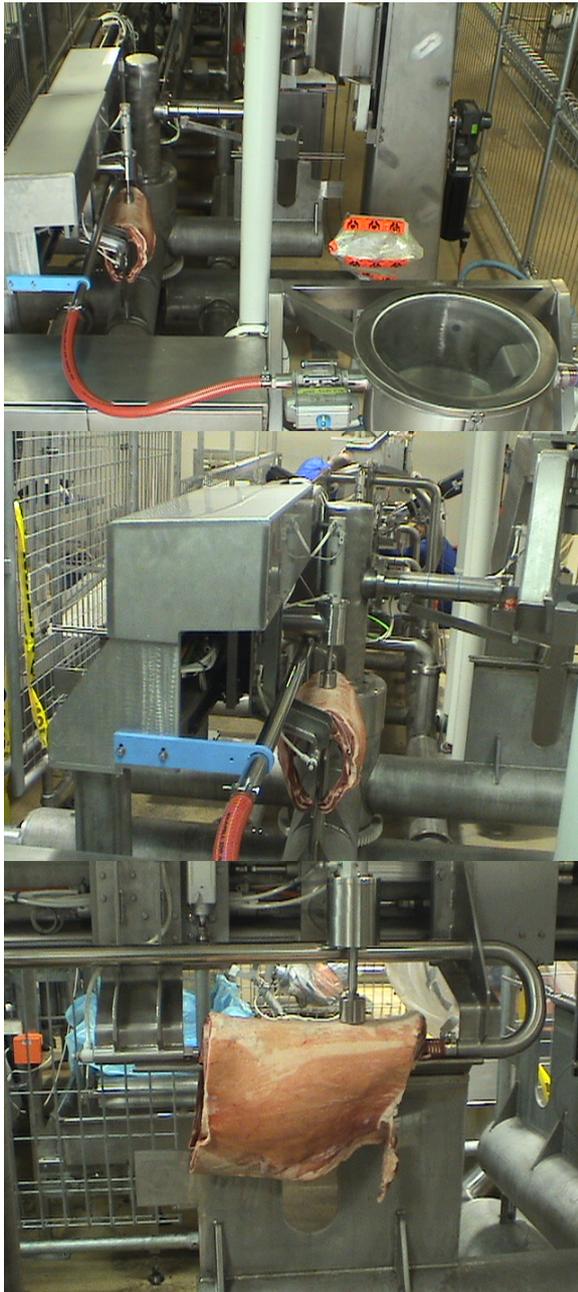
The following provide specific images of the product being processed or the produce once processed.

#### Splitting



#### Spinal Cord Removal





**Flap Removal**



## 5 (Conclusions and recommendations) - Section

RTL successfully completed and demonstrated a pre-production prototype operating under commercial food processing conditions. The developed system will provide a substantial platform to further evolve the fully automated middle bone-in solution.

For the RTL vision to be realised to suit large Australian lamb processing companies the current middle lab prototype requires further enhancement. This includes but is not limited to finalising the existing development via processing thousands of parts not the hundreds that were processed during the current developments.

As such RTL, with support from MLA is currently undertaking a new development project that will:

1. Continually refined the development through processing thousands of middles through the existing system,
2. Develop and install the required material handling conveyers and chutes that will take the processed parts from the middle machine to downstream further processing,
3. Integrate the middle system with the primal system via the middle system integration robot than will enable 10 middles per minute to be automatically processed within the development room,
4. Undertake value adding R&D including Frenching and Chining integration.

At the conclusion of these developments RTL will be able to demonstrate to the Australian industry the system operating at the equivalent of 10 carcasses per minute.