final report

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Automated lamb bone-in forequarter processing system – Stage 1

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Abstract

Attracting and retaining labour, ensuring safe operational environments and focusing on maximising the conversation 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 single cell automated forequarter cell, which will provide a solid platform for the pending future project that will develop a production prototype ready for commercial sale within Australia.

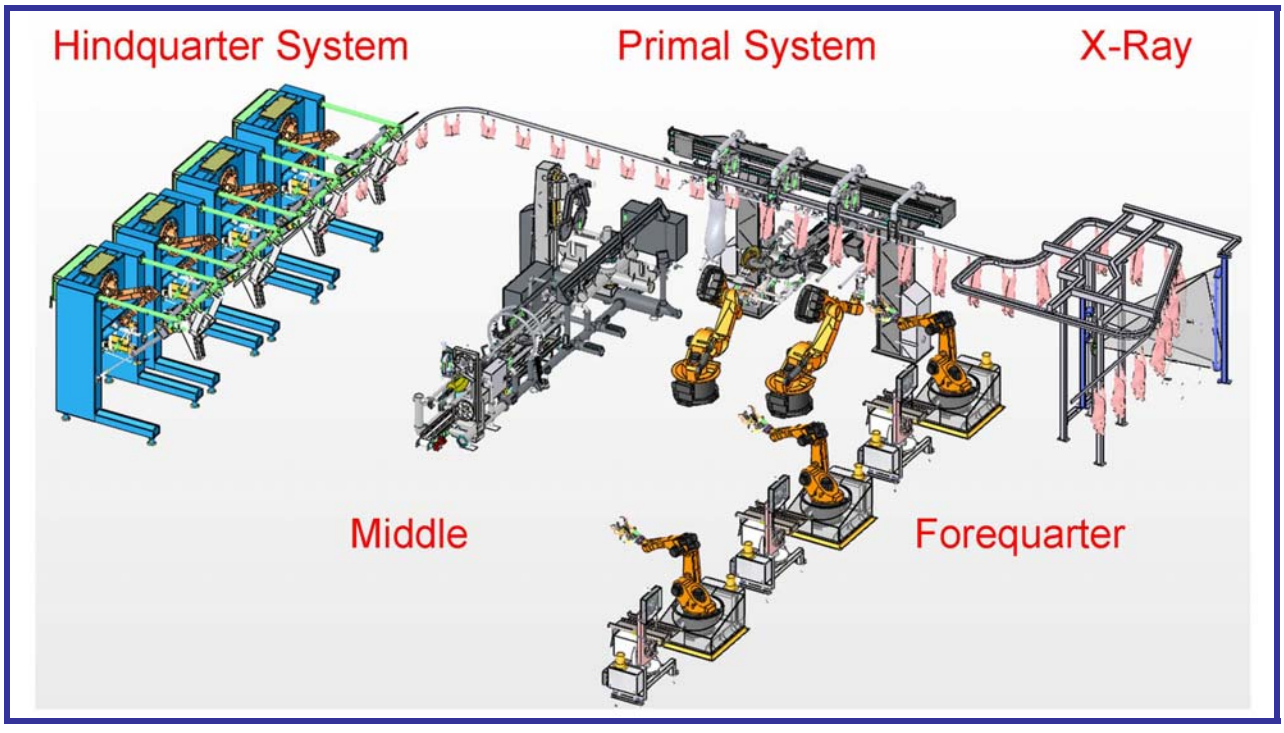
Executive summary

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
4. hindquarter processing

All of these technologies are informed via various vision and sensing solutions including RTL's patented full carcase lamb x-ray system.



This project aimed to, and successfully developed and demonstrated, a forequarter processing module 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 where 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.

Contents

1 Background

Since 2003 MLA has been supporting RTL to develop its vision of a fully automated boning room. This has includes 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

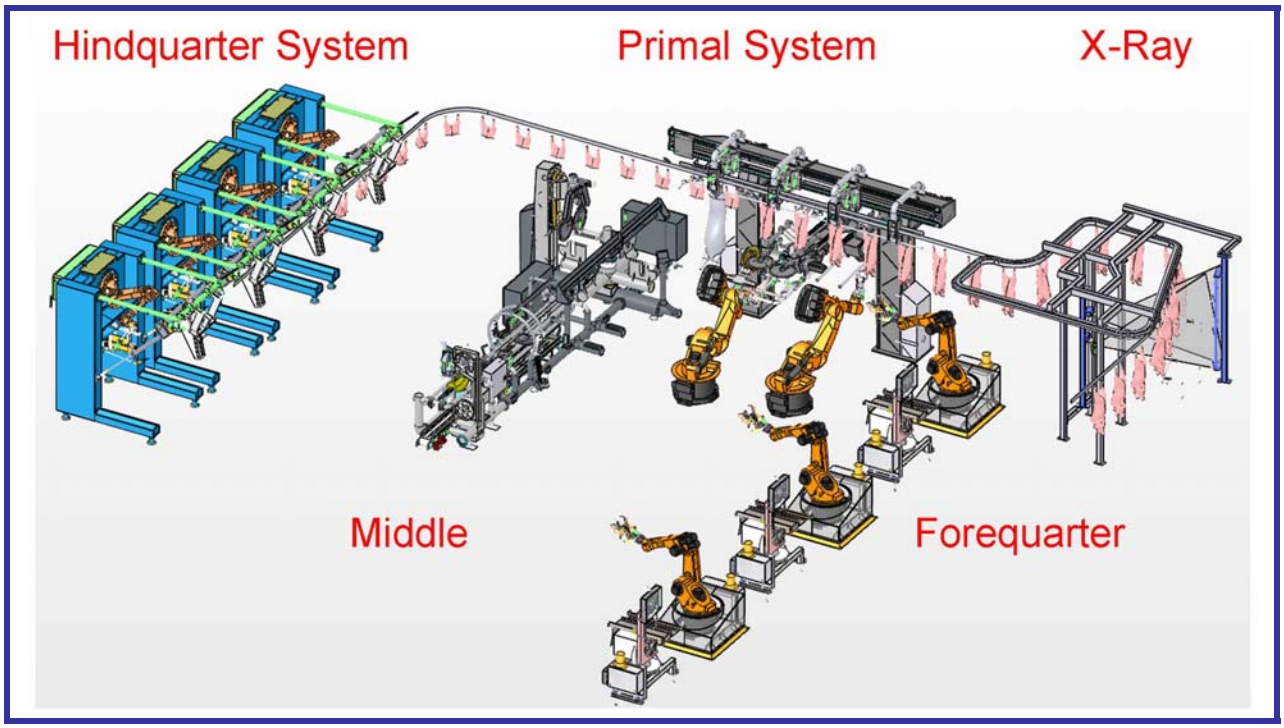


Figure 1: RTL Fully Automated Bone-In lamb Boning Solution

By the end of February 2011, RTL has completed working prototypes of (1) an x-ray system, (2) a primal system operating at 10 carcases 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 carcases into hindquarter, middle and forequarter sections. The objective of this project was to develop a Forequarter Processing solution that will be fed with lamb forequarter sections from the primal cutting operation. The system was to process all bone-in cuts.

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

1. Knuckle tip removal
2. Neck Cuts
3. Shank and Brisket Removal
4. Vertebrae splitting

Contractually the objective was stated as the development of:

> ***The project covers the development of the individual cell performing the cuts mentioned above, together with the integration with LEAP III (primal cutting), operating automatically in a prototype development facility. Upon completion, a working prototype will have been designed, built and tested under normal operational conditions, and the technology will be ready to be permanently installed and run in a plant.***

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

3 Methodology

The methodology was:

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

3.1 Australian Steering Committee

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

4.1 System Schematic and Realisation

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.

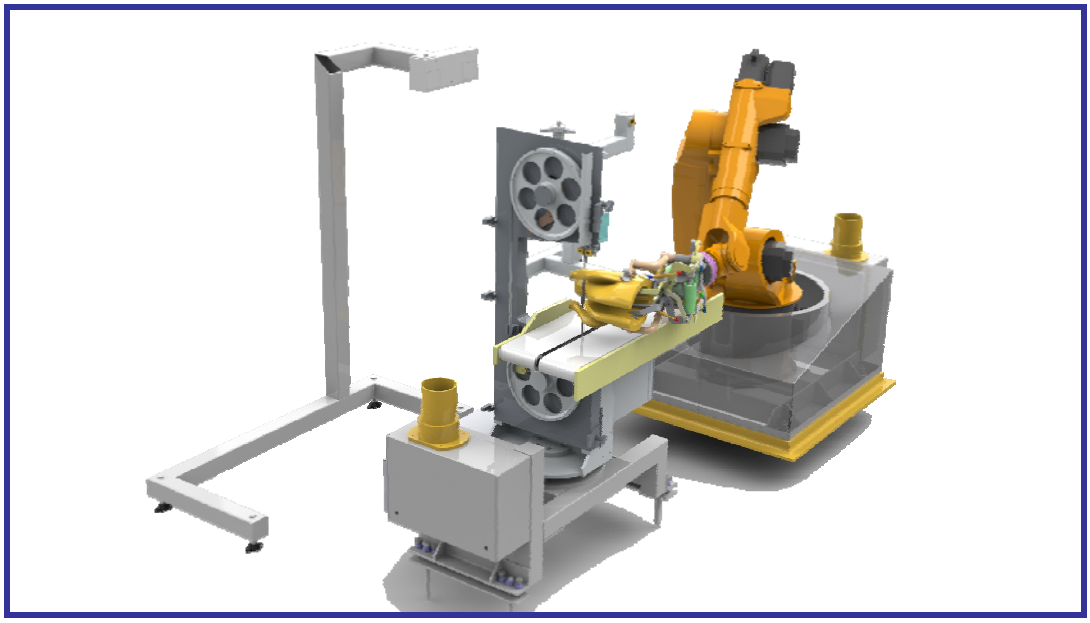


Figure 2: Forequarter System proposed concept

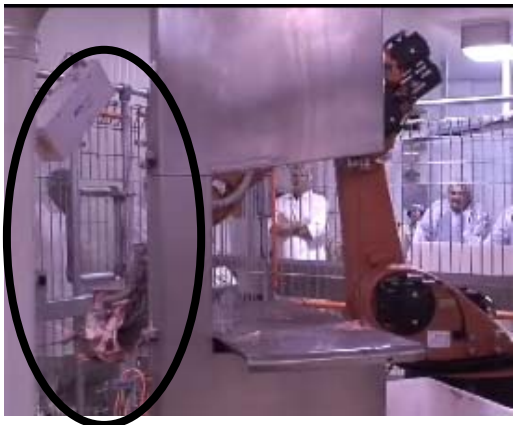
Figure 3: Forequarter System installed in R&D production room

4.2 Forequarter System Operating Principles / Process

Step 1 – Primal system (Tower 1) removes forequarter from carcase

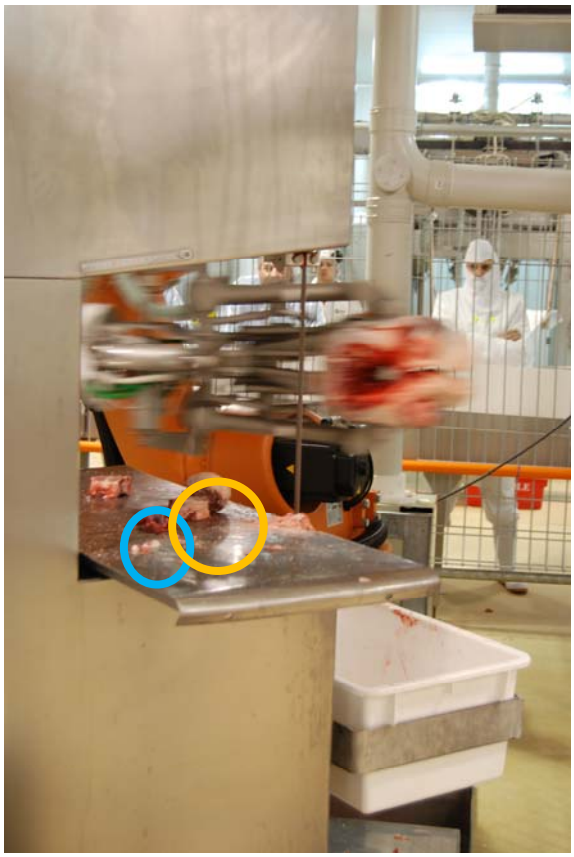
Step 2 – Integration robot transfers the middle section to the middle system loading fixture on the middle system carousel

Step 3 – Fixture clamp positions and locks forequarter for referencing

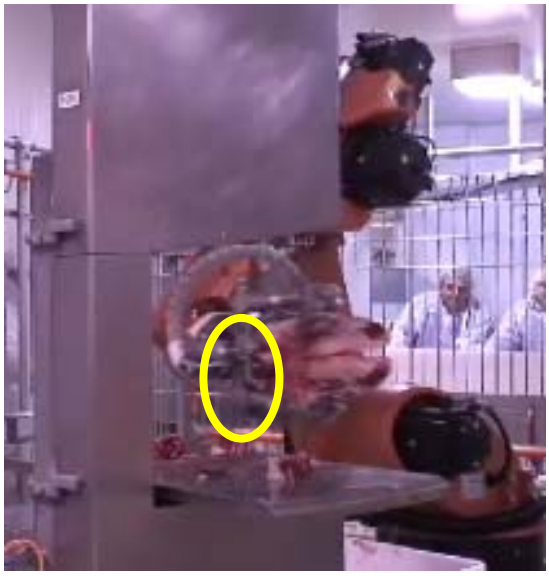


Step 4 – Forequarter cell processing robot removes forequarter from fixture and undertakes additional scanning requirements

Step 5 – Neck Atlas (i.e. tipped) is removed (cyan)

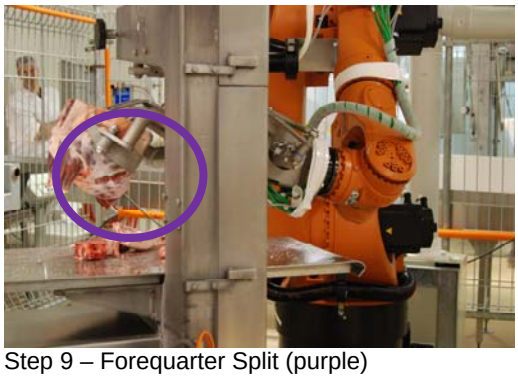


Step 6 – Neck chops cut (orange)



Step 7 – Shanks are tipped (yellow)

Step 8 – Brisket cut (red)



Step 9 – Forequarter Split (purple)

4.3 Resulting Product Presentation

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

General Photos

5 Conclusions and recommendations

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 forequarter bone-in solution.

For the RTL vision to be realised to suit large Australian lamb processing companies the current pre-production 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 forequarters 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 forequarter system with the primal system via the forequarter system integration robot than will enable the equivalent of 10 forequarters per minute to be automatically processed within the development room,
4. Design and produce layout of how a series of forequarter systems would integrate via input and output material handling devices to produce a total solution that can process 10 carcases per minute.

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