final report

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AUS-MEAT Accreditation of the VIAscan® Sheep Carcase System for GR Fat Scoring of Lamb Carcases

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CEDAR CREEK COMPANY

AUS-MEAT Accreditation of the VIAscan® Sheep Carcase System for GR Fat Scoring of Lamb Carcases

P.PSH.0376

Milestone 1 Report

Date: 17th July 2009

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1. COMPANY OVERVIEW

Cedar Creek Company (CCC) is a specialist technology company, whose core business is the development and implementation of advanced software and hardware systems for the perishable & general food & beverage processing industries. CCC services its customer base from its head office in Brisbane, with regional offices in New Zealand and Chile, catering to a global customer base.

CCC provides the food industry with a range of software systems and associated hardware, backed by business analysis, integration, implementation and support services, to deliver real, on-going value to its clients.

CCC places strong emphasis on building ongoing business partnerships with its clients, based on a thorough understanding of their business needs and priorities that enables it to offer informed analysis and advice and to incorporate this into the design of its systems and solutions.

2. PROJECT BACKGROUND

The project for the AUS-MEAT Accreditation of GR Fat Score was initiated by Gathercole's Tatura as part of a program to improve the efficiency of plant operation and reduce on-plant labour costs. The areas of labour saving as identified within the Gathercole's Tatura operation include the manual processes around carcase grading functions; carcase chiller marshalling; and sortation.

Smallstock Carcase Traceability Project

To achieve the labour reduction and subsequent savings, adoption of new technology is required, primarily the implementation of an automated hook tracking system using RFID and the automation of the GR measurement using VIAscan systems.

An over-arching project utilises an automated hook tracking system as the primary enabling technology and information back-bone. The scope of the project encompasses the supply of a fully integrated carcase correlation system from RFID devices fitted to live animals to Hot Standard Carcase Weight (HSCW) scales to the boning room entry. The objective is to track individual carcases throughout this process with the addition of animal health recording available on evisceration and retain via touch screen terminals.

The over-arching project is structured in four components:

1. Individual animal/carcase traceability from live animal RFID to carcases hooks
2. Automated Grading Station including AUS-MEAT Accreditation of the VIAscan® Sheep Carcase System for GR Fat Scoring
3. Automated Chiller Marshalling and Sortation
4. Boning Room Input and Carcase Load-out

The focus of this report, which forms a part of Component 2 of the over-arching Traceability Project is the first milestone of the project to attain AUS-MEAT accreditation of VIAscan Sheep Carcase System. Additional details on the background to this project are contained in Appendix I.

3. OBJECTIVES

The objectives of this project (Milestone 1) were to:

1. Evaluate the prediction performance of the VIAscan® Sheep Carcase System (SCS) when predicting GR Fat Score at a single abattoir.
2. Assess if the SCS predicted Fat Score would satisfy the AUS-MEAT accuracy requirements.
3. Decision point for progression of the trial to the next stage.

4. METHODOLOGY, RESULTS AND DISCUSSION

4.1 OVERVIEW

The AUS-MEAT accreditation of the VIAscan predicted Fat Score has been divided in to 3 stages as outlined in the Partners in Innovation Application.

Milestone 1

Development of Trial Design and Protocols, and Confirmation of Performance at a single site (Cross Bred lambs only). This stage is proposed to demonstrate that the VIAscan SCS could satisfy the AUS-MEAT requirements when measuring Fat Score in commercial operations, prior to conducting larger scale trials under the protocols required for AUS-MEAT accreditation. This stage was initially conducted in Victoria as well as Western Australia. Pending the successful outcome of this stage, Stage 2 is proposed.

Milestone 2

Confirmation of Performance on mixed breed types at both eastern and western Australian sites. The data for this stage will be collected in compliance with the protocols required for AUS-MEAT Accreditation. The purpose of this stage is to confirm performance across a range of mixed breed types on both eastern and western Australian lamb populations. Pending the successful outcome of this stage, Stage 3 will be undertaken.

Milestone 3

Conduct of final accreditation trial at both eastern and western Australian sites and finalisation of AUS-MEAT Accreditation this stage will require further carcase performance data from both eastern and western Australian VIAscan locations to provide adequate numbers required for AUS-MEAT Accreditation. Included in this stage also is the demonstration of VIAscan System performance with respect to Consistency and Repeatability.

Delays in the progress of the project were the result of undertaking additional and separate development to enhance the performance of the VIAscan system and improve the chance of success of the project. These advances are related to the calibration of the system and are leveraging off developments that Cedar Creek Company have undertaken in Europe and New Zealand.

The trial was conducted at WAMMCO, Katanning and Castricum Bros. Dandenong in February and April 2009 respectively. Mr Rob Davidson (Supply Development Manager, WAMMCO) and Nick Linden (Victoria Department of Primary Industries) undertook the trials on behalf of Cedar Creek Company.

4.2 DATASET DISTRIBUTION

A total of 249 carcases were measured across the sites in Western Australia and Victoria. The GR Tissue Depth for each lamb was measured by the manual Cut and Measure Technique and the tissue depth recorded in millimetres. This was then converted to a GR Fat Score according to the AUS-MEAT criteria outlines in Table 1.

Table 1: GR Fat Score Ranges.

GR Tissue Depth Range (mm)	GR Fat Score
0-5mm	Fat Score 1
6-10mm	Fat Score 2
11-15mm	Fat Score 3
16-20mm	Fat Score 4
>20mm	Fat Score 5

The breakdown is detailed in Table 2 and illustrated in Figure 1 below.

Table 2: Distribution of Measured Lamb GR Carcase Fat Scores across Sites.

GR Fat Score	Count			Percentage		
	WA	Victoria	Combined	WA	Victoria	Combined
1	3	6	9	3%	4%	4%
2	43	8	51	46%	5%	20%
3	38	22	60	41%	14%	24%
4	9	51	60	10%	33%	24%
5	-	69	69	0%	44%	28%
Total	93	156	249	100%	100%	100%

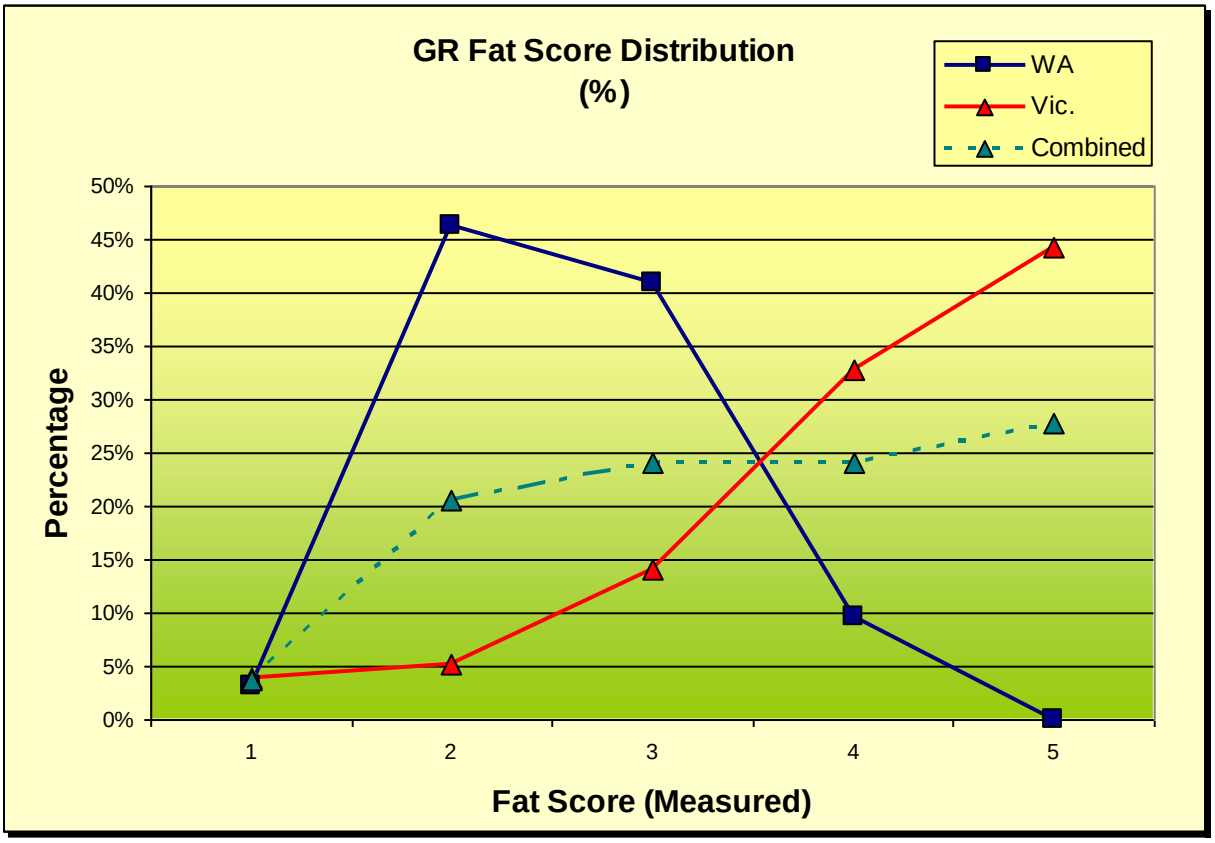

Figure 1: Percentage Distribution of Measured GR Fat Scores across Sites

The initial data collection was conducted at the Western Australia plant where approximately 90% of the samples were recorded as Fat Score 2 (FS2) and Fat Score 3 (FS3). The reason for the narrow range of Fat Scores was because the range of carcases processed by the abattoir at that time encompassed a very narrow range. In order to increase the confidence in assessing the capability of the VIAscan System across the range of Fat Scores, additional lambs were sought at a Victorian plant to balance the Fat Score distributions and better represent the range of fatter lambs. The range of lambs targeted at the Victorian site yielded approximately 77% of lambs producing Fat Score 4 (FS4) and Fat Scores 5 (FS5).

The overall result is a relatively uniform distribution of Fat Scores for the combined dataset from FS2 through to FS5. While it is desirable to have a higher representation of FS1 carcases, previous trials with VIAscan have demonstrated its relatively strong performance in differentiating FS1 and FS2 carcases so the low representation of this Fat Score is not seen as a risk to the outcome of this investigation.

4.3 GR PREDICTION MODEL

A regression was derived to predict GR Tissue Depth on the total sample of 249 carcases. The model was able to predict the GR Tissue Depth (mm) with a high level of accuracy with a Residual Standard Deviation (RSD) of 2.54mm and Coefficient of Determination (RSQ) of 85%. The Standard Deviation of the measured GR Tissue Depths is 6.64mm. There was no evidence of a site bias with respect to the prediction of GR Tissue Depths.

The predicted versus actual GR Tissue Depths are shown in Figure 2.

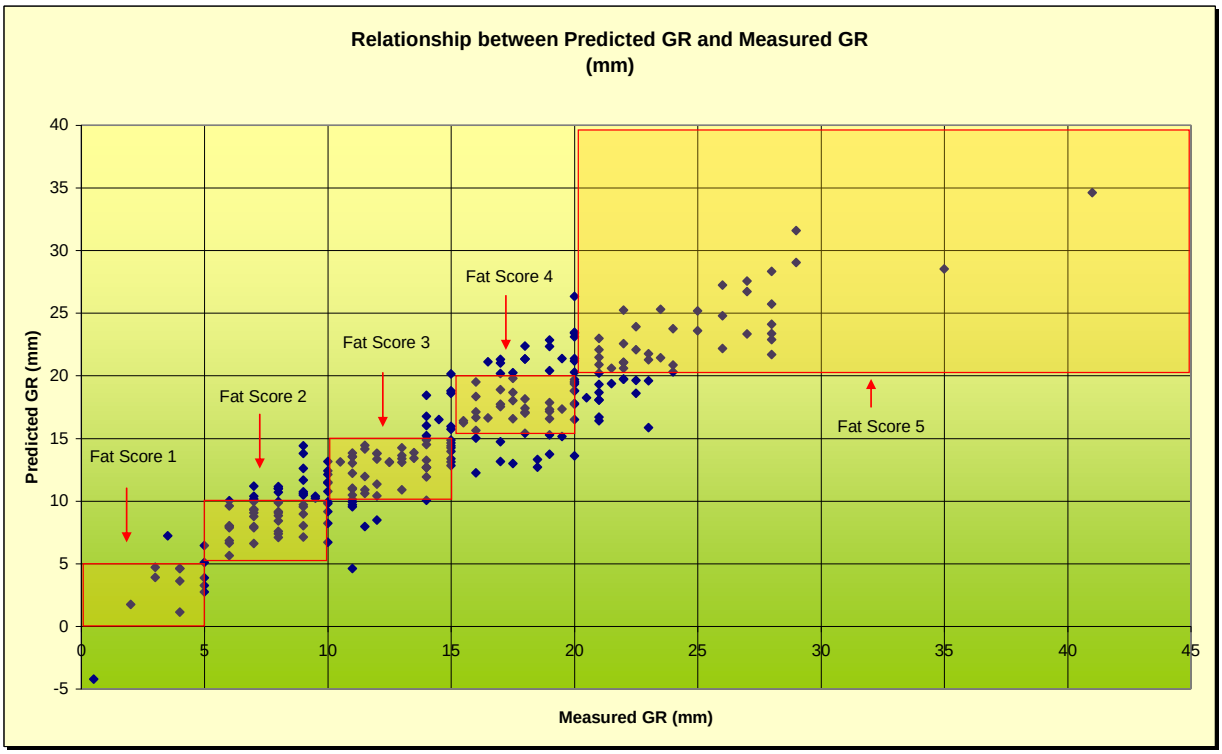

Figure 2: Relationship between Predicted GR Tissue Depth and Measured GR Tissue Depth.

4.4 PERFORMANCE CRITERIA FOR AUS-MEAT GR FAT SCORE PREDICTION

To achieve AUSMEAT accreditation the VIAscan SCS must assign the correct Fat Score with a tolerance of ±2mm of a score boundary for at least 90% of the sample as per the AUS-MEAT National Accreditation Standards Manual.

In addition, the objective measurement systems must also demonstrate that they are repeatable (repeatedly measure the same result on the same object within the same system) and consistent (different systems must consistently measure the same result on the same object). These criteria are addressed in the Protocols for AUS-MEAT Accreditation and are proposed to be addressed in later stages of this trial.

4.4.1 PERFORMANCE ACROSS ENTIRE DATA SET

Overall, the VIAscan SCS was able to assign 91.2% of the lambs with a GR Fat Score that satisfied the AUSMEAT accuracy criteria. Therefore, only 8.8% of the lambs had a predicted GR Fat Score incorrectly assigned (Table 3).

Table 3: The ability of the VIAscan Sheep Carcase Systems to assigned the correct GR Fat Score across the entire dataset

GR Fat Score	Count	%
Within Limits	227	91.2%
Outside Limits	22	8.8%
Count	249	100.0%

4.4.2 PERFORMANCE WITHIN FAT SCORES

The VIAscan SCS performance within each GR Fat Score is shown in Table 4.

The GR model has performed at or within the limits of the AUS-MEAT accuracy criteria for all Fat Scores except Fat Score 1. The sourcing of additional carcases has produced a relatively even distribution of Fat Scores from Scores 2 to 5, however only nine carcases were available representing Fat Score 1. Only one carcase of the nine produced a predicted GR outside the Fat Score 1 range and it exceeded the ±2mm acceptable range by 0.21mm. Due to the relatively small numbers of carcases available for FS1, only one carcase exceeding the allowable range will represent 11% of the carcases in that score thus exceeding the performance criteria. Cedar Creek Company is confident that additional carcases in this range and the strong results on previous occasions at this end of the Fat Score range and significant numbers of carcases will produce positive results.

Table 4: Performance within each Fat Score, based on the AUSMEAT accuracy criteria.

Fat Score	Nos.	GR Range	Nos.	Proportion (%)
1	9	Fat Score 1 +2mm	8	89%
		Total out of range	1	11%
2	51	< -2mm	1	2%
		Fat Score 2 ±2mm	47	92%
		> +2mm	3	6%
		Total out of range	4	8%
3	60	< -2mm	3	5%
		Fat Score 3 ±2mm	56	93%
		> +2mm	1	2%
		Total out of range	4	7%
4	60	< -2mm	3	5%
		Fat Score 4 ±2mm	54	90%
		> +2mm	3	5%
		Total out of range	6	10%
5	69	< -2mm	7	10%
		Fat Score 5 ±2mm	62	90%
		Total out of range	7	10%

4.5 AUS-MEAT GR FAT SCORE ACCREDITATION

AUS-MEAT was consulted regarding the performance criteria required to achieve AUS-MEAT accreditation as well as the requirements of protocols and trial design to support the accreditation of the VIAscan System. Feedback indicated that the datasets for both Calibration and Validation could be collected in the same collection session/phase with the data then separated into Calibration and Validation data sets. This procedure has been adopted on several occasions when undergoing the certification of the VIAscan Technology in European markets and is a legitimate statistical process. Procedures are established to assure that the independence of the Validation dataset and assurance of the integrity of assessing the performance of the system.

5. CONCLUSION AND RECOMMENDATIONS FROM MILESTONE 1

The VIAscan Sheep Carcase System has demonstrated it can successfully predict GR Fat Score on Cross-Bred lambs with sufficient accuracy to satisfy AUS-MEAT performance criteria when assessed both on an overall basis and within individual Fat Scores. The collection of data from both Victorian and Western Australian lamb populations has also provided confidence in the performance of the system across broad geographic areas.

Based on the conclusions above and the opportunity to collect Calibration and Validation data together, it is recommended that the next stage of the Project combine Milestone 2 (Confirmation of Performance on mixed breed types at both Eastern and Western Australian sites) and Milestone 3 (Conduct of final accreditation trial at both eastern and western Australian sites and finalisation of AUS-MEAT Accreditation) into a single data collection stage.

The benefits of this will be to improve the efficiency (and reduce cost) involved in the collection of data for the remainder of the project, as well as enabling an increase in the total numbers of carcases included in the data set. It also reduces the opportunity for the introduction of issues surrounding manual measurements between Calibration and Validation trials that can potentially confound the assessment of the true performance of a technology. The collection of all remaining data for this combined stage will be conducted in accordance with the protocols established with AUS-MEAT. This will enable the data from the next stages to be eligible for provision to AUS-MEAT for the Accreditation of the VIAscan Systems for Fat Score assessment.

6. Appendix I: Project Background

The material in this section is adapted from the "Partners In Innovation" project funding proposal to Meat and Livestock Australia and is provided to offer a detailed background to this project and its role in a broader over-arching traceability project.

Adaptation from "Partners In Innovation Project Funding Application: The Attainment of AUS-MEAT Accreditation of the VIAscan Sheep Carcase System for GR Fat Scoring of Lamb Carcases. (February 2008)

How has the Project "come about"?

This project was initiated by Gathercole's Tatura as part of a program to improve the efficiency of plant operation and reduce on-plant labour costs. The areas of labour saving as identified within the Gathercole's Tatura operation is the manual processes around carcase grading function and carcase chiller marshalling and sortation.

To achieve the labour reduction and subsequent labour savings, adoption of new technologies are required, primarily the implementation of an automated hook tracking system using RFID and the automation of the GR measurement using VIAscan systems.

The project application focused solely on the stage of gaining AUS-MEAT Accreditation of the VIAscan Sheep Carcase System for GR Fat Scoring of Lamb Carcases SASTEK has had previous industry experience on automating this same process and believe it to be an industry wide challenge.

What currently happens and why does it need changing?

The manual assessment of GR fat levels of sheep carcases has long been recognised as a relatively expensive physical operation and one that has been identified as providing the opportunity for automation, while improving the robustness of the measurement.

The current "grading" practices operating in lamb processing establishments have been in operation for decades. These involve a person physically undertaking the following tasks:

- Identification of lamb carcases to confirm allocation to relevant supplier slaughter lot.
- Weighing of each carcase
- Manual GR Fat assessment of each carcase (either through palpation, lamb probe or manual cut & measure). Lamb Probe GR measurements can be reported in millimetres. The most common method of reporting is GR Fat Score which refers to a fat depth range.
- Application of relevant in-house grades
- Stamping or ticketing carcases to facilitate subsequent identification and sorting.
- Various interfaces have been implemented to improve the efficiency and robustness of information collection however, in all cases, an operator is required to undertake a number of manual operations including carcase identification and assessment of GR Fat.

These manual tasks are repetitive and prone to errors. In addition, there is a significant cost in training operators, maintaining their necessary skill levels, as well as providing redundancy in the event of absenteeism.

With the commercial accessibility of a number of technologies, the opportunity now exists to replace these manual tasks with systems and processes to improve the efficiency of the processes and reduce the costs to industry. These technologies include RFID and the VIAscan Technology.

What alternatives have been investigated or are available?

Currently, there are no other technologies available to measure GR Fat Score automatically at line speed in commercial Australian lamb processing plants. The VIAscan Technology was accredited by AUS-MEAT in 2002 however, constraints imposed by AUS-MEAT on the VIAscan being located prior to the Grading station and the need for an operator to manually assesses carcases that were not provided with a GR Score by the VIAscan System (eg. heavily damaged or trimmed carcases) meant that an operator was still required. However, now the availability of RFID and automated carcase sorting enables these carcases to be automatically railed off and managed separately off-line rather than needing to have an operator on-line full time.

Since 2002, there have been significant upgrades to the VIAscan Technology to maintain currency with available parts and components and advances in vision systems. This has resulted in the platform that was accredited by AUS-MEAT being superseded and ultimately being made redundant. In addition, a much wider range of sheep breeds are now being slaughtered through commercial flocks. The combination of these issues necessitate the VIAscan Technology be assessed to confirm its ability to assess GR Fat Score across the range of carcases now being processed commercially in Australia.

What happens in other industries?

A range of technologies are utilised in other industries (namely beef and pork) for the objective measurement of single point carcase tissue depths. These are predominantly manually operated insertion probes but also include ultrasound and CT Scanning. High cost on-line systems have also been employed in Europe that use automated systems for taking multiple insertion probe measurements. While these systems have application in their respective markets/industries and have varying limitations, they are considered to not offer a solution to the need raised by the stakeholder of this project. This consideration is also in respect to the VIAscan Technology being a proven and robust technology currently assessing in excess of 8.5M lambs annually across Australia, New Zealand and Europe.

Experimentation/Investigation work to date

A number of projects have been conducted by SASTEK and Meat and Livestock Australia (the previous owner of the VIAscan Technology) in relation to the VIAscan Technology. As indicated above, development work lead to the system achieving the performance levels required for achieving AUS-MEAT GR Fat Score accreditation. This was prior to a significant upgrade of the technology as well as a sample of carcases that did not reflect the breed/carcase type variability now seen in commercial flocks and being processed

Recent projects since the upgrade of the Technology have focussed primarily on the development of the Technology to predict carcase yield, as well as EUROP Fat and Conformation Score Classification. These areas of focus have been driven by the commercial users of the Technology.

Estimated cost before and after on the impact to the Processor

The financial benefit of this project depends on the scale of processing operation and their labour configuration at the scales/grading station area.

Based on the scope of this project being to automate the GR Fat Score assessment of lamb carcases, for many plants in Australia, this will enable the removal of one labour unit (valued at in excess of $50,000 pa + on-costs). In addition, there will be savings on training and compliance costs. For many plants, this saving will be greater due to the need to have multiple labour units to accommodate absenteeism and annual leave requirements. These savings do not include the cost of downgrades that occur through erroneous assessments resulting from manual assessments or inaccurate input of assessment information. It is anticipated that the processor will be still be required to have a labour unit who has successfully completed the AUS-MEAT Advanced Carcase Fat Measurement Course to manage exceptions where carcases may be heavily trimmed and a valid GR Fat Score assessment is not available from the automated VIAscan System.

The anticipated cost to a processing site that does not currently have a VIAscan system installed is $75,000 over three years. This applies to a VIAscan system supplied for the sole purpose of GR Fat Score assessment. This includes installation, commissioning and training, and is subject to commercial acceptance testing and conditions.

It is proposed that for sites in Australia where VIAscan Sheep Carcase Systems are currently in operation and where these sites assist in the conduct of this project to gain AUS-MEAT Accreditation for VIAscan GR Fat Score assessment, then no additional fees will be applied for provision of the on-line VIAscan GR Fat Score assessment. This waiver of an additional fee for GR Fat Score will be in recognition of the processors' contribution of their facilities and assistance with the project.

Where to Next after this Project

The successful outcome of this project will provide the "enabling technology" to allow the operator-less assessment of GR Fat Scores on-line in lamb processing plants. While this alone will produce benefits in many plants, the next major step will be the integration of this solution into a development project further improve the efficiency of plant operation and reduce on-plant labour costs. This will be achieved through the utilisation of RFID technology to automate a number of manual tasks including identification of carcases, operation of the weigh/grade station and the pushing and sorting of carcases into chillers.