Final Report

AMPC
AUSTRALIAN MEAT PROCESSOR CORPORATION

RFID SORT CHILLER

Harvey Beef

Automated RFID Beef Chiller Carcase Sorting System

Project Code
2021-1213

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1.0 Executive Summary

Harvey Beef is WA's largest beef abattoir, regularly processing over 700 head per day of multiple cattle types and grades. Consequently, in their pursuit to drive safety, efficiencies and savings, whilst maintaining complete traceability and the highest quality standards, they are continually seeking pathways to achieve these strategic goals through the utilisation and application of innovative technologies. With expected increases in processing, improved and increased capacity along with flexibility is required to be implemented into the Harvey Beef production and storage systems.

Harvey Beef have identified the opportunity to create a carcase sorting system using RFID, Emydex application processing & PLC systems along with mechanised pushers, that has allowed them to automatically and correctly identify and sort beef sides, extending traceability and feedback for each beef side through the chilling and grading process. This automated process directs sides into pre-determined sorting/boning groups within the chiller based on post chill MSA grading, and then outfeeds them into the boning room as required, via an automated system.

Harvey Beef identified that through this project we could improve efficiencies, reduce time taken to compile efficient boning plans, reduce production errors, increase productivity and throughput, reduce required labour units, positive cost benefit and ROI analysis. Whilst some of these have not been maintained since commission due to unforeseen circumstances, we have seen all of these benefits while running the sort chiller as intended. We hope by the end of 2024, we will be utilising the sort chiller as intended.

2.0 Introduction

Prior to this project, the processing pathway within the Harvey plant allows for beef sides to be graded on the slaughter floor and a bar code label applied, with the relevant slaughter grade information recorded into the database.

Sides from the kill floor are manually pushed into chillers and are chilled overnight then MSA graded in the chiller, with grading information for each side uploaded to the database. Chiller teams then sorts the chillers by manually running sides on and off rails within chillers to sort sides into boning groups. This is very time consuming and labour intensive. The carcases are then manually pushed from the chillers into the boning room – manually scanned into the boning room, aligning the carcase tag information with the additional carcase data held on the database.

This process has various restrictions placed upon it, primarily that of limited space and chiller capacity, but also the reliance on physical labour, and the continual manual intervention to collect and record data, exposing the process to errors, missed records, and reliance on tags that can often be dislodged.

Harvey Beef have extended the boning room and alongside this Harvey Beef identified the opportunity to create a carcase sortation chiller to allow better sortation and flow of carcases from chiller to boning room. Initially the sortation chiller was going to be mechanised with manual controls to run the chains and pushers. Harvey Beef then looked at automation of the chiller utilising RFID, Emydex application processing and programmable logic controller (PLC) systems along with the mechanised pushers. This project was then established.

RFID tags in the carcase gambrels will be used to identify the carcase once it is hung on the kill floor chain using the body number created at the NLIS station. Carcases will be sorted from the kill floor into the main chillers based on their slaughter grades. Once in the main chillers, applicable carcases will be post-chill MSA graded. Carcases are then moved from the chiller to the sortation chiller where the system will identify beef sides for sortation automatically, extending traceability and feedback for each beef side through the chilling and grading process. This automated process directs sides into pre-determined sorting/boning groups within the chiller based on post chill MSA grading and rail allocation, and then outfeeds them into the boning room as required, without the need for manual pushing and sorting of sides.

3.0 Project Objectives

This project aims to demonstrate the viability and measurable benefits derived via:

- Improved efficiencies across all areas (manual handling, carcase flow, accuracy of sortation)
- Reduction in both time taken, and production errors
- Increased productivity via throughput
- A reduction in required labour units
- A positive cost benefit and ROI analysis

Harvey Beef's additional objectives for this project were as follows:

- Improved health and safety for the chiller workers.
- The elimination of lost revenus cause by production errors resulting in carcase downgrades
- Visibility of beef chiller stock by final grade to assist with production planning
- Improved traceability throughout the process via the RFID gambrel and body/side association.

4.0 Methodology

- The project will seek to measure the current workflow processes and timings, including labour units and associated costings, error rates, to demonstrate a baseline to measure anticipated improvements within these categories
- The successful implementation of the Emydex system, including the RFID skids, automated gates, sensors, and functional database and operational software
- Inception meeting with key stakeholders. BIC, Emydex, Harvey Beef, Meateng, AMPC.Scope and objectives defined for all parties. Structural design, process flow, trigger points, grading, system integration, reporting expectations all agreed to. Appendix 1 (Sort Chiller Flow and Design), Appendix 2 (system Mapping)
- Commence work structural, mechanical and systems
- Trial of systems and mechanical interface and make amendments as required
- Practical completion, work instructions created, risk assessment completed, training rolled out to operators
- Monitoring the system's performance to measure the cumulative benefits and specific outcomes against those initially prescribed

4.1 Process Flow & Traceability

4.1.1 Slaughter Floor Processing

Hook Room

The first point that the RFID gambrel is read is in the hook room. This is where the clean hooks are placed on the line to be reused for a new carcase record. An indicator beside the RFID reader will display to the operator that the hook has read successfully by turning on a green LED, if it fails the LED will turn red.

The RFID number will be sent via the PLC to the Emydex DCI. The prior carcase number associated with the RFID number is cleared at this time. It is not done at the entry to the boning room at the BRI, as the ability to track the RFID and carcase further down the line may be required in the future.

Leg Stand

The rail from the knocking box to the first legging stand where the RFID is to be recorded and associated with a carcase is a separate chain from the main chain where the RFID will be recorded and tracked through to the chillers. To sequence the carcases on the line, the body number recorded at the Emydex NLIS station is used to provide the body number at first-legging. As there can be several carcases between the NLIS station and the first legging stand the sequence will be applied on a FIFO basis i.e., the first body past the NLIS station will be assumed to be the first body at the legging stand.

Grading/Weigh Station

The animal side is graded at the weigh station where it gets assigned a chiller grade automatically via our production system and is paired up with the RFID chip embedded in the gambrel. The data on the carcase tag matches the data referenced on the RFID until post chill MSA grading takes place, where the RFID is updated with the new grade information.

In the images below body number 572 has the RFID value 83341744575670562 assigned to the left side and RFID value 83341747318183201 assigned to the right side.

Figure 1: EMYDEX Screen of body 572 with RFID value assigned

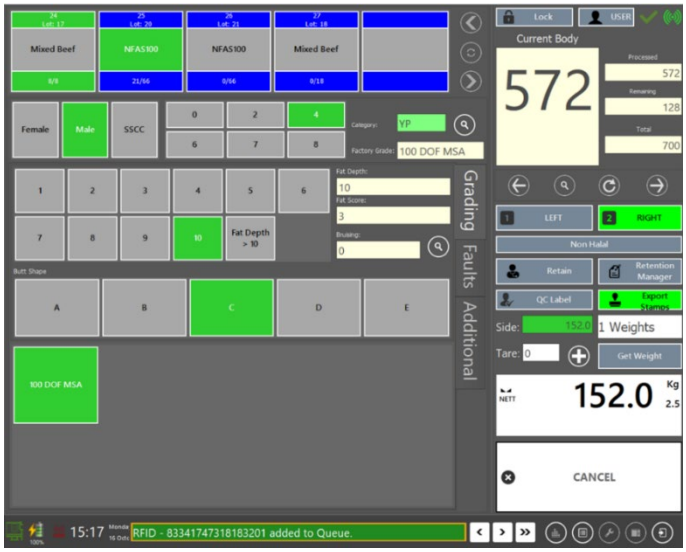


Figure 2: EMYDEX Screen of body 572 with RFID value assigned

DOK : 16-Oct -2023 Carcass No. : 572 Search Update Delete Copy

BatchNo	20231016-DAY-1
BloodCollection	IsBloodCollected : False - Tank #0 - IsGraded : False
BodyCalculatedColdWeight	294.5
BodyCalculatedHotWeight	303.5
BodyColdWeight	0
BodyDisposalWeight	0
BodyGradedWeight	303.5
BodyHotWeight	303.5
BodyKillPLanReservationWeight	0
BodyLiveWeighedTimestamp	
BodyLiveWeight	0
BodyLiveWeightTare	0
BypassGraderTicketLabelPrinter	False
CarcassDefects	(Collection)
CarcassDefectsList	
CarcassFaults	(Collection)
CarcassForeInspectionStatus	None
CarcassHindInspectionStatus	None
CarcassId	36064812342001572
CarcassIndicators	(Collection)
CarcassIndicatorsList	
CarcassInspectionActions	(Collection)
CarcassInspectionETag	0
CarcassInspectionQCHold	False
CarcassInspectionRetainHold	False
CarcassInspectionStatus	None
CarcassInspectionStatusUpdaterId	
CarcassMinorFaults	(Collection)
CarcassNo	572
CarcassState	PutAway
ChainNo	1
ChillerGradeCode	GF

Figure 3: EMYDEX DCI Management Screen for Body 572

Side1	RFID : 83341744575670562 - State : Created
AllocatedToWONo	
CalculatedColdWeight	147
CarcassId	0
CarcassInspectionStatus	None
ChillerPullOutTimestamp	17/10/2023 2:28 PM
ChillerPutAwayRailCode	
ChillerPutAwayTimestamp	
ChillerRailSeqNo	0
ChillerSortationGroupCode	GF
CreatedTimestamp	
DetainedReleasedTimestamp	
DetainedTimestamp	
DisposalTimestamp	
DisposalType	None
DisposalWeight	0
FaultDeductionWeight	0
GradedTare	0
GradedTimestamp	16/10/2023 3:17 PM
GradedWeight	151.5
GradedWeightManuallyEntered	False
GraderScalesWeight	0
GradingLabelBarcode	01993149850145993102015150112310162110572121111
HotWeight	151.5

Side2	RFID : 83341747318183201 - State : Created
AllocatedToWONo	
CalculatedColdWeight	147.5
CarcassId	0
CarcassInspectionStatus	None
ChillerPullOutTimestamp	17/10/2023 2:28 PM
ChillerPutAwayRailCode	
ChillerPutAwayTimestamp	
ChillerRailSeqNo	0
ChillerSortationGroupCode	GF
CreatedTimestamp	
DetainedReleasedTimestamp	
DetainedTimestamp	
DisposalTimestamp	
DisposalType	None
DisposalWeight	0
FaultDeductionWeight	0
GradedTare	0
GradedTimestamp	16/10/2023 3:18 PM
GradedWeight	152
GradedWeightManuallyEntered	False
GraderScalesWeight	0
GradingLabelBarcode	01993149850145993102015200112310162110572221114
HotWeight	152

Figure 4: EMYDEX DCI Management Screen for Body 572 Continued

4.1.2 Pre-Sort Chiller Carcase Loading

Post weigh grade station carcases are directed into pre-sort chillers and manually pushed onto the pre-sort chiller rails. The Emydex & PLC systems handshake data for expected grade beef sides (kill grade) via RFID gambrels, creating carcase inventory. Post overnight chilling, the MSA grader will grade the chilled sides and update grading as required on the data capture unit (DCU), the final grade is then uploaded and recorded into the Emydex system and the RFID chip.

4.1.3 Sortation Chiller Carcase Loading

Chillers and rails including both in and outfeed rails are defined in the Emydex system. The Chiller team alongside the Production Planners create a “boning run plan” & pre-allocate rails in the Sortation Chiller (sort chiller) for boning groups within the Emydex system. Emydex directs carcase sides to a rail depending on grade information as per planner’s allocation (Emydex messages PLC and PLC controls the gates and conveyors).

Each sort chiller rail has a physical limit of 6 tonnes per rail, the system ensures that this limit is not exceeded as the rail is loaded.

Carcase chiller grades can be downgraded or sub-graded (such as marble scores withing a grade) using the Emydex scanner. Downgrading and Sub-grading will assign an updated Chiller Grade to ensure it is handled correctly when arriving at the sortation chiller.

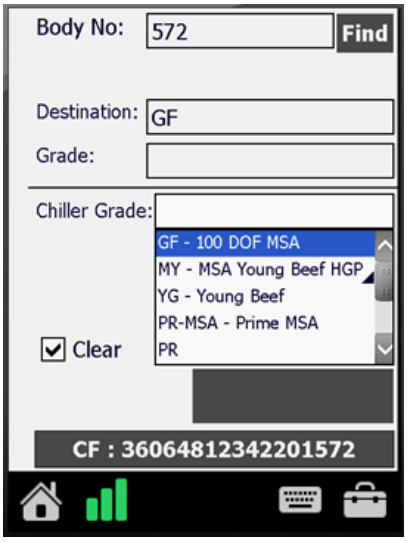


Figure 3: EMYDEX Chiller Grading Mobile Scanner Application (SDA) Body 572

Sortation Groups get assigned to a sortation rail. In this case, the Sortation Group ‘GF’ got assigned to rail 15. The changes are then pushed to the live PLC system using the ‘Update DCI’ button.

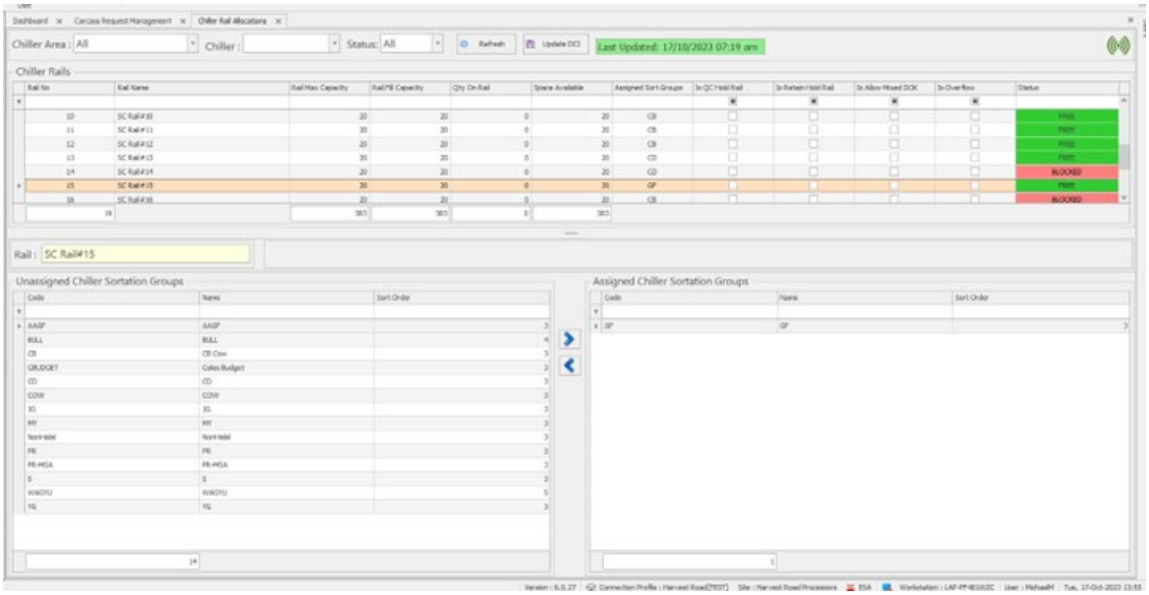


Figure 6: EMYDEX DMS Client Rail Allocation Screen – Assigning Chiller Sortation Group GF to Rail 15

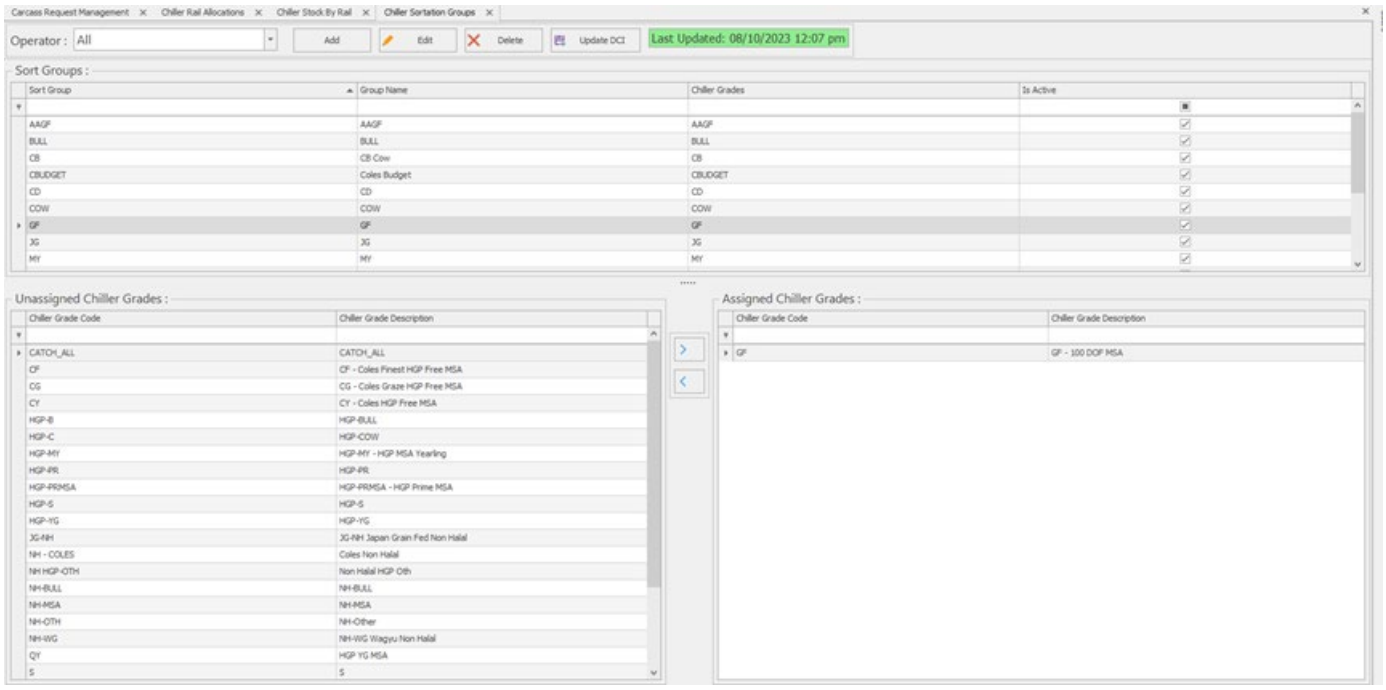


Figure 7: EMYDEX DMS Client Chiller Sortation Group Screen – Assigning Chiller Grade ‘GF – 100 DOF MSA’ to Sortation Group GF

Sortation Groups are created on the ‘Chiller Sortation Group’ page, whereby Chiller Grades are associated with a Sort Group. Typically, each Chiller Grade will have a one-to-one mapping with a Sort Group, although it is possible to have multiple Chiller Grades associated with a Sort Group to conserve rail space.

The sort chiller set up allows for the following information:

Chiller Rail Code	A unique code is used to identify each rail
Description.	A description of the rail.
Chiller Code	The code of the chiller the rail is in.
Chiller rail number.	The unique rail in the chiller.
Fill Priority	To tell the PLC which rails to fill first within the specific chiller.
Fill Capacity.	The rail capacity.
Max Fill Cap.	The limit used to cause a change to a new rail.
PLC Point Id.	The code used to identify the rail to the PLC.
IsRail.	Is this an actual rail or a PLC point used for identification?
IsActive.	Is this rail in use currently?
Is PutAway Rail.	Use to identify rail location such as the infeed to the Decontamination chamber that are not used for storage but that can identify where a side currently is.

Skids get assigned to the specified rail. The ‘Carcase Request Management’ screen provides the user with a visual indicator of sortation chiller skid holdings and rail capacity with the option to review the carcasses on the rail. Moreover, the ‘Carcase Request Management’ screen provides additional functionality to block, unload and reset individual rails. The below image has the full rail 15 selected with a list of carcasses on the rail.

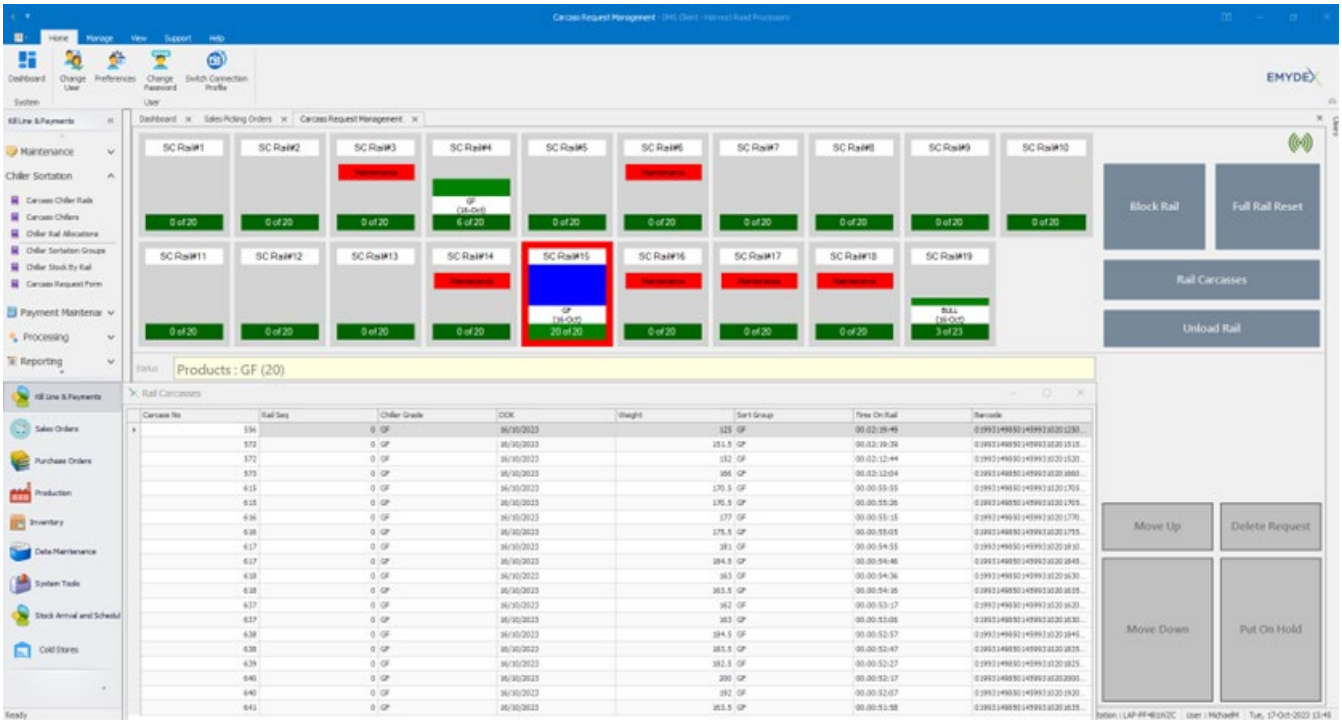
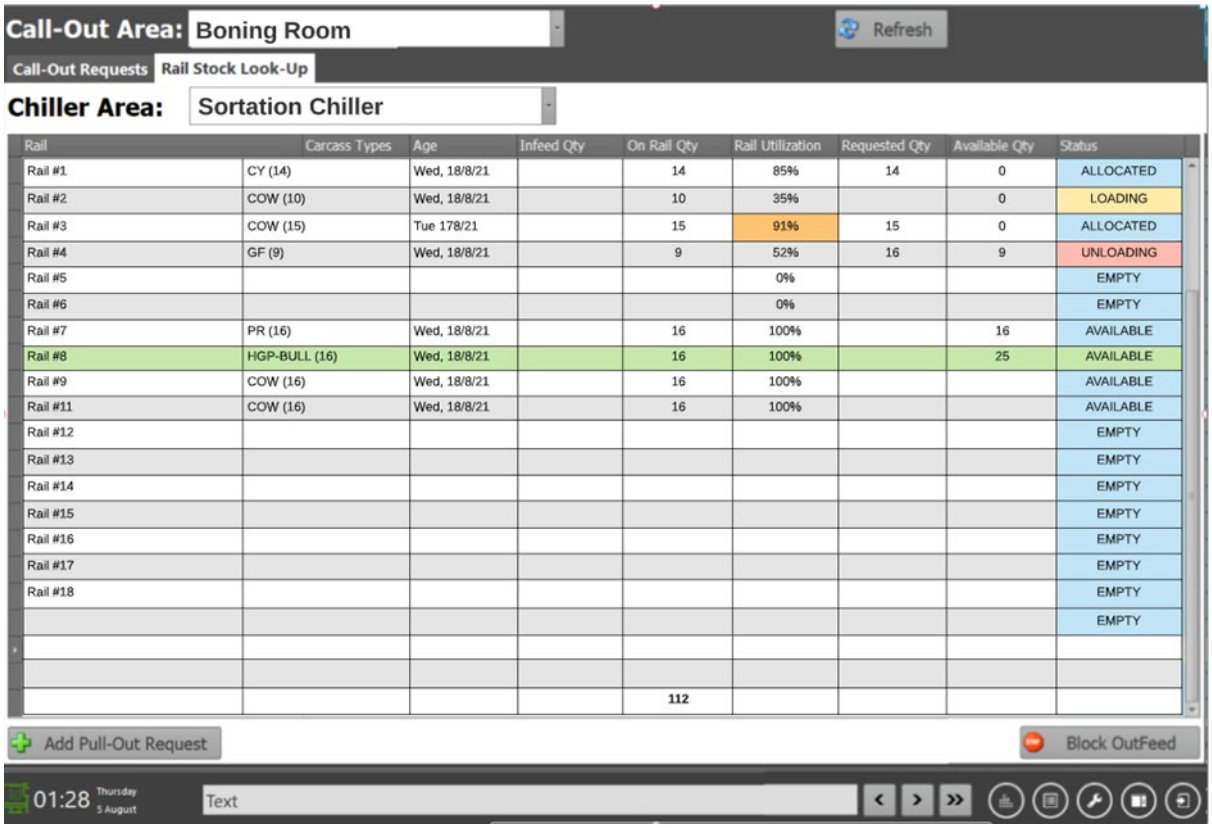


Figure 8: EMYDEX DMS Client Carcase Request Management Screen – Rail 15 selected with listing of skids on rail.

4.1.4 Sort Chiller Unload – Boning Room Input

Instructions to unload the sort chiller are called call-out requests. A touch screen terminal allow an operator to view the carcase rails in the sort chiller and to generate instructions to call them out to the boning room.

Call-out requests are queued so the rails that are to be unloaded can be set up in advance for any rails that currently have carcasses on them using the 'Call Out Requests.'



Rail	Carcass Types	Age	Infeed Qty	On Rail Qty	Rail Utilization	Requested Qty	Available Qty	Status
Rail #1	CY (14)	Wed, 18/8/21		14	85%	14	0	ALLOCATED
Rail #2	COW (10)	Wed, 18/8/21		10	35%		0	LOADING
Rail #3	COW (15)	Tue 178/21		15	91%	15	0	ALLOCATED
Rail #4	GF (9)	Wed, 18/8/21		9	52%	16	9	UNLOADING
Rail #5					0%			EMPTY
Rail #6					0%			EMPTY
Rail #7	PR (16)	Wed, 18/8/21		16	100%		16	AVAILABLE
Rail #8	HGP-BULL (16)	Wed, 18/8/21		16	100%		25	AVAILABLE
Rail #9	COW (16)	Wed, 18/8/21		16	100%			AVAILABLE
Rail #11	COW (16)	Wed, 18/8/21		16	100%			AVAILABLE
Rail #12								EMPTY
Rail #13								EMPTY
Rail #14								EMPTY
Rail #15								EMPTY
Rail #16								EMPTY
Rail #17								EMPTY
Rail #18								EMPTY
								EMPTY
				112				

Figure 10: Sort chiller management and call out screen

The Emydex system (DCI) will process the call out requests based on the sequence of the requests listed on the terminal. As each rail is started and then finished, the status on the display will change as per the statuses described above. The DCI will in turn instruct the PLC to move the carcasses from the sort chiller to the BRI/Boning Room.

The PLC advises the DCI when the rail is empty so the next rail can be unloaded. The next request in the queue will generate a message to the PLC to unload the next rail.

A divert rail is available immediately before the BRI, any carcasses read at the BRI that do not meet the currently selected boning room input line will be rejected. This will be via a signal sent from the BRI to the DCI which in turn will send a message to the PLC to divert the carcase.

The Skid then gets processed at the Boning Room Intake (BRI) computer.

Though not currently implemented, as the outfeed is yet to be programmed, RFID gambrel will be read at the BRI computer and the associated information from the read RFID value will be sent to the BRI station. The existing manual carcase ticket scan will remainin place in the event of an RFID read failure, until system is fully tested.The current process involved manually scanning each carcases ticket onto the BRI computer.

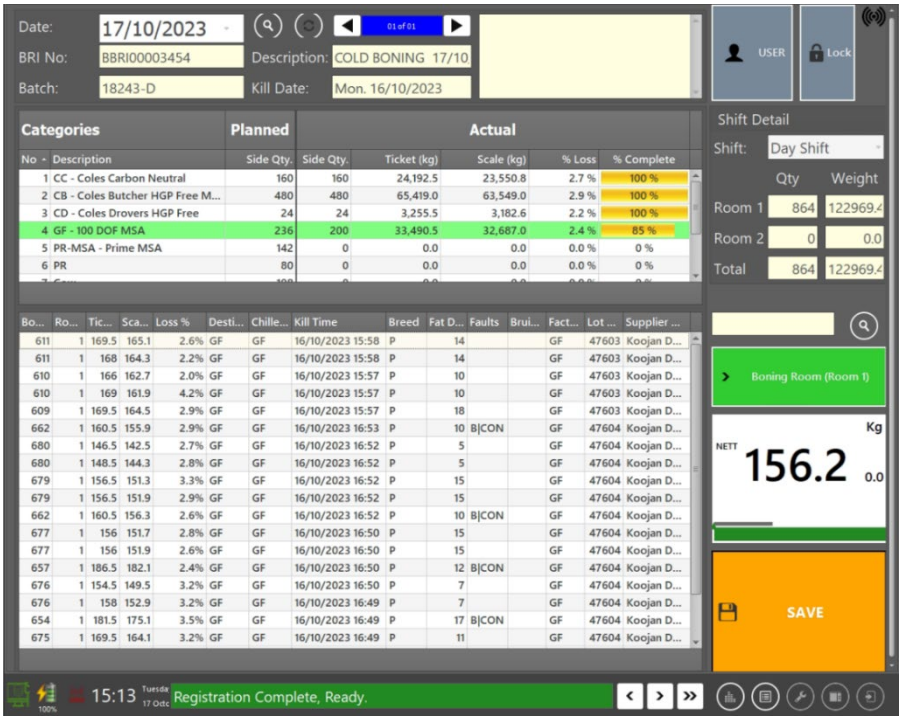
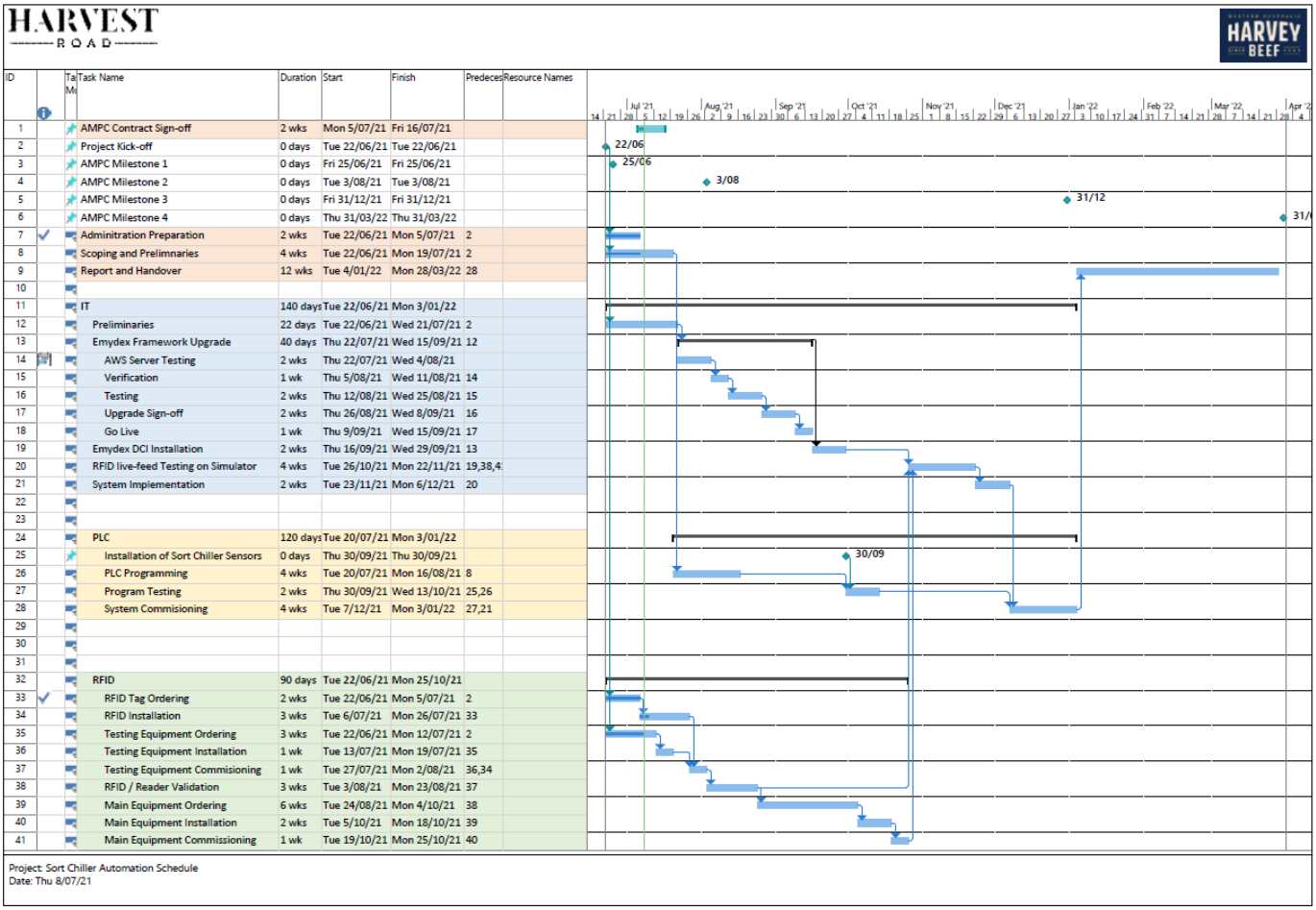


Figure 11: EMYDEX Boning Room Intake Application scanning in Body 572 to the Work Order

Emydex had facilitated a project like this, however not at the capacity of multiple grades of beef that may change grades between booking to boning numerous times.

4.2 Planned Project Schedule



ID	Task Name	Duration	Start	Finish	Predeces	Resource Names
1	AMPC Contract Sign-off	2 wks	Mon 5/07/21	Fri 16/07/21		
2	Project Kick-off	0 days	Tue 22/06/21	Tue 22/06/21		
3	AMPC Milestone 1	0 days	Fri 25/06/21	Fri 25/06/21		
4	AMPC Milestone 2	0 days	Tue 3/08/21	Tue 3/08/21		
5	AMPC Milestone 3	0 days	Fri 31/12/21	Fri 31/12/21		
6	AMPC Milestone 4	0 days	Thu 31/03/22	Thu 31/03/22		
7	Adminitration Preparation	2 wks	Tue 22/06/21	Mon 5/07/21	2	
8	Scoping and Prelimnaries	4 wks	Tue 22/06/21	Mon 19/07/21	2	
9	Report and Handover	12 wks	Tue 4/01/22	Mon 28/03/22	28	
10						
11	IT	140 days	Tue 22/06/21	Mon 3/01/22		
12	Preliminaries	22 days	Tue 22/06/21	Wed 21/07/21	2	
13	Emydex Framework Upgrade	40 days	Thu 22/07/21	Wed 15/09/21	12	
14	AWS Server Testing	2 wks	Thu 22/07/21	Wed 4/08/21		
15	Verification	1 wk	Thu 5/08/21	Wed 11/08/21	14	
16	Testing	2 wks	Thu 12/08/21	Wed 25/08/21	15	
17	Upgrade Sign-off	2 wks	Thu 26/08/21	Wed 8/09/21	16	
18	Go Live	1 wk	Thu 9/09/21	Wed 15/09/21	17	
19	Emydex DCI Installation	2 wks	Thu 16/09/21	Wed 29/09/21	13	
20	RFID live-feed Testing on Simulator	4 wks	Tue 26/10/21	Mon 22/11/21	19,38,4	
21	System Implementation	2 wks	Tue 23/11/21	Mon 6/12/21	20	
22						
23						
24	PLC	120 days	Tue 20/07/21	Mon 3/01/22		
25	Installation of Sort Chiller Sensors	0 days	Thu 30/09/21	Thu 30/09/21		
26	PLC Programming	4 wks	Tue 20/07/21	Mon 16/08/21	8	
27	Program Testing	2 wks	Thu 30/09/21	Wed 13/10/21	25,26	
28	System Commisioning	4 wks	Tue 7/12/21	Mon 3/01/22	27,21	
29						
30						
31						
32	RFID	90 days	Tue 22/06/21	Mon 25/10/21		
33	RFID Tag Ordering	2 wks	Tue 22/06/21	Mon 5/07/21	2	
34	RFID Installation	3 wks	Tue 6/07/21	Mon 26/07/21	33	
35	Testing Equipment Ordering	3 wks	Tue 22/06/21	Mon 12/07/21	2	
36	Testing Equipment Installation	1 wk	Tue 13/07/21	Mon 19/07/21	35	
37	Testing Equipment Commisioning	1 wk	Tue 27/07/21	Mon 2/08/21	36,34	
38	RFID / Reader Validation	3 wks	Tue 3/08/21	Mon 23/08/21	37	
39	Main Equipment Ordering	6 wks	Tue 24/08/21	Mon 4/10/21	38	
40	Main Equipment Installation	2 wks	Tue 5/10/21	Mon 18/10/21	39	
41	Main Equipment Commissioning	1 wk	Tue 19/10/21	Mon 25/10/21	40	

Figure 12: Project schedule planning with various project stages

5.0 Project Outcomes

Reduction in production errors

The elimination of errors where the wrong carcase type is pushed into the boning room causing a potential downgrade of all production from that carcase. Completed. Over the course of a year, we expect this return to equate to a minimum of $51k, this is based on mixing one of our higher grades of Wagyu into a lower grade of Wagyu as they had all been identified as Wagyu and not by marble score rail allocation prior to this project. This project has allowed us to “regrade” carcasses post chill into a “subgrade” such as marble score identification. As these bodies are all chilled in one chiller, sorting them into the boning room based on marble score prior to this project was difficult and had little traceability of optimised grading or validated boning runs.

Improved efficiencies and increased productivity

Visibility of stock by final grade to assist with production planning.

All carcase inventory and boning runs, now have complete system visibility via Emydex carcase inventory reports based on kill destination and DCU regrade reports. Prior to this project, the planners and boning team had to wait until grading was completed and a spreadsheet filled in by the grader that showed inventory per grade and Emydex was updated from this. Now we can see as live data, and with minimal human error from data entry faults.

Improved traceability throughout the process via the RFID gambrel and body/side association, as the RFID is updated with real time data from kill, grade, chill grade and entry into the boning room.

Additionally, we have increased capacity to hold bodies throughout the day, and have eliminated the bottle neck of kill infeed (75/hr) vs boning outfeed (35/hr) as detailed below:

	Pre-Sort Chiller Implementation	**Post Sort Chiller Implementation**
Chiller Capacity	1499 sides	+ 437 sides
Infeed to Chillers	2.5 sides/minute 150 sides/hr	4 sides/minute 240 sides/hr

A positive cost benefit and ROI analysis

ROI		
		Weekly
Total Spend on the project	$ 1,315,683	
Cost Saving on Chiller Operators	-	19% cost reduction
Error reduction Saving	-	5% cost reduction
ROI (Tot/Weekly Saving)		177

The sortation chiller utilises minimal additional energy to what a normal chiller requires. As the chiller is only maintaining carcase temperatures, not bringing carcases to below CCP, but is larger, it has similar energy consumption to existing chillers. Therefore increased costs as a result of energy consumption from the sortation chiller has been minimal.

Reduction in required labour units

As a result of the sort chiller installation we can reduce units of labour by 4 employees, equating to $335k per annum. Projected to reduce further one once we get automatic RFID carcase registration into the boning room (cold weight scanning). The infeed into the sort chiller alone, as opposed to chiller operators manually pushing sides, reduces labour cost by 19% per week by reducing sort and load times for the boning room intake.

Improved health and safety for the chiller workers.

Chiller operators have reported less injuries and less strains with the utilisation of the sort chiller, although difficult to quantify. By reducing the manual labour, and physical contact with carcasses we expect to see a reduction in soft tissue injuries and dropped carcase incidents. Thus far a reduction in reported muscular discomfort, sprains and strains has been observed over a 3 month period.

The Chiller operators were quick to learn the functionality of the Sortation Chiller due to the simplicity of rail grade allocation and automated controls. The Chiller Team was proactive in responding to changes to the Boning room plan and updating the sortation plan swiftly to accommodate changes to infeed animal types.

With the reduction in manual handling of carcases when pushing into the sortation chiller, the risk of dropped carcases has been significantly reduced. Though some cases or dropped carcases did occur during commissioning and teething issues, no operators have been at risk thanks to no need for manual pushing/pulling.

Refrigeration

As this is not a carcase chiller for pulling down the temperature of the bodies, we haven't tested how long the chiller takes to bring down the carcase temperature under the CCP. The sort chiller has been maintaining the return air temperature set point of 7 degrees while operating and hasn’t seen much variation in the temperature depending on the amount of bodies in it. The refrigeration was designed to have the capacity to pull down the temperature of the bodies like a normal carcase chiller, so that in future if we wanted to use it as a normal chiller the refrigeration can handle it.

Trials and Troubleshooting

Problem: Excessive loading on the stacker causes jolting/incomplete pushing and pulling action

Figure 13: Annotated Infeed rail with Congestion of skids around the rail incline

The entry point of the stacker is positioned on an incline requiring additional mechanical force to move the skids. Having too many skids at the entry point places substantial stress on the stacker as a greater overall force is required to move the skid both vertically and horizontally, as opposed to just horizontally. Consequently, the stacker jolts when the required force is greater than what it can provide and potentially is unable to complete a full push motion, followed by throwing a system fault.

Solution: Having the Chiller operators limit the number of skids that enter the stacker entry point has vastly improved the performance of the stacker and allowed for a seamless push and pull motion. In addition, increasing the air pressure on the stacker has increased the stacker's pushing capabilities.

Problem: Different skid movement behaviours observed

All skids pushed along the stacker are expected to stop between each pusher after every stacker push/pull action. Only one skid must enter the infeed carousel as both the PLC and Emydex systems are designed to only process one skid at a time.

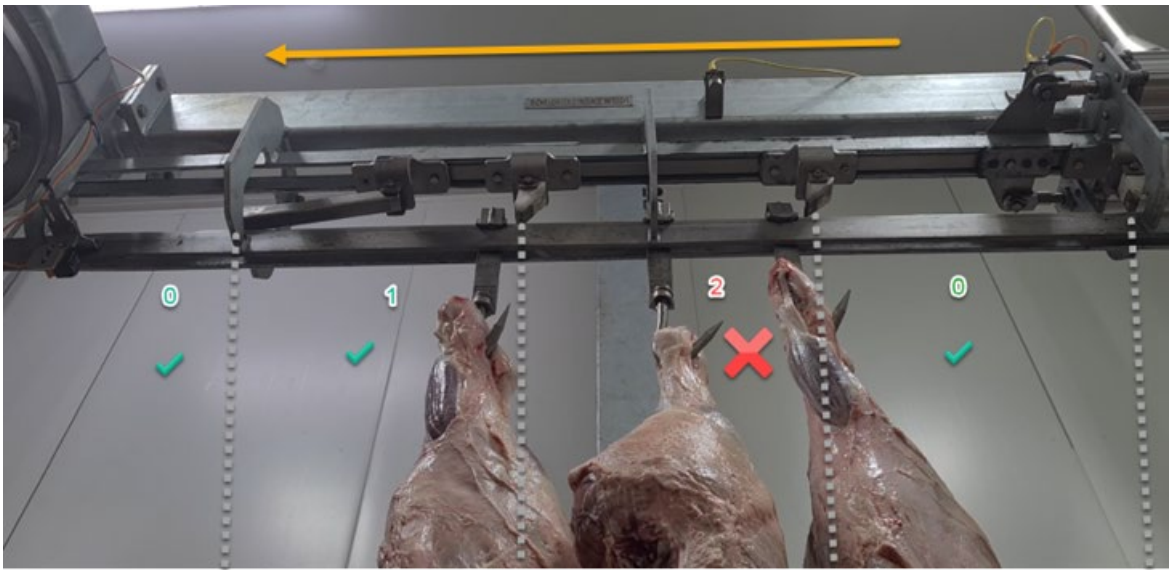


Figure 14: Annotated Infeed Rail showing the expected skid positions along the rail

Multiple skids at the infeed carousel per index will cause the successive skid to not get sorted and potentially get dropped due to early premature triggering of the Sort Rail ‘Open and Close gate’ function.

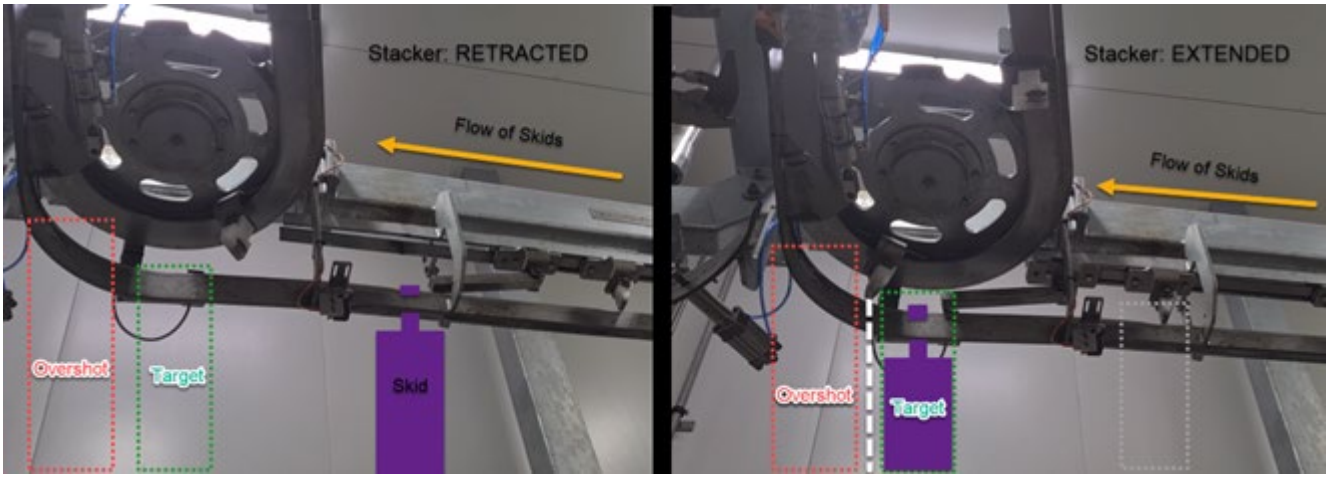


Figure 15: Annotated demonstration of the Infeed Rail stacker retract (left) and extend (right) motion when pushing skids

Having the skids positioned in the expected/target location allows the skids to be moved again in sequence and prevents skids from amassing, over-advancing or becoming stuck. Factors such as hook wear, skid weight, and stacker pushing force have the potential for pushed skids to over or undershoot the skids' intended advanced location.

Solution: Small grooves have been installed along the rail to ensure the skids fall into the expected location, greatly improving the flow of skids along the stacker by ensuring all passing skids fall into their intended location for every stacker push/pull action. As a failsafe, logic has been incorporated into the PLC system to identify multiple sensor readings, allowing the Chiller operator to re-sequence the skids before entering the infeed carousel.

Figure 16: Annotated Infeed rail showing the grooves in the rail to better secure the skid when moving along the rail.

Problem: Rail Entry Points failed to detect passing skid

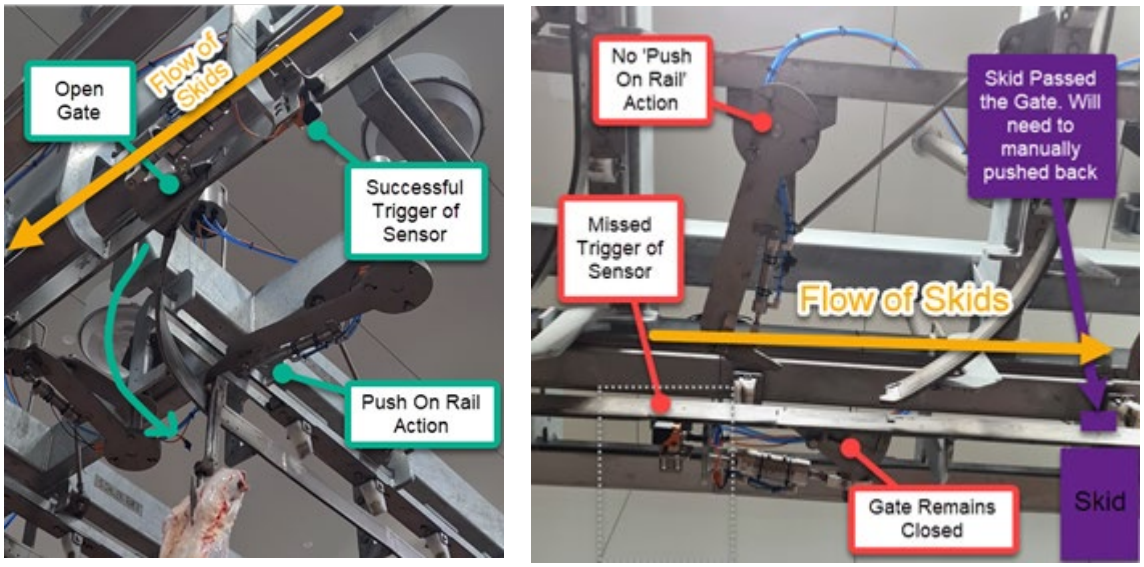


Figure 17: Annotated outcomes of Successful (Left) and Unsuccessful (Right) triggering of the Rail Gate

The rail gates will trigger a mechanical 'rail sweep' operation when a skid has arrived at the intended gate destination within the allocated sequence index and time frame. The proximity sensor must detect the passing skid as a pre-requisite before the 'push on rail' functionality can be enacted. Failure to detect the passing hook will cause the skid to miss the gate and trigger a timeout fail, subsequently, requiring the Sortation Chiller operator to move the skid back and then manually trigger the sweep operation.

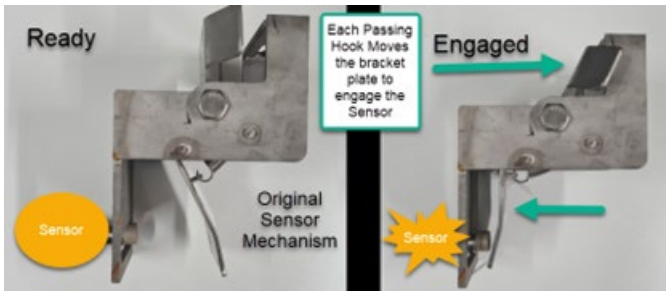


Figure 18: Original Gate Detection Sensor for detecting the passing skid.

Figure 19: Revised Gate Detection Sensor for detecting the passing skid

Through testing, it was discovered that the original sensor mechanism had a high failure rate as it relies on the passing hook to push against the proximity bracket to trigger the proximity sensor. Over time the bracket effectiveness deteriorates due to the material warping from the constant movement.

Solution: Upgrading the Proximity Sensors to an inductive cube with a larger detection surface area as well as positioning it underneath the rail eliminated the reliance on the proximity bracket in the sensing process. Ultimately, allowed the hooks to be better detected the hooks without being subjected to wear and tear.

Cleaning and maintenance

The sort chiller is easy to clean, fitting in with our usual schedule of daily foaming, hosing and sanitising. There is a satellite station set up in the sort chiller which delivers hot water, foam and sanitiser minimising cartage of chemicals and hoses through this area.

The sort chiller is not maintenance heavy with general planned and preventative maintenance, including lubrication of chains, maintenance of points and working capacity of gates, fitting in with our usual schedule of works.

Project Schedule

Due to delays during the Covid-19 period, the project overall was delayed by 18months.

In November 2023 one of our carcase chillers went offline and reduced available carcase chiller space. After only a few months in full operation as an automated sortation chiller it had to be put back into manual mode to accommodate more bodies in the Sort chiller. We are planning to put the sort chiller back in Auto mode as soon as we get the carcase chiller is back online.

Future pieces of work

Automation of carcase into each chiller based on the RFID tag

This was part of the preliminary scope and some basic design were done but was removed from the project scope and the focus was to get the RFID working in the Sort chiller. Currently this has not been prioritised as we are busy with a few other projects. But something we would come back to in future.

Better yield measurement and traceability of cuts in the boning room on each body using RFID tag and AI camera technology

This was briefly part of the initial project aspiration but didn't go any further as the technology needed was still in its infancy. Harvey Beef will continue to watch this space and may implement objective measurement technology in the future.

6.0 Conclusions / Recommendations

Budget forecasts, actual costs, services, and material availability have been greatly affected over the last two years throughout the Covid-19 Pandemic and labour shortages, this has been at the forefront of the variation request submitted to AMPC in the month of June 2023. The entire project was delayed by 18months.

Despite the setbacks, we have already observed a great benefit of having the additional rails and configuration of the sort chiller, even whilst running manually, allowing the employees in the chillers to make decisions on where best placement of the sides should be to facilitate a smooth boning run with minimal mix ups or movement of bodies.

The Boning Room and Chiller Manager made the following comments. The addition of the sortation chiller has been a great asset to production and the chillers, with additional holding capacity. The ability to load rails utilising automation has made a significant difference in the manual labour required and the risk of dropped carcases due to human error has been reduced. The outfeed is yet to be fully tested but the option to utilise automation to load carcases into the boning room, removing manual handling, would further drop labour requirements. Initially the infeed syncing issues when loading the chiller caused some disruption, but this was resolved when a provider came on site to modify the infeed rail (as discussed in section 5) which then made loading a lot smoother. The ability to saw ribs and feather

bones can no longer be done in the sortation chiller with automation due to carcase spacing and movement, meaning these tasks have been moved to the boning room or prior to entry into the sortation chiller. The control panel into the sortation chiller does not allow visualisation of outfeeds when changes are made. These challenges and solutions are still being worked on.

In short, this project has been difficult to get to end state, with multiple vendors, labour shortages and materials shortages due to Covid-19. However, seeing the ease of sorting our many grades and breeds, even in a prior to full automation has been beneficial with great feedback from employees.

Having a comprehensive use case for all unexpected behaviour will ensure that the Chiller operators have a clear directive for overcoming any challenges to limit downtime and sorting complications. Moreover, having the system detect, log and report as many abnormal behaviours is highly advantageous in improving the operators' proficiency with the system.

For processors investigating opportunities for implementation of an automated sortation chiller consider the following. How complex are your sorting needs? Do you need to be sorting multiple carcase types/categories/weight ranges prior to entry into the boning room.

Simple Marshalling Area: this would be enough for processors who don't have many cattle types or grades and require minimal sorting before sending carcases into the boning room and full automation may not be necessary, just some automation in push/pull to reduce manual handling

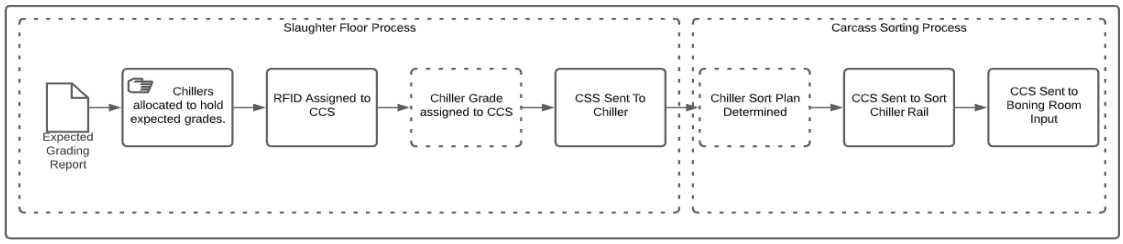
Automated Sortation Chiller: recommended for processors that need to sort a lot of cattle based on various factors, prior to entry into the boning room and don't have the capability to slightly sort straight from the slaughter floor into chillers, either due to lack of chiller space or smaller lot numbers affecting kill order of each cattle grade being processed.

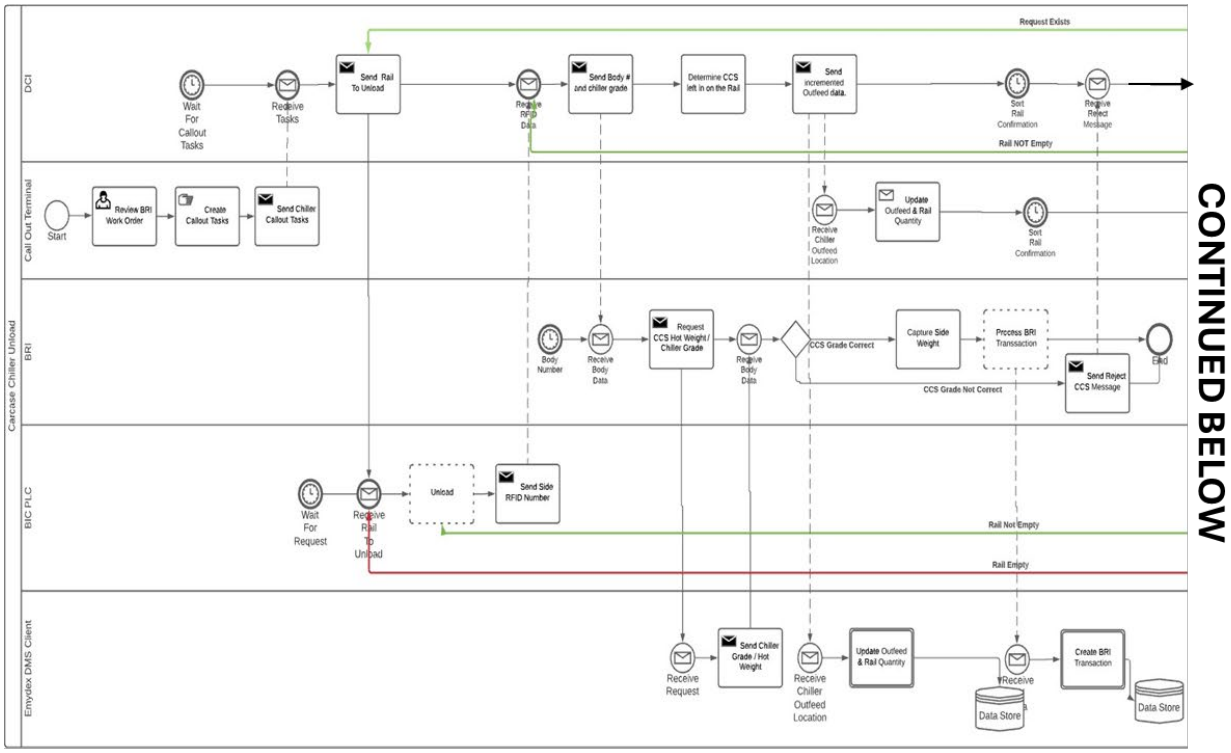
Benefits of the sortation chiller as identified in this report include improved efficiency with automation saving time and labour compared to manual, increased accuracy reducing the chance of human error in sorting cattle, better organisation allowing for precise sorting based on pre-defined criteria and ability to meet production demands and schedules, ability to target niche customer orders by weight ranging bodies and sorting with minimal human assumptions, potential to reduce injuries through manual labour reduction and risk of dropped carcases, potential to optimise yield and traceability due to sorting into efficient boning runs and not just on chiller grade of chiller capacity.

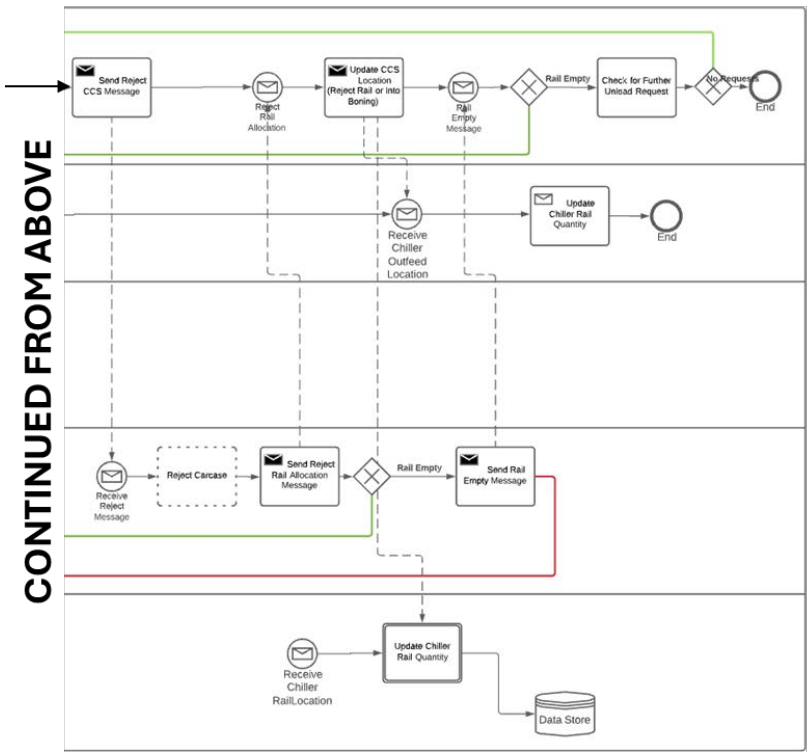
Only limited data was able to be provided and that the data provided was only from a short period of operation, giving limited representation of performance of the system due to operational constrains and the requirement for increased chiller capacity for a period of time

7.0 Appendices

Appendix 1 – System Mapping







Appendix 2 – Glossary

Term	Description
BRI.	Boning Room Input, an industrial computer running the Emydex MDA software use to scan and weigh carcasses immediately before they enter the boning room.
Call out request.	An instruction to the DCI or operator to unload a rail.
Chiller.	A temperature-controlled room used to store carcasses.
Chiller Grade.	A carcase grade applied to a beef carcase in the beef chiller. It is defaulted from the slaughter floor grade and be changed using a handheld barcode scanning unit which is connected to the Emydex back-office client.
Chiller Weight.	The weight which is recorded immediately after the decontamination chamber and post trimming. It is in addition to the HSCW.
CCP.	Critical Control Point. In this instance referring to the requirement for carcases to be chilled to a surface temperature of less than 7◦C within 24hrs of slaughter.
DCI.	Data Communications Interface, an Emydex module that integrates PLC control equipment with the Emydex MES. It will be used to instruct the PLC to direct carcasses to the correct rails based on rules defined in the Emydex back-office client system.
DCU.	The handheld portable data entry unit or ‘scanner’ used by the MSA grader in the carcase chillers to record the meat quality attributes of the carcase.
Emydex.	The supplier of the current MES.
Gambrel.	A stick or iron for suspending slaughtered animals, also known as skid or hook.
HSCW.	Hot Standard Carcase Weight, recorded at the grader and used to determine the carcase destination which in turn determines the chiller grade.
MES.	Manufacturing Executions System, software used to manage production processes.
MSA.	Meat Standards Australia, an organisation that has developed and manages carcase grading criteria that can predict eating quality.
MSA Grading.	The classification of carcasses into a particular MSA grade based on carcase characteristics that can only be measured after the carcase has been in the chiller for a certain amount of time.
NLIS.	National Livestock Identification System. Australia’s system of livestock identification and traceability for cattle, sheep and goats. All livestock are identified using a visual or electronic ear tag/device.
PLC.	Programmable Logic Controller.

Prox Sensor.	Proximity sensor, a device on the rail that can detect that a carcase (side) has passed that point. It is used to identify that a carcase is at a specific point but can not identify the RFID or carcase information. The PLC can therefore identify that a carcase is at a position and if an associated RFID has been read.
Rail.	A physical length of steel suspended from the ceiling of a chiller upon which carcasses can be stored.
RFID.	Radiofrequency identification, denoting technologies that use radio waves to identify people or objects carrying encoded microchips.