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Final report

Coles RROA Insights and Innovation Manager: High Value Meats Strategy

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Abstract

Coles RROA and MLA Donor Company (MDC) have agreed to progress a Collaborative (Value-adding) Co-innovation Program over a second three-year period commencing in 2021 and concluding in 2024. The program is designed to support the development and implementation of Coles RROA's red meat high value growth strategies in both the domestic and global markets to be achieved via a range of innovative products, packaging, processes and new business model concepts. It is noted that in addition to the development of new high value products to meet customer demand, the program will extend more broadly into the Coles RROA's business activities where opportunities to innovate red meat markets are identified.

The Collaborative Value-adding Co-Innovation Program will be overseen by a joint Coles / RROA / MLA Steering Group and implementation will be managed by a team comprised of RROA, MLA and external resources as required. This project provided support for a full-time (i.e 1 FTE) RROA Co-Innovation Manager for an initial period of three years with the option to extend to a second three-year term exercised, based on overall progress of the program and projects. As the program strategy evolved specific R&D projects were developed, and additional resources to support these projects were considered as required. Each individual R&D project was contracted via a separate schedule to be attached to the Collaborative Head Agreement.

Executive summary

Background

Retail Ready Operations Australia Pty Ltd (Coles RROA) have agreed to commence a new Collaborative Innovation program with MLA over a three-year period commencing 01 Sep 2021.

This agreement will support an Innovation Program Manager to implement the Coles RROA collaborative innovation strategy. This Innovation strategy aligns with MLA's strategic priorities. Coles RROA state that their previous Co-Innovation program contributed to a 59% increase in volume, a 65% increase in value and 133 new red meat product launches through their plant over a 3-year period.

MLA and Coles RROA have agreed on the following four project pillars.

1. Supply Chain Efficiency & Sector Opportunities
2. Operational Excellence
3. Product Innovation
4. Digital Solutions

The Coles RROA collaborative innovation strategy on a page is provided in Appendix 2. Specific projects in each of the pillars were reviewed and agreed to at a joint Coles RROA / MLA workshop and were further developed into actionable projects by a Steering Group during Milestone 1. They are aligned to MLA's strategic priorities and the Coles RROA overall business strategy and included measurable performance indicators which identify the contribution of the initiatives undertaken in this agreement to the bottom line and benefits the program deliverables to both Coles RROA and the Australian red meat industry.

The timeframe for development and implementation of the Collaborative Innovation program is 3-years. During the 3-year period, a range of activities are planned including, but not limited to;

- Documenting clear objectives for initiatives in each of the strategic pillars;
- Setting quantifiable performance targets for initiatives in each of the project pillars, including the development of baselines and measurement systems to monitor progress;
- Development of an innovation skills and resources plan to build capability to effectively implement the program strategies;
- Implementing initiatives to support the cultural changes required to deliver against innovation objectives.
- Development of brand, marketing and supply chain differentiation options to capture value.
- Agreement and implementation of a communication plan (created in collaboration with MLA's Communications Team) to extend learning from this program to broader industry and MLA members.
- As the program evolves it is anticipated that specific R&D projects will be developed, and additional resources to support these projects will be considered on an as needed basis. R&D projects will be contracted individually, however each will refer to the Collaborative Head Agreement between MLA and Coles RROA.

Program Management:

The Collaborative Co-Innovation program and Innovation Manager will be jointly managed by Coles RROA and MLA as follows:

A joint Steering Group will oversee the program and Innovation Manager and will sign-off annual plans and annual go/no go reviews. It is anticipated that the Steering Group for the Innovation Manager will be comprised of:

• Coles RROA – Patrick Youil and Suvir Salins

• MLA – Program Manager – Innovation Capability and Relationship Manager Value Chain V.1 112020 Page 6 of 34 The development and implementation of the broader Co-Innovation strategy will be undertaken by a joint project team comprised of:

- Coles RROA – Supply Chain and Transition Manager, Patrick Youil
- Coles RROA – Innovation Manager, Suvir Salins (supported equivalent to 1 FTE) – to be supported as part of the project;
- MLA – Relationship Manager Value Chain
- MLA – Program Manager – Innovation Capability
- MLA – Program Manager – Objective Measurement
- MLA - Group Manager - Science and Innovation
- MLA – Program Manager – Supply Chain Technology Innovation
- MLA – Project Manager – Objective Measurement & Supply Chain Innovation.

Objectives

Implement the innovation strategy as agreed under the following key project pillars:

- Supply Chain Efficiency & Sector Opportunities
- Operational Excellence
- Product Innovation
- Digital Solutions

The Co-Innovation program impact will be measured by the contribution of innovation initiatives to the following triple bottom line indicators;

Financial - Return on Investment (ROI) comprised of;

- % of sales attributed to new products developed as part of the innovation program,
- increased volume of red meat sold by the business attributed to the innovation program, and / or,
- increased value of red meat sold by the business over the three years of the program,

Social - Demonstrated evidence that the program investments have accelerated innovation adoption within the participants enterprises and value chains, including;

- Quantifiable improvements in innovation and project management capability over three years,
  - Change in the time it takes new products to get to market,
  - % of innovation concepts that are successfully adopted / launched,
- Co-Innovation Manager completes MLA's capability development program.

- **Environmental** - Improvements in environmental sustainability attributed to the program. The number of new sustainability initiatives undertaken or the inclusion of sustainability considerations in projects undertaken as part of the agreement (as agreed).

As well as a measure of the Co-Innovation program's contribution to the following;

- Any increase in the number of new markets or channels supplied by the business,
- Enhancements to brand strategy and or positioning that positively impact brand equity,
- Efficient project delivery in accordance with budgets and timelines,
- Quality of reports
- Contribution to Insights to Innovation events and network meetings
- Reports and project communication outcomes submitted to MLA in accordance with MLA's style guide and report guidelines (available at http://www.mla.com.au/researchertools);

Industry Benefit

As a result of MLA's support for this program, the following broader industry benefits will be achieved:

- Generic tools and approaches to building enterprise and supply chain innovation capability and achieving innovation outcomes that will be disseminated to the broader industry as agreed;
- Better understanding of the critical issues impacting on the competitiveness of the industry that will be extended more broadly to other enterprises within the industry as agreed;
- New technologies and new scientific knowledge (arising from projects within the Collaborative Co Innovation program) which will be commercialised and/or disseminated for the benefit of the broader industry as agreed.

Methodology

The primary focus of the Innovation Manager (IM) is to implement the Innovation Strategy developed by the Steering Group. The major activities to be undertaken by the IM will include:

- Provide leadership and ownership of the Innovation Strategy across the following key project pillars, which includes the Coles focus on Sustainability:
- Supply Chain Efficiency & Sector Opportunities
- Operational Excellence
- Product Innovation
- Digital Solutions
- Sustainability

- Be the interface between the innovation strategy and the core business strategy to provide foresight regarding implementation, validating and commercialisation of specific initiatives in order to identify and capture competitive advantage from the project.
- Participate in innovation skills development activities as agreed with the Steering Group;

- Develop and build personal and business capability needs as required (skills, resources, infrastructure, supply, technology),
- Assist in developing and monitoring project performance benchmarks and KPI indicators and other measures of impact as agreed with the Steering Group;

Ensure the scope of the innovation strategy extends to producers and suppliers to drive maximum company and value chain benefit;

- Develop and implement agreed innovation projects and coordinate site project teams as required under the project pillars during the 3 year project period;
- In collaboration with MLA, determine appropriate funding mechanisms for agreed projects;
- Manage and monitor expenditure and track benefits generated from project activities;
- Manage relationships with research partners, research providers, equipment suppliers, and other external parties as appropriate;
- In partnership with the Steering Group identify data governance, capture, linkage, enrichment, storage, analysis and security processes required to implement the innovation strategy;
- Develop and/or evaluate innovation tools for facilitation of the program;
- Prepare quarterly and final project reports (templates provided by MLA);
- Develop and implement a communication plan in collaboration with MLA's Communications Team, as agreed by the Steering Committee;
- Present findings to internal and external parties as agreed by the Steering Committee;
- Participate and/or facilitate in independent cost benefit analyses as required to underpin decision making regarding investment in innovation projects and programs.

Results/key findings

Uplift of 180T red meat volumes through the 2021 to 2024 reporting period, which represents a 47% uplift.

There were 158 new red meat product launches through the plant over the 3-year reporting period.

The Co-Innovation program supported 89 new initiatives across the five strategy pillars.

Five new MLA funded projects were developed from Co-Innovation pilot programs or proof of concepts in this 3 year period.

Additionally the Co-Innovation Program contributed to Coles achieving the following Sustainability targets over the 3 year reporting period.

- 87.4% recyclable packaging
- 45% renewable electricity sources
- 36% emissions reductions
- 86.7% of solid waste diverted from landfill.

Benefits to industry

Key benefits have been shared through this and previous reports across the Supply Chain & Sector, Operational Excellence, Product Innovation and Digital Solutions pillars including Sustainability benefits associated with new materials, technologies or processes. These reports have detailed new technologies or processes the industry can employ to achieve similar results.

Future research and recommendations

Coles is committed to furthering the financial, social and environmental benefits achieved through our partnership with Meat & Livestock Australia. As such, many of the initiatives begun in each of the pillars will continue to be developed, with some generating projects in their own right.

Most notably, but not limited to, the following initiatives will be further researched:

- RFID embedded finished goods labels for track, trace, inventory transparency with the view of ultimately lifting on farm sales of red meat.
- Benefits of Artificial Intelligence in Production, Planning, Quality and other departments, particularly machine vision applications.

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1. Background

Coles RROA and Meat & Livestock Australia agreed to progress a Collaborative (Value-adding) Co-innovation Program Phase 2 over a three year period commencing in October 2021. The program was designed to support the development and implementation of Coles RROA's red meat high value growth strategies in both the domestic and global markets to be achieved via a range of innovative products, packaging, processes and new business model concepts.

2. Objectives

The specific focus of the program targetted a range of new product and business growth activities across the 5 pillars of Operational Excellence, Digital Solutions, Supply Chain and Sector Opportunities, Product Innovation and Sustainability.

The Collaborative Value-adding Co-Innovation Program was overseen by a joint Coles RROA / MLA Steering Group and implemented by a team comprised of Coles RROA, MLA and external resources as required.

The project provided support for a full-time (i.e. 1 FTE) Coles RROA Co-Innovation Manager for a period of three years beyond the initial three-year term already completed.

The program strategy was developed by a joint team of Coles RROA and MLA team members that focused on the 5 pillars of aligned strategy goals and resulted in several key R&D projects being approved for development. Each individual R&D project was contracted via a separate schedule and attached to the Collaborative Head Agreement.

The program aimed to achieve financial, social and environmental benefits to Coles and the wider red meat industry.

The program was very successful in meeting these aims with the following notable achievements.

Uplift of 180T red meat volumes through the 2021 to 2024 reporting period, which represents a 47% uplift.

There were 158 new red meat product launches through the plant over the 3-year reporting period.

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Additionally the Co-Innovation Program contributed to Coles achieving the following Sustainability targets over the 3 year reporting period.

- 87.4% recyclable packaging
- 45% renewable electricity sources
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- 86.7% of solid waste diverted from landfill.

3. Methodology

To achieve the program's goals, the methodology employed by the Co-Innovation Manager was to research various technologies, materials and processes the Coles business was interested in, suppliers or vendors had introduced the manager to, or that the manager had discovered themselves. The research was comprised of desktop reviews, pilot programs, proof of concept systems or trials. This research would be reported in each MLA milestone report to be shared with the red meat industry. If the initial research looked very promising, the Co-Innovation manager would seek funding to progress the research to a full project.

4. Results

The following reports highlight the key results across the 4 project pillars of Operational Excellence, Digital Solutions, Supply Chain and Product Innovation and the Coles pillar of Sustainability.

A summary of the main projects completed are shown, followed by details of the key projects, their outcomes and lessons learnt.

4.1 Operational Excellence

The pillar of Operational Excellence focuses on such items as Automation, Production metrics and Lean implementation among other things.

A summary of the main projects completed are as follows.

- Exoskeletons
- Pathogen reduction/shelf-life extension
- Shelf-life extension fridges and freezers
- HVAC mould reduction
- Packaging decontamination
- Production line enhanced cleaning
- Robotics cobot meat pick and place
- Robotics cobot ready meals pick and place
- Vacuum head enhancements for meat pack pick and place
- Boston Dynamics robotic Spot the dog for security walks and roof space equipment thermal/acoustic inspections
- iCrust Cobot primal loading
- Waterjet Xray vision and 3D robotic cutting paths
- Waterjet servo electric pump upgrade
- Waterjet robotic cutting path experiments to optimise cutting performance
- Waterjet portion orientation by robotic pick and place
- TVI1600 portioning upgrade for fixed weight portioning
- Slicer optimisations
- Line downtime handling optimisations for maximum OEE
- End of line optimisations for maximum OEE
- New label design with intermittent glue lines for reduced labeller jams

- Upgrade investigations for plastic detection AI Vision system
- Microwave plastic detection system research collaboration
- Deep Learning Vision for label and meat inspections
- Corned beef production automation upgrade design
- MAP gas optimisation research
- Optimisation research for Liquid Nitrogen cooling nozzles
- Seal integrity via gas analysis research

4.1.1 Exoskeletons

Proposal

- Address manual handling issues associated with repetitive handling of meat cartons
- Trial use of new exoskeletons to remove strain points for personnel

Key Benefits

- Injury prevention
- Labour optimisation
- Elimination of cumbersome material handling equipment
- Portability

Project Cost Components

- Exo-skeleton rental and trials
- Project Management
- Justification confirmation
- Project Reporting and recommendations

The Exoskeleton trial was kicked-off with a training workshop at RROA with Safety, Operations, Biosymm and Engineering staff.

Natasha from Biosymm, the physiotherapy company who supply the exoskeleton units, trained the trainer, Keith, Suvir and Stephanie, and they in turn trained operators on the use of the ShoulderX and BackX-S.

ShoulderX Unit for high to mid-height tasks

BackX-S Unit for mid to low lifting tasks

Training on the use of the online portal, to collect operator feedback on the initiation of the trial and then at the conclusion, was provided to track the benefits of the units.

Six operators were involved in the trials based in the Red Meat Production area, with the task of decartoning using the BackX-S.

Some initial feedback of struggle when walking (especially up steps) was experienced by operators, but a quick discussion between Ruth and Natasha of Biosymm, resulted in the decision to turn off the unit when walking, this made the process much more acceptable for the operator.

At the end of the first shift Keith and Natasha had a quick conversation with the operator to get his initial feedback. He was much more comfortable with walking and general use of the exoskeleton but did mention he could feel the extra weight, however over time the operator became conditioned to the unit and did not feel its weight anymore.

With the extra walking distance and the fitting time of the units there is an approximate extra 6mins (12mins per break) per person involved. Each operator used the units for 2-4 hrs per day for the first day, then 6 hrs on the second day and then 8 hrs each day for the remainder of the trial.

The units were trialled for a 4 week period.

Lessons Learnt

The overall feedback was that RROA tasks, in any area of the plant, are not restricted to just the single motions that each device supports. Most tasks require several motions some of which are assisted while other motions are restricted by the devices. Playing with various settings to find a happy medium did not resolve the restrictions. For instance a motion from high to a mid-position was assisted, while another motion from mid to low was restricted. Likewise a motion from low to mid was assisted but walking while carrying the load was restrictive even with the setting that enables walking to be easier. If there were tasks with limited motion required, these devices would be hugely beneficial. RROA remains open to using these devices should tasks with these limited motions which are also very repetitive become apparent in the future.

4.1.2 Pandara's Puradigm Air and Surface Purification Solutions for shelf-life extension, HVAC mould reduction, packaging hygiene and protection of staff health

The project aimed at evaluating a unique ***Advanced Active Photocatalytic Oxidation (PCO)*** technology to reduce &/or ***eliminate airborne and surface pathogens***, including SARS-CoV-2 (novel coronavirus) and its variants, for its potential to ***extend shelf life of food products*** with inclusion of red meat. In addition to reviewing the potential effectiveness of reducing the health risks in the workplace and improved food safety, this project also evaluated specific applications for red meat processing and the process steps for successful

implementation. The expected profitability gains through widespread introduction are likely to be shared up and down the value chain with producers, suppliers and customers.

The PCO phenomena was originally discovered by ***Akira Fujishima***[1] in 1967, the so-called Honda Fujishima effect. This phenomenon was developed into an air purification system by NASA scientists in the 1990s for use on the Space Shuttle and International Space Station. Some of the key patents for this NASA technology were later acquired by ***Puradigm***[2], who in 2011, made a breakthrough that took this passive technology and developed it into an active, safe and scalable technology capable of reaching every corner of an enclosed space***, inactivating pathogens and volatile organic compounds in both the air and on surfaces.***

Real-world evidence as reported by certified labs from several years of use at various hospitals, indoor grow facilities, food processing plants, university, school, office and retail spaces around the world, show high levels of reduction in both airborne and surface microbial loads, are achievable at scale.

The technology has been successfully tested at the ***CSIRO's***[3] ***Australian Centre for Disease Preparedness against SARS-CoV-2, Delta variant*** which showed that the device has an active agent which was able to inactivate the virus on surfaces remote from the device, without elevating ozone above safe or pathogenic levels. The study did not investigate what the active agent is, as this has been investigated through many previous studies which showed it is comprised of water vapour surrounded by a non-thermal plasma (NTP) ie H+ and -O2 ions, basically a ***charged water aerosol***. The ions are naturally produced outdoors and our bodies are adapted to live with them, so it is ***totally safe, yet very effective*** at destroying both bacteria and volatile organic compounds and inactivating viruses of all types. When used continuously, this NTP, doesn't allow pathogens to build up and so doesn't need to be as harsh as general sanitation chemicals such as alcohol or other disinfectants. The most effective implementations are preventative rather than as a remediation method ie ***prevention is better than cure***. However remediation is certainly possible, but just requires longer exposure times, as was shown in the results within this project for heavily contaminated surfaces.

The proposed project brought this air and surface purification technology to Australia for validation in a specific Stage 1 application within red meat processing. The project provided insights and practical knowledge on how this publicly ***available technology can be applied to benefit red meat production operations across the whole value chain***. It is envisaged that this may lead into further research aimed at incorporating the technology into MAP, Utilities, odour control in waste management and increased sanitation in equipment cleaning applications to provide additional microbial reduction with associated cost savings and efficiency gains.

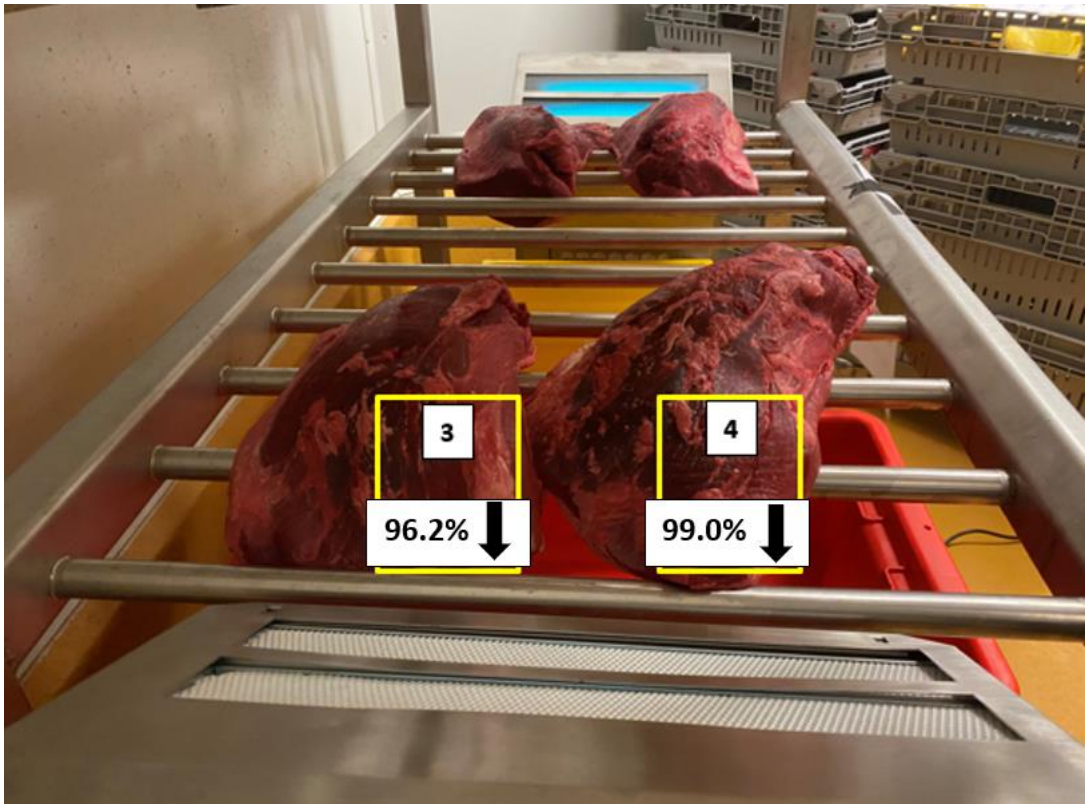
The project scope included three separate trials. The areas of investigation focused on shelf-life extension, mould reduction in the HVAC system and packaging disinfection. The trials were conducted across both the RRROA and Chef Fresh sites.

1. Akira Fujishima - Akira Fujishima - Wikipedia
2. Puradigm is a US-based company (www.puradigm.com) with local Australian distributor Pandara (https://pandara.life)
3. *"Performance testing of Active PCO technology for SARS-CoV-2 inactivation on surfaces", CSIRO.* Only available in full with permission by Coles Group Limited. The study aimed to confirm the existing study reports and enable internal Coles evaluation of the technology, and should not be deemed as an endorsement of the technology by the CSIRO.

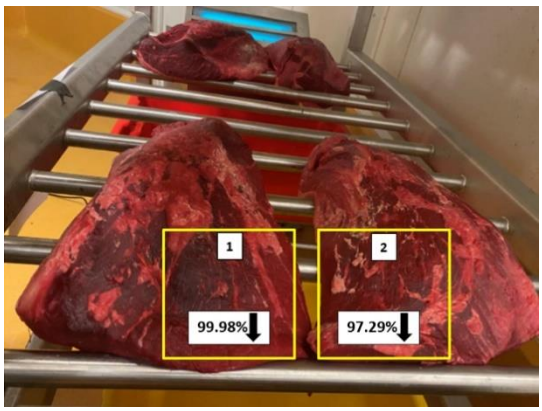
Results/key findings

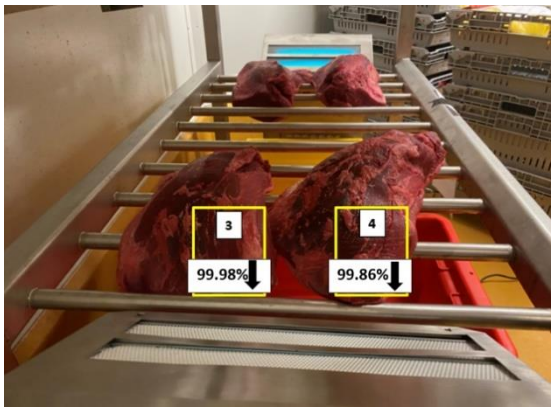
Microbiological Reductions on Primal Surfaces for various exposure times

24hr Exposures – 99% / 2 Log Reductions (35 day aged primals / Extremely high count)



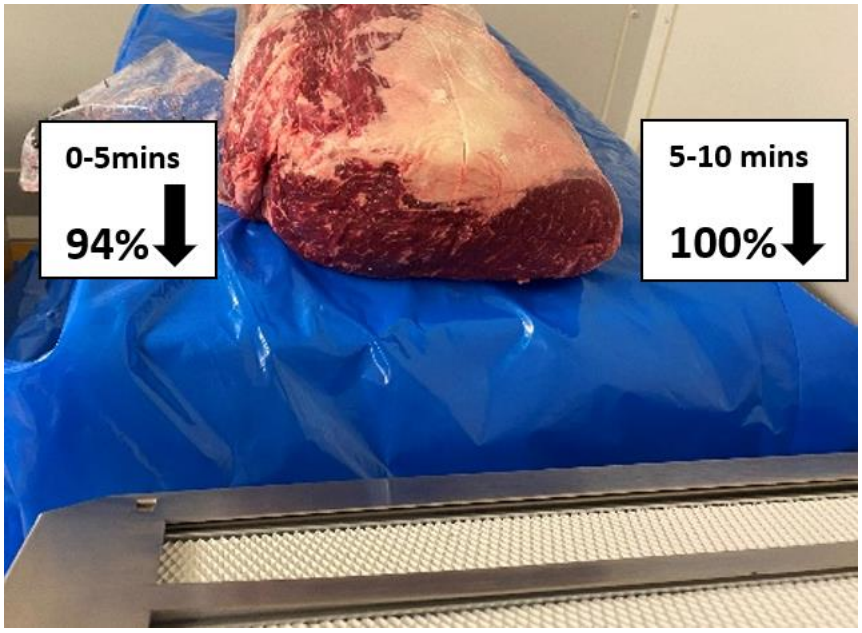
>24hr Exposures – 99.99% / 4 Log Reductions (35 day aged primals / Extremely high count)





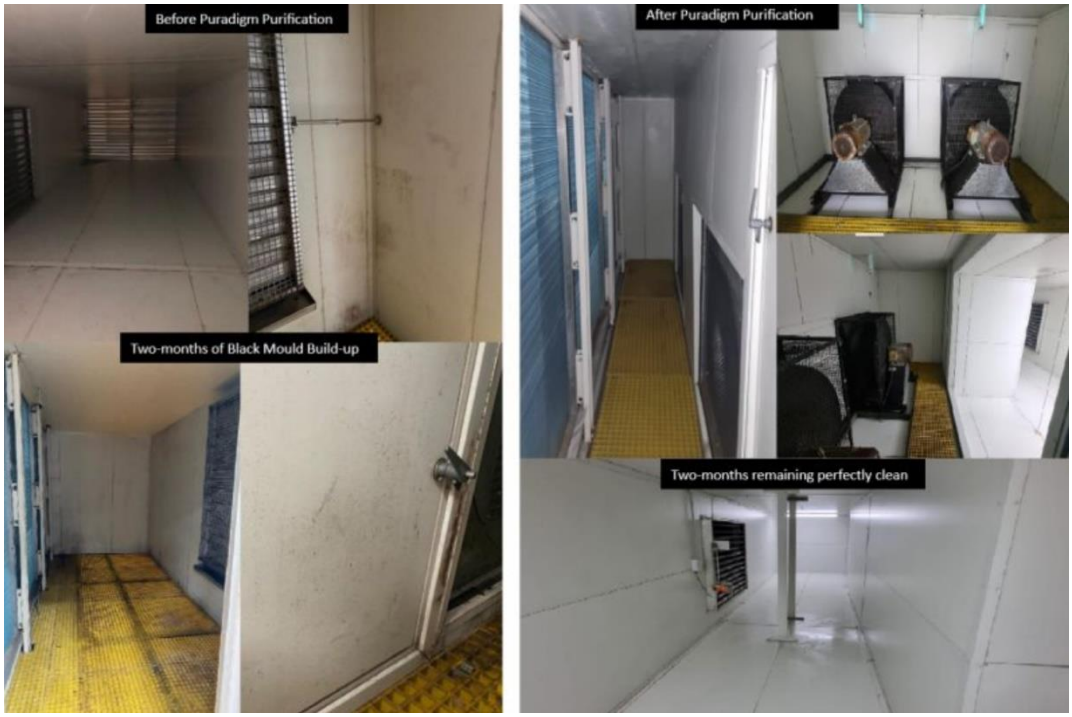
5 min Exposures – 90% / 1 Log Reductions (Fresh primals 10 day aged / Low count)

10 min Exposures – 100% / >8 Log Reductions (Fresh primals 10 day aged / Low count)



Microbiological Reductions on HVAC Air Handling Unit (AHU) Surfaces

Black mould is one of the most difficult microbiological pathogens to remove from air and surfaces. ***Puradigm was able to keep the HVAC's AHU surfaces clean well beyond the usual 2 month cleaning period***. It should be noted these surfaces experience high humidity every night but this posed no issue for the Puradigm charged water aerosols. The air is being circulated during the day at very ***high flow rates of 20 m^3/s*** per AHU. Every evening the plant is cleaned which produces large quantities of steam (***100% humidity***) and the AHU air flow rates are lowered to around 5 m^3/s and ventilated to atmosphere. In this way the AHUs are subjected to some extreme conditions which are ***more severe than seasonal humidity changes***.



Microbiological Reductions on Packaging Surfaces covered in Water

High concentration of staphylococcus submerged in water – no reductions

Large quantities of water will block the effect of Puradigm's charged water aerosols. However, as can be seen in the HVAC AHU trial, damp or dry surfaces experience significant and rapid reductions.

The Chef Fresh facility's packaging decontamination has two rooms, one with raw product packaging which is very wet and the other with dry packaging material. Puradigm is only suitable for the dry packaging material room, while alternate decontamination technology, is required for the heavily wet packaging material surfaces.

Benefits to industry

These trials confirm the effectiveness of Puradigm's air and surface purification technology within various red meat industry environments and detail the implementation considerations which are specific to this industry. ***The following benefits are based on global research findings as well as those carried out in this project.***

The benefits for the red meat industry are:

- Primary processors - ***Carcase surface purification*** over short or long exposure times – reduced reliance on chemical washes or DNA damaging interventions such as UV. ***Enhanced shelf-life of products.***
- Primary & Secondary processors - ***Primal surface purification*** over short exposures prior and during portioning. ***Enhanced shelf-life of products***.
- Primary & Secondary processors – ***Cleaning of Air Handling Units***, ***refrigeration coils*** and surfaces, 24/7 cleaning, ***reducing chemical clean frequency, usage and cost***
- Primary, Secondary and Supermarkets - reducing air borne & surface pathogens including ***SARS-CoV-2, cold, influenza, norovirus and other bacteria and viruses*** and thereby keeping staff & customers safe, ***reducing absenteeism*** and enhancing the well-being of people, plants and animals.
- Primary & Secondary processors – ***Purification of external packaging surfaces*** prior to opening within high risk production areas.

- Primary & Secondary processors – Purification of production surfaces between chemical cleaning periods, ***to minimise the risk of outbreaks such as listeria***, and ***enhance shelf-life*** of products.
- Supermarket – ***Reduce surface pathogens in deli and fresh produce aisles*** to ***enhance shelf-life*** of products
- Puradigm is over ***2400x faster than HEPA alone purification***, as the air is not required to pass through the Puradigm device, but instead every part of the volume of an indoor space is filled with the ***natural charged water aerosols***, deactivating pathogens in seconds rather than 40 mins or more.
- ***Safer and more effective than UV*** which requires slow air flow and close proximity, and requires the air to be brought to the device. UV can also be blocked by shadowing and damages the DNA of products thereby changing its taste and texture.
- ***Puradigm is safe for continuous operation in occupied spaces*** keeping people and products protected at all times, never allowing pathogens to build up to unsafe levels which would then require harsh chemical interventions.

Future research and recommendations

Further research aimed at incorporating the technology into ***MAP packaging***, ***odour control*** in waste management, ***minimise offensive odours such as those from fish, equipment cleaning***, transportation of ***fresh produce***, ***transportation sanitation*** for ***mould control***, and ***combined applications with Denba*** to provide additional microbial reductions/control ***for enhanced shelf-life of products***, reduced energy consumption for frozen products and enhance frozen products to fresh or sashimi-grade on defrosting.

Trials in supermarkets and ***primary processing*** to investigate optimal implementation strategies for the benefits listed above should be conducted.

Export market research analysis aimed at the benefits of certifying processing plants as COVID-19 safe production environments.

This project has confirmed that Puradigm represents a paradigm shift in purification, promising a wide range of benefits to all industries, including the red meat industry.

Lessons Learnt

The Puradigm technology should be used continuously to allow its 2-4 log reductions to keep contaminants or pathogens at low levels or eliminate them. If the natural technology is used episodically, the period of time to reduce pathogens can take a length of time which exceeds the exposure time. Prevention is better and faster than cure.

Contaminants which are submerged will not be reduced.

High humidity environments are fine. However the HVAC power units should be enclosed in a waterproof enclosure to avoid condensation on its surfaces and bolts getting rusted, or change bolts to stainless steel.

Although the units can treat very large volumes of space, for faster reduction times more units should be employed with close proximity to the surfaces to be treated.

To treat the air sufficiently ensure units are on either side of air curtains and within the air curtain air flow.

Airflow paths may cause corners of rooms or ducts to experience no or little treatment in very high flow rate flows so more units would be required to overcome this.

Keep the units as far away from return air vents as possible to allow as much air and surfaces to be treated.

4.1.3 Denba shelf-life extension and frozen food technologies

As part of the business' focus on pathogen reduction, using the Puradigm technology, another technology from Japan, Denba+, was also tested. There is a unique opportunity to review the benefits of a combined utilisation of these natural and novel technologies to maximise the pathogen reductions and thereby the resultant shelf-life extensions.

Denba does not inactivate viruses or kill bacteria, but rather slows down the growth of bacteria on both the surface and within fresh produce. If combined with Puradigm's ability to inactivate/kill viruses and bacteria on surfaces and in air, the combination of these technologies could provide a major breakthrough in shelf life extension.

Denba+ Technology Overview

DENBA+ claims to be one of the world's most advanced food preservation technologies, achieved by their ability to resonate and activate water molecules.

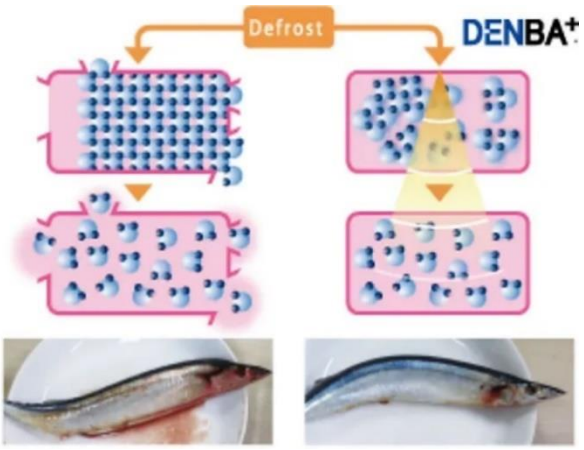
The water molecule resonance activates the cells in the food, which suppresses the production of bacteria, and in turn extends the freshness of the food.

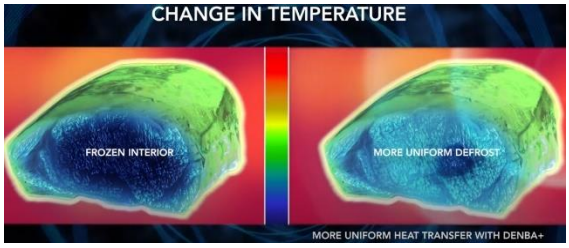
Denba+ Applications

Freezing and defrosting

Generally freezing and defrosting cause cell damage of fresh produce which results in blood and yield loss and modification in taste. Denba+ utilises low voltage and low frequency space electrostatic wave technology to freeze produce without damaging the cells. The shape of the ice crystals are modified by the field to be circular and evenly structured instead of the usual snowflake, jagged structure which damages cell membranes.

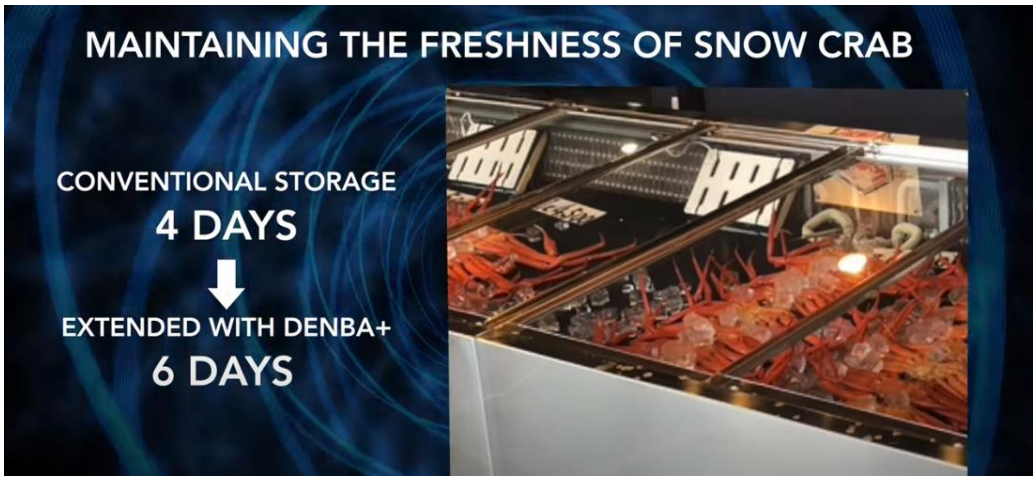
When defrosted within the Denba+ field the cells remain undamaged avoiding blood leaks and the subsequent yield loss or taste modification. The Denba+ field homogenises the temperature gradient through the produce to ensure the temperature is evenly distributed from outside to the core of the produce.





Images provided by Denba Japan

Shelf-life Extension



Images provided by Denba Japan

Limitations of Denba+ Technology

The effects of the Denba+ electrostatic wave are only beneficial while the product is within the field. Once the product is removed from the field the normal bacterial growth will resume i.e. there are no long lasting effects with exposure to the electrostatic wave.

Value proposition and benefits to the Australian red meat industry

- Longer shelf life through deep chilling of fresh produce with reduced risk of freezer burn
- Faster and more efficient freezing of fresh produce
- Freezing product such that small, round ice crystal structures form, reducing cell damage
- Defrosting product frozen with Denba to reduce cell damage and yield loss due to purge, while also retaining fresh look, texture and taste
- Transport of frozen product with better maintenance of temperatures with no hot spots
- Storage of frozen product with better maintenance of temperatures with no hot spots
- Retail fridges, freezers, cool rooms achieving higher efficiencies and longer shelf life with no hot spots with the resultant reduction in waste and markdowns.

Results

Both Denba and Control fridges are Denba supplied fridges with one fridge with its electrostatic field on and the other with the field off. Both fridges were in an identical environment and had the same internal temperature of -1.5C, as logged by calibrated QA temperature loggers.

Mince samples in both Denba and Control exceeded the best before date by 8 days with the Denba samples being in slightly better condition than the Control samples in colour. Both sets of samples experienced red level micro counts at day +8, but due to no odour and no external browning, this is reduced to an amber level. Both fridges kept the samples in a fresh state with only 1 or 2 samples experiencing some slight surface ice or some internal hardening. Those samples which experienced the ice in the Denba fridge, were in a cold spot relative to the

temperatures being recorded by the temperature logger, being in the bottom, middle of the fridge when it was near empty.

Denba Japan are concerned that both Denba fridges are experiencing the electrostatic field and thus there is limited difference between the samples in the fridges with both sets lasting well beyond the nominal shelf-life. Lower temperatures have contributed to the additional shelf-life, however it is unclear how much the Denba field has contributed to the extra shelf-life.

According to the Beef Shelf-life calculator developed through the MLA/AMPC/UTAS, Beef Mince stored for 9 days at -1.5C in a MAP format should achieve an extra 17 days of shelf-life through temperature alone, based on a visual inspection. This trial's samples ran out at +8 days so it is unclear how many additional days would have been possible before the external colour browned and the odour changed. Further trials would be necessary before the effect of the Denba field compared to temperature effects alone, can be determined.

The next trials will continue to explore the deep chilled environment, and will also extend this into testing the frozen food capabilities.

Further R&D may include:

- Benefits for frying within the Denba field, to reduce the requirement for high temperature frying, thus reducing carcinogens and energy consumption.
- Benefits for oven warmed product such as BBQ Chickens to allow longer storage
- Yield uplift for vertical farming/indoor grow products
- Shelf-life extension for floristry products within chilled and ambient environments
- Health benefits for office staff through seating units

Lessons Learnt

Each product type has a sweet spot of deep chill temperature. If the fridge is set at a specific temperature for a particular product, other products will not be benefited as much as if the temperature was fine-tuned for that particular product. Thus the temperature should be set at a comprised level to equally benefit all product types ie meat vs vegetables vs fish.

High flow air inside the fridge will freeze exposed liquid as the Denba field will not be able to resonate the liquid molecules to keep them liquid if the air is vibrating the liquid molecules as well.

The deep chill can have cold spots in the fridge which is below the average ie at the bottom, middle back of the fridge which can ice up or even freeze, especially if the fridge is almost empty.

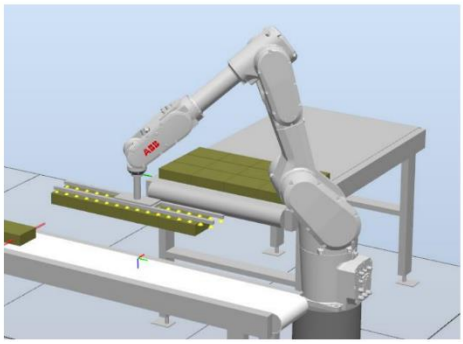
The Denba field doesn't appear to have much benefit in ambient temperatures for non-growing fresh produce. There is evidence outside the scope of this project that growing products may experience yield benefits if exposed to the Denba field due to increased circulation ie health benefits of people, higher growth for crops, etc.

4.1.4 Robotics Development

DEVELOPMENT PROPOSAL
REF DP001CCF-A

ROBOTIC ENGINEERING SOLUTIONS

COLLABORATIVE ROBOTIC TRAY BUFFERING



Coles Chef Fresh investigated the opportunity to automate the handling of ready-made meal trays

- System Processes
  - Sleever stopped
- Trays accumulate at infeed of sleever
- Trays removal from infeed conveyor
- Trays placed on storage table
- Trays removed while sleever is non-operational
- Sleever returned to operating status.
- When a gap is detected on the infeed conveyor, trays are removed from storage table and returned to infeed conveyor.

- The design rate for the system is
- Trays are received at approximately 40 trays per minute
- POC trials will pick and transfer 2 trays at a time

Proof of concept trials will be required to minimise project risk and validate design concepts :

- Confirm optimal tray gripping system
- Confirm robot speeds and cycle time
- Confirm tray buffering requirements
- Confirm Safety requirements

At this stage the anticipated milestones from initial technology evaluation through to installation and commissioning of a commercial system are outlined below. At completion of each milestone the development methodology will be revisited and updated based on learnings.

Stage Gate 1 – Robot Gripper Trials at Coles

- Procurement of system hardware required for the trial.
- Mechanical and electrical construction of the test system in Coles workshops
- Development of trial protocol document.
- Conduct trial as per test protocol

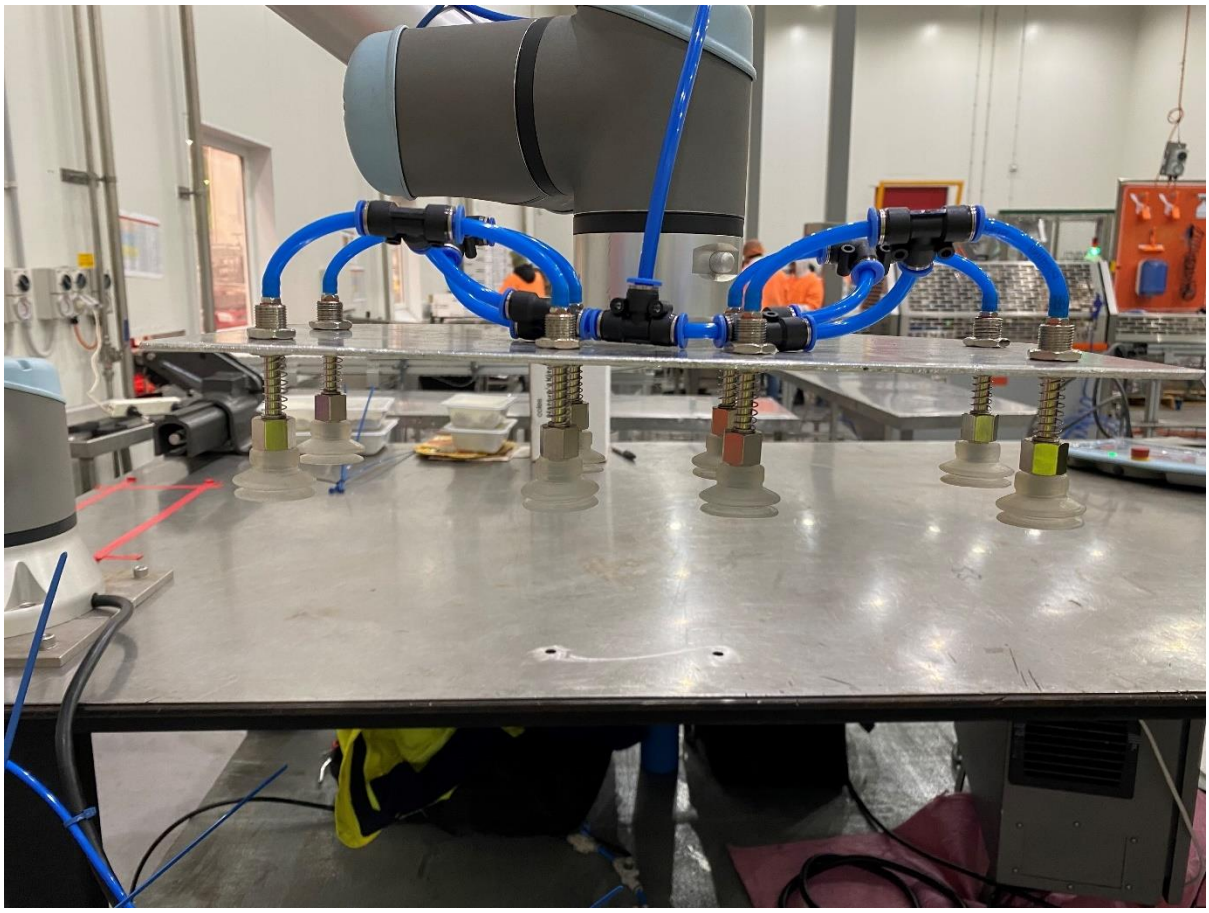
• Preparation of detailed trial report to be submitted to Coles Chef Fresh
• Meeting with Coles Chef Fresh to discuss progression to next stage (Go/No Go decision)

Stage Gate 2 – Robot trials on live production line
• Procurement of system hardware required for the trial.
• Relocation of the robot system to the production floor
• Development of trial protocol document
• Conduct trial as per test protocol
• Preparation of detailed trial report to be submitted to Coles Chef Fresh
• Meeting with Coles Chef Fresh to discuss progression to next stage (Go/No Go decision)

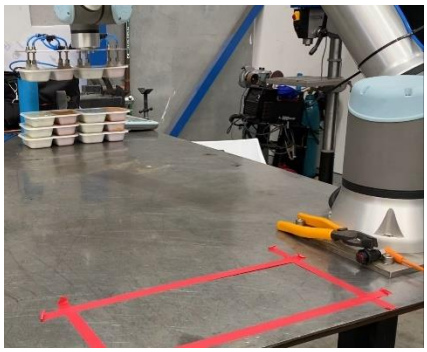
Stage Gate 3 – Production System Engineering Refinement
• Mechanical / Electrical refinements to system resulting from trial analysis.
• Detailed engineering design of production system:
o Detailed mechanical drawings
o Electrical schematics & wiring diagrams
• Development of firm costings for deliverable unit
• Meeting with Coles Chef Fresh to discuss

Stage Gate 1 & 2 Results

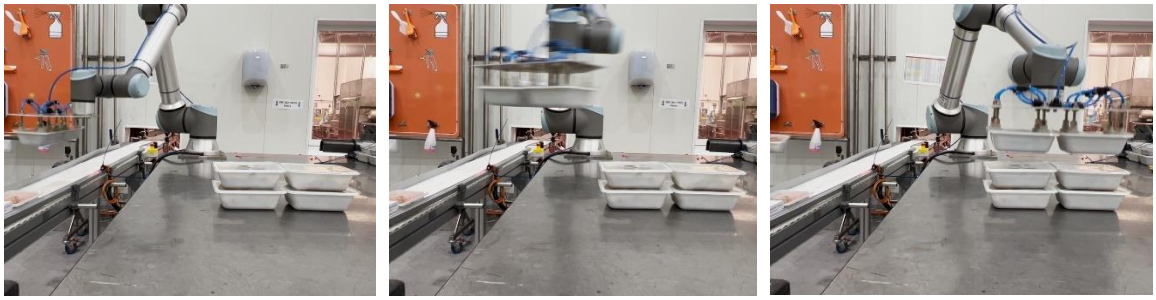
Concept Gripper constructed

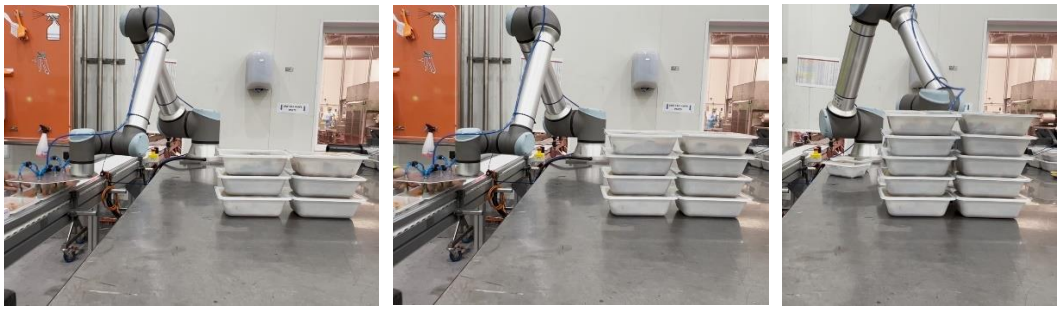


Bench tests in Coles Chef Fresh workshop for stacking and unstacking

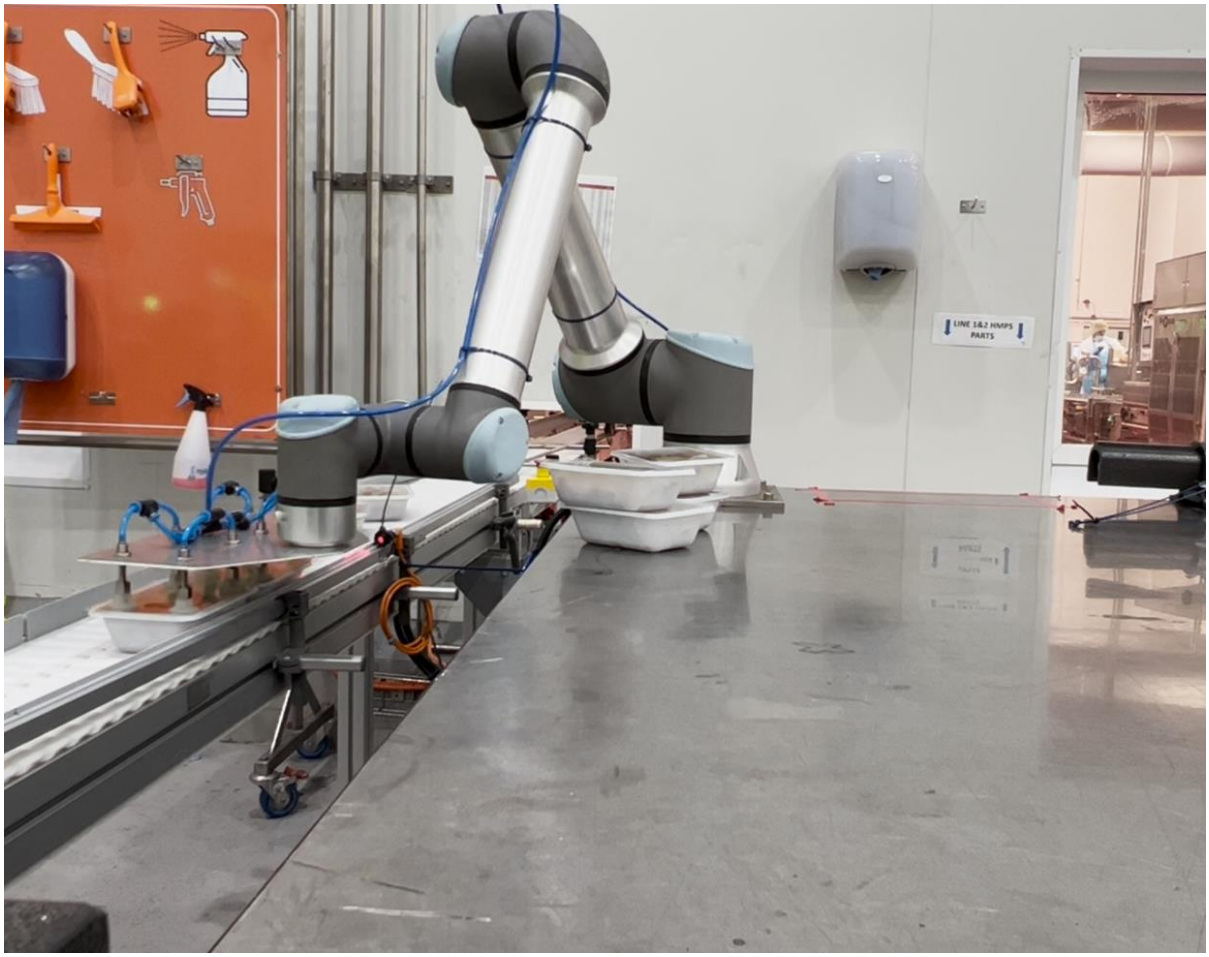


Production Tests in Coles Chef Fresh on Line 2 stacking and unstacking from multiple stacks





Unloading the bench and placing trays back onto the conveyor



The photo-eye sensor (PE) and conveyor guiding were very simple for the trial with manual intervention for guiding required. The full production system will require more PEs and proper guiding to enable more consistent detection of trays in position and sufficient gaps on the conveyor when returning trays to the line.

It was also noted that trays could overlap slightly and their lips interlock. The pick-up path can be altered to lift and pull away at an angle to avoid interlocking trays jamming on pick up.

Stack stability was good up to 4 trays high. Any higher and the stacks start to become unstable.

Stage 3 will require detailed design phases to engineer the accumulation bench appropriately to allow trays to be stacked 4 high, remain stable and accumulate via an indexing system to accommodate the limited reach of the cobot while providing sufficient accumulation for major stops.

Engineering are now reviewing the results of the Stage 1 and 2 trial to determine the best course forward for the Stage 3 production design phase.

Lessons Learnt

Cobot applications must be relatively slow operations so they are safe working alongside people. If an application requires higher speeds than is safe for people occupied spaces, a regular robot within a caged space should be utilised.

Robotic applications are quite capital intensive, so to achieve a return on investment in a reasonable amount of time, the throughput improvement or headcount reductions need to be high enough to support this level of investment.

4.1.5 JBT's DSI Waterjet Trimmer

Coles RROA implemented the first water jet trimming system for red meat in Australia. The system trims of excess fat if the fat dimension is above the specification for any particular product. Achieving 140-200+ portions a minute for various product types, the waterjet trimmer provided a large increase in throughput from the manually trimmed rate of 24 portions/minute. Additionally the portions were cut more consistently and resulted in a large head count reduction with associated cost saving.

The system does have limitations if the portions to be cut require a 3D cutting path or even lots of large path changes, due to the restrictions of the cutting head to 2D paths only and vision system limited to surface vision only. Utilisation of a multi-axis robotic head and X-ray vision could overcome these limitations.

Furthermore the maintenance of such a high pressure water jet is quite complex and costly. Changing from a diamond head to a ruby head provided a cost saving despite the ruby wearing more quickly than the diamond head.

Proposal

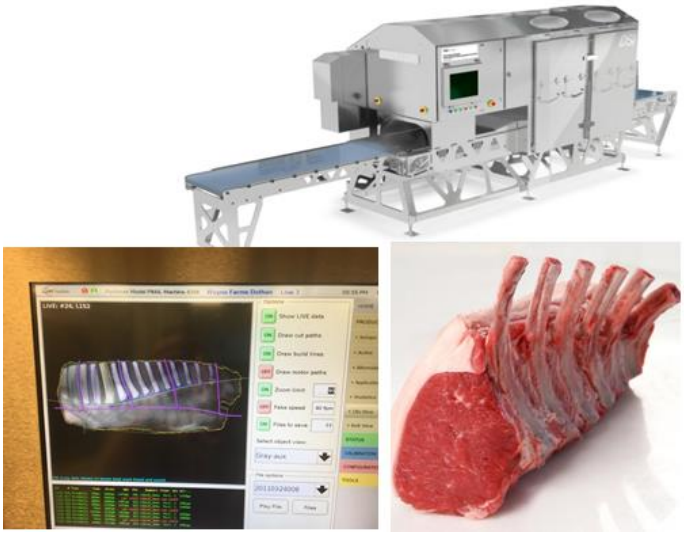
- Implement lower cost, lower maintenance servo pump
- Utilise DEXA/MEXA to enable guided waterjet cutters to portion lamb racks
- Implement multiple axis robotic head for 3D cutting paths
- DEXA trial
- MEXA trial

Key Benefits

- Labour Reduction – 6 HC and Speed
- Yield Improvement
- Quality Improvement
- Safety–less manual operations

Project Cost Components

- DEXA/MEXA lease / installation / programming
- Robotic multi-axis robotic waterjet installation
- Line operating trials / labour
- Project Management



Problem Description – Machine

The high water pressures required for clean and consistent portioning causes reliability issues with part wear requiring constant maintenance.

Learnings

Investigation into servo driven electric pumps as compared to the existing hydraulic pumps, has shown potential reliability improvements. The electric pumps also manage pressure changes on the run more easily.

JBT have provided options to upgrade the waterjet flow pump to a Quantum 87k electric servo pump. The following are the potential benefits from the upgrade. This upgrade is planned for Q1 FY23.

I. Higher Uptime at 98%
II. Running Cost is up to 60% less
III. Maintenance Cost is up to 57% less
IV. 75% less moving parts than the current Flow Pump,
V. Power Consumption is up 60% less than the current Flow pump
VI. Easier to Maintain and keep machine to STD
VII. Cleaner water, less contamination, hence longer life with orifices
VIII. 8 litres of Hydraulic oil verses 140 litres
IX. Smaller footprint required
X. Intelligent Digital Diagnostic controls, hence higher protect and early detection for when an error may occur
XI. Most quiet machine in the marketplace running at 70dBA
XII. Up to 75% less cooling water required.

These improvements are ongoing.

Lessons Learnt

- Waterjet trimmer is a 2D cutting path twin robot head which can chop portions in half travelling between portions if the orientation of portions is too random
- Orienting portions consistently into the waterjet trimmer ensure portions are not damaged between trimmings, and it also speeds up the performance of the portions/minute trimmed
- Trimming, even at 60-70k PSI, can leave fat sections partially connected to the portion and requires further operations to remove and discard the fat
- Electric servo driven water pumps are more efficient and cost effective
- Using ruby trimming heads are more affordable even if they require changing more often than diamond heads
- Using a TVI1600 can position and orient portions into the waterjet trimmer rather than manually aligning the portions with operators

4.1.6 Microwave for Polymer Detection

Coles RROA implemented a deep learning vision system which was able to detect plastic contaminants within ground meat on the mince line.

The vision system however, is prone to false rejects due to some primals with blue sinew which looks very similar to blue plastic. Large amounts of images have to be utilised to further train the deep learning algorithms to reduce these false positives. Furthermore if the plastic is embedded within the meat, rather than on the surface, it can be entirely missed.

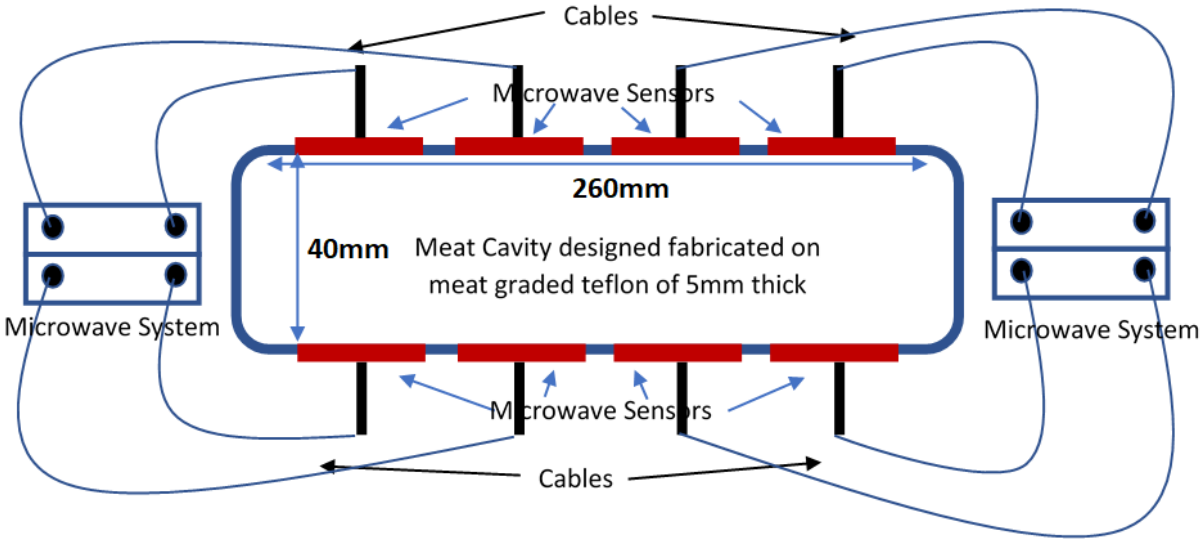
In partnership with Murdoch University and MLA, Coles RROA are investigating the use of microwaves to penetrate the meat so it can be detected on the surface or within the meat. This will also not be prone to false positives due to blue sinew.

Murdoch University have developed a design for a production implementation at RROA. The university will manufacture a test unit and trial at their premises.

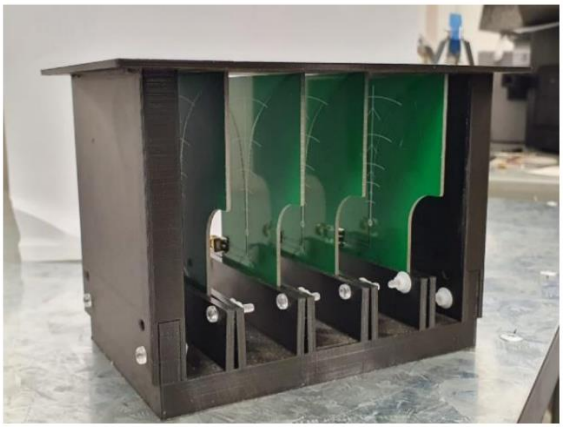
The proposal is to install a microwave detection array around the Pre-grinder extrusion outlet.

The width of the outlet is approximately 260mm and height is 40mm.

The flow speed that the microwave detection system must be capable of measuring is approximately 300mm/s ie 18 m/min.



The fabricated antenna holder with proposed antenna for the planar array system

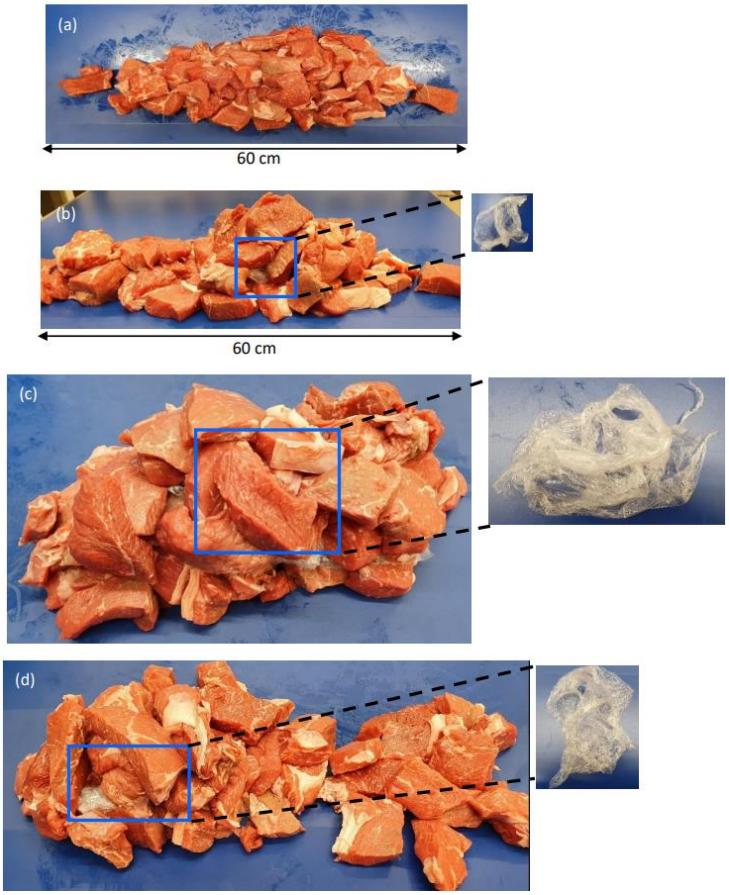


The team discussed how best to conduct the final scientific trials at Murdoch using the Coles specifications used in the vision-based polymer detection system. The line speed the system must be capable of handling is between ***30-42.5m/min*** with sizes of contaminants down to ***1.5mm x 1.5mm***. Current vision system can only detect contaminants with a minimum size of 20mm x 20mm reliably.

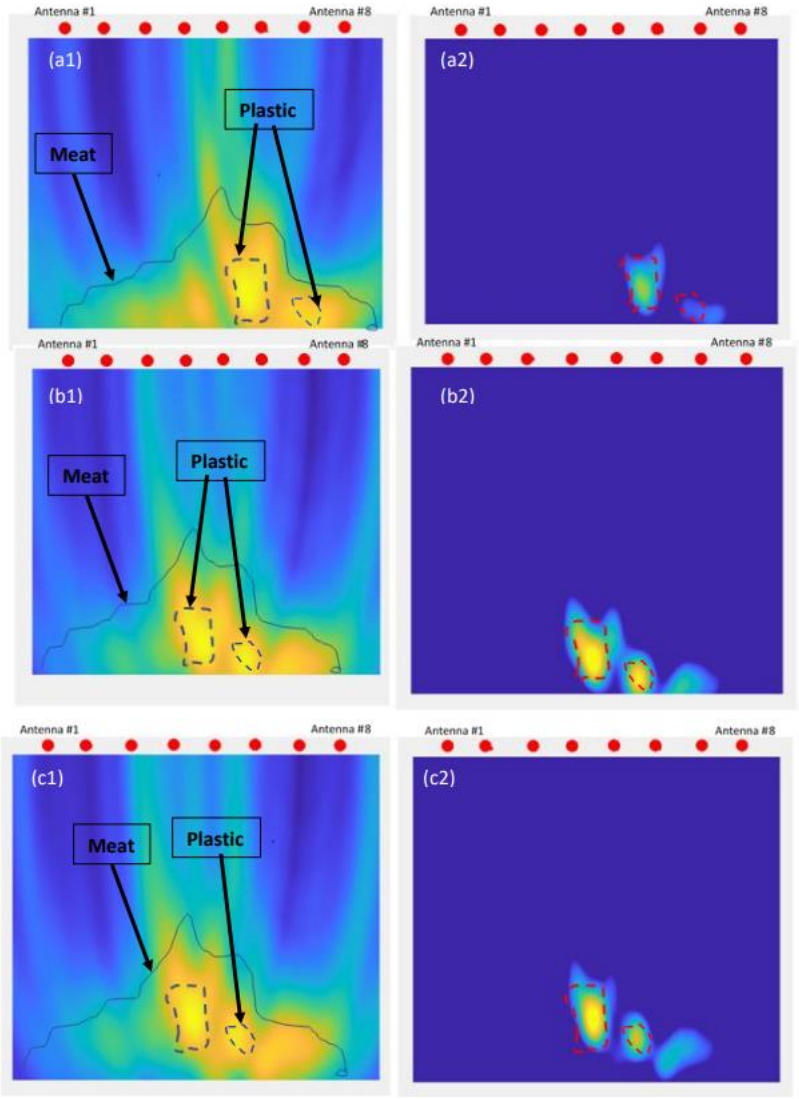
Currently the proto-type microwave system is running at 3m/min looking at sizes of contaminants in the range of 10mm x 10mm.

Complete industrial based automated microwave imaging system with sixteen antennas on food graded conveyor system for multiple and automated real imaging of the meat for plastic or unwanted object detection.

Phantom 2 was designed by using trimmed beef samples with non-visible plastic hidden within meat samples (various size and locations were tested) on a conveyor system.



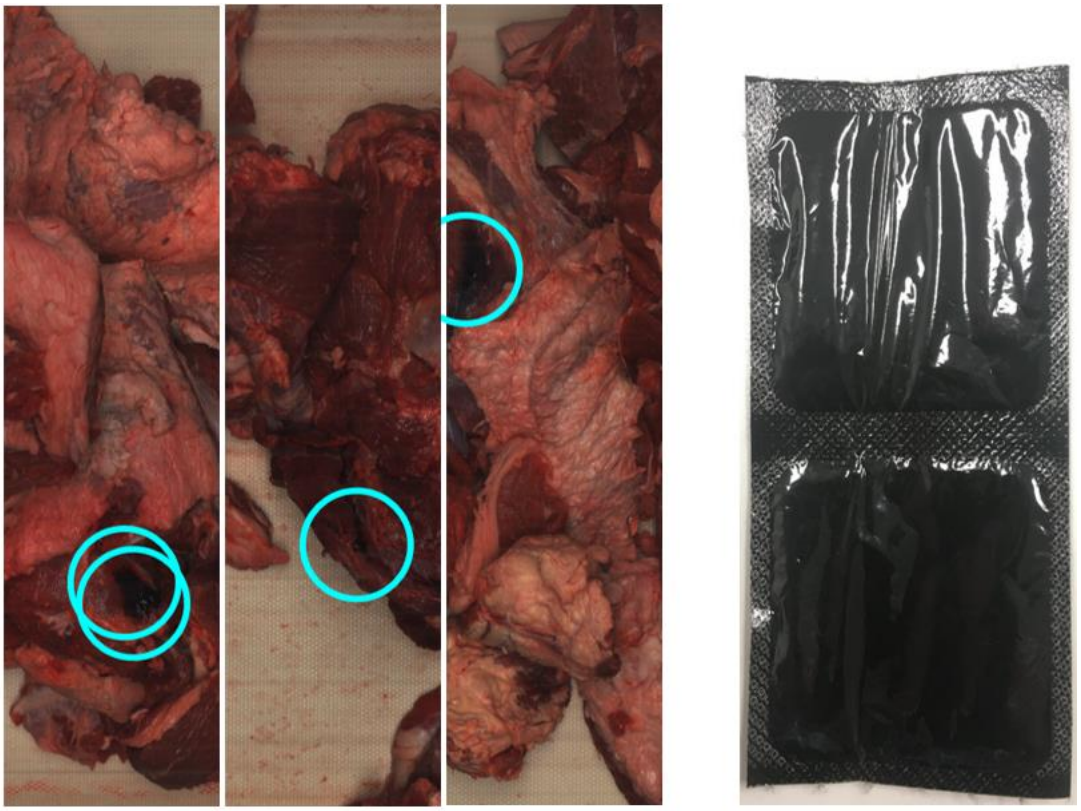
Phantom with hidden plastic (depicted in Fig. 34) at scanning positions (a) measurement #5 (b) measurement #7 (c) measurement #9. Two imaging techniques were used, (1) represents standard confocal imaging technique (2) represents the confocal imaging with optimisation propagation.



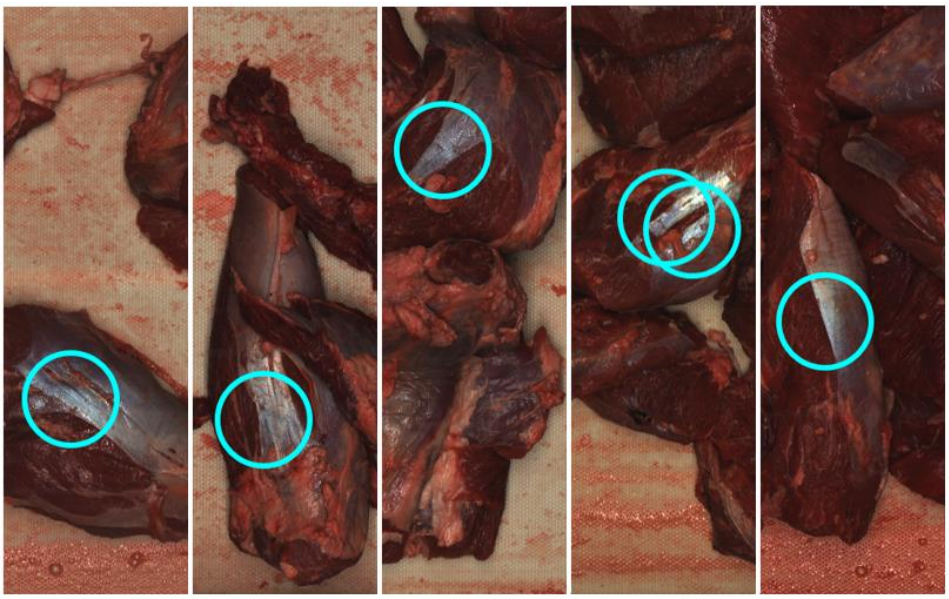
Typical contaminant list includes, but is not limited to, the following items:

- Dark Blue Bin Liners
- Transparent blue bin liners
- Transparent green bin liners
- Clear Cryovac bags, with black logo text
- Blue rubber gloves and aprons
- Hair Nets, green and red
- Ear Plugs, orange with light blue string
- Soakers pads – white or black

Detection algorithms must not issue false positives due to dark blood clots or shiny blue sinew.



Black blood clot detection images and black soaker pad



False positive detections on Beef 95CL due to white meat membrane

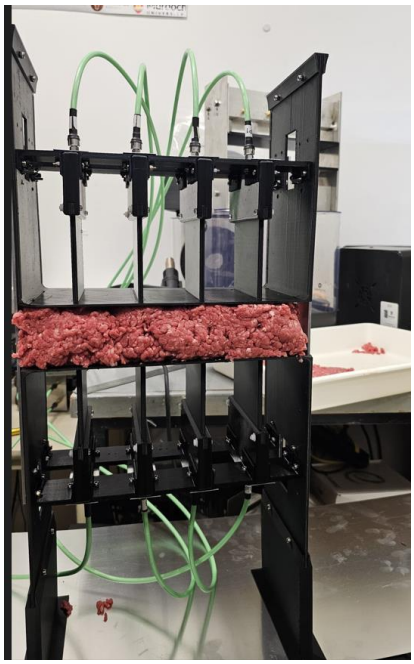
The product that must be analysed for contaminants by the microwave system is predominantly beef mince but must be capable of handling lamb and pork with CLs in the range of 65 to 95.

RROA is willing to provide meat samples, post the grinder, so the test rig will be able to be developed using real-world meat configurations that are typical in the production environment.

The team also discussed the best options to trial the final microwave rig in the production environment. Possibly the rig will require a RROA proof of concept housing fabricated in-house or a rig fabricated by a contractor. Will require a non-metallic housing to avoid interference with the microwave antennas.

The microwave antennas are constrained in their measurement distance needing the antennas to be close to the meat. The antennas can be arranged in an array around the conveyor to better detect plastic underneath or within the meat. This array will be housed inside the RROA or contractor built housing to protect them from collision with the meat passing along the conveyor.

Next steps are for Murdoch to begin creating their test rig using production environment variables discovered during their RROA site visit.



Lessons Learnt

This project is ongoing, but the business will be ensuring that the microwave rig will be capable of measuring small plastic pieces at production speeds and able to handle the challenging environment of washdowns and meat and fat on components.

4.1.7 Deep Learning/Artificial Intelligence Vision

Current machine vision technology, focused on label inspection, utilise rule-based algorithms to determine whether an inspection passes or fails. Variations such as lighting, colour, material type, orientation, position, font type, smudges and other obscuring artefacts, can easily cause rule-based vision algorithms to generate false rejects. Artificial Intelligence (AI) based vision systems have long been touted as the solution to these limitations, giving machine vision a more human-like capability of discerning true failures from false. Up until now, AI-based deep learning vision systems have been extremely complex both in hardware as well as software configuration, requiring high levels of expertise to generate meaningful results.

This project will develop the first off-the-shelf deep learning smart camera for Beef and Lamb meat inspections to produce a truly holistic system which isn't limited to just standard label inspections, but can also recognise meat cuts including portions and primals. Utilising an off-the-shelf smart camera with built-in deep learning capabilities, enhances the security of the system as it is not reliant on PC infrastructure which are prone to cyberattacks. Intrinsic deep learning functionality within the smart camera results in a very easy to configure system which can be taught to recognise any object with a fairly small dataset of 5-30 images rather than the thousands of images typically required. This means that the time to productive results is reduced, the number of people able to configure the system with limited specialised knowledge is increased, and the number of potential use cases is very large indeed.

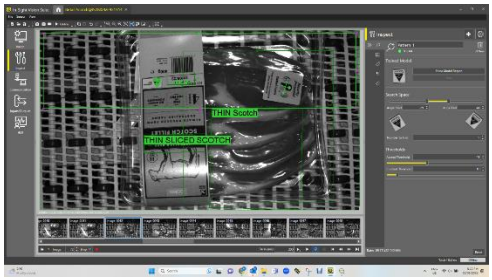
Coles RROA will develop the pilot system on the Line 4 VSP/MAP product line which represents a challenging packaging format with C-wrap, D-wrap and DIGI labels. In particular, labels can undulate over the VSP pack causing warped images and lighting challenges. Even with the MAP format, the high gloss surfaces can cause challenging lighting conditions for traditional vision systems.

This pilot system will also investigate the benefits for primal identification, 2D code reading, and foreign language OCR, which are all wider industry benefits for this technology.

Proof of Concept 1-day Trial

The Cognex smart-camera was trained on only 7 to 9 sample images and then tested on 100 samples to ***recognise the label main text***, ***read the date code via OCR***, ***read the barcode***, ***recognise that the security label*** was present and ***recognise the cuts of meat*** within the packaging. The recognition was 100% in the post-trial analysis after some fine-tuning of the deep learning algorithm's parameters. During the initial on-site trial, only training 3 to 4 images, the label recognition was 99.99% while the cut recognition was 94%. Note that the lighting was in-built within the camera which will not be the case for a production installation. A diffuse lighting source with polarised lenses will be utilised which will remove all glare or over exposure from the uneven surfaces of the VSP packaging or C wrap label.

Label, Cut and Security Recognition and Date Code OCR



Proof of Concept 1-week trial

Ahead of the final MLA/AMPC Vision Project being approved, RROA and Cognex conducted a 1-week trial with the deep-learning D900 InSight camera. The report of the scope of trial and results are shown below.

Scope

The scope of this testing was to determine whether the Cognex A.I vision system in the RROA environment was able to fulfill, at a rudimentary proof-of-concept level, the specifications detailed below.

Note that the vendor was limited to basic brackets and no booth to control lighting for this trial, so results in a production system are expected to be far superior.

Table 1 - Assessment criteria

Required	KPI	UI	Future
Label Text (OCR)	Label Accuracy (%)	Ease of Selection	Integration with Innova
Date Code (OCR)		Ease of program creation	Additional information extractable
Bar Code reading		Fine tuning	
Security Label Presence		Reporting functionality	
Promo Label Presence		Change log reporting	
Meat Type Inspection	Meat Inspection Accuracy (%)		
Seal Integrity	Seal Integrity Accuracy (%)		
	Throughput (ppm)		
	Processing Latency (ms)		

Methodology

The performance of the vendor was measured against Table 1 over a testing period of 1 week. Testing was done on Line 1 using **Beef Rump** and **Lamb Loin** as the focus SKUs.

The following tasks were conducted by the vendor.

- 1-2 days of data collection
- 1-2 days of training
- 1 day of testing with controlled failure modes

On the final day of testing, the Cognex system was tested by the QA team using samples created to test each requirement.

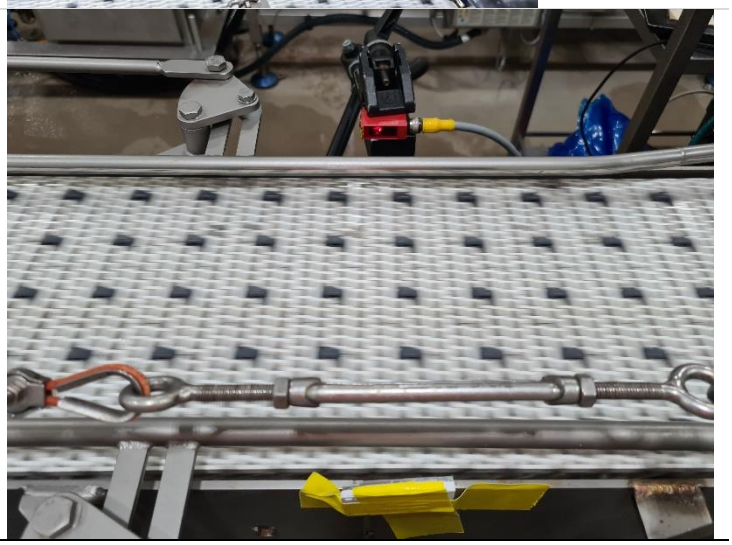
The specific samples created are described below:

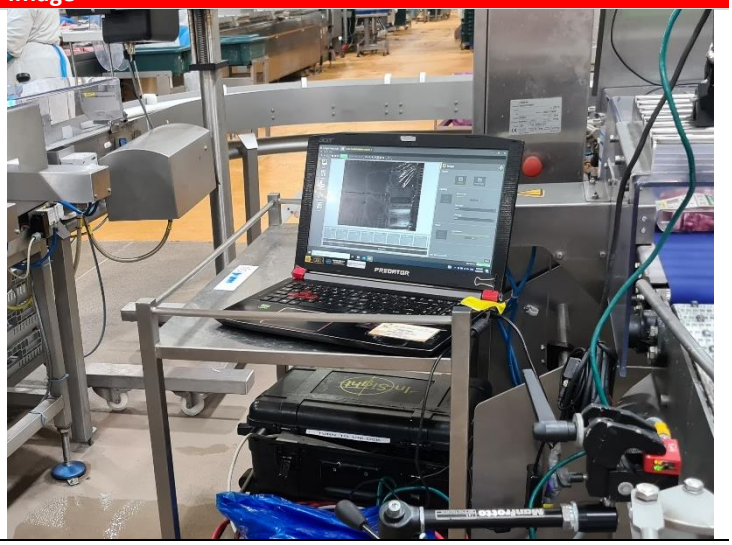
- Roundels
  - ‘Special’ roundel presence and location
  - ‘$X’ roundel presence and location
  - ‘$X’ and ‘$kg’ differentiation
- Primary Label

- Double Label
  - Incorrect Label
- Meat cut
  - Incorrect meat cut

Equipment Setup

Table 2 – Equipment and Images

Equipment	Image
Smart Camera (lens would be altered to lower the camera while still providing the required field of view in the production system, and be installed within an enclosed booth with fixed lighting)	
Photoelectric Sensor for image trigger	

Equipment	Image
Laptop for program download and image storage (Production system would have an IPC with screen and PLC for line integration. A server in the control room will manage product/order selection)	

To ensure no interference with the devices outside of testing hours, the set-up area was closed off from the production floor workers and the devices were wrapped in plastic to ensure no water damage to equipment during wash-downs.

Results

Table 3 - Failure mode results

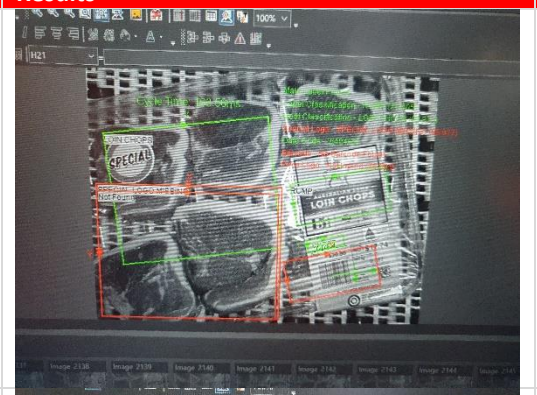
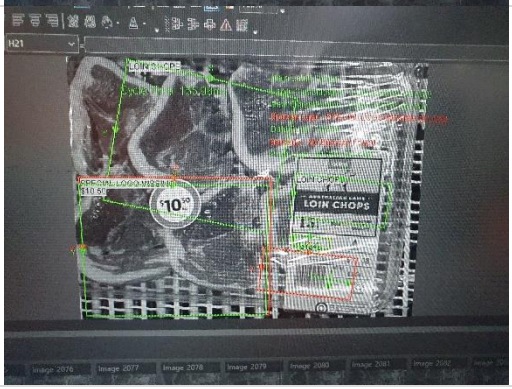
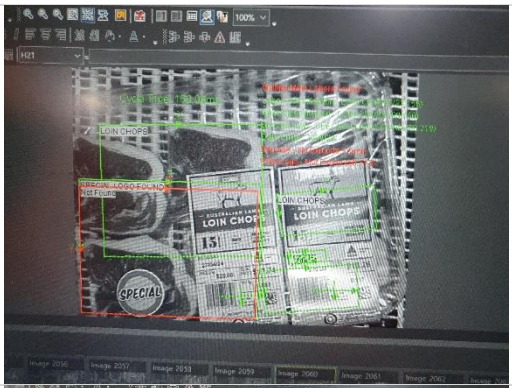
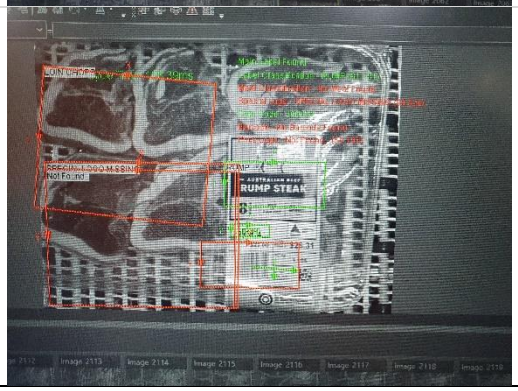
Criteria	Results	Comments
'Special' roundel presence and location		• **Roundel location:** System had the ability to choose a 'region of interest' for its location check and fail if the label wasn't in the region as indicated by the red box and text "SPECIAL LOGO MISSING" • **Roundel presence:** System was able to recognise the roundel as a 'Special' label using deep learning. Box would turn green.
'$X' roundel presence and location		• **Roundel location:** System had the ability to choose a 'region of interest' for its location check and fail if the label wasn't in the region. • **Roundel presence:** System was able to recognise the roundel as a '$10.50' label using deep learning. Box highlights green and label text displayed
'$kg' and '$X' differentiation	**N/A**	Could not be tested as '$kg' roundel was unavailable during testing
Double label		• The System was trained to identify 'Multiple Main Labels Found'
Incorrect Label/Incorrect Meat Cut		• The System identified the meat type as loin chops, and the main label as rump steak – therefore identification of incorrect meat cut vs main label was shown

Table 4 - Assessment Criteria Results

Criteria	Result	Comments
Label Text (Deep learning)	Achieved	Despite a lack of enclosure and proper lighting which resulted in poor quality images **deep learning on label text proved successful**.
Date Code (OCR)	Achieved	Date Code OCR was successful despite poor resolution images compared to what will be achieved in a production system.
Bar Code reading	Not Achieved	A lack of enclosure and proper lighting resulted in lower resolution images which made barcode reading unachievable. This was proven in the previous trial which has better lighting control. A different lens which would allow the camera to be closer and produce higher resolution images would easily read the barcode. In the previous trial 100% barcode reads were achieved.
Security Label Presence	N/A	No security label was available at the time of testing. The previous test was able to robustly detect the presence of the security label.
Promo Label Presence	Achieved	The System could confirm promo label presence, type and location
Meat Type Inspection	Achieved	Both the Rump and Lamb Loin meat cuts were trained with only 2-4 images. The recognition rate was very high over several thousand images despite such poor image quality due to the nature of the rudimentary test setup.
Seal Integrity	N/A	No control samples for seal integrity were developed. Was told this was possible for outer edge seal inspection with better set-up conditions.
Throughput (ppm)	387 ppm	Higher throughput is achievable with better lighting conditions so camera exposure time can be reduced. However this far exceeds the requirement of 120ppm.
Processing Latency (ms)	155 ms	Lower processing latency is achievable with better lighting conditions so camera exposure time can be reduced. However this latency far exceeds the 500ms required.
Ease of Selection	Achieved	Can drag and drop images into classifications to optimize A.I. training

Criteria	Result	Comments
Ease of program creation	Achieved	System allows for full customizability with creation of new labels. Two modes: Easy access or complex spreadsheet.
Fine tuning	Achieved	Fully customizable software. Can fine tune camera, deep learning and OCR settings to name a few
Reporting functionality	Achieved	System allows for live view and export of multiple statistics including number of inspection, vision failures, reason for failures etc.
Change log reporting	Possible	Was informed this could be developed
Integration with Innova	Possible	Was informed this could be developed
Additional information extractable	Achieved	Was informed could be possible: • Fat percentage • Meat orientation

The impressive results of this latest trial has now led to an AMPC-MLA collaborative project, led by AMPC-MLA project steering committee.

Lessons Learnt

This project is ongoing.

- Diffuse lighting handles shiny, flat MAP surfaces, shiny label surfaces, and undulating VSP surfaces.
- Black and white cameras produce higher resolution images of barcodes and text when compared to colour cameras
- Seal integrity checks require different lighting conditions when compared to label and meat inspection. This inspection will be reviewed at a later phase
- The Cognex InSight deep learning smart-camera requires outliers and average images for best results, but only require 20-30 images for training for extremely accurate results.
- Deep-learning algorithms are built-in to the camera and so no PC is required, however as a front-end User interface, a PC is recommended
- Deep-learning algorithms can be applied to any types of inspections, not just labels or meat
- This Cognex smart-camera is not suited for very varied objects ie people, whole fish of various species, sizes and orientations. A more traditional, PC-based AI vision system capable of more complex deep-learning algorithms are suited to those applications

4.1.8 Multivac/Bizerba TVI1600 Primal Portioner

The Co-Innovation Manager researched the possibility of introducing a Bizerba TVI1600 to replace the two TVI500s. While providing a significant ***yield uplift per year*** for bone in SKUs, the TVI1600 can position the portions along the infeed laser line and space the portions appropriately for the DSI water jet trimmer and the portions can be left and right facing, as per successful experiments run on the waterjet which increased the waterjet's performance.

The orientation of the portions will be determined by the way the operator loads the primals into the TVI1600. In this way the business can achieve another ***3 headcount reduction***, by removing the need for the two infeed operators who are required to orient the portions before the waterjet to optimise its trimming operations, and one of the two TVI500 operators.

The yield uplift calculations were confirmed by the supplier, Bizerba, to further support the data analysis conducted in the previous milestone.

A Capital Expenditure submission has been made to the business, supported by the work done in previous milestones, and if successful, the TVI1600 installation will become a project in its own right.

It is expected that the project will have a quick 1 year 11 months payback.

Lessons Learnt

- If the operator loads the primals in consistent orientations into the TVI1600, the orientation of the portions out of the machine can be controlled. This was important when feeding the waterjet trimmer
- Maintenance on the TVI1600 can take the machine out of operation for 3-4 days. Using an outfeed conveyor out of the TVI1600 allows TVI500s to be used as an alternative while the TVI1600 is being maintained.

4.2 Digital Solutions

The pillar of Digital Solutions focuses on such items as data driven decision making, data collaboration, business optimisation and production data analytics among other things.

A summary of the main projects completed are as follows.

- Product traceability through AI vision
- RFID Crate tracking
- RFID embedded finished goods label tracking
- RFID Security label for meat security
- Team Assurance digital task and communication portal
- Process confirmation checks via tablets for consistent line operation
- OFS Digital Dashboards on the production floor for live performance metrics, downtime management and OEE uplift
- Interactive, large, touchscreen TVs for tiered meetings centred on OFS and Team Assurance for data drive decision making at all levels of management
- Data analytics through OFS to drive real change in operational behaviours with resultant OEE uplift
- OFS seminar with wider industry to share learnings
- Jira with addons for complex project management

4.2.1 OFS Digital Dashboards

Current State of Lost Time Capture and Reporting

Currently we have multiple ways across both sites, RROA and Chef Fresh, of capturing lost time.

Ranging from excel data capture, control room input and partially complete digital dashboards at RROA, to on the floor pen/paper capture at Chef Fresh.

Both systems are heavily dependent on human interaction or hampered by heavy IT or engineering support and thus open to error and lost/incorrect information being gathered.

Project Aims

Launch vendor's data capture solution (OFS – Operator Feedback System) across RROA and Chef Fresh

1. Install OFS data capture system

2. Do not be dependent on Coles IT infrastructure

3. Train teams to input lost time reasons from the floor and analyse data captured

4. Generate required reports automatically

5. System to be easily installed and incorporated into any line/equipment across Coles Manufacturing

6. *Be fully supported by supplier*

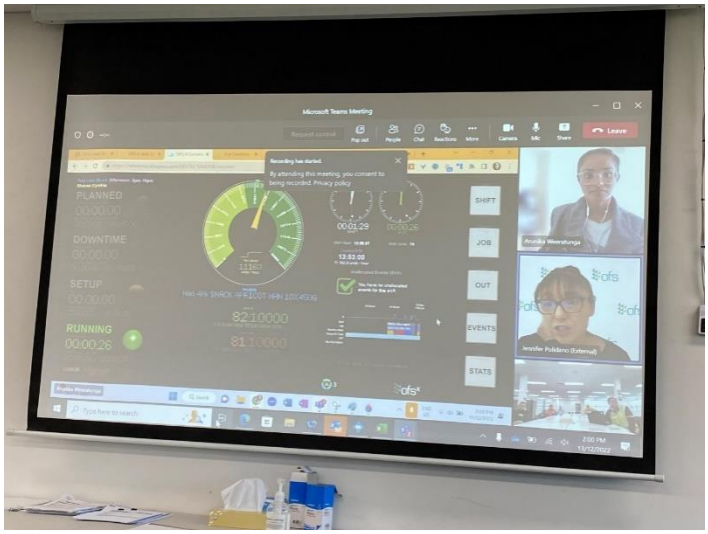
Proof of Concept

A POC system has been installed on Line 4 at Chef Fresh. Utilising a 30 day trial system from OFS, which is comprised of a hardware control box and two photo eye sensors, a downtime monitoring system which complies with the project remit is being tested.

OFS Hardware installed on Line 4

Digital Dashboard Installed on Line 4

Team Training on OFS



Chef Fresh rolled out the OFS system from just the Line 4 Proof of Concept, to now ***Line 1 to 8 and the VA lines***. The Innovation Manager supported master data configuration including line rates per SKU and training sessions.

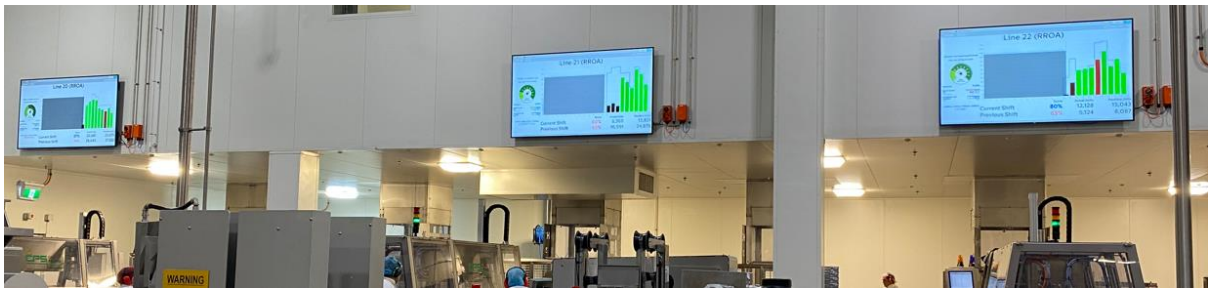
A ***POC*** set of systems have now been installed at ***Coles RROA*** on Lines 1 and 6. RROA was able to support ***direct integration into PLC outputs*** which reflected existing line sensors or sequences for accurate tray and crate counts, rather than having to install OFS sensors onto the line. The benefit of this is a simpler installation. Additionally if the sensors, that the PLC outputs are derived from, fail, the line will stop and cause operations to rectify the sensor. This is different to the Chef Fresh OFS sensors, which can fail without stopping the line and thus data can be lost if no one attends to these failures.

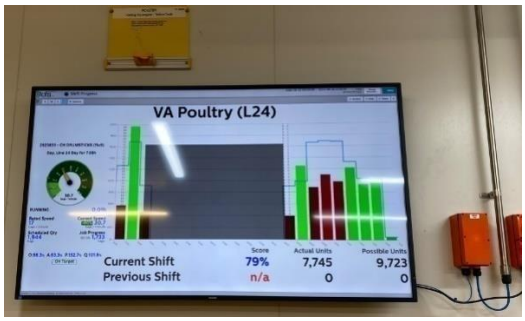
The ***iPads*** being used for the Process Confirmation checks are being utilised for the OFS ***downtime reason entries*** by each line's operators.

After a very successful POC on Line 1 and 6, the remaining lines 2,3,4, 4.5, 5, 20,21,22,23,24 and 32 were wired into 3 OFS panels via either direct integration to existing line sensors or sensors were added to the lines where none existed.

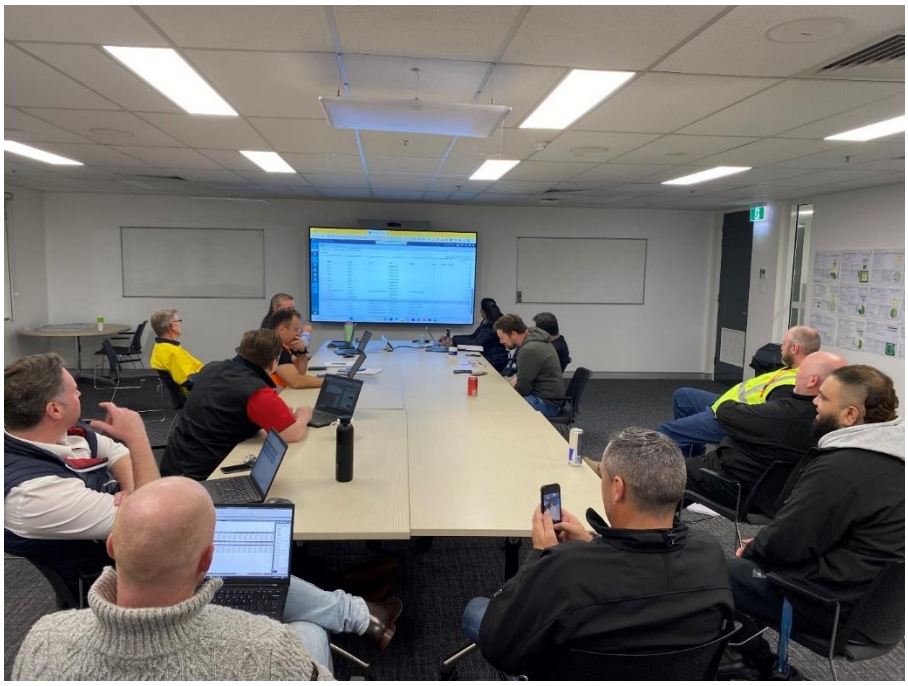
The OFS panels provide a direct cloud connection via their routers which removes the need to integrate with the plant's IT infrastructure. This enabled the system to be setup within days, and fine-tuned over weeks, rather than the traditional months of integration time.

86" line TVs were installed on each line so operators have a live indication of the current performance and indication that operators need to enter downtime reasons via the line iPads.





Multiple training sessions were organised for operators, supervisors and system admins across several days and several follow-up visits to ensure full system understanding and utilisation.



Meeting Room Interactive Screens

Interactive Touchscreens have been installed in the Tiered meeting rooms to facilitate the use of Team Assurance and OFS, allowing the team to stand around the TV and interact with the tools in a hands on way.

The TVs allow touch interactions, web browsing, stylus annotating and saving of images to phones.

Tier 2 Interactive Screen

Tier 3 Interactive Screens

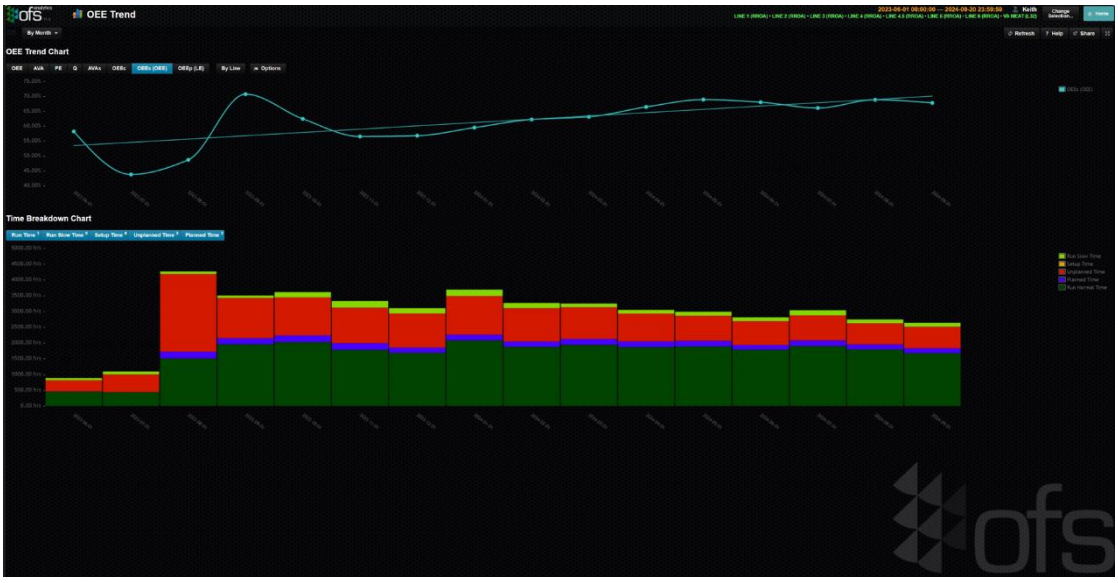
The OFS Digital Dashboards have been instrumental in an uplift in OEE across the site.

One aspect of production that has been consistently seen from the initial Proof of Concept in the Digital Officer milestones, and through the Co-Innovation projects, has been short stops. There is a consistent 20-30% of downtime caused by tiny pauses in the line which cumulatively have a significant impact on the line OEE.

Through the Tiered meetings, this Short Stop downtime reason was able to be raised as a major concern that Production should focus on. OFS data driven decision making has allowed Production changes to be implemented based on data rather than opinion.

OEE Uplift since install

(Noting in Nov 23 & Jul 24 the target performance rates were increased thus the slight dip in OEE for those periods)



Coles RROA was pleased to host an OFS introduction seminar for industry partners and suppliers to showcase RROA's OFS journey, implementation and results. Partners such as General Mills, YouFoodz/HelloFresh, Sunrice, Cleanaway, ITW, Tassal, Resource Co, Norfolk Foods, SRS and MLA attended. RROA supports industry collaboration events such as these, to uplift the Red Meat and associated industries, in order to broaden adoption of best in class operations' tools, such as OFS, to improve production efficiencies, which lower costs and drive volume uplifts.

Lessons Learnt

- Being able to see data trends isn't enough to improve the data. People must make consistent changes to the way they operate to improve the operations which are driving the data. OEE improvements through this data transparency is an ongoing effort, not a once off, silver bullet.
- Everyone must use the same data view/OEE calculation so that the targets are the same. Some views or OEE calculations generate slightly different values.
- There are many dashboard options, however the ability to customise colours, or the layout is limited at the moment, only segments of the display can be altered by removing some data and replacing it with other data types

4.2.2 Product Traceability

Radio Frequency Identification (RFID) Projects

Coles Retail Ready Operations are looking to evaluate the use of a permanent RFID label on each crate in order to improve readability and to provide a potential replacement to single use barcode labels moving forward which would provide major benefits from both a cost and sustainability perspective.

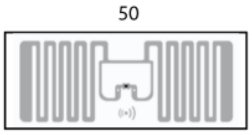
Trial 1 – Crate Tracking

- All crates (~700k) to have an rugged RFID label attached on the wide edge of the crate
- RFID readers to be installed at 10 locations: two each for all nine mezzanine level conveyor "onramps" plus two at the QA station
- RFID readers to capture crate RFID tag data and send to the Warehouse Management System

RFID label to be applied to the same slot as the barcode label on the other end of the crate

RFID TAGS

RAMP propose an extremely durable RFID label to be used on the crates. The labels will be 50mm x 20mm. It is expected that each crate will only need 1 RFID label but this is subject to testing and there is a possibility that one might not suffice.



RAMP propose a custom RFID label for this requirement to ensure the label meets the specific requirements. The label will be 100% fully inspected to remove any non-functioning RFID inlays.

The label has 3 components:

1. RFID Inlay

The Avery Dennison Miniweb M730 inlay is designed for global supply industrial applications. They excel through superior performance in demanding environments and on difficult-to-tag materials, due to their good tolerance against the detuning effect of high dielectric materials. The inlay is equipped with the M730 IC from Impinj. The IC comes with 128-bit EPC memory and offers an enhanced "autotune" adaptive RF tuning feature. In addition, the IC has an improved read and write sensitivity, enabling faster and more accurate bulk reading compared to any other inlays on the market.

2. Surface material

The proposed label will be made from Polylith. Polylith is an extremely versatile, polymer-based material that prints like paper but boasts the best properties of plastic. Polylith is far stronger than conventional paper and supports a massive selection of grades, gauges, finishes which make Polylith the perfect material for this application. Polylith is resistant to water, chemicals, oils and grease. It is dimensionally stable when exposed to moisture and humidity and can withstand temperatures ranging from -23F to 220F. Polylith is resistant to cracking, shrinking or distortion in size or color.

3. Adhesive

The label will include the STYLUS 765 premium double sided polyester adhesive. 765 is constructed of a transparent distortion-free polyester film coated with a heavy coat weight of modified acrylic adhesive & separated by a red Polypropylene film liner.

765 offers excellent initial adhesion & final adhesion resulting in a high shear strength bond. It is resistant to ageing & the influence of chemicals especially domestic cleaners & polishing agents. Bonds well to plastics, polycarbonate, metal, glass, rubber PE, EVA & many other surfaces. Has very good low & high temperature resistance & is U.V. resistant

Should always be applied to a clean, dry, grease & dust free surface. Care should be taken to ensure that plastic components are free from release agents. Press firmly into position to obtain maximum benefit from the pressure sensitive adhesive. Optimum performance will be obtained when the bond is formed at 23ºC. At low temperatures there is a chance of condensation & the tack of the adhesive can be reduced.

These labels will be supplied in rolls of 3,000 with 100% inspection of all RFID inlays in the manufacturing process and removal of faulty inlays.

Sample labels will be provided to Coles for testing in wash conditions prior to mass production.

RFID READERS

Fixed RFID read-points will be required to read tags on crates tacked up to 10 high in both wide edge leading and narrow edge leading orientations at the various locations as they move along the conveyor system.

Ramp will design a suitable read station using best of breed reader components from the leading global manufacturers.

Indicative layout:

Similar layout installed elsewhere:

Expected Bill of Materials:

1. IP66 enclosure
2. 4 port Smart RFID reader
3. 4 x antennas

Trial 2 – Delivering Significant Opportunities from Farm To Fork – Pilot Program

Unlocking Near Perfect Stock Accuracy in Red Meat

A Proof of Concept (POC) has been supported by the Co-Innovation Manager to support the business in its investigation of the benefits of embedding RFID tags into finished goods labels to close the loop at the secondary processing end of the supply chain, to link up with the RFID tracking of cattle to carcase to primal.

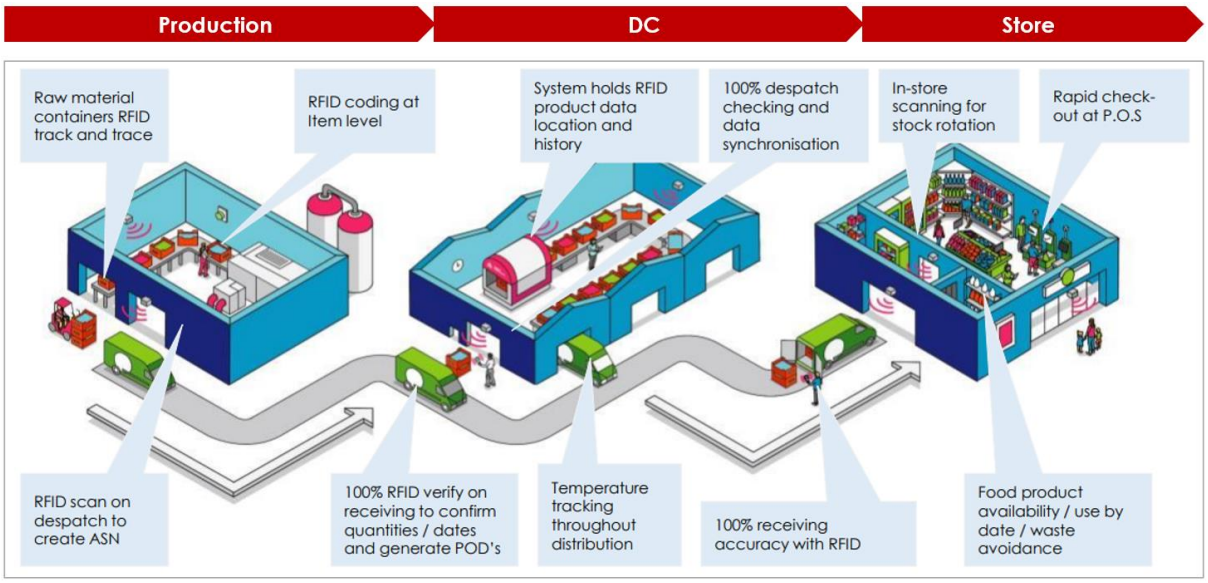
Outcomes from the RFID POC indicate that daily RFID scans on Meat will have a significant positive impact on growing sales.

- Coles current meat stock accuracy deteriorates to a ranges between 35% - 60% between stock counts (monthly).

- Poor stock accuracy results in the wrong volumes being ordered for stores.
- This results in the below negative outcomes :
    - Lost meat sales in stores
    - Failure to pick meat in online orders
    - Customers choosing Chicken or Fish options
    - Loss of the customer cart. Customers choosing to shop in competitors or online
    - Increased meat waste, where order volumes are too large
    - Increased meat markdowns , where order volumes are too large
    - Poor customer sentiment and satisfaction
    - Increased workload for store teams
- The RFID POC demonstrated that meat stock accuracy can be increased to 85-95% (Increase of 50% from base)
- Based on the success of the POC a West Australian RFID pilot program has been planned which will generate meat orders based on RFID scans. This will dramatically improve stock accuracy.
- With increased stock accuracy stores will receive perfect stock orders removing many instances of out of stocks. This will result in higher availability levels in stores, creating more sales of meat products and thus increased production.
- Data indicates that Coles lose significant sales in meat (lamb, beef and sausage) every week due to incorrect inventory along with other factors. This value can be seen as an opportunity to increase production volumes leveraged by RFID.
- Perfect stock accuracy driven by RFID meat integration will grow customer loyalty and average basket size as stock will be more readily available when they visit stores or shop online with Coles

International and local production facilities who have embraced RFID are reaping benefits

- RFID enables the accurate tracking of meat products from production to stores. Collected data along the way to improve processes
- RFID data can support quicker and more efficient despatch of items, creation of ASNs and removal of manual processes and labour at production
- RFID enabled products can be electronically receipted throughout the supply chain supporting faster invoice payment and stock receipt



RFID Production benefits

- Food trackability
- Batch tracking
- Tracking through production to store
- Improve inventory management
- Avoiding overproduction and reducing food waste
- Use by date tracking
- Instant and accurate product recalls
- Cold-chain management
- Improved order fulfilment tracking

Lessons Learnt

- RFID labels contain metal so should be placed after the metal detector
- RFID tags within crates or bins should be placed within a cavity which is safe from water or in areas which are less likely to be hit bit a forklift or transport automation
- The body overseeing the RFID tracking and data should be across the entire supply chain to make decisions which are not siloed as issues in one part of the supply chain might require a solution from another part of the supply chain

4.3 Supply Chain

The pillar of Supply Chain focuses on such areas as shelf-life, quality, business models and sector relationships among other things.

A summary of the main projects completed are as follows.

- Cartons to plastic crates for cost efficiencies and reductions on waste to landfill
- Boxes to Pallecons for sustainability targets
- New design of pallets for crate transport
- New design of FB4 bins for raw material transport
- Open innovation through the Faster fresher flows project design for optimised order flow
- End of Line Robot 8 optimisation design and research
- Artificial Intelligence research for planning and inventory optimisation
- Collaboration with local label suppliers to bring world-class capabilities to the Australian market
- Baler to Compactor upgrade for cardboard recycling

4.3.1 Cartons to Crates

Proposal

Eliminate >1.5 million cartons from our supply chain by converting to returnable swing bar crates

a) Crate capacity /cost analysis, CHEP negotiation
b) Forklift movement /Interim, storage and staging of crates planning
c) Wrapping of crates with shrink wrap prior to movement review
d) De-hire protocols / tracking
e) External (outside of factory) storage – (UV stability analysis)
f) Crate utilisation/ Racking requirement and stability review
g) Crate identification and scanning (wash off labels etc) review

Key Benefits

- Conversion from cardboard box to reusable swing bar crate for raw materials
- Meeting sustainability targets related to removal of packaging from the network

Project Cost Components

- Financial Cost/Benefit Analysis
- Trials and Ramp Up Plan development
- Crate storage solutions
- Shrink-wrap equipment
- Forklift resourcing
- Crate ID/scanning solutions
- Digital solution integrations

Coles is working through the logistics and commercials of the transition of cartons to crates.

Aging requirements which require longer crate hire with resulting higher cost have to be balanced against the costs associated with cartons, such as manual handling, disposal and waste to landfill.

The transition began with an 8 week trial with a single SKU on the use of Swing Bar Crates (SBC's) out of our Primary Processing (PP) facilities.

We commenced packing SKU 9268068 for deliveries effective from Monday the 25th of July.

Several other SKUs commenced from the 6th of August.

3933561 – BEEF VALUE RUMP (FP), 8506310 – BEEF TENDERLOIN (FP), 434372 – BEEF TENDERLOIN BUTT (FP), 434339 – BEEF RUMP (FP)

Based on the cut plan and load outs we currently supply the items into SRS, RROA, BEC and RIVALEA from our partner PP.

There will be no changes to any part of the product specification or piece counts. The only change will be the secondary packaging format changing from a carton to an SBC.

The SBC's will be returned to RROA's local CHEP depot twice a week for de-hiring purposes.

Labels will be the same format as currently used at RROA and will be soluble for the crate washing process.

The 8 week trial reviewed the following items:

- Crate on pallet transport issues
- Pallet wrapping quality – ensure shrink wrap from top to bottom of pallet to avoid pallets slipping
- Contamination between layers of crates managed with cardboard liners
- Pallet yields – crates with same weight but less crates per pallet (30 crates/pallet vs 40 cartons/pallet – 25% capacity reduction)

- Pallet height could increase to 1.3m in racking but this is not a suitable height for manual handling at decrating
- Need to ensure sliding crates across other crates when unloading doesn't cause bale arm damage

- Crates are locked into bale arms so don't slide around like cartons. This is good for stability, but not when removing crates from the pallet.

- Need to lift a little in order to slide into a good position from which to lift.

- Do not lift with bale arms else they will break with these heavy loads

- Ensure operators don't put their thumbs through the crate handles when tipping else their thumbs could catch and get injured.

- Use palms under the crate to tip.
- Carton and Crate manual handling issues were assessed by a trained physio over several weeks of the trial.

Several of the key findings are listed below.

- Cartons require repetitive knife work which cause injury
- Both Cartons and Crates have issues when unloading heavy loads from the top of a pallet
- Crate handling presents a slightly lower risk than carton handling

Physio Report

In summary, the differences between the two methods are due to: - The use of a knife for opening the cardboard boxes - Stacking of the crates, or the disposal of the boxes.

As seen in the completed ManTRAs, the cumulative risk for the cardboard boxes is higher for all areas of the body. The reasoning for this is primarily due to the use of the knife to open the cardboard boxes. The worker is required to get into awkward postures particularly when the boxes are stacked higher, leading to a higher cumulative risk for the neck/shoulder and arm/wrist/hand.

With the crates, one of the hazards which will need to be controlled is the stacking of used crates. Administrative controls which prevent workers from stacking it over shoulder height is necessary to minimize load on the shoulders, neck, and back. However, if this is controlled, then the physical demands of the new crates are less conducive to musculoskeletal injuries when compared to the cardboard boxes.

Shortly after this report was compiled, the empty crate palring system was installed which removed the risk associated with stacking empty crates above shoulder height.

The only remaining risk for both cartons and crates is handling heavy loads above shoulder height when unloading full pallets. The business is reviewing possible solutions to mitigate this risk.

Next Steps

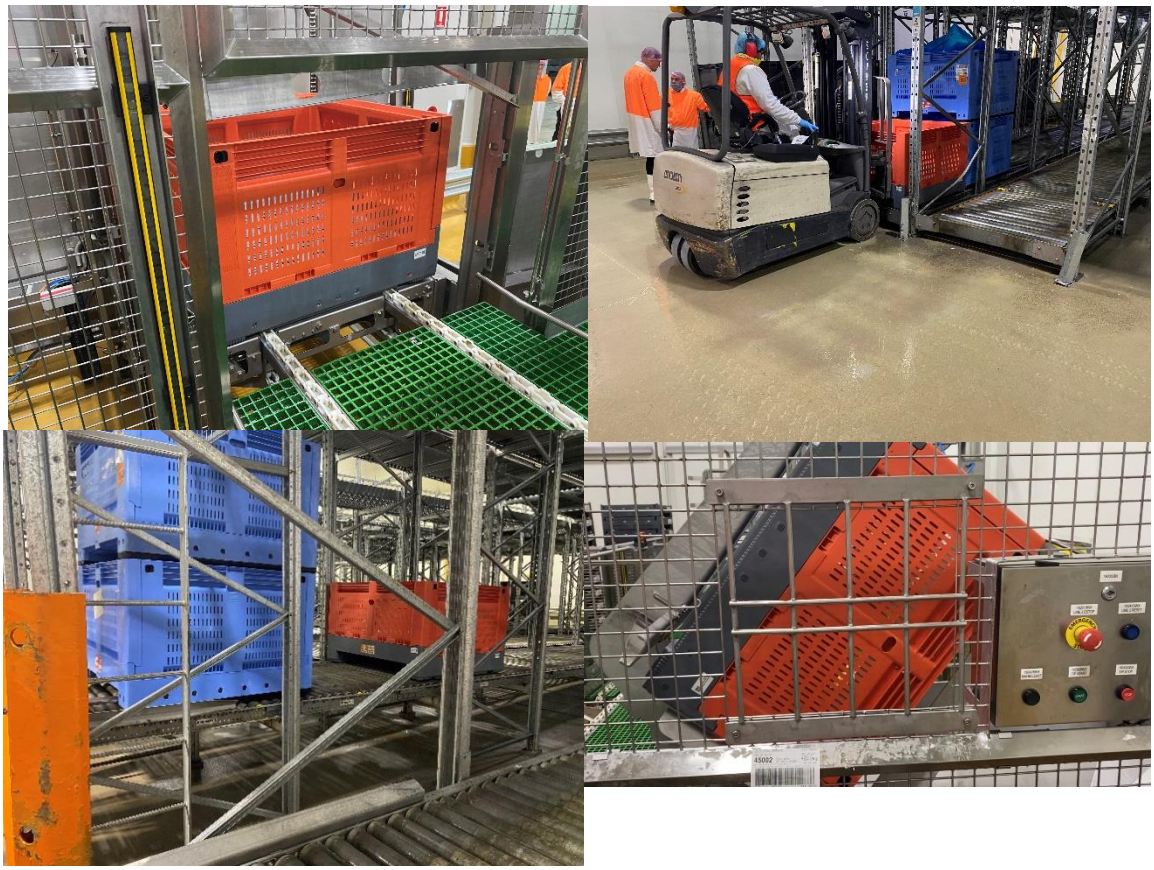
The business will continue to transition cartons to crates as suppliers are able to transition.

4.3.2 New Bin Trial

Our current pool of bins experience high levels of damage which has a significant financial impact on the business.

Coles RROA, in partnership with the PACT Group have launched a trial of a new High Grade Poly Propylene bin for the transfer of raw material to determine if this level of damage can be mitigated.

The bin was tested empty and full to check that it was able to transfer through the site's automation.



The pilot program started Feb 2024 with a pickup of 198 bins. Several loads transitioned through the supply chain in the first few weeks with only a few minor damages being recorded as shown below, and one major damage to the base of one bin caused by a forklift.

Statistics continued to be collected through the 12 week trial to determine if the rate of damage both in frequency, total number and cost, is below those experienced with the current pool of non-PACT bins.

Week 1-2 Statistics

630 bins returned / 7 damaged / 0.11% damage rate / Total Repair cost TD $190.

Full 12 Week Statistics

The new PACT Bin design for RROA ended its 12 week pilot program trial. The trial was a great success with a lower damage and cost per repair than the current pool of bins after several cycles through the entire supply chain.

3490 bins returned / 24 damaged / 0.7% damage rate / Total Repair cost TD $2,205.

This compares to an average of 4% damage rate with the current non-PACT pool of bins.

4.3.3 Faster Fresher Flows in Red Meat Processing through open innovation

Coles RROA proposed to customise TilliT, an open-source, license free, suite of applications designed to improve order enhancement through pick and pack integration to achieve faster, fresher, flows in food processing and logistics specific to red meat. The goal of the project is to reduce the order cycle time to retail shelf by one day, with the general business rules and methodologies employed, available to share with the wider red meat industry.

Milestone 1 focused on the ***design of the FFF channel*** for RROA through a planned 3 month period, but achieved not just the design, but the ***fully implemented release 1*** TilliT module at a ***45% below budget cost.***

TilliT Release 1 has enabled the ability to predict what orders are coming through to the Buffer Chiller in order to automatically schedule the picks and continuously build the pallet loads, rather than waiting for the entire order to be completed before building the pallet load. Additionally the loads are built in a way that optimises the truck load through evenly levelled layer pallet loads, that has increased utilisation by 15%.

The result of the optimised pallet loads was a ***15% uplift in truck utilisation*** moving from an average of 42 crates/pallet to 48 crates/pallet. This has resulted in a reduction in 51 B-Double transport movements which is a ***46.5T reduction in greenhouse gases ie a saving of 235 trees per year***. This is just based on the minimal rollout achieved in the first phase release. Further benefits will be realised upon the final deployments in July 2023.

Time savings of approximately 30% for both loading at RROA and unloading at the DC have also been achieved with 2.4m double stacked pallets which are possible with the even layer level pallet loads.

I**mproved utilisation of truck loads through layer leveling – 15% improvement**

Benefit to Coles and the wider Meat Industry

This ***Faster Fresher Flows initiative*** showed that the strategy of employing ***license free, open-source development applications***, was a very ***cost-effective*** way of developing a ***tailored red meat application*** stack that integrates store orders to secondary processors, production execution and ***pick order optimisation at the processor, truck load optimisation***, and ***coordination between processors and stores*** in order to select the best processor based on criteria such as price, packaging format, shelf life, machine availability etc.

Any other proprietary suppliers can leverage this approach to achieve faster, fresher, flows. Timeframe will be post RROA develop.

Other parts of the business have benefited from the solution such as Chef Fresh and non-Red Meat sectors.

Lessons learnt

Due to the ***complexities of the meat supply chain***, with varying weights, varying prices per customer per store, multiple packaging formats with shorter or longer shelf-life and multiple suppliers to select from to fulfill customer orders, ***a more holistic and integrated approach was required*** to optimise the order to production to delivery process flow, in the supply chain. This meant, in order to achieve the highest level of optimisation, RROA, the Coles DCs and other associated ***suppliers***, all needed to be ***integrated via the same application stack***. However the benefit of 1 day out of the order cycle for RROA was achievable without the other suppliers being integrated. Having the other suppliers integrated allowed for the customer, via DCs, to have ***more options*** to fulfill orders in a way that minimised the order cycle and cost, while maximising shelf-life, ***in the face of any particular supplier issue.***

The ***customer can utilise information on the supplier sites, equipment, lines and people, by products and packaging format, accounting for shelf life constraints, in order to optimise the supply chain to leverage opportunities and bypass issues***. Information transparency provided

to the customer allows the orders to be balanced across the week in order to do such things as produce short shelf-life product or packaging formats, on the highest volume consumption days and optimise across suppliers. The information across suppliers and within the supplier production profiles, informs the business which packaging formats to increase, to ***ensure multiple packaging formats are available for the various demand scenarios***. The FFF channels allow site capabilities to be shared with the customer to allow the customer to ***make appropriate orders across time which will optimise the supply chain to deliver the freshest product with the longest shelf life, utilising the transport channels in the most efficient manner.***

Open Innovation

The presentation below focuses on the benefits of open innovation at the heart of the Faster Fresher Flows project.

Our Business

Our **vision** is to become the most trusted retailer in Australia and grow long-term shareholder value.

coles

- 840+ supermarkets around Aus
- 900+ liquor stores (Liquorland)
- 22 Coles Local stores
- 480 rapid delivery stores and more than 600 Click & Collect locations

- 120,000 team members
- 8,000 suppliers
- 430,000+ direct shareholders
- 6 million+ customers through store and eCommerce platforms every week

colesgroup

Our Business

Located in Erskine Park NSW, RROA is what we call as a secondary processor.

RROA supplies all Coles stores in Central Australia and the Eastern Seaboard.

RROA supplies the majority of Coles Branded Meat products in NSW & QLD.

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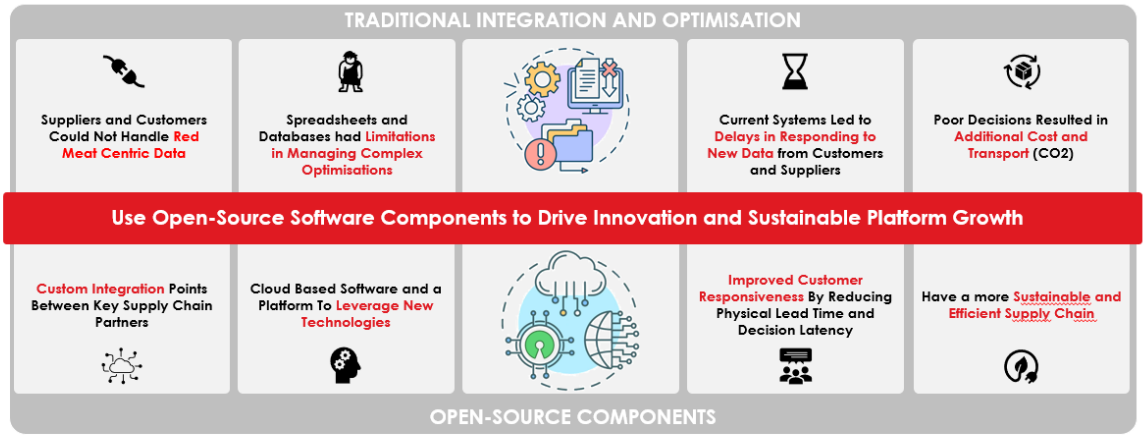
Open Innovation

Innovation Proposal

Participation in MLA Co-Innovation and Digital Innovation Programs Indicated Several Common Industry Challenges With Data Management & The High Cost of Technology



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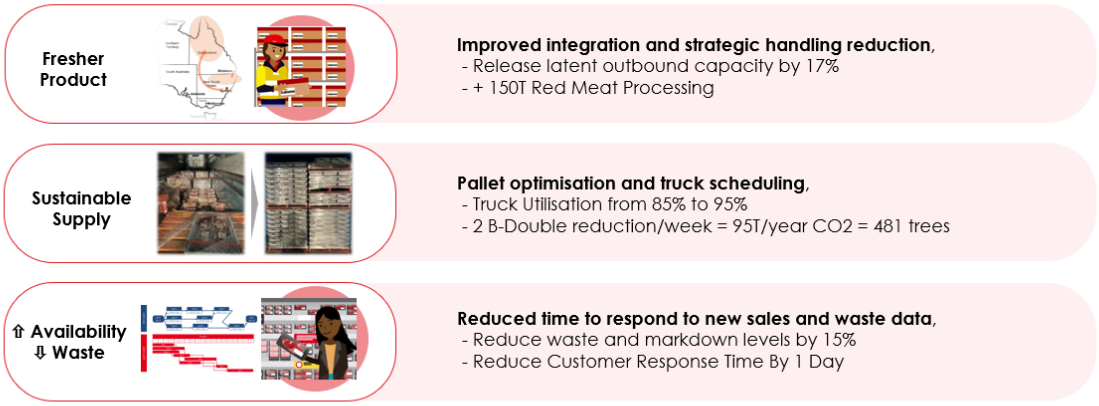
8

Specific Objectives

To Prove the Capabilities of the Technology Platform, We Identified Specific Objectives that Could Be Accelerated By Digital Innovation



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Open Innovation

Innovation Proposal

This project successfully leveraged open-source components on stable platforms to achieve cost-effective innovation. A trusted technology partner provided crucial support and guidance.

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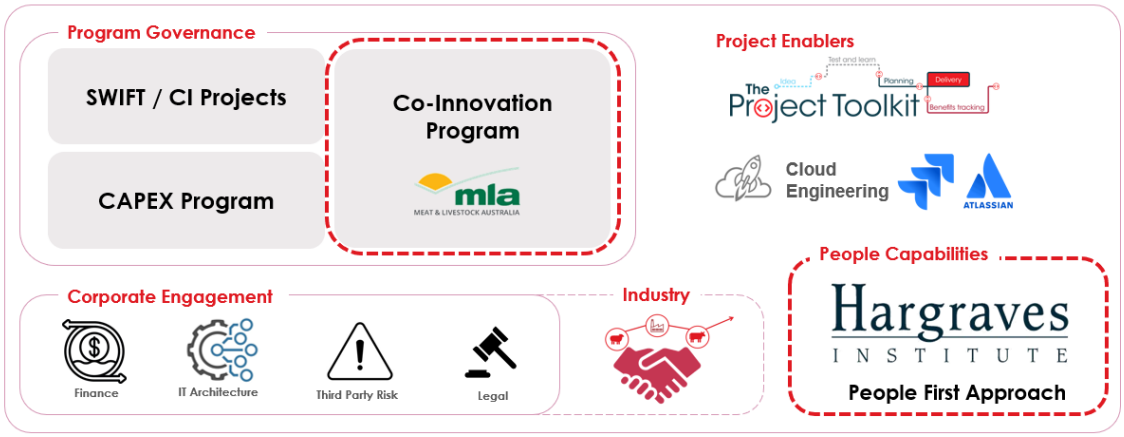
10

Innovation Pipeline

A Co-Innovation Pipeline as well as a People First Approach to Innovation Been an Enabler to Overall Innovation and Appetite for Risk



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12

Innovation Pipeline

Having an Overarching Strategy Drove Genuine Leadership Commitment to Innovation and Empowered Teams to Deliver

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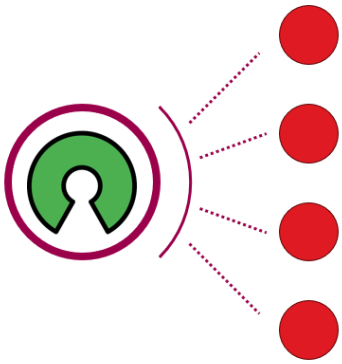
Lessons Learnt

Key Watchouts and Leanings When Implementing Open-Source Components as an Innovation Strategy



Open Source is Not for Everything – Ensure a Hybrid Approach:
Differentiate core and non-core features – tailor your design accordingly
Ringfence components to reduce risks and avoid complexity

Create Opportunities to Test and Learn with Emerging Technologies:
Build a platform that supports easily interchangeable components
Avoid being locked into partnerships and "hooked" on updates

Build a Solid Core with the Future In Mind:
Ensure you have a solid disengagement plan for what you don't control
Ensure you have the capability to manage security risks to information and operations

Create a Community That Is Open to Sharing Risks and Knowledge
Look for opportunities to generate and share new knowledge
Simplify supply and support integration with network suppliers
Advocate for

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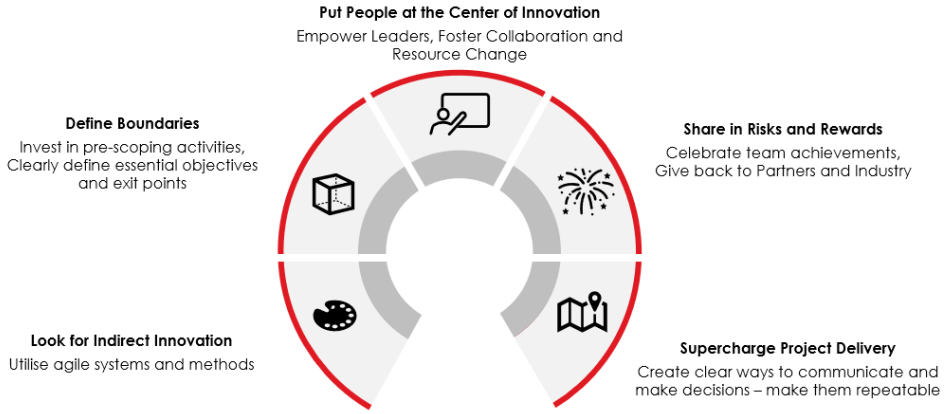
15

Lessons Learnt

Empowering people through strong partnerships and industry collaboration unlocks breakthrough innovation that benefits everyone



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4.4 Product Innovation

The pillar of Product Innovation focuses on such areas as improving quality and compliance, yield optimisation, market insight access and new product development among other things.

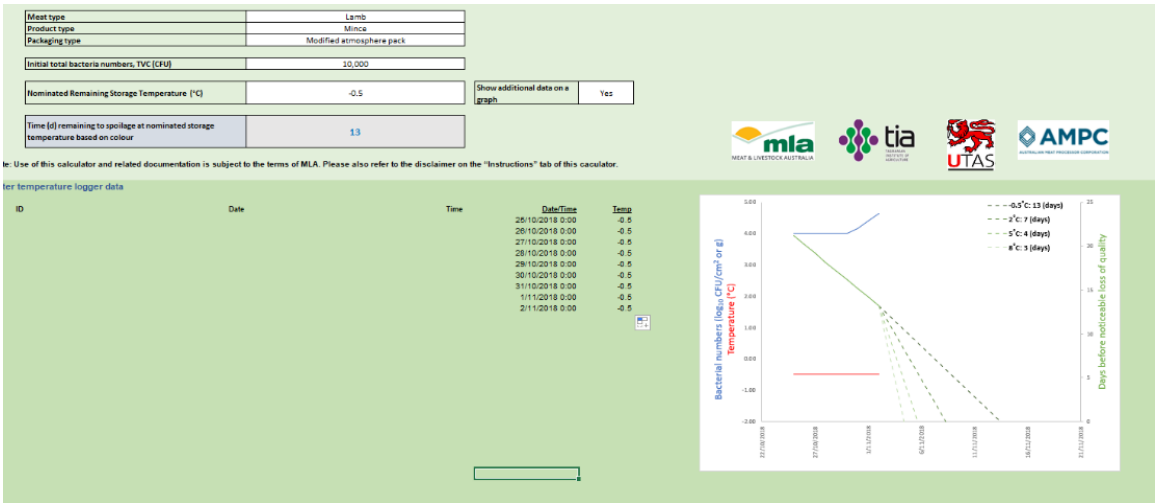
A summary of the main projects completed are as follows.

- NPD strategy alignment with MLA, Chef Fresh and RROA
- Premium and economy range growth strategies
- Frozen product design
- Corning product yield optimisations
- Beef and Lamb NPD
- Attend IFFA, Germany to learn new market trends, process, packaging and product innovations
- Attend FoodPro Expo to learn new process, packaging and product innovations
- Attend Appex Expo to learn new process, packaging and product innovations
- UTAS Lamb Shelf-life study for shelf0life calculator
- Export New Product Development

4.4.1 UTAS Lamb Shelf-life Calculation Tool

RROA procured and processed several sets of aged lamb primals into finished goods packs. The Innovation manager worked with RROA's suppliers to procure the primals at various ages and coordinate the processing in a timely manner to produce finished packs which could be shipped as quickly as possible so UTAS could develop an accurate shelf-life model. The model incorporated not only the various ages of primals, but also the type of cut and packaging format.

UTAS will have a published model that the industry can use to predict accurate shelf-lives of products by specifying storage and final temperatures, initial micro counts, meat cut and packaging format, for lamb. RROA assisted in the review of the initial portal, and used an early release in the Denba project.



Lessons Learnt

- The Coles method for shelf-life determination includes temperature abuse and pre-aging the meat. This may differ from the shelf-life calculator model and so should only be used as a guide.
- Not all packaging types are equal ie MAP is not all the same performance, nor VSP, so again the calculator calculation may fall far short or exceed the actual shelf-life capable from certain material structures, formulations or gauges.

4.5 Sustainability

The pillar of Sustainability focuses on such areas as increased recyclability, recycled content, minimise material usage, reduce food waste and efficient use of utility resources among other things.

A summary of the main projects completed are as follows.

- Recyclable packaging trials – MAP, VSP, Shrink bags, Flex Flex, Preformed trays
- Collaboration with industry bodies such as APCO, PlanetARK, Foodbank, redcycle and others
- Lab analysis of packaging material structure and compositions to confirm supplier claims
- Film downgauging trials
- MAP packaging Liquid Lock trials for soaker pad removal
- PPE recycling
- Linerless label transition
- Locally produced packaging films
- Cardboard, plastic offcuts and rubber chock recycling
- Pallecon capacity improvements
- Fight Food Waste CRC Workshops to reduce food wastage

4.5.1 MONO APET films or those with water-soluble PE layers for recyclability

The VSP Platformer and Tray Sealer machines tend to be very susceptible to the sealing layer in standard films due to a build-up of residue which clogs the vacuum ports. Furthermore thicker gauges of film cause excessive wear on the machine parts.

Sealed Air have produced a unique MONO structure which was trialled. The material was only 500um base and 100um top as compared to the regular film which is 550um base and 150um top. Despite the thinner gauge, the film formed much more robustly than the thicker, standard film with no bent or bowed edges. During sealing the MONO structure was able to handle sealing through contamination. However the lower gauge is more susceptible to machine wear ie seal bar wear will cause the film to slip and not seal well onto the base tray.

The thinner 500um gauge has the added advantage of running cooler than the thicker 550um which allows the machine to run slightly faster cycles times, reduce machine wear and reduce or eliminate edge bends or bowing which results in a very nice and uniform tray.

PET materials which have a water soluble PE layer allow the PE layer to be separated from the PET and the PET is then able to be fully recycled. This allows up to 93% of the material to be recycled.

This is compared to materials which have PE layers hot melted onto the PET which means the entire material can not be recycled.

Other materials with starch or similar soluble layers to allow PET to be separated, only allow around 32% of the material to be recycled.

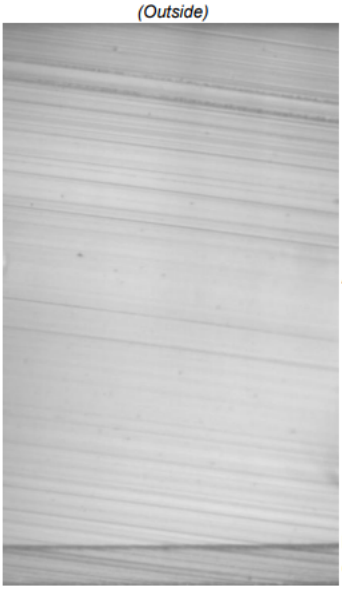
Multivac's Multisteps base packaging film claimed to have such a water soluble PE layer. Our partner Gunn Labs analysed their film and confirmed the claims as shown in the report below.

6 STRUCTURAL ANALYSIS OF MULTISTEPS BASE FILM:

6.1 Total thickness 453 µm. Range of measurements 447 to 460µm.

6.2 Cross-section:

(Outside)



A PET 422µm

B Adhesive (PVA?) 3µm

C POLYETHYLENE (LDPE or similar) 28µm

(Inside)

NOTES:

6.3 Traces (probably well under 1%) of a silicone denesting agent were detected on the inside surface. This is a common additive for trays, added to allow individual trays to be easily removed from a stack. Silicone may also be present on the outer surface, but is more difficult to detect on PET than on PE. Little or no silicone was found in the Plantic or Berconia base films.

6.4 The PREP report states that the adhesive is water-soluble. To confirm this, we placed film in (a) boiling water for 30 minutes and (b) cold water overnight. In both cases, the adhesive softened sufficiently for the polyethylene layer to be peeled off by hand. We can state that the adhesive has some degree of water solubility, but we do not know whether APCO have a definition or test method for water solubility of adhesive.

6.5 We calculate that LDPE comprises 4.3% (by weight) of the Multisteps base film.
The PREP report states that the primary material is PET and the secondary material is LDPE 10%. The Multisteps base film's LDPE percentage is well under the amount stated in the PREP report, which should be no problem for APCO as it would result in better recyclability.

6.6 Overall, we do not have enough information to state definitively if the Multisteps base film fully complies with its provided data, but we see no significant problems with it.

4.5.2 Fight Food Waste CRC

Coles RROA has been involved as a member of the Fight Food Waste CRC steering committee in a program that promoted collaboration between government, universities, consultants and industry to better understand food wastage "hot spots" along the supply chain which are impacting the Red Meat industry.

RROA representatives, Patrick Youil, Sheetal Maharaj, Gaurav Prasad and Suvir Salins attended two workshops in December 2022 to contribute their expertise on supply chain, quality and engineering issues that contribute to food wastage.

The final report details the findings of a research project into meat loss and waste loss in Australian beef supply chains. The research was conducted by Queensland University of Technology (QUT) and Royal Melbourne institute of Technology (RMIT), with support from Meat and Livestock Association (MLA), Queensland Department of Environment and Science (QDES) and the Fight Food Waste CRC (and its participants).

The focus was on upstream stages of beef supply chains, including primary processing (abattoirs), secondary meat processing (value-add), tertiary processing (prepared meals) and cold chain distribution up to retail. The aim was to fill gaps in data about the amounts, sources and causes of beef meat losses, and co-develop solutions for meat loss reduction with industry partners. The method included case study analyses, industry engagement and consultation, supply chain workshops, and use of the DIRECT tool to estimate true cost of beef loses.

Results/key findings

The project estimated that around 6% of beef meat that would otherwise be directed to human food is potentially lost between livestock receipt and the retail door. This is a more accurate baseline than currently available and is in line with similar estimates from the UK. A preliminary catalogue of loss reduction solutions was compiled, which can feed into subsequent development of a Sector Action Plan as part of Australia's Food Waste Reduction Strategy. The most significant loss reductions will come from collaborative supply chain solutions that hinge on greater transparency, communication and collaboration between supply chain stages and actors.

Benefits to industry

If the preliminary catalogue of meat loss reduction solutions are implemented, the benefits will be financial savings across the supply chain. The data and information about beef meat losses and solutions will enable participation by the beef industry in Australia's Food Waste Reduction Strategy, and increased social licence by contributing to society's call for food waste reduction. The supply chain collaboration that many of the solutions call for also provides opportunity for innovation, that would otherwise not be possible from supply chain actors working independently.

Future research and recommendations

The information generated by this project should feed into the development of Sector Action Plan (SAP) under Australia's Food Waste Reduction Strategy. There are still some data gaps remaining in terms of quantities and destination of beef product rejected by retailers, which was flagged as a priority source of losses for the industry, requiring collaborative solutions. In future work, it will be important to engage the cold chain carriers who could not be engaged in this project, despite attempts.

Lessons Learnt

- Not all sustainability claims are accurate and should be verified with a 3rd party such as Gunn Labs
- Even when sustainability claims are accurate, the local recycling capability can be limited by the sorting centres and their ability to accurately scan and recognise the various plastic types and structures. If they can't recognise the plastic, even if a recycling plant exists to properly recycle the plastic, the plastic may not get sorted correctly and end up in landfill or inadequately recycled
- There is no physical way of accurately determining the recycled content of plastic. This is based on supplier claims
- The higher the recycled content, generally the more brittle the plastic which can be an issue if the pack is dropped, such as at reject points, and if it was a false reject the pack needs to be completely reworked as they are often broken during the reject fall into a bin.

5. Conclusion

5.1 Key findings

Uplift of 180T red meat volumes through the 2021 to 2024 reporting period, which represents a 47% uplift.

There were 158 new red meat product launches through the plant over the 3-year reporting period.

The Co-Innovation program supported 89 new initiatives across the five strategy pillars.

Five new MLA funded projects were developed from Co-Innovation pilot programs or proof of concepts in this 3 year period.

Additionally the Co-Innovation Program contributed to Coles achieving the following Sustainability targets over the 3 year reporting period.

- 87.4% recyclable packaging
- 45% renewable electricity sources
- 36% emissions reductions
- 86.7% of solid waste diverted from landfill.

5.2 Benefits to industry

Key benefits have been shared through this and previous reports across the Operational Excellence, Supply Chain, Product Innovation and Digital Solutions pillars including Sustainability benefits associated with new materials, technologies or processes. These reports have detailed new technologies or processes the wider red meat industry can employ to achieve similar results to those enjoyed by Coles.

- Open Innovation utilising open source/license free software solutions to develop red meat solutions that are affordable yet targeted to provide planning tools and integration with suppliers to enhance and optimise order flow
- Technologies to further enhance hygiene with the downstream benefits of shelf-life extension, reduced cleaning frequencies and costs, and reductions in waste and markdown
- Easy to implement digital dashboards for data sharing, live performance tracking and improvements in operational efficiencies
- Advanced red meat trimming or portioning solutions for improved yields, faster throughputs and consistent portioning.
- New Artificial Intelligence vision solutions which are affordable, simple to implement and have less vulnerabilities to cyberattacks.
- Recyclable materials to meet the industry’s sustainability targets

6. Future research and recommendations

Coles is committed to furthering the financial, social and environmental benefits achieved through our partnership with Meat & Livestock Australia. As such, many of the initiatives begun in each of the pillars will continue to be developed, with some generating projects in their own right.

Most notably, but not limited to, the following initiatives will be further researched:

- RFID embedded finished goods labels for track, trace, inventory transparency with the view of ultimately lifting on farm sales of red meat.
- Benefits of Artificial Intelligence in Production, Planning, Quality and other departments, particularly machine vision applications.

Coles recommends that entities within the red meat industry review the details of the following initiatives within this report and/or contact Coles RROA, for possible implementation within their organisations to achieve the wide ranging benefits Coles RROA and Chef Fresh have enjoyed.

- Faster Fresher Flows in Red Meat Processing through open innovation
- Pandara's Puradigm Air and Surface Purification Solutions for shelf-life extension, HVAC mould reduction, packaging hygiene and protection of staff health
- Denba shelf-life extension and frozen food technologies
- JBT's DSI Waterjet Trimmer
- Deep Learning/Artificial Intelligence Vision
- Liquid Nitrogen Mince Cooling
- OFS Digital Dashboards
- RFID Embedded Labels
- Multivac/Bizerba TVI1600 Primal Portioner
- MONO APET films or those with water-soluble PE layers for recyclability

7. Appendix – Supporting Documents

7.1 Appendix 1 Coles Group – Vision, Purpose & Strategy

7.2 Appendix 2 Coles RROA Collaborative Innovation Strategy

Coles RROA / MLA Partnership Strategy (2021-2024)

Aspiration: By 2024 Coles will increase red meat consumption across local and export markets by 10%

Expected Values: (1) Export Sales Values doubled by FY24 (2) New Formats: 5% increase by 2024, 10% increase by 2030. (3) Meat Network Productivity: 10% reduction in controllable costs by 2024

HOW

Quality products | **Drive continuous improvement initiatives** | **Data driven insights** | **Deliver cutting edge quality initiatives** | **Consumer focus** | **Industry leading collaboration**

Priorities and Projects by Area

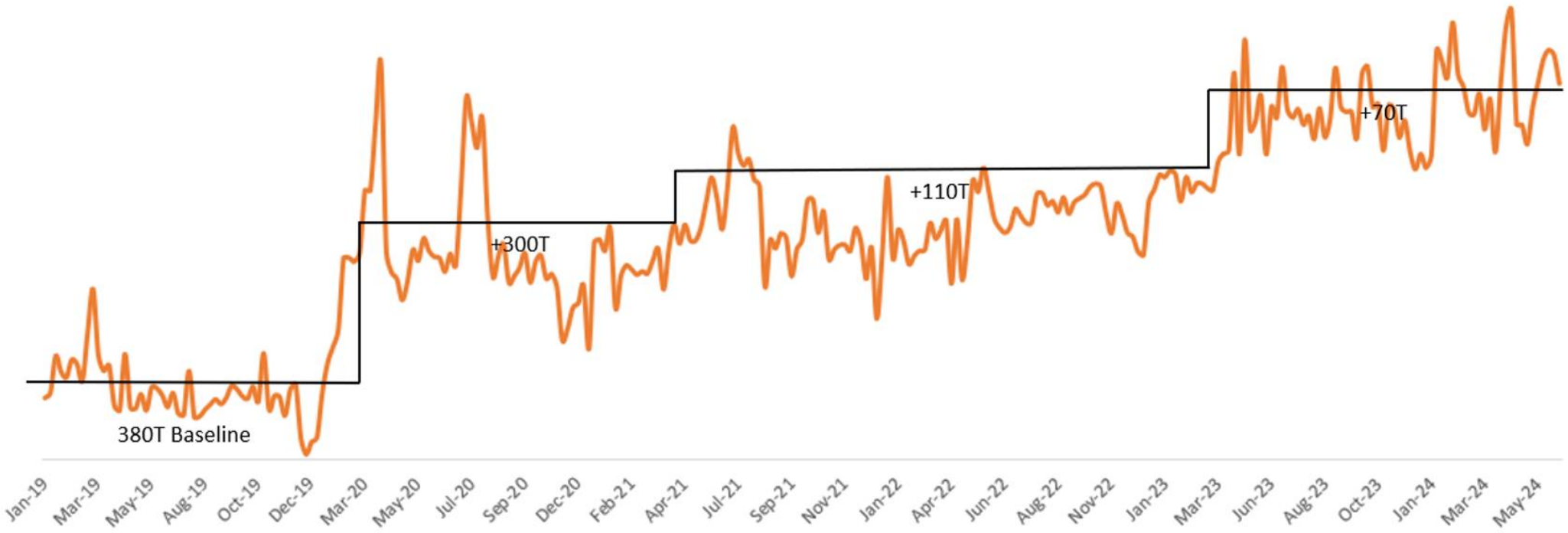
RRM Operational Excellence	Digital Solutions	Supply Chain & Sector Opportunities	Product Innovation	Sustainability – (Coles Internal)
Automation • Line 1 automation to eliminate remedial task around meat handling /transfers • Cobotics, Vision and AI applications • Vision OCR inspection systems • Introduction of Augmented maintenance systems	**Data Driven Decision Making** • Capture and use essential data to inform decisions and operations • New platforms & technologies • Enhanced data visualisation • Develop a data model specific to packaged meat production	**Shelf-life** • Work with suppliers to improve shelf-life • Sustainable or new packaging formats/materials/easy-open • Packaging cold-chain compliance traceability • Develop raw material shelf-life modelling for retail ready meat	**Improve Quality & Compliance** • Continuous sanitising technology • Dynamic, equipment processing flow based shelf-life calculations	**Increase Recyclability** • Transform all meat packaging to fully recyclable by 2025 • Soaker pad elimination • Use of Bio-degradable inks • Increase recycled content of raw materials • Promote recycling of packaging materials using ARL format
Production Metrics • Automated online quality attribute measurement, i.e. fat levels, visual lean, grading, yield, finished pack inspections • Yield Optimisation program	**Data Collaboration** • Enhance data through employee insights • Implement data sharing via cloud, blockchain and other data streaming technologies • Business to business data exchange for meat attributes	**Business Models** • Feedback integration to suppliers and producers – Muddy Boots	**Yield Optimisation** • Development of new technology for fixed-weight on portioning – TVI1600 trials • Portion control – portion number and weight – improving online customer experience	**Minimise Material Usage** • Equipment capable of using recyclable materials • Minimise packaging and waste • Low/no waste Equipment options • Replacement of cardboard shippers with reusable crates for raw material • Lower Gauge packaging films • Printed top film for fewer labels
Lean Implementation • Rapid implementation and scaling of new ideas • Maximise employee engagement of new technologies • Leverage best in class FMCG Lean program implementation • Training programs, RCM programs	**Business Optimisation** • Meat-centric enterprise application development through open-source platforms • Introduction of a BI platform / dashboard and predictive modelling to manage KPI's • Technology to manage animal welfare and maximise yield	**Sector Relationships** • Build sector relationships to improve innovation – Lumachain traceability • Collaboration projects with suppliers and producers – raw materials, packaging and transport	**Market Insight Access** • Adopting product solutions from external sources • Market analysis – economy meat cuts eg end-cuts • Portion optimisation: budget/premium – DSI fat acceptance levels	**Reduce Food Waste** • Packaging to extend freshness and shelf life by using alternate MAP technologies and Vacuum formats • Sales of un-used cuts • Surplus donated to Food Bank/Second Bite
Supply Chain Efficiency • Faster, Fresher Flows • Transport optimisation-double stacking/pallet standardisation • End-to-end optimisation • Robotic truck loading • Improved factory Density Model	**Production Data Analytics** • Inventory optimisation / Analytics / Order shaping / Constraint management • Automate OEE measurement and reporting • Live KPI dashboards in factory • Data mining using deep learning and AI to guide initiatives • Automated workflows for production efficiency improvements • Leverage Industry 4.0	**Guarantee Quality** • Foreign matter/ plastic detection in meat • Paddock to Plate traceability processes (DNA traceback/AI) • Extend shelf life and freshness • Product origin information • MSA Eating Quality index • High speed in line seal integrity checks • Temp sensitive/Shelf-life sensitive embedded devices	**New Product Development** • Value adding products to meet customer needs • Discovering different cuts and uses for the whole animal • Frozen meal solutions • Product life - ageing in bag, optimise / extend shelf life • Ease of use - information on pack/ online • Value add meats that deliver convenience i.e. tenderize etc	**Efficient Use of Utility Resources** • Greenhouse gas reductions • Minimise Refrigeration load by management of room isolations • Rainwater use in building utilities • Building management systems to monitor and control energy use • Solar power/Battery storage

7.3 Appendix 3 – Co-Innovation Program KPIs

Value Added Products

FY 24 Results

Product description	Projected % of Enterprise Turnover	FY24 Results % Uplift from Baseline to Current	Comments	FY 25 Forecast	Comments
Cut line beef/lamb	10	35	300T	3	Expect volumes to be steady with a slight increase. More focus on product freshness, shelf-life, eatability and widening the range of stores which can stock fresh, red meat
Corning	10	13	110T	3	
Mince	10	8	70T	3	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