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Picking, Packing and Materials Handling Review

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Executive Summary

This project quantifies the areas of industry need for beef, sheep, goat and lamb processors in relation to picking, packing and materials handling, the technological opportunities relevant to these needs, the likely developmental challenges and analysis of cost, benefit and possible technological or provider gaps.

Global pressure requires agile systems

Increased globalisation and greater market access is providing many opportunities for Australian meat processors. But with this comes a higher demand on service, responsiveness and traceability, driven by a generation of consumers with information at their fingertips. Customers have access to a larger pool of suppliers, increasing pressure on companies to reduce costs. Agile systems and materials handling infrastructure is becoming more important in remaining competitive while responding to these increasing demands. Appropriate materials handling solutions limits the potential for process errors and reduces the labour cost per unit while increasing productivity and consistency. This allows manufacturers to optimise the process by which raw material is converted to commercial product with the highest possible utilization of input costs with minimal waste.

Materials handling systems are becoming more sophisticated but there are gaps

Australia is leading the world in adoption rates in beef and lamb slaughter and boning automation. However, materials handling advancements in Europe are far ahead of Australia, due in part to markets and geography that support centralised processing of large volumes of consistent product lines. These technology and capability advancements are helpful for Australia to consider but most solutions are not directly transferrable requiring adaptation of component technologies and capabilities.

Site visit results and industry priorities

Processors across the industry were consulted as part of the review along with site visits to five processors across small and large beef, lamb and goat processors.

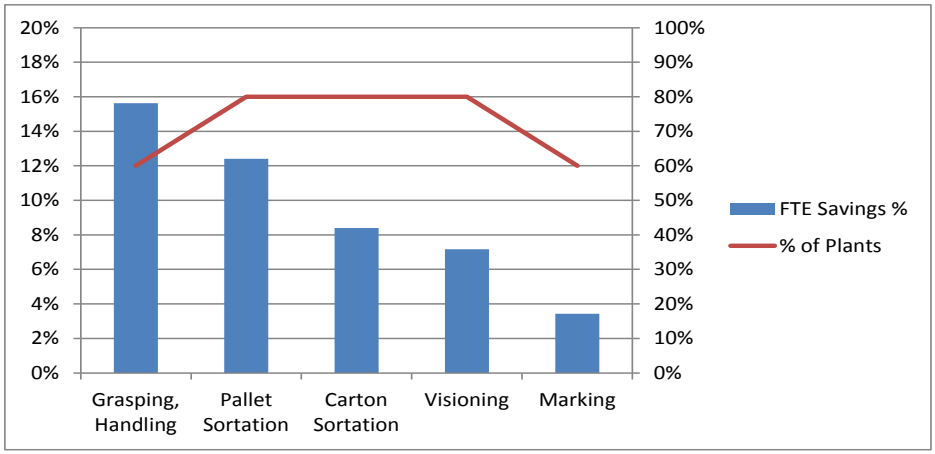

Figure 1: Opportunities by area of equipment capability

The FTE savings displayed in Figure 1 like grasping and handling tasks tend to be the harder jobs to automate. Although visioning does not provide as big a saving as other capabilities it is an enabling technology in some larger applications and could make some solutions to a wider group of processors. Some areas such as port marking will not save many labour units, but may increase the payback for more complex jobs if coupled with another system such as a shipping container loader.

High level business case analyses was conducted on priority areas identified from the processor site visits and in conjunction with solution providers. The benefits of these systems for the sites visited are summarised in Table 4 on page 17 and detailed in appendix 9.1 *Milestone 4 .* They include:

- Automatted primal carton packing
- Automated shipping container loader
- Lamb primal breaking for domestic carcase and quarter carcase loadout
- Carcase stringing, bagging and loadout
- Trim sortation and packing
- AGV palletisation, storage and retrieval of carton product
- Automated primal bagging (existing solution)
- Real time yield reporting
- Carton labelling (existing solution)

Strategic development considerations

Based on the rate of change in materials handling capabilities in other parts of the food industry, the component technologies are becoming available to enable some Australian processors to make radical improvements in materials handling over the next 10 years. The incentive for this is to reduce costs, increase efficiency and agility to meet increasing global competition.

This development journey is not clear cut as it requires progressive development of industry capability while individual plant needs vary widely. However, there is a general strategic path that applies to all companies and requires capability development at a number of levels to support a faster rate of industry transformation.

summarises this development path and breaks technology solutions broadly into either radical or incremental improvements. These general classifications are broken into three specific types of commercial solutions including:

- Small projects
    - Most likely to deliver short term incremental improvements
    - Can provide learning's to the plant and automation providers for development of future systems
- Integration technologies
    - larger scale solutions combining a number of different technologies or addressing a number of issues within a plant; AND

- Large infrastructure projects
    - most likely to support radical improvements
    - Usually limited by other smaller bottle necks that once addressed create a tipping point that justifies ROI

These commercial solutions are supported to varying degrees by enabling technologies that require integration with other capabilities to become a commercial solution. Development of these capabilities is often most neglected because new innovation is required beyond aggregation of existing technology and may not result in a commercial product in the first instance.

Understanding how new R&D investments fit in the capability evolution is helpful and should be mapped to some degree as solutions are developed.

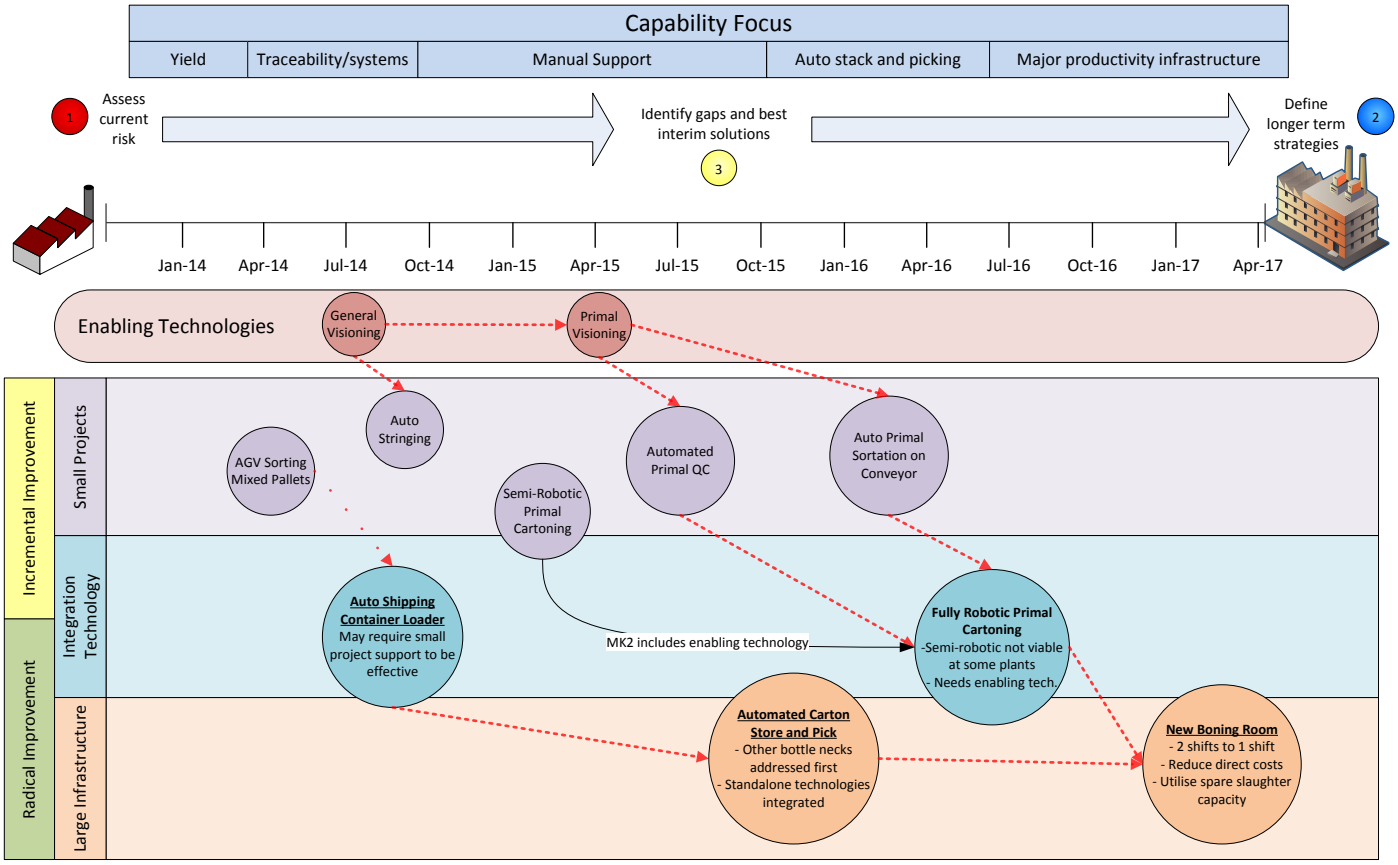

Figure 2: Strategic development scenario for materials handling within a red meat processor

Key observations

① All plants are on a journey of capability development to maintain competitiveness where the global trend is toward increasing sophistication in management of materials handling and logistics

② All plants need interim solutions in at least some areas before step change is possible. AGV solutions that re-palletise mix pallets are an example of an interim solution to automated carton storage.

③ On a case by case basis some plants will have the opportunity to move directly into step change solutions. In materials handling these are usually customisable to the plants unique range of circumstances.

④ A range of solutions require or would benefit from additional enabling capabilities but investment in these capabilities is risky for providers.

⑤ Each plant is unique in its needs and the pathway of development will be very different.

The Australian red meat industry has a wider range of variables to deal with than those in Europe and the USA such as a wider range of export customers, more destinations, less concentrated populations. This requires a greater level of flexibility which makes direct application of large infrastructure solutions hard. Some impacts include:

- Smaller processing line installs rather than high volume lines for single customers
- Different ways to access technology
- Adaptations to existing lines are required to provide interim solutions

Provider capabilities in materials handling and picking solutions for the meat industry are developing. But providers have the pressure of developing immediate commercial solutions for clients. Broad design considerations to meet the wider market are of concern but the main focus and pressure is in delivering the immediate solution. This will involve the adaptation or combining of proven technology components.

Recommendations

A wide and varied range of opportunities for development of materials handling and picking and packing capabilities have arisen from this review. Those detailed in this report are priority areas for the plants surveyed but are not an exhaustive list of development needs across the industry. Although some key areas of development are listed, the industry has a wider need for meat industry specific materials handling capability. Part of the recommendations break down the development into key capability areas, all of which require development as a multi-pronged development approach to address short, medium and long term needs across the range of meat processors.

1. The meat industry has a need for materials handling solutions to be developed across the range of solution categories covered in the report including:
    a. Enabling technologies
    b. Small projects
    c. Integration technology
    d. Larger infrastructure projects where development of capability components can be easily transferred to other integration technology solutions

2. A balanced portfolio of projects in each area should be under development. Loose development pathways should be identified that:
    a. Progressively link capabilities to make solutions viable across more of the industry. For example, primal carton packing involves some manual inspection and intervention cost so is uneconomical for some plants, but automation of QC visioning would increase the value proposition for a wider range of plants.; or
    b. Build and connect new capabilities towards integration for larger more difficult automation solutions. For example, visioning and grasping for Auto stringing lamb carcases leads to auto stringing and hanging of quarters which may lead to grasping of bags for auto carcase bagging.
3. Development of enabling technologies in the area of primal grasping and manipulation technology should be considered where:
    a. Adaptation to the wide range in size and shape of primal cuts across beef, lamb and goats is accounted for
    b. Bagged and un-bagged primals can be managed
    c. Technology takes into account the range of processor configurations and product presentation before and after packaging
    d. Prioritise development path to species and cuts balancing trade-off between risk and reward
4. Development of enabling technologies in the area of primal visioning systems have the potential to enhance and support a large number of materials handling solutions and should consider the following:
    a. Primal identification
    b. Quality checking requirements
    c. Prioritisation of tasks over time to progressively minimise development risk
5. Development of enabling technologies needs to consider the range of commercial applications they could be used in and implications for providers that may want to access these capabilities.

Glossary

Term	Description
CBA	Cost Benefit Analysis
ROI	Return on Investment
FTE	Full-time Equivalent labour unit
MLA	Meat & Livestock Australia
PPH	Picking, Packing and Materials handling

Contents

1 Introduction

Materials handling (“picking and packing”) of post boned & sliced product, as well as half and whole carcasses and parts (primals, sub-primals & shelf ready portioned) is a significant cost to processors as well as a potential value add to the majority of businesses dealing with beef and small-stock processing.

This project is directed at benchmarking and quantifying the areas of industry need in relation to picking, packing and materials handling; the technological opportunities relevant to these needs; the likely developmental challenges; an analysis of cost and benefit; and possible technological or provider gaps.This review considered beef, sheep, goat and lamb, noting that the main difference in terms of issues/solutions and recommendations will relate to the size of the cuts, product ranges, plant configurations and engineering and product specification.

2 Objectives

This review considered analysis of solutions that processors either require or are undertaking, a review of existing technologies (including other industries), and the identification of technological (manual assist or automated) solutions be undertaken as part of this project, along with a priority list of tasks of importance to industry. Additionally, recommendations towards either developing targeted solutions, or undertaking proof of concept design, were also considered in the review. The outcomes of this project will be used to inform future investments in this area and identifies specific tasks, current solutions/technologies including manual assist options, opportunities for future design solutions and a feasibility assessment that accounts for industry need.

The following key elements of the processing businesses were considered when reviewing the relevant options, current and future solutions for picking / packing and materials handling:

1. Investigating possible yield Improvement through picking and packing solution application at various stages;
2. Labour sustainability & productivity;
3. OH&S;
4. Product quality;
5. Traceability.

These elements have been factored into the project findings and identify development needs and considerations for picking, packing and materials handling for the Australia red meat industry

3 Activities conducted

A wide range of actvities were involved in assembling these study results and included the following components:

- Development of a survey and cost reporting methodology to normalise data collection across each site
- Desktop review of a wide range of automation products, components and integrated solutions within and outside the meat processing industry
- The review considers issues, gaps, risks, solutions and recommendations that are applicable to a range of plant size, throughput, speeds of operation, configuration and products. Processors in each of the following categories were consulted within the project, as well as site visits to five processors wihtin these categories:

Plant	Plant Type	Species	Notes
1.	Medium Volume	Beef /Lamb	Mixed species
2.	Medium Volume	Beef	High number of product skus
3.	Medium Volume	Beef	Relatively low number of product skus
4.	High Volume	Beef	
5.	High Volume	Lamb/Goat	

- High level business case analyses was conducted on priority areas identified from the processor site visits and in conjunction with solution providers.
- Summary of findings and key strategic considerations for materials handling developments initiatives

4 Site Visit Results

There are a number of development opportunities that could benefit the picking and packing section of beef, lamb and goat abattoirs where no automated systems are commercially available. Some opportunities apply to all three species while a number are species specific.

The flow diagram in Figure 3 and Figure 4 identifies the opportunities in each section of the abattoir after the carcases exit the chiller. The opportunities have been detailed in high level opportunity analysis later in this report and the high level specifications of the systems have been included.

The business case analysis included in Milestone 4 and summarised later in this section are a result of the data collected during each site visit. The opportunities identified during the site visits included labour savings. The opportunities include high level breakdown of the possible Full Time Equivalent (FTE) savings. Detailed costing's of each system have not been included as they will vary between plants, depending on site specific specifications.

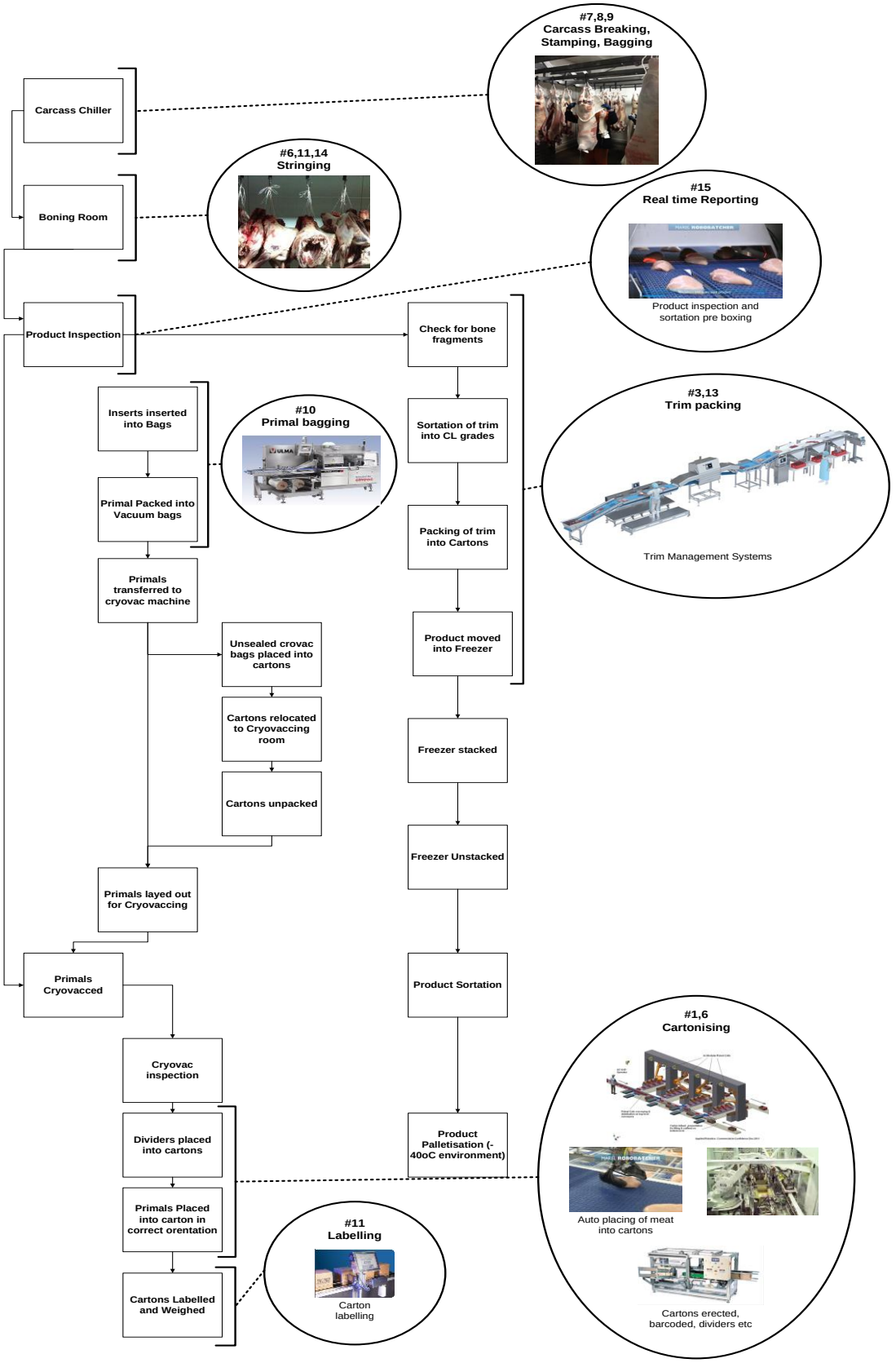

Figure 3: Picking and packing process flow

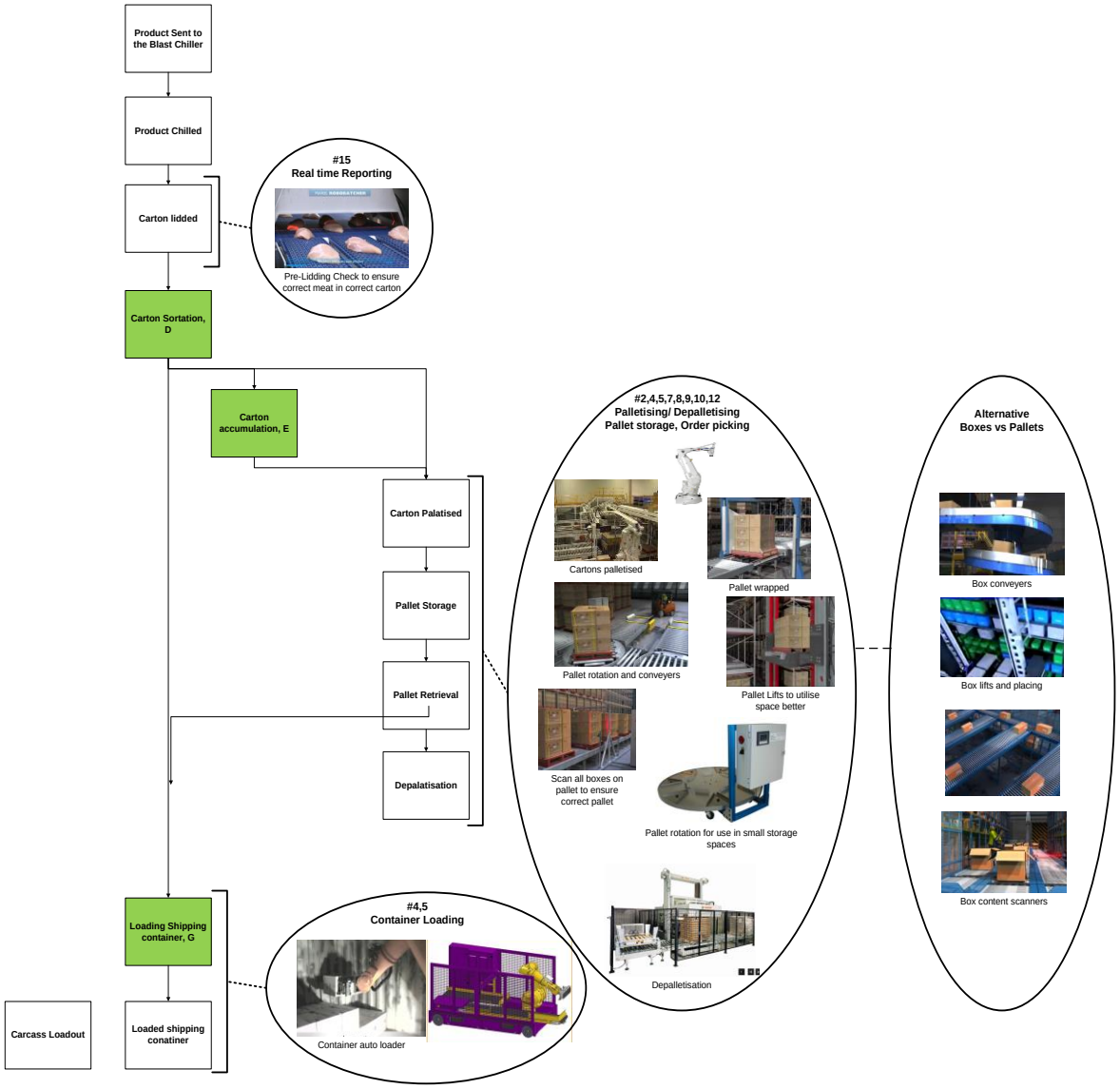

Figure 4: Materials handling process flow

The FTE savings displayed in Figure 1 and **Table 1** like grasping and handling tasks tend to be the harder jobs to automate. Although visioning does not provide as big a saving as other capabilities it is an enabling technology in some larger applications and could make some solutions to a wider group of processors.

Some areas such as port marking will not save many labour units, but it may increase the payback for more complex jobs if coupled with another system such as a shipping container loader.

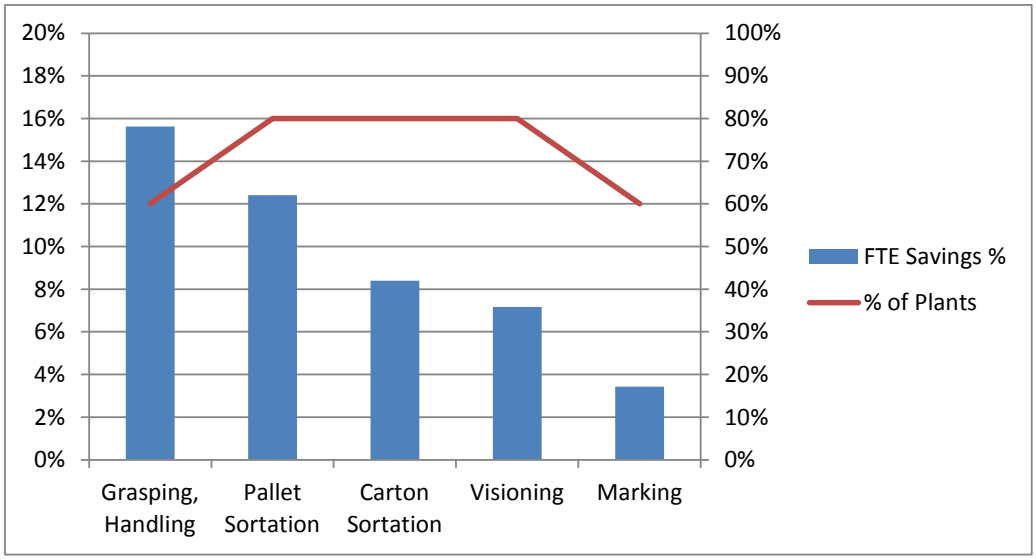

Figure 5: Opportunities by area of equipment capability

Visioning capabilities support automation in other areas. Quality Inspection for example is a manual process and until it can be automated, limits the ability to automate conveyor sortation.

Table 1: The number of FTE's saved for each area in Figure 1

Equipment Capability	# Opportunities	# Plants	FTE Savings %
Grasping, Handling	5	3	16%
Pallet Sortation	6	4	12%
Carton Sortation	6	4	8%
Visioning	8	4	7%
Marking	3	3	3%

Error! Reference source not found.Table 2 shows the opportunities which were discussed during the site visits and helped prioritise the importance of solution areas prior to completing the CBA's.

Table 2: Opportunities - Total by Area

Plant Section	Opportunity Area	# Plants	FTE Savings %
Blast Chiller	Chillers	3	19%
Carcase loadout (whole and half carcases)	Load Out	5	6%
Chiller	Labelling	2	4%
Cold Store	Cold Storage	1	0%
Freezer	Plate Freezing	1	16%
Picking & Loadout	Pack off	2	2%
Product packaging	Cartonising	3	11%
Trim Packing	Trim Weighing	1	4%

Table 3: Individual areas of opportunities with the number of plants and FTE savings

Plant Section	Opportunity Area	Opportunity	# Plants	FTE Savings %
Blast Chiller	Chillers	Idea 6 - Auto carcass breaking (better accuracy)	1	45%
Blast Chiller	Chillers	Idea 7 - Carcass stamping	1	2%
Blast Chiller	Chillers	Idea 8 - Carcass bagging for freight	1	9%
Carcase loadout (whole and half carcases)	Load Out	Idea 12 - Auto container loading	2	2%
Carcase loadout (whole and half carcases)	Load Out	Idea 3 - Load out bottle necking (small area - no room for forklift)	2	9%
Carcase loadout (whole and half carcases)	Load Out	Idea 5 - Stringing and hanging solution	1	7%
Chiller	Labelling	Idea 10 - Auto labelling	2	4%
Cold Store	Cold Storage	Idea 4 - Cold storage sorting	1	0%
Freezer	Plate Freezing	Existing plate freezer to pallet	1	16%
Picking & Loadout	Pack off	Idea 9 - Auto bagging	2	2%
Product packaging	Cartonising	Gordon Bros. /Real Cold Idea??	2	11%
Product packaging	Cartonising	Idea 11 - Stacking cartons onto pallets	1	10%
Trim Packing	Trim Weighing	Idea 2 - push trim into boxes for weighing	1	4%

Once the opportunities in **Table 3** were identified from the site visits and coupled with the systems available from Milestone 2 the opportunities were presented back to the companies involved. This involved a round table discussion with each of the companies involved with milestone 3 and Australian solution providers to ensure the CBA's were prioritised based on participant needs.

A wide and varied range of opportunities for development of materials handling and picking and packing capabilities have arisen from this review. Those detailed in this report are priority areas for the plants surveyed but are not an exhaustive list of development needs across the industry.

4.1 Automation solutions analysed

High level business case analyses was conducted on priority areas identified from the processor site visits and in conjunction with solution providers. The benefits of these systems for the sites visited are summarised in Table 4 on page 17 and detailed in appendix 9.1 *Milestone 4 .* They include:

- Automatted primal carton packing
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- Real time yield reporting
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There are a number of these systems which only one or two plants had identified as an opportunity. The reason that these systems have been addressed was the future impact these systems could have on the way Australian meat processors manage their material handling and cold storage. For example the costs of carton storage systems which were previously prohibitive are decreasing in price and become a major opportunity for Australian processors in the near future.

A wide and varied range of opportunities for development of materials handling and picking and packing capabilities have arisen from this review. Those detailed in this report are priority areas for the plants surveyed but are not an exhaustive list of development needs across the industry

4.2 Industry opportunities quantified

The Table 4 summarises the priority development areas identified by the processors involved in the project. Savings are primarily on labour saving with some additional operational and OH&S savings where available. Additional benefits will arise but data was not available for inclusion in these business cases. Section 9.1 in the appendix includes detailed analysis and assumptions for each of the solutions summarised in this table.

Table 4: Industry benefits identified in project for the development of automation systems in picking, packing and materials handling

Opportunity	Type of plants	Capital	FTE's saved	OH & S ($/year)	Value Increase ($/year)	Total Benefit
Cartoning Primals	Large Plants	$ 730,000	10	$ 33,333	$ 83,583	$ 3,539,465
Shipping container loader	All Plants*	$ 761,346	6	$ 54,759	$ 380,562	$ 3,216,876
Carcases breaking	Lamb plants**	$ 1,980,000	3	$ 59,200	$ 1,209,897	$ 11,164,879
Carcase stringing and loadout	All plants stringing carcases	$ 401,010	4	$ -	$ 200,506	$ 3,389,867
Trim packing	Large Plants	$ 541,421	5	$ -	$ 270,679	$ 2,288,071
Palletisation and De-palletisation	Plants with complex markets	$ 2,492,472	23	$ 83,052	$ 1,246,241	$ 10,534,657
Carton storage and retrieval	Large plants	$ 3,088,436	30	$ 92,483	$ 1,544,451	$ 13,055,617
Primal bagging	All Plants	$ 1,293,118	12	$ 51,109	$ 646,621	$ 5,466,020
Carton labelling	All Plants	$ 360,912	4	$ -	$ 180,455	$ 1,525,413
Total		$ 11,648,716	98	$ 373,936	$ 5,762,995	$ 54,180,865

* Number of systems required will vary depending on container loading rate achieved in final commercial system.

** Beef plants would also benefit from a similar system however the technical requirements would be substantially different and not costed in this project

5 General findings from sites

5.1 Emerging trends

- Picking, packing and materials handling is becoming more complex due to:
    - Diversity of customer requirements across multiple export markets is increasing
    - Ability to supply single products compared with traditional full sets is required to remain competitive
    - The changing dynamics of export market access and exchange rates
- More pressure to reduce costs. Requires technology interventions that lead to step change.
- A wider range of major capital infrastructure options for materials handling and storage is becoming more economical and delivers increased agility and flexibility with lower operational costs. Companies are becoming progressively more capable to respond quickly and efficiently to global customer requirements as facilities are upgraded.

5.2 Processor Considerations

- Large infrastructure projects are not justifiable unless they have become critical to business continuity. But as infrastructure is replaced there are significant opportunities to reduce operational costs.
- The size and species of plant is not as relevant to the areas of need as each plants unique constraints such as:
    - Existing infrastructure
    - Available land for expansion
    - Customer and product mix
    - Growth strategies
    - Capital availability
- Focus on bottle necks in specific areas should be considered as part of the overall process. Site observations highlighted solutions considered in relation to a range of other “next bottle necks” can lead to more integrated longer term solutions. There is application for smaller one-off projects to address short term bottle necks.
- Development of independent stand-alone solutions can be critical to address short term gaps while a company is preparing for larger longer term infrastructure improvements

5.3 Proof of concept – enabling technologies

- Development of enabling capabilities required for solutions may not fill an immediate company need in their own right but should be considered for development where they become components that assist multiple other technologies to move from unviable to viable investments. An example of this is primal cut identification software which has the ability to:

    - Save people in conveyor sortation in boning room (auto bagging and auto sortation)
    - Drive picking and packing robots to select, orient and place the correct products
    - Automate quality control processes. Some automation solutions propose to save materials handling labour but cannot achieve the QC aspect of the previous jobs. Adding back QC staff makes the solutions unviable in some cases.
- Small standalone solutions such as automated container loading and carton sortation can be enablers required to support larger infrastructure.
    - There are often complex challenges with old infrastructure that require a combination of smaller projects over time to build a solution within the sites constraints.
    - Developing a plan that allows step development towards new enabling capacity is important.
    - Some of the solution concepts analysed in this project indicate sound payback on short term bottle neck projects but also move a plant closer to the next stage of development.
- Being able to identify development opportunities that fill current capability gaps and minimise development risk for larger materials handling projects is important in supporting materials handling capability across the industry.

5.4 Providers

- The providers already engaged in the Australian meat industry have a wide and varied range of skills. All bring experience external to the industry in their given fields. They varying in level of experience with commercial meat environment installations which is not insignificant but are as well qualified as any companies in adapting solutions.
- Unlike slaughter and boning activities that are generally uniform processes, automation of small sections of picking and packing within plants requires a higher level of customisation. For example, picking, sortation and traceability systems have very different capacity, speed and volume requirements between plants.
- Providers are driven by the need to develop new solutions that meet the immediate customers need.
- Most new automation opportunities require adaption of existing capabilities and include assembly and testing of existing components. Some require additional enabling capabilities that do not yet exist to service a wider section of processors, particularly in the area of visual inspection and complex material handling.
- Primal visioning capability for inspection, identification or manipulation is a large challenge yet to be developed for beef and lamb. No one commercial project would warrant development of that technology. This type of enabling capability is more suitable to industry funding than specific solutions. Although the development of small component solutions can provide stepping stones to larger step change. These various developments are further differentiated in the next section.

5.5 Strategic development considerations

Based on the rate of change in materials handling capabilities in other parts of the food industry, the component technologies are becoming available to enable some Australian processors to make radical improvements in materials handling over the next 10 years. The incentive for this is to reduce costs, increase efficiency and agility to meet increasing global competition.

This development journey is not clear cut as it requires progressive development of industry capability while individual plant needs vary widely. However, there is a general strategic path that applies to all companies and requires capability development at a number of levels to support a faster rate of industry transformation. Figure 6 summarises this development path and breaks technology solutions broadly into either radical or incremental improvements. These general classifications are broken into three specific types of commercial solutions including:

- Small projects
    - Most likely to deliver short term incremental improvements
    - Can provide learning's to the plant and automation providers for development of future systems
- Integration technologies
    - larger scale solutions combining a number of different technologies or addressing a number of issues within a plant; AND
- Large infrastructure projects
    - most likely to support radical improvements
    - Usually limited by other smaller bottle necks that once addressed create a tipping point that justifies ROI

These commercial solutions are supported to varying degrees by enabling technologies that require integration with other capabilities to become a commercial solution. Development of these capabilities is often most neglected because new innovation is required beyond aggregation of existing technology and may not result in a commercial product in the first instance.

As processors build more effective capability the temptation is to move from assessing the risk and need in the left of the figure and move immediately to interim solutions without considering how those interim solutions will fit with the longer term vision. The risk is that short term solutions are not scoped or built to consider requirements in the next stage of the plants development and could impact on cost, capacity and speed of improvement. Furthermore, prioritising these needs in the wider scheme may identify alternative order of development that creates a larger step change. The example in the figure identifies a picking and packing development path resulting in substantial productivity gains in the boning room. A number of bottle necks including primal packoff and cold storage prevent this step change. Those supporting processes also have bottle necks. For example:

- Auto-Shipping-Container-Loading uses an AGV as a component. Development of an AGV to sort mix pallets is a separate project that pays for itself and meets a short term need.

- In the process each project develops provider capabilities, builds processor confidence in more complex AGV tasks on uneven flooring and prepares for development of an industry wide auto container loading solution.
- Primal cartoning is a major need in a few sites because of bottle necks upstream to the boning room and downstream to improved picking and packing solutions. The first stage solution requires manual identification of primals and provides sound ROI for some plants. Inclusion of primal scanning becomes an enabling component in a Mark II system makes it a viable solution for a wider range of processors. This enabling technology supports and range of applications which can be progressively developed in parallel with the primal visioning. Grasping end effectors are other important parts of this application not included in the example.

Understanding how new R&D investments fit in the capability evolution is helpful and should be mapped to some degree as solutions are developed.

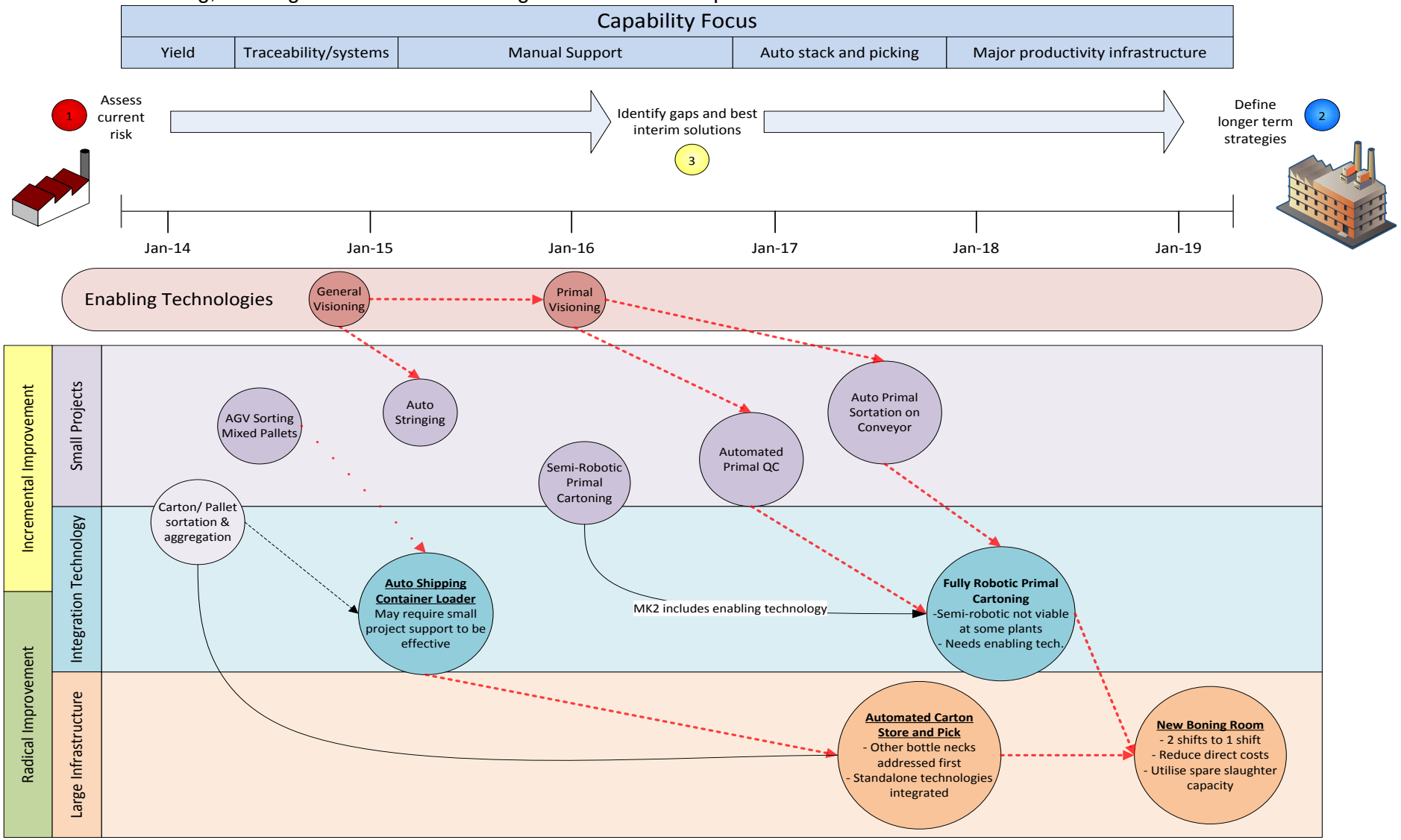

Figure 6: Strategic development scenario for materials handling within a red meat processor

5.6 Key observations

① All plants are on a journey of capability development to maintain competitiveness where the global trend is toward increasing sophistication in management of materials handling and logistics

② All plants need interim solutions in at least some areas before step change is possible. AGV solutions that re-palletise mix pallets are an example of an interim solution to automated carton storage.

③ On a case by case basis some plants will have the opportunity to move directly into step change solutions. In materials handling these are usually customisable to the plants unique range of circumstances.

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The Australian red meat industry has a wider range of variables to deal with than those in Europe and the USA such as a wider range of export customers, more destinations, less concentrated populations. This requires a greater level of flexibility which makes direct application of large infrastructure solutions hard. Some impacts include:

- Smaller processing line installs rather than high volume lines for single customers
- Different ways to access technology
- Adaptations to existing lines are required to provide interim solutions

Provider capabilities in materials handling and picking solutions for the meat industry are developing. But providers have the pressure of developing immediate commercial solutions for clients. Broad design considerations to meet the wider market are of concern but the main focus and pressure is in delivering the immediate solution. This will involve the adaptation or combining of proven technology components.

5.7 Processor environments

Companies are in a number of different states of development of their picking, packing and materials handling solutions. The basic constraints vary between processors with some examples provided in the following Table 5.

Table 5: Description of different processor considerations

Company State	Implications	Development paths
Aging materials handling infrastructure requires large investment	Opportunity to select new emerging capability to achieve large gains in productivity	A range of short term needs with 1-2 year payback but more importantly address a bottle neck while deciding on medium term larger capital investment
	Constrained by land area and existing infrastructure. Requires innovative ways to refurbish or progressively replace existing infrastructure within current buildings.	Integration of a series of smaller solutions required. Address bottlenecks step by step. Large upstream opportunities possible after addressing a range of materials handling limitations.
Due to volume growth many areas from boning onwards are limiting productivity.	Too many areas for available capital.	Requires mix of large infrastructure change in most labour intense area, coupled with small customised shorter term solutions in other areas to assist and realise ROI from larger investment.
Smaller domestic carcase focus but opportunities for growth in products, processes and markets.	Requires strong strategic direction to ensure investment in best opportunity areas.	Many options to implement existing technologies from well-established industry processes. Limited options for automation of materials handling for core domestic load out processes. Need to determine strategic priority to broaden product offering and adapt existing primal handling technologies OR develop technology to improve core carcase business processes.
Well managed upstream processes. Materials handling and distribution under pressure. Lots of space to expand.	Limited constraints except capital. Work the existing M&H asset with extra labour, prolonging large investment.	Increasing shifts and volume from existing upstream asset allows expansion of warehouse. Multi-site consolidation and off-site warehousing introduce other considerations about how best to structure on-site materials handling as part of a larger organisation.

6 Factors Affecting Site Specific Automation Development

A range of factors contribute to the development and installation of automation solutions in picking, packing and materials handling for each processor and are discussed here.

6.1 Planning process – Innovating for the future

- Approaches to planning and prioritising projects vary widely but lean towards short term fixes to immediate bottlenecks.
- The driving reason is the large amount of capital required to make significant changes to processes. Sometimes larger investments do not deliver enough improvement to justify ROI and can be limited by bottlenecks upstream or downstream from the investment. For this reason smaller component improvements, able to justify an ROI in their own right, become important to a plants continuous improvement pathway.
- The planning and development of systems as progressive components requires a longer term vision but can achieve considerable increase in plant capacity over time.
    - For example, projects that progressively increase the capacity of the picking and packing section of the plant over time can reach a tipping point that enables large changes in slaughtering and or boning productivity. Moving from two to one production shift can increase the labour efficiencies in the boning room for example. This is further accentuated where there is automation installed in the boning room not run running at the maximum capacity.
    - Effect of bottle necks on benefits of the systems, E.g. The shipping container loader will enable the loading dock but to be utilised the system needs to be provided with a constant product flow
- Plants access to capital or prioritisation of capital often limits ability to develop more than immediate operation critical capacities. So the incentive to develop new materials handling capability for needs in the future is not prioritised.
- The risk for some processors is placing too much focus on the immediate short term fix without considering the long term strategy. This requires:
    - Looking at the entire systems and improving the worst areas but ensuring there is the possibility of future expansion
    - Strategies to enable future expansion in plants without limiting the current developments
- Projects with high development risk and uncertain ROI are hard to get processor interest in. Some of these types of projects require base research to limit risk prior to seeking processor support.
    - These types of projects are important to ensuring overarching industry adaptation to global trends in picking and packing and materials handling
    - These types of projects require close liaison with industry to account for variation in plant specific requirements

6.2 System reliability once installed

- Given meat processing is a low margin business where operational costs are driven by throughput; there is almost no tolerance for adaptation, adjustment or playing with equipment to get it to work after installation. For example, AGV's in commercial use in Europe for pallet handling in load out do not operate well on uneven cement. One processor who wants to install AGV's is reluctant to do anything because of this.

6.3 Solutions require adaptation to constraints

- Site requirements can be quite different. This requires more adaptation of materials handling solutions than slaughtering and boning automation
- Complexities involved with the development of innovation for materials handling are different for each site and involve a greater number of variables such as:
    - Number of product skus
    - Number of customers
    - Building a new cold store. This would allow the most expansion but needs to be flexible enough to account for seasonal and export market variation so as not to limit the capabilities. Large fluctuation in the mix of fresh and frozen production is one example of solution flexibility required in many Australian plants.
    - Technologies from other industries are transferrable to existing infrastructure but most require some level of adaptation. In many cases the ideas and strategic materials handling trends are more important than the complete solutions. Available components can be sourced and combined with customised controls. This is where Australian solution providers are critical in the development pathways.

7 Recommendations

A wide and varied range of opportunities for development of materials handling and picking and packing capabilities have arisen from this review. Those detailed in this report are priority areas for the plants surveyed but are not an exhaustive list of development needs across the industry. Although some key areas of development are listed, the industry has a wider need for meat industry specific materials handling capability. Part of the recommendations break down the development into key capability areas, all of which require development as a multi-pronged development approach to address short, medium and long term needs across the range of meat processors.

1. The meat industry has a need for materials handling solutions to be developed across the range of solution categories covered in the report including:
    a. Enabling technologies
    b. Small projects
    c. Integration technology
    d. Larger infrastructure projects where development of capability components can be easily transferred to other integration technology solutions
2. A balanced portfolio of projects in each area should be under development. Loose development pathways should be identified that:
    a. Progressively link capabilities to make solutions viable across more of the industry. For example, primal carton packing involves some manual inspection and intervention cost so is uneconomical for some plants, but automation of QC visioning would increase the value proposition for a wider range of plants.; or
    b. Build and connect new capabilities towards integration for larger more difficult automation solutions. For example, visioning and grasping for Auto stringing lamb carcases leads to auto stringing and hanging of quarters which may lead to grasping of bags for auto carcase bagging.
3. Development of enabling technologies in the area of primal grasping and manipulation technology should be considered where:
    a. Adaptation to the wide range in size and shape of primal cuts across beef, lamb and goats is accounted for
    b. Bagged and unbagged primals can be managed
    c. Technology takes into account the range of processor configurations and product presentation before and after packaging
    d. Prioritise development path to species and cuts balancing trade-off between risk and reward
4. Development of enabling technologies in the area of primal visioning systems have the potential to enhance and support a large number of materials handling solutions and should consider the following:
    a. Primal identification
    b. Quality checking requirements
    c. Prioritisation of tasks over time to progressively minimise development risk
5. Development of enabling technologies needs to consider the range of commercial applications they could be used in and implications for providers that may want to access these capabilities.

8 References

8.1.1 List of Tables

8.1.2 List of Figures

9 Appendix

The body of work conducted in this project has been progressively built on through each of the milestones with the key findings from the work summarised in this final report. The detailed outputs from each of the milestones has been included here as reference material in each of the following sections"

9.1 Milestone 4 – Priority solutions (Business Case Analysis)

9.2 Milestone 3 – Site visit findings

9.3 Milestone 2 – Desktop Technology Review

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Picking & Packing, Milestone 4 report

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Contents

1 Introduction

Materials handling (“picking and packing”) of post boned & sliced product, as well as half and whole carcasses and parts (primals, sub-primals & shelf ready portioned) is a significant cost to processors as well as a potential value add to the majority of businesses dealing with beef and small-stock processing. This project is directed at benchmarking and quantifying the areas of industry need in relation to picking, packing and materials handling; the technological opportunities relevant to these needs; the likely developmental challenges; an analysis of cost and benefit; and possible technological or provider gaps.
This review considered beef, sheep, goat and lamb, noting that the main difference in terms of issues/solutions and recommendations will relate to the size of the cuts, product ranges, plant configurations and engineering and product specification.

The review considers issues, gaps, risks, solutions and recommendations that are applicable to a range of plant size, throughput, speeds of operation, configuration and products.
Processors in each of the following categories were consulted within the project:
1. High volume beef;
2. High volume lamb/goat;
3. Medium volume beef; and
4. Medium volume lamb/goat.

2 Objectives

The objectives of milestone 4 were to present findings back on the costing of automation systems in different areas of the picking, packing and handling sections of the abattoir. This milestone used the outcomes from milestones 2 and 3 to conduct the following:

- Prepare a research summary report;
- Survey processors concerning their needs;
- Obtain input from providers;
- Conduct working group discussions to prioritise areas of need;
- Summarise findings;

The above objectives were successfully completed. The information in the following report is a detailed summary of the findings.

3 Overview

There are a number of development opportunities that could benefit the picking and packing section of the beef, lamb and goat abattoirs. There are a number of opportunities that apply to each of the three species and a number that would be species specific.

The flow diagram in Figure 1 and Figure 2 demonstrates the opportunities in each section of the abattoir after the carcases exit the chiller. The opportunities have been detailed in high level opportunity analysis later in this report and the high level specifications of the systems shown have been included. Detailed costing’s of each system have not been included as they will vary between plants, depending on site specific specifications.

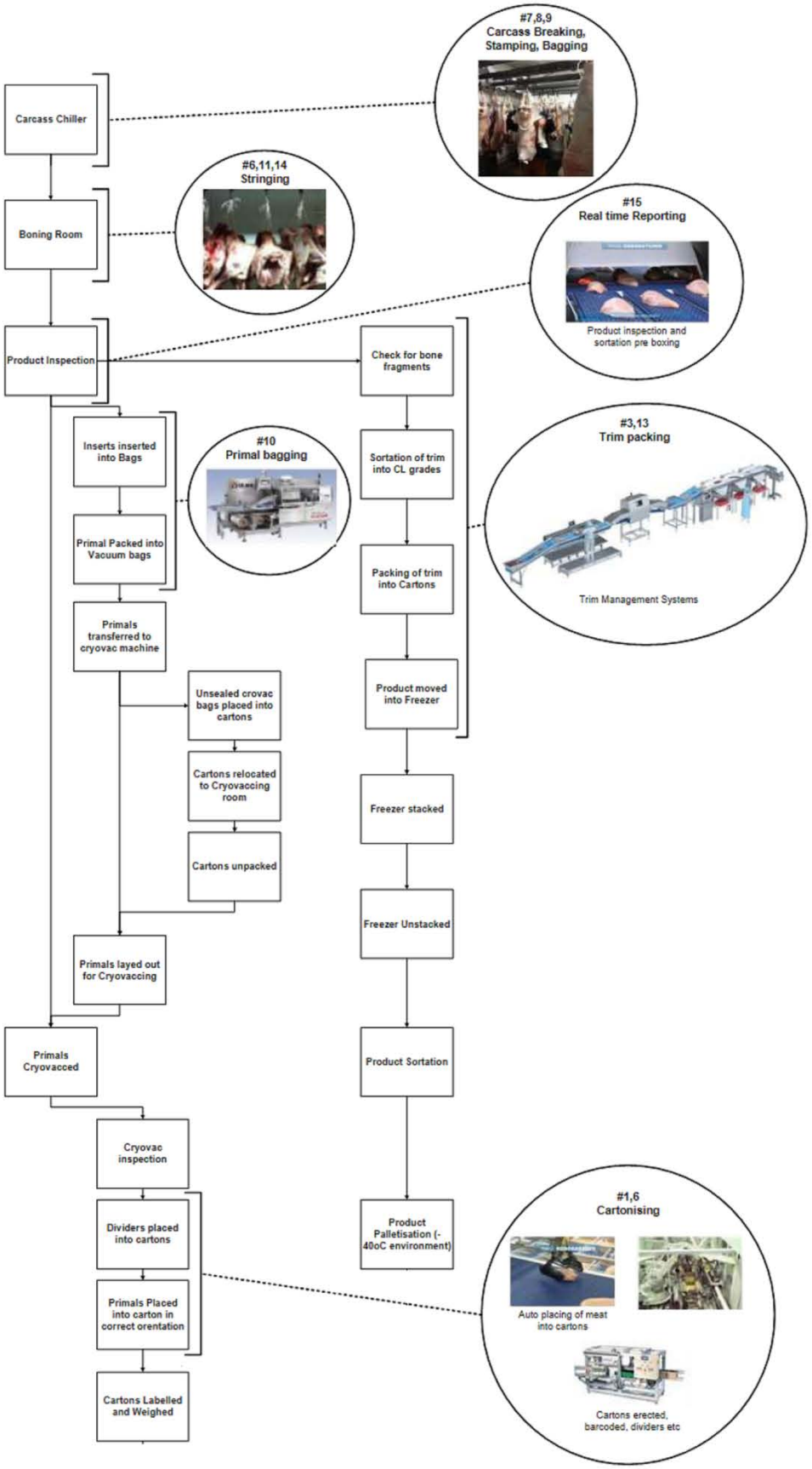


Figure 1: Picking and packing process flow

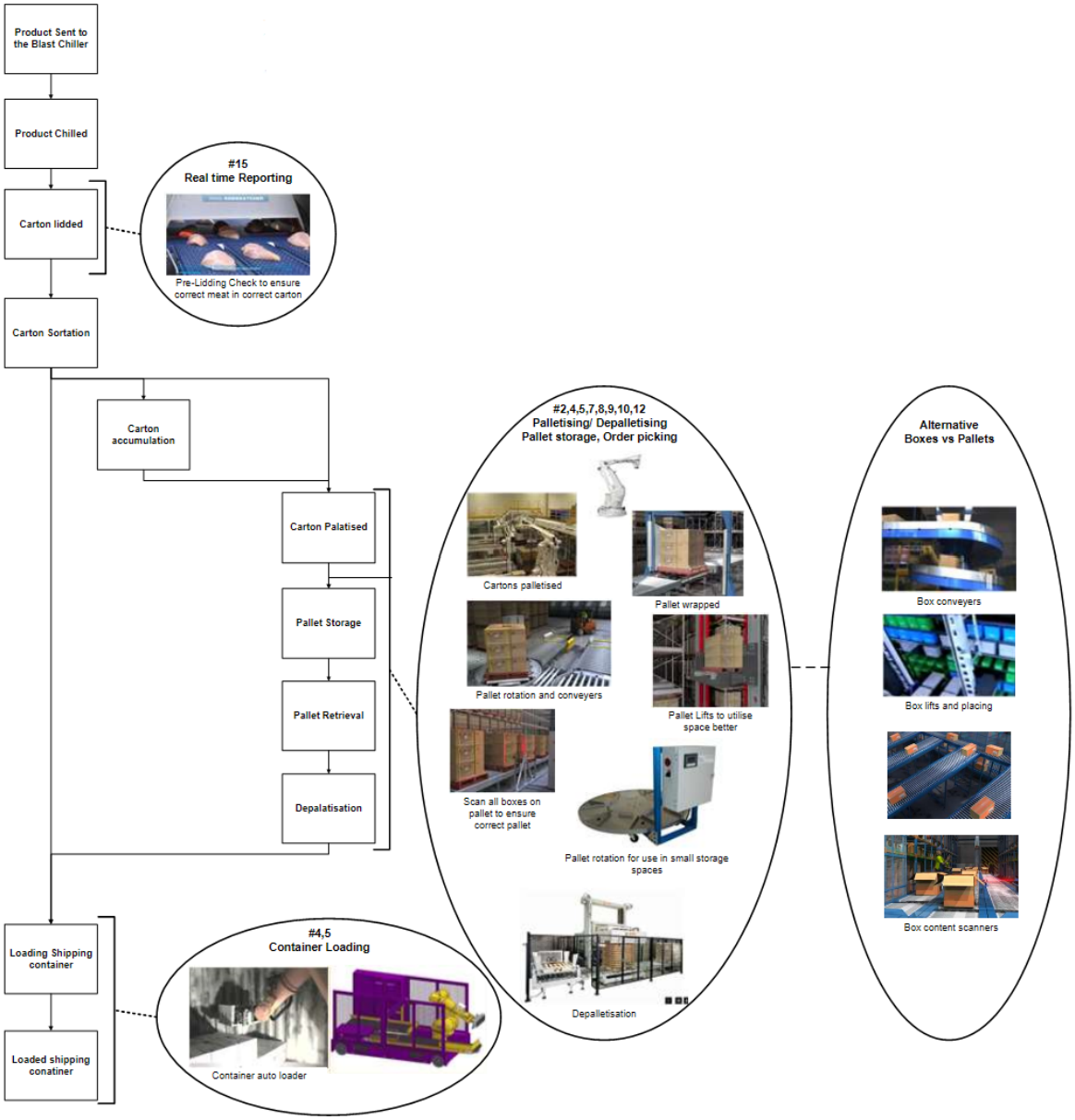


Figure 2: Materials handling process flow

4 Methodology

4.1 Data collection

Five site visits were conducted across small and large beef, lamb and goat processors to identify common challenges in picking, packing and materials handling and to understand challenges unique to each site. One day site visits were conducted in the following plants:

Plant	Plant Type	Species	Notes
1.	Medium Volume	Beef /Lamb	Mixed species
2.	Medium Volume	Beef	High number of product skews
3.	Medium Volume	Beef	Relatively low number of product skews
4.	High Volume	Beef	
5.	High Volume	Lamb/Goat	

There are a wide and varied range of methods used at each plant visited so the systems required differed between plants. The review focuses on the critical issues faced by each plant.

All plants walked through the physical processes and explained them in detail. Most provided full details of manning levels in each area of the plant. Only one company was willing to provide more comprehensive costing data on a confidential basis. Given the project is intended to compare costs between sites; the comparisons have been limited to labour savings in each area. Given most yield impacts are controlled prior to this the labour savings make up the biggest component of costs.

Additional costing assumptions provided from other sources have been used with the manning data collected in this project to supplement the project specific CBA analysis conducted.

4.2 System Cost

There are two costing approaches used through each Cost Benefit Analysis (CBA) in this report. They are as follows:

1. Cost of the system that has been established and provided by the manufacturer. In these instances the return on investment has been calculated according to equipment cost.
2. Where there is no system currently available or no cost made available, the return on investment was set as 2 years and the cost of the system calculated as a result of the savings estimated.

These costing's were then applied to all the scenarios presented in the next section.

4.3 Fixed Model Drives

The scenarios used throughout this section of the report have been developed to present a high level estimate on the savings that could be achieved in each area of opportunity. The savings shown are mainly attributed to labour savings. Table 1 summarises the scenarios used where there are no current systems available.

Table 1: Range of plant scenarios compared

Plant Scenario – 2 shifts	
Standard market** – part production	• Limited number of product skews being produced; • 75% reduction in manual handling of cartons;
Standard market – All cuts	• Limited number of product skews being produced; • 90% reduction in manual handling of cartons;
Complex markets** – part production	• A high number of product skews being produced; • A 75% reduction in product handled by hand;
Complex markets – All cuts	• A high number of product skews being produced; • 90% reduction in manual handling of products;

** *Standard market refers to plants with a consistent set of products and limited need for flexibility and agility while Complex markets requires to plants that deal with a wide range of product codes and customers that demand a lot of flexibility from the processes.*

There are a number of sections through this report that have not used these scenarios. In these cases there are already systems installed and operational, of which the previous CBA figures have been utilised and a summary of each system provided.

5 Results and Discussion

The following section demonstrates the areas of opportunity where no automated systems are commercially available. The cost benefit analysis included in each section are a result of the data collected during each site visit and estimated expenditure required to achieve a payback period of less than 2 years.

5.1 Site Visit Results

The opportunities identified during the site visits were then compared back to the labour savings. The opportunities detailed in this section are a high level breakdown of the possible Full Time Equivalent (FTE) savings and then compared to the opportunities through the results section of the report.

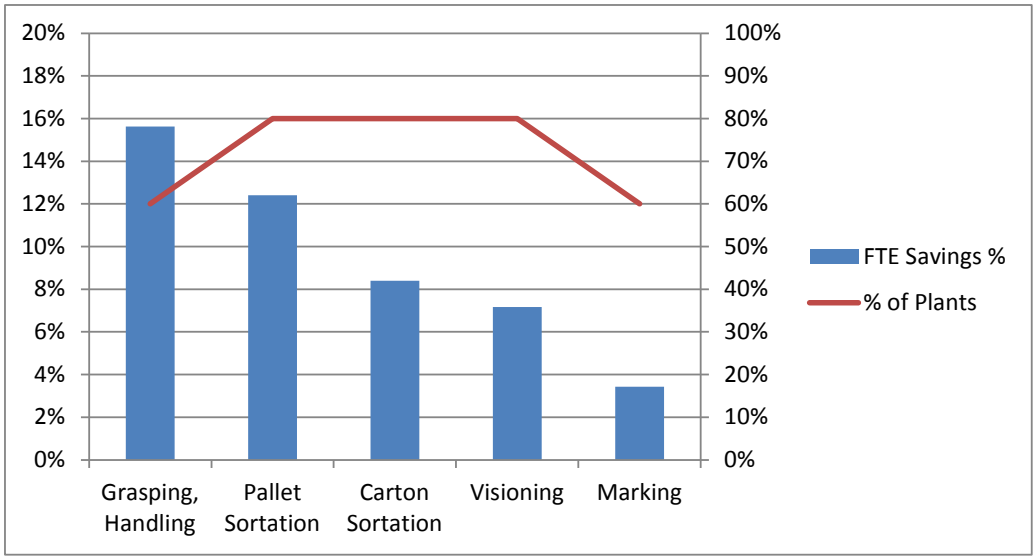


Figure 3: Opportunities by area of equipment capability

The FTE savings displayed in Figure 3 and Table 2 like grasping and handling tasks tend to be the harder jobs to automate. Some areas such as port marking will not save many labour units, but it may increase the payback for more complex jobs if coupled with another system such as a shipping container loader.

Table 2: The number of FTE's saved for each area in Figure 1

Equipment Capability	# Opportunities	# Plants	FTE Savings %
Grasping, Handling	5	3	16%
Pallet Sortation	6	4	12%
Carton Sortation	6	4	8%
Visioning	8	4	7%
Marking	3	3	3%

Table 3 shows the opportunities which were discussed during the site visits and helped prioritise the importance of solution areas prior to completing the CBA's.

Table 3: Opportunities - Total by Area

Plant Section	Opportunity Area	# Plants	FTE Savings %
Blast Chiller	Chillers	3	19%
Carcase loadout (whole and half carcases)	Load Out	5	6%
Chiller	Labelling	2	4%
Cold Store	Cold Storage	1	0%
Freezer	Plate Freezing	1	16%
Picking & Loadout	Pack off	2	2%
Product packaging	Cartonizing	3	11%
Trim Packing	Trim Weighing	1	4%

Table 4: Individual areas of opportunities with the number of plants and FTE savings

Plant Section	Opportunity Area	Opportunity	# Plants	FTE Savings %
Blast Chiller	Chillers	Idea 6 - Auto carcass breaking (better accuracy)	1	45%
Blast Chiller	Chillers	Idea 7 - Carcass stamping	1	2%
Blast Chiller	Chillers	Idea 8 - Carcass bagging for freight	1	9%
Carcase loadout (whole and half carcases)	Load Out	Idea 12 - Auto container loading	2	2%
Carcase loadout (whole and half carcases)	Load Out	Idea 3 - Load out bottle necking (small area - no room for forklift)	2	9%
Carcase loadout (whole and half carcases)	Load Out	Idea 5 - Stringing and hanging solution	1	7%
Chiller	Labelling	Idea 10 - Auto labelling	2	4%
Cold Store	Cold Storage	Idea 4 - Cold storage sorting	1	0%
Freezer	Plate Freezing	Existing plate freezer to pallet	1	16%
Picking & Loadout	Pack off	Idea 9 - Auto bagging	2	2%
Product packaging	Cartonizing	Gordon Bros. /Real Cold Idea??	2	11%
Product packaging	Cartonizing	Idea 11 - Stacking cartons onto pallets	1	10%
Trim Packing	Trim Weighing	Idea 2 - push trim into boxes for weighing	1	4%

Once the opportunities in Table 4 had been identified from the site visits and coupled with the systems available from Milestone 2 the opportunities were presented back to the companies involved. This involved a round table discussion with each of the companies involved with milestone 3 and Australian solution providers to ensure the CBA's were prioritised based on participant needs.

The following opportunities were costed as a result of the feedback provided from the companies involved:

- Cartoning Primals;
- Shipping container loader;
- Carcases breaking;
- Carcase stringing for Loadout;
- Trim packing;
- Palletisation and De-palletisation;
- Carton storage and retrieval;
- Primal bagging;
- Carton labelling.

There are a number of these systems which only one or two plants had identified as an opportunity. The reason that these systems have been addressed was the future impact these systems could have on the way Australian meat processors manage their material handling and cold storage. For example the costs of carton storage systems which were

previously prohibitive are decreasing in price and become a major opportunity for Australian processors in the near future.

The following section details the Cost Benefit Summary's (CBS's) above and hardware that is already available for other industries. The machinery for most of the opportunities discussed would need to be modified for the operating conditions required by Australian processors.

5.2 Cartonizing Opportunity (#1 and #6)

5.2.1 Background

The challenges faced between these plants vary substantially depending on the number of product lines being processed per hour and the varying customer packaging requirements.

In some plants a larger number of staff is required to pack primals into bags and cartons after the end of the boning room table. In these plants automation solutions could be developed for bagging primals, vacuum sealing primals, packing primals into cartons and labelling cartons for traceability.

The main issues faced include:

- Speed at which primals can be cartoned;
- The number of products which can be packed using the same piece of equipment;
- Production inspection requirements;
- Requirement for carton inserts;
- Design of the existing room to allow automation installation.

5.2.2 Potential solution

The packing of primals into cartons once they have been vacuum sealed shows potential to be an area of investment for the red meat industry. Mechanical equipment is available to lift, rotate and place products into cartons, although this equipment has not been designed to be used on beef or lamb.

There may be an area of opportunity to design a piece of equipment to sort primals and place them into cartons. The equipment will be required to handle the following variations:

1. Variation in product consistency including length, shape and rigidity;
2. Variation in cut weight;
3. Correct product identification for each carton;
4. Dividers placed into cartons;
5. Orientation of primal in cartons;
6. The number of products placed into cartons;

The requirements for these sections may differ between species.

Figure 4: Configuration of primals as in this carton varies from cut to cut and market specifications.

5.2.3 Cost Benefit Analysis

The costing's displayed in Table 4 and Table 6 represent plants with a small, or high volume range of products (labelled Standard Markets), with either a low or high number of product skews (labelled Complex Markets). In general, the more complex the mix the more staff required to pack and the larger potential savings. However the complexity of the automated solution also increases. The modelling work conducted here is purely designed to help automators weigh up the trade-offs in their approach and the type of companies most likely to benefit from automated primal carton packing. The capital costs used in

Table 5 are not real and based on what-if-scenario modelling to estimate the type of costs that could be afforded to achieve an acceptable return on investment.

It will be harder for plants with simple market mix to get a return on investment during the initial stages of development as compared with a complex plant with lots of pack-off staff.

Table 5: ROI on various potential scenarios

SUMMARY PERFORMANCE MEASURES*				
* Automation methods compared back to manual packing				
	Std Mkts - Part	Std Mkts - All Cuts	Complex Mkts - Part	Complex Mkts - All Cuts
Capital cost	$130,000	$490,000	$130,000	$730,000
Gross return Per head	$0.44	$1.31	$1.31	$4.35
Total costs Per head	$0.11	$0.42	$0.18	$0.90
Net Benefit Per head	$0.32	$0.88	$1.12	$3.46
Net Benefit / cobotic unit	$46,883	$32,038	$163,014	$83,583
Annual Net Benefit for the plant	$46,883	$128,150	$163,014	$501,496
Pay back (years)	2.77	3.82	0.80	1.46
NPV	$255,493	$673,020	$1,070,440	$3,539,465

Table 6: Summary drivers for potential plant configurations

	Std Mkts - Part	Std Mkts - All Cuts	Complex Mkts - Part	Complex Mkts - All Cuts
Head / Hour	73	73	73	73
Head / Day	580	580	580	580
Head / Annual	145,000	145,000	145,000	145,000
FTE's saved	1.0	3.0	3.0	10.0
Rework improvement	0	0	0	0
Machine Capacity (Head/hour)	0	200	200	200
Number of systems	1	4	1	6
Useful working life	8	8	8	8

Table 5 shows the number of labour units required currently in each plant to pack primals for different market requirements.

There is the opportunity for plants with complex markets and packing requirements to assign the easier portion of their carton packing tasks to automation solutions.

5.2.4 Equipment Components Available

The following components have been used in different industries to automate the picking and packing of product into cartons. These systems will need to be modified for the red meat industry but may be used for the basis of design.

IRB 360 Flex Picker

Flex Picker IRB 360 is the “second generation” robot for pick and place applications. This type of robotic arm may be useful in the development of a primal packing system as it has already been installed into several food processing facilities. The attachment on the end of this robot would be required to be able to pick up primals without damaging the vacuum seal bags

Link: http://new.abb.com/products/robotics/industrial-robots/irb-360

Equipment Capabilities	Potential Plant Sections
Grasping, Handling	Boning Room Product Packaging Trim Packing

Marel RoboBatcher

The Marel RoboBatcher is unique for this type of equipment because not only does it batch fast with high precision, but it also communicates with other equipment in the processing line including scanners, check weighers and yield reporting tools.

RoboBatcher is designed for the poultry industry and is used to pack chicken fillets into trays. It can handle fixed weight batching, catch weight and counting jobs. The RoboBatcher can batch into four different types of trays and two types can be handled at the same time.

Furthermore, a discharge solution for additional tray packing makes it possible to batch in bulk for catering, which results in minimal giveaway.

Link: http://marel.com/poultry-processing/systems-and-equipment/broilers/grading-and-batching/batching/batchers/robobatcher/415?prdct=1&pc=2

Equipment Capabilities	Potential Plant Sections
Grasping, Handling	Boning Room Product packaging

Case packers, VR30/MP

This piece of equipment would need some modifications to allow its adaption in the red meat industry. However the following points are the capabilities of the VR30/MP:

- More than 30 pack cycles a minute depending on product, packing format and gripper.
- Compact footprint
- Superior reliability
- Rapid changeovers
- Flexible product in-feed presentation
- Optimum product handling
- Flexible-to-handle product, sleeves and promotional inserts
- Easy operator and maintenance access
- Intuitive and comprehension machine operator interfaces

Link: http://www.visy.com.au/automation/packaging-machinery/

Equipment Capabilities	Potential Plant Sections
Grasping, Handling	Product packaging

5.3 Container Loading Opportunity (#4 and #5)

The development of a shipping container loader was identified by all companies visited as an opportunity to automate for the following reasons:

- Loading of shipping containers is currently a major bottle neck;
- Due to the nature of the work it is a major OH & S issue;
- The current process is very stop-start;
- Damage to cartons due to manual stacking;
- Traceability and tracking of product automatically – labour saving;

5.3.1 Development Considerations

The automated packing of cartons into a shipping container shows potential as an area of investment from the red meat industry. Mechanical equipment has the ability to lift and rotate cartons in a set location and stack to ceiling height. This is already conducted by palletising and de-palletising systems. There is a system available in Europe which can load cartons into a shipping container at room temperature. This system's main constraints are as follows:

- The operational speed of the system is too slow for meat processing plants.
- The ability of the system to operate in cold environments may be limited.
- The capability of the suction cap when handling wet, slippery and icy cartons.
- Level flooring is required

The main capabilities of any system to load shipping containers in a red meat abattoir would be to conduct the following:

1. Scan cartons as they enter the shipping container.
2. Reject any product which is out of spec.
3. Port marks the cartons prior to stacking.
4. Hold cartons to load last for ease of customs checks.
5. Load cartons in any orientation.
6. Allow the container to be loaded to the roof.
7. Photograph every carton or row of stacked product for order of loading proof.

The savings presented in the following preliminary cost benefit will be affected by individual plant circumstances. In plants where the loading of the shipping containers is the bottle neck the plant will achieve greater savings than those presented here due to flow through of efficiencies in other areas.

5.3.2 Cost Benefit Analysis

The following costing's have been developed from the equipment a cost supplied by the manufacturers and demonstrates the affect that the rate of loading has on the payback periods and number of systems required.

Table 7: ROI on various potential scenarios

	TEAU - Small plant	Required - Small plant	TEAU - Large plant	Required - Large plant
Capital cost	$1,326,000	$761,346	$3,925,000	$1,547,432
Gross return Per head	$2.98	$2.98	$2.04	$2.04
Total costs Per head	$0.71	$0.44	$0.72	$0.28
Net Benefit Per head	$2.27	$2.54	$1.33	$1.77
Net Benefit / cobotic unit	$170,599	$380,562	$96,640	$386,861
Annual Net Benefit for the plant	$341,197	$380,562	$579,839	$773,722
Pay back (years)	3.89	2.00	6.77	2.00
NPV	$2,673,483	$3,216,876	$3,996,135	$6,540,385

Table 7 shows the return on investment expected the TEAU system is currently available in Europe and the required payback period for an Australian developed system. The main differences in payback periods are attributed to the number of systems required. The result for the large plant between the two systems has been caused by the plants requiring three times as many TEAU systems as to achieve the payback period required.

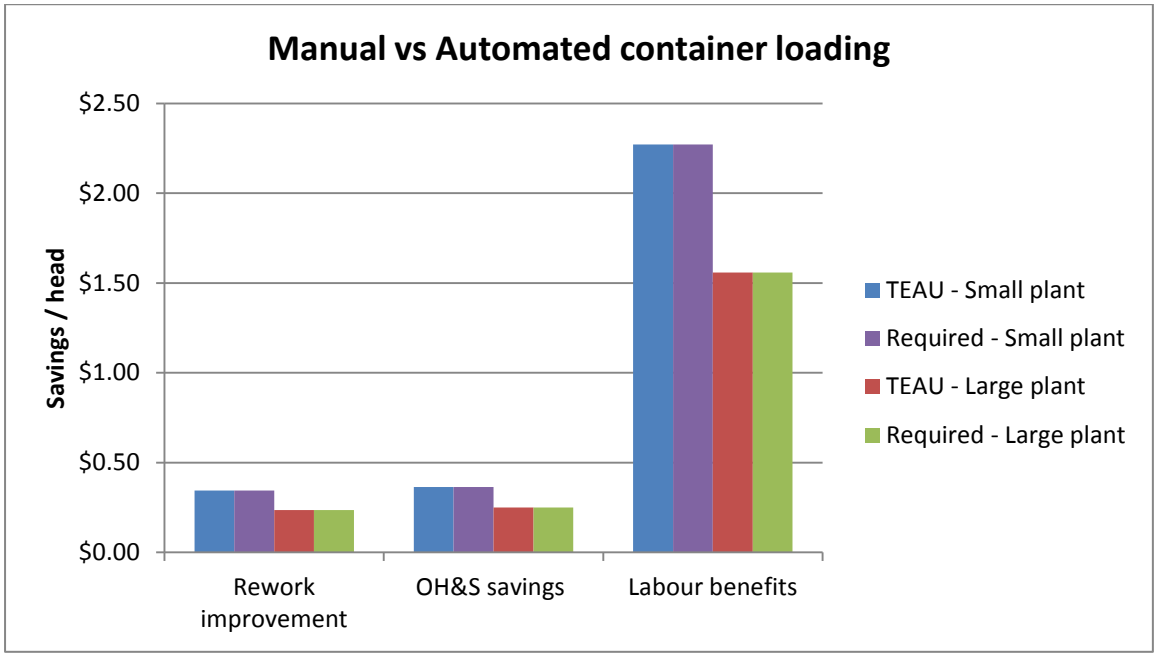


Figure 5: Summary drivers for potential plant configurations

There is the opportunity for plants with complex markets and packing requirements to track the exact cartons entering the shipping container and reduce the number of claims. Figure 5 shows the possible savings identified. These savings are given as an overview, but if the system was to be developed, it would require more detailed costing's to be completed.

5.3.3 TEUN's Shipping Container Loader

Shipping container loader with the following specifications:

- The loading capacity depends on the dimensions of the cases.
- Cycle time is ±15 seconds. Per cycle we can pick multiple cases.
- The adaption of this system to a cold store will require modification, depending on temperature
- The TEUN will require an extendable conveyor to "follow" PAQR1's movements.
- The cost of the equipment is $500,000.

Link: http://www.teun.com/en/applications/loading-of-boxes/

Equipment Capabilities	**Potential Plant Sections**
Shipping container loader	Picking & Load out

5.3.4 Hardware Available to Complete Each Capabilities

The following hardware are components which will need to be included with the shipping container loader to:

- Increase the traceability of products
- Increase the evidence available for customer claims
- Reduce the labour requirements at the loading bay by automatically completing the port mark.

DataMan 300 code reader

The DataMan® 300 series of readers was developed to handle the most difficult-to-read DPM (Direct Part Mark) codes as well as challenging 1-D linear barcodes and 2-D Data Matrix codes and for indexed or high-speed lines. The benefits include:

- Unmatched read rate performance
- Decode the most challenging 1-D and 2-D barcodes with enhanced 1DMax+™ and 2DMax+™ code-reading algorithms
- 2DMax+™ algorithm reads DPM codes no matter the mark type or surface
- 1DMax+ with Hotbars™ technology provides higher read rates of damaged 1-D linear barcodes at a faster pace than ever before

Link: http://www.cognex.com/factory-id-reader.aspx?langtype=2057

Equipment Capabilities	**Potential Plant Sections**
Scanning	Product packaging Picking & Loadout Product tracking

Vision inspection automation

Robotic Automation Systems specializes in vision inspection automation employed in plastic moulding operations, including online, offline and cleanroom applications. Applications of this equipment are:

- Short Shots
- Flashing
- Assembly
- Defects
- Insert / Part Verification
- Presence (correct insert / part)
- Orientation
- Function
- Dimension / Tolerance

Link: http://www.roboticautomationsystems.com/vision.html

Equipment Capabilities	Potential Plant Sections
Visioning – primal ID	Product Inspection
Traceability	Picking & Loadout

REAjet Inkjet Printer

Designed for large character printing of industrial products:

- High-speed printing
- Designed for industrial applications
- Versatile print options
- Modular multi-head configuration
- Ink options include fast dry and vivid colours

Link: http://www.visy.com.au/automation/index.php?id=262

Equipment Capabilities	Potential Plant Sections
Marking	Picking & Load out

HSAjet Inkjet Printer

This system is ideal for high-resolution image reproduction:

- Prints graphics, barcodes and fonts
- High resolution, high contrast print quality
- Customised touch screen operation
- Uses blank cartons and prints online

Link: http://visytech.com/wp-content/uploads/2012/03/spec_sheet_hsajet_tipc.pdf

Equipment Capabilities	Potential Plant Sections
Marking	Picking & Load out

5.4 Carcass Breaking Opportunity (#7, 8 and 9)

In domestic lamb and goat processing carcases are first sorted then pushed manually along rails to the point where they can be broken either by a hand saw or run across a table saw or bandsaw. Although processors often have breaking saws some carcases are still cut by hand. The accuracy for both methods may not be good given breaking saws are setup in chillers and operated throughout the night in poorer lighting conditions. Loss in value by miss-splitting and leaving more meat on the lower value portions have shown to be a big opportunity to improve yield and value in larger automated plants and may be an opportunity here.

There are currently three options available to automate the cutting of small stock carcases. They have been developed for different types of small stock abattoirs. The benefits associated with these three systems are:

- Reduce labour requirements;
- Improved boning room efficiency;
- Increased yield benefits (Option one only);
- Decreased carcase shrink (Option two only);
- Reduced work cover premiums;

The developed systems are integrated into larger continuous boning room operations which can justify the relatively large expense of the systems. There may be a possibility to utilise technology in a lower cost automated or semi-automated system that processed carcases that are fed onto a moving chain to a cutting station.

5.4.1 Systems compared

The three systems detailed in Table 8 have the following broad specification:

System 1

Robotic Technologies (RTL) and Scott's Technology in conjunction with MLA have been developing automated lamb boning equipment with a vision towards developing a fully automated process from the chiller exit through to the packaged product. The costing presented in 5.4.2 is for the LEAP III systems and the primary financial benefit is due to yield and productivity improvements. For more information please refer to the MLA project P.PSH.0574 (Green, 2013a).

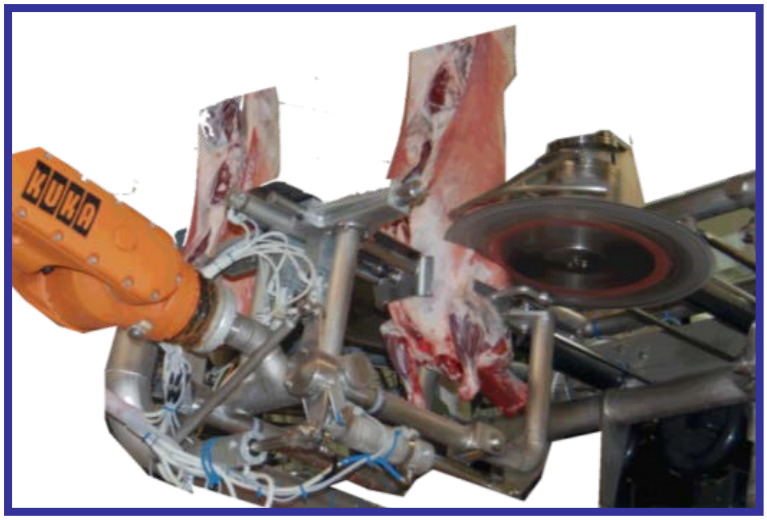


Figure 6: Leap III primal cutter

System 2

This system has been developed by MAR to automate the dissection of low value small stock carcases. This system is comprised of one robotic cell, visioning software and a circular saw but is only suited to processes with minimal cutting specifications. It has been developed to allow for carcases to be dissected warm or cold and complete both the vertical and horizontal cuts. For more information on this system please refer to the MLA project P.PIP.0387 (Green, 2013b).

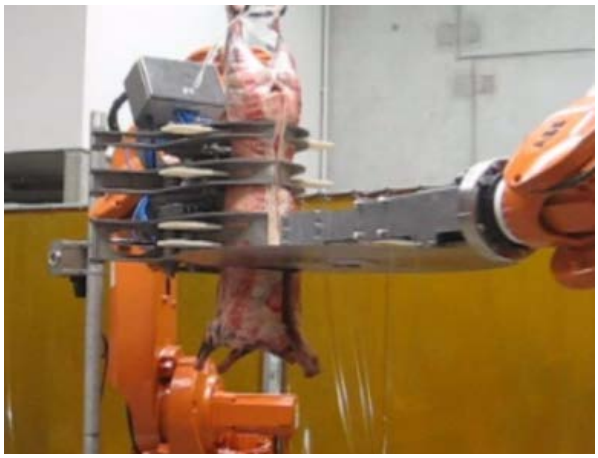


Figure 7: The Automated 6 way primal cutter

System 3

This system is the ROC450 automated lamb primal cutting system which has been developed and installed by MAR in conjunction with AMPC and MLA. The main benefits of this system are contributed to an increase in the throughput and labour savings in the boning room. This system has provided substantial benefits to the plant where it is installed. The accuracy of this system decreases when cutting carcases over 22kg. For more information on this system please refer to the MLA project P.PIP.0313 (Green, 2013c).

Figure 8: ROC 450 primal cutter

5.4.2 Cost Benefit Results

The results displayed in Table 8 have been adapted from ex-ante and ex-post studies of the systems described above. These costing's will vary between plants but can give an indication of the ROI of each of the system.

Table 8: CBA results for the three systems available for the dissection of small stock carcases.

SUMMARY PERFORMANCE MEASURES			
	System 1	System 2	System 3
Gross return Per head	$2.06	$1.94	$1.19
Total costs Per head	$0.39	$0.16	$0.33
Net Benefit Per head	$1.67	$1.78	$0.87
Annual Net Benefit for the plant	$1,209,897	$1,084,867	$394,997
Annual Net Benefit for the ex cap	$1,326,163	$1,175,144	$500,993
Pay back (years)	1.49	0.56	2.10
Net Present Value of investment	$11,164,879	$9,971,548	$2,537,458

The production details which attribute to the CBA results in Table 8 are detailed in Table 9. For specific details on each of these systems the information can be recovered from the MLA project reports identified above.

Table 9: Breakup of system specific benefits and costs

SUMMARY PERFORMANCE MEASURES			
	System 1	System 2	System 3
Number of head processed	890,400	810,950	720,000
Processing Rate (Head/min)	8	6	6
FTE's Saved	3	20	3
Labour benefit per head	$1.08	$1.02	$1.73
Technique benefit per head	$1.07	$1.01	$0.22
Accuracy benefit per head	$0.91	$0.00	($0.37)
Capital cost	($1,980,000)	($862,184)	($1,050,000)

5.4.3 Summary

The three systems costed in this section can all have a substantial benefit to small stock abattoirs in Australia. The systems all have different applications and learning's from the development of these systems. Adaptions in conjunction with carcase sorting technology could benefit further automation in this area for domestic processes.

5.5 Carcase Stringing and Loadout (#6, 11 and 14)

The process of stringing carcases and cuts differs between beef and lamb carcasses but is a very manual process as explained in the following section.

5.5.1 Lamb Carcases

The loading out of lamb carcases and primals is affected by the customer's specifications and destination. The customer specification ranges from hanging primals without a covering to wrapping carcases in two different bags prior to export.

Domestic Carcase Loadout:

The process involved with splitting, hanging and stringing lamb carcases for domestic orders includes the following process:

- A hanging string is placed through the hock as it leaves the slaughter floor;
- Carcases split into specifications;
- Primal hung from the rail;
- A smaller hook replaces the plastic slaughter floor gambrel;

The main complexities involved with automating this process is the variation in the location of the strings in the carcase. The different locations which carcases need to be strung can be seen in Figure 9.

The development of an automated system would benefit this section of the plant. However the following are some of the considerations which will affect the ability to automate the process.

- Each part of a carcase has a different shape;
- The entry point of the string varies between cuts and carcases;
- Picking up of hooks and placing on rails would need to be automated;

This combination of tasks makes the automation job dynamic and difficult.

Figure 9: Lamb carcases strung for Loadout

Export carcase Loadout:

The preparation of carcases for export orders requires the carcases to be wrapped prior to export. The number of labour units required when preparing carcases for export in large plants is between 12 and 20 labour units during peak demand. The process involved with preparing carcases for export orders are:

- Tuck the fore shanks back toward the neck;
- Wrap the carcase is a stocking net (Figure 10);
- Load carcases into container for air freight;
- Frozen carcases need to be wrapped in a plastic.

The automation of carcase Loadout for airfreight would decrease the labour requirements and OH & S costs of plants. The following are processors that if automation could complete it would maximise the benefits of the system.

- Automated carcase wrapping, with stocking netting;
- Automated wrapping of carcases with plastic for frozen export;
- Automatic container loading, particularly when carcases are laid flat for export;

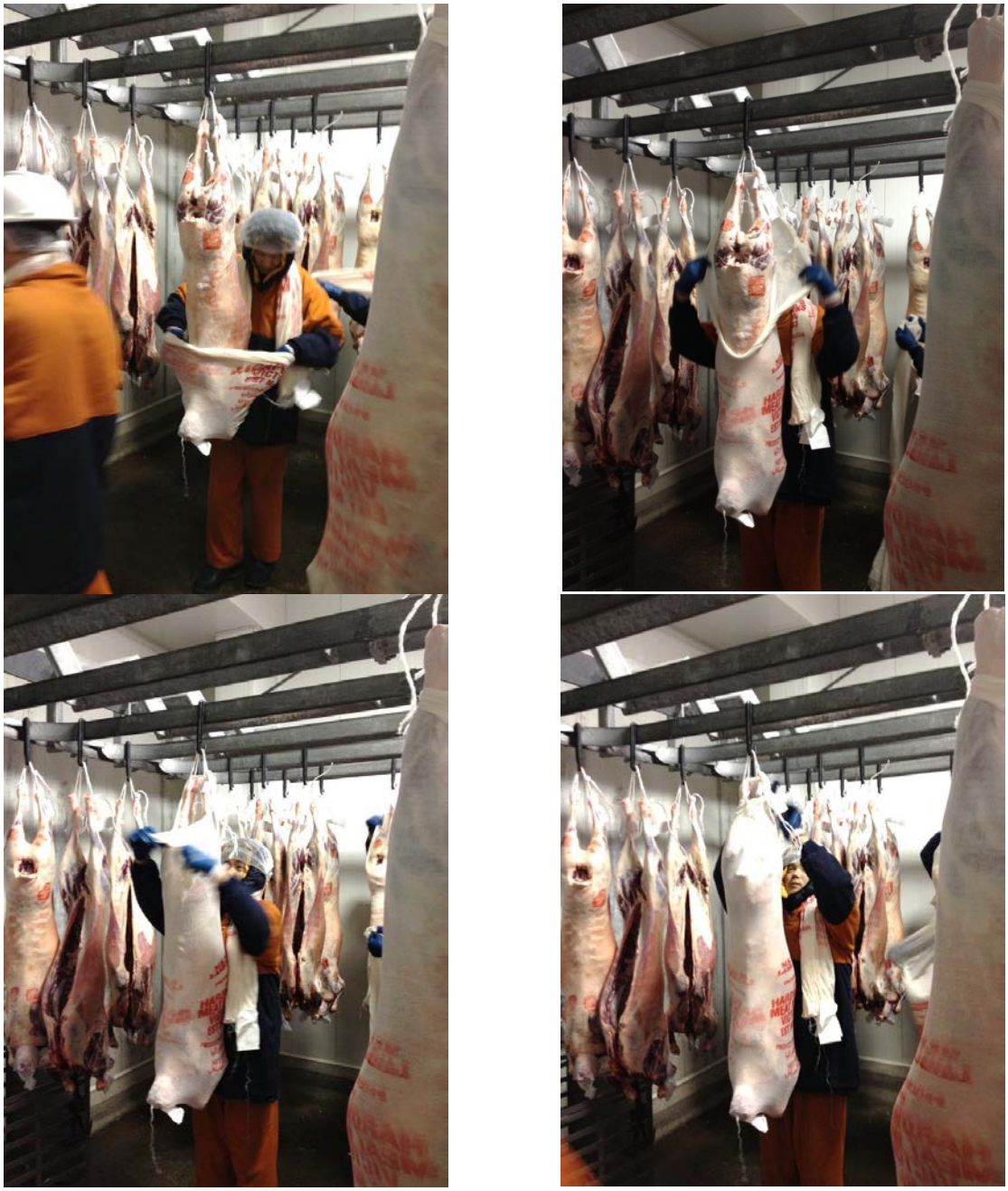


Figure 10: Process involved with bagging a carcase

5.5.2 Beef Carcases

Beef carcases are hung the same way as lambs but only as quarters. The string used is thicker and the process requires different types of activities and labour units.

In the plant visited, 7 FTE's were required for the process from the chiller to Loadout involving moving the carcases from the chiller, stringing, quartering and moving quarters from full rails to quarter rails and to the marshalling area for loadout. This is a manual job but difficult to automate due to the stringing and re-hanging required.

Beef carcase and primal loadouts could be any combination of cuts like flanks, butts and rumps. 4 FTE's were required to fill these orders including:

- 1 FTE breakdown and mark cuts from carcases;
- 1 FTE strings carcases;
- 1 FTE picks carcases and pushes product;
- 1 FTE loads the truck;

Cost of string of stringing carcases ranges from $2-10/carcase depending on the number of cuts broken down.

Figure 11: Beef carcases stringing

5.5.3 Cost Benefit Analysis

The benefits of an automated carcases stringing has returned a very low value opportunity. Although if an automation systems could bag carcases for export orders, the ROI would be greatly increased. The processes involved with breaking and stringing are as follows:

- Breaking of carcases;
- Stringing of primals;
- Wrapping carcases;
- Hanging the primals;
- Picking up of hooks and placing on rails;

As a result of the high number of activities required to string primals and carcases. The variation in the ideal stringing location makes the automation job dynamic and very difficult.

Table 10: Required ROI for the development of a carcase stringing system.

SUMMARY PERFORMANCE MEASURES*				
* Automation methods compared back to manual packing				
	Smallstock - Domestic	Smallstock - Export	Beef - Part	Beef - All Cuts
Capital cost	$300,753	$801,963	$401,010	$401,010
Gross return Per head	$0.45	$1.21	$1.51	$1.51
Total costs Per head	$0.05	$0.14	$0.18	$0.18
Net Benefit Per head	$0.40	$1.07	$1.34	$1.34
Net Benefit / cobotic unit	$150,380	$401,016	$200,506	$200,506
Annual Net Benefit for the plant	$150,380	$401,016	$200,506	$200,506
Pay back (years)	2.00	2.00	2.00	2.00
NPV	$1,271,184	$3,389,867	$1,694,907	$1,694,907

The assumptions in Table 11 have been used to demonstrate the variation between the payback periods for beef and lamb plants. The amount of benefit obtained from these results will vary between plants and the capabilities of an automated solution.

Table 11: Assumptions used to calculate the ROI.

	Smallstock - Domestic	Smallstock - Export	Beef - Part	Beef - All Cuts
Head / Hour	99	99	39	39
Head / Day	1,500	1,500	600	600
Head / Annual	375,000	375,000	150,000	150,000
Cartons per day	17,294	17,294	6,918	6,918
FTE's saved	3	8	4	4
Rework improvement	0	0	0	0
Number of machines	1	1	1	1
Useful working life	15	15	15	15

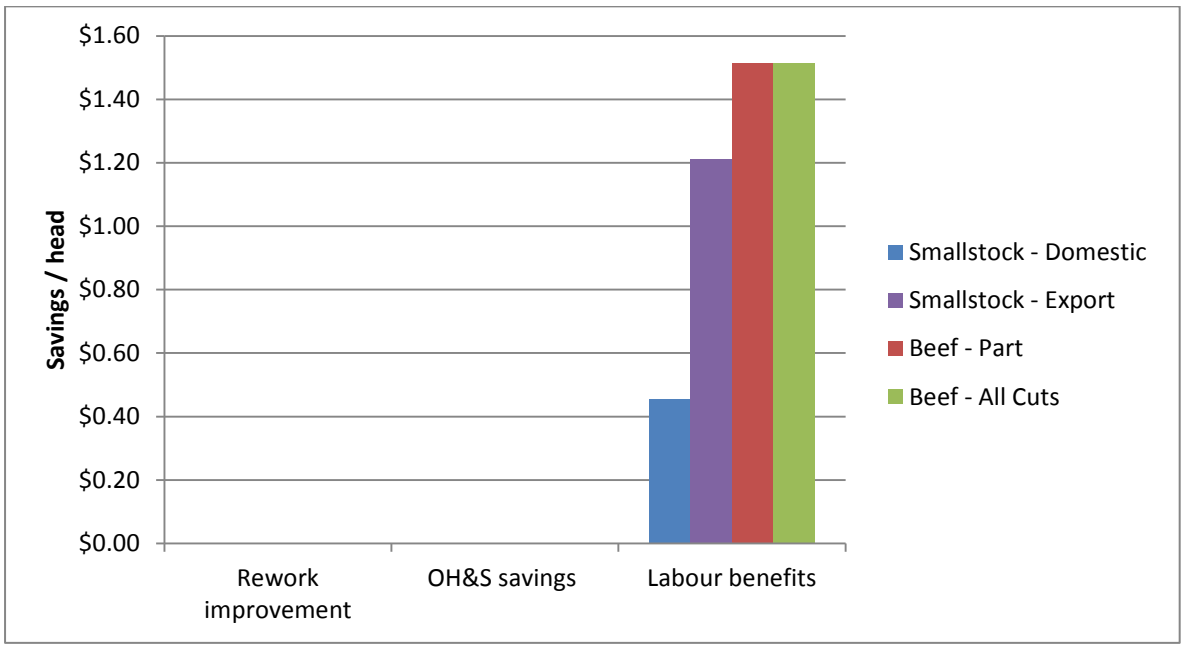


Figure 12: Savings achieved through automating the string of carcases

As can be seen in Figure 12 the majority of savings attributed to stringing carcasses is all associated with labour savings.

5.6 Trim Packing Opportunity (#3, 13)

The opportunity to automate the sortation and packing of trim into different CL grades has a number of benefits. In most plants the work is labour intensive so there is an opportunity to save labour. The value of different trim qualities is substantial and claims can occur if product doesn't meet targeted CL tolerances. Plants will pack trims with more lean content to avoid claims. If automated mixing of trim could be done more accurately than manual systems by mixing different meat to ensure the fat percentage of products sold. The increase in value of trim would be significant.

Larger plants already have x-ray systems to monitor CL content in cartons already packed. This does not optimised what is packed however. Even in large plants where every CL blend is packed and the monitoring system sorts to the best trim code based on CL content, there is still lost value. Global demand for different trims changes regularly. Although the total CL content of a plants trim will not change on a day there is an optimum mix of trim blends a plant could produce that is worth more than another combination of blends.

In order to save labour and increase blend accuracy a system would need to conduct the following:

- Identify fat content of each piece of meat;
- Calculate the greatest return for products and mix CL grades to meet particular specifications;
- X-ray the trim to ensure no bone fragments remain and confirm CL content;
- Automate some parts of the process to gain labour savings;

There are a number of systems on the market or in trial development. Plants have different requirements and some of these would not be acceptable solutions for reasons such as foot print or minimum volumes to justify capital expense.

5.6.1 Marel's Trim management system

Marel's trim management system is designed to analyse beef trim for fat/lean ratio, and give processors the ability to manage their trim and hit target fat percentages. It is available as part of their boning room solution. The main features of this system include:

- X-ray technology for accurate chemical lean measurements;
- Batching into desired chemical lean ratio;
- Available as stand-alone unit or integrated with a Marel StreamLine system;
- Superior bone and other contaminant detection.

Equipment Capabilities	**Potential Plant Sections**
Visioning – primal ID (e.g. X-ray, Pallet stacking)	Boning Room

5.6.2 Other concept systems

A number of systems are in various stages of development and represent substantial return on investment if successfully commercialised:

- FPE are considering development of a system that blends and tests trim quality in line with the process discussed above (Sentence, 2008).
- Naked Block freezing was conducted as a series of MLA and AMPC joint projects (A.TEC.0056 and A.TEC.0067) to determine the viability of packing trimmings without cartons. Part of this project included the sorting and blending of trims to meet target CL contents.

5.6.3 Cost Benefit Analysis

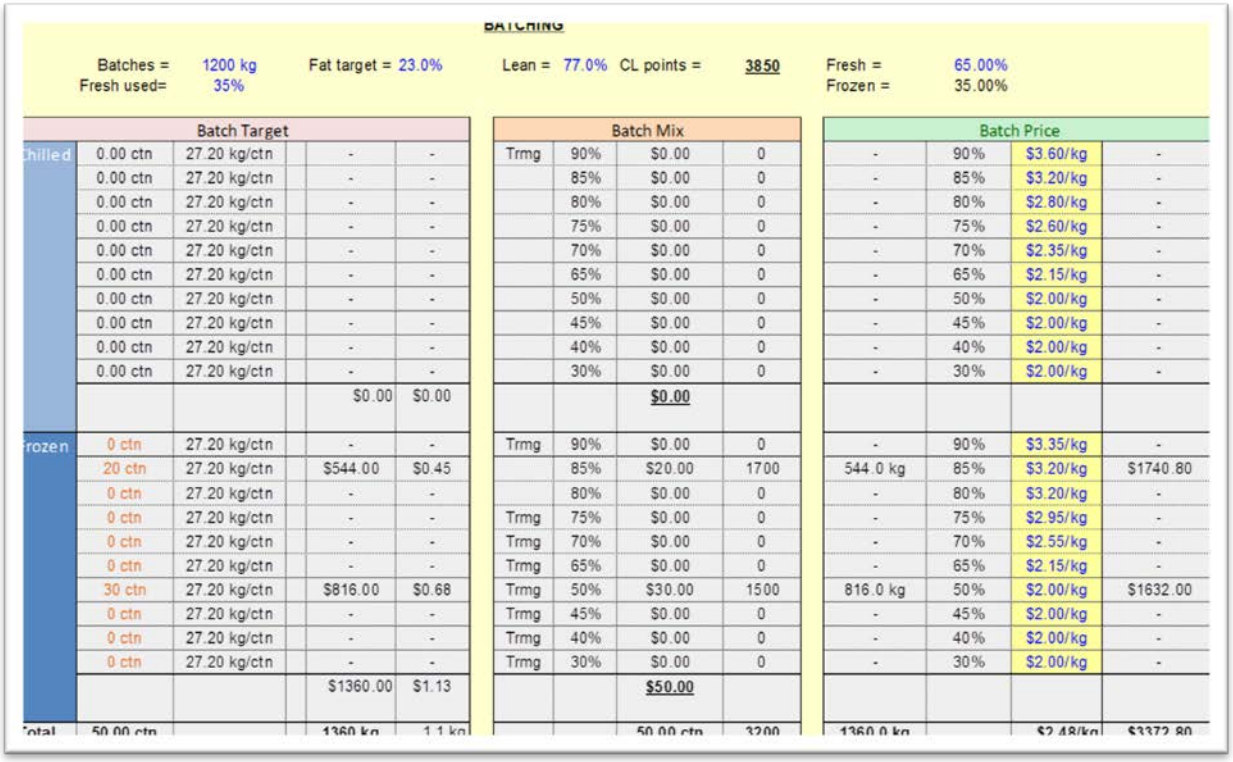
The costing's displayed in ne fragments being sold in trim

Table 12 only include labour savings. In addition to these savings there could also be the following benefits:

- Reduction in trim testers required;
- Increased value of trim sold into different CL grades
    - Additional value could range from $250,000 to $1M annually for a 1% increase in CL accuracy depending on size of plant using commercial solver in Figure 13.
- Reduction in possible bone fragments being sold in trim

Table 12: Required ROI for the development of a trim packing system.

SUMMARY PERFORMANCE MEASURES*				
* Automation methods compared back to manual packing				
	Std Mkts - Part	Std Mkts - All Cuts	Complex Mkts - Part	Complex Mkts - All Cuts
Capital cost	$300,791	$360,948	$451,184	$541,421
Gross return Per head	$1.14	$1.36	$1.70	$2.05
Total costs Per head	$0.13	$0.16	$0.20	$0.24
Net Benefit Per head	$1.00	$1.20	$1.50	$1.80
Net Benefit / cobotic unit	$150,377	$180,453	$225,566	$270,679
Annual Net Benefit for the plant	$150,377	$180,453	$225,566	$270,679
Pay back (years)	2.00	2.00	2.00	2.00
NPV	$1,271,149	$1,525,379	$1,906,725	$2,288,071



BATCHING

Batches = 1200 kg Fat target = 23.0% Lean = 77.0% CL points = 3850 Fresh = 65.00%
Fresh used= 35% Frozen = 35.00%

	Batch Target				Batch Mix				Batch Price			
Chilled	0.00 ctn	27.20 kg/ctn	-	-	Trmg	90%	$0.00	0	-	90%	$3.60/kg	-
	0.00 ctn	27.20 kg/ctn	-	-		85%	$0.00	0	-	85%	$3.20/kg	-
	0.00 ctn	27.20 kg/ctn	-	-		80%	$0.00	0	-	80%	$2.80/kg	-
	0.00 ctn	27.20 kg/ctn	-	-		75%	$0.00	0	-	75%	$2.60/kg	-
	0.00 ctn	27.20 kg/ctn	-	-		70%	$0.00	0	-	70%	$2.35/kg	-
	0.00 ctn	27.20 kg/ctn	-	-		65%	$0.00	0	-	65%	$2.15/kg	-
	0.00 ctn	27.20 kg/ctn	-	-		50%	$0.00	0	-	50%	$2.00/kg	-
	0.00 ctn	27.20 kg/ctn	-	-		45%	$0.00	0	-	45%	$2.00/kg	-
	0.00 ctn	27.20 kg/ctn	-	-		40%	$0.00	0	-	40%	$2.00/kg	-
	0.00 ctn	27.20 kg/ctn	-	-		30%	$0.00	0	-	30%	$2.00/kg	-
			$0.00	$0.00			$0.00					
Frozen	0 ctn	27.20 kg/ctn	-	-	Trmg	90%	$0.00	0	-	90%	$3.35/kg	-
	20 ctn	27.20 kg/ctn	$544.00	$0.45		85%	$20.00	1700	544.0 kg	85%	$3.20/kg	$1740.80
	0 ctn	27.20 kg/ctn	-	-		80%	$0.00	0	-	80%	$3.20/kg	-
	0 ctn	27.20 kg/ctn	-	-	Trmg	75%	$0.00	0	-	75%	$2.95/kg	-
	0 ctn	27.20 kg/ctn	-	-	Trmg	70%	$0.00	0	-	70%	$2.55/kg	-
	0 ctn	27.20 kg/ctn	-	-	Trmg	65%	$0.00	0	-	65%	$2.15/kg	-
	30 ctn	27.20 kg/ctn	$816.00	$0.68	Trmg	50%	$30.00	1500	816.0 kg	50%	$2.00/kg	$1632.00
	0 ctn	27.20 kg/ctn	-	-	Trmg	45%	$0.00	0	-	45%	$2.00/kg	-
	0 ctn	27.20 kg/ctn	-	-	Trmg	40%	$0.00	0	-	40%	$2.00/kg	-
	0 ctn	27.20 kg/ctn	-	-	Trmg	30%	$0.00	0	-	30%	$2.00/kg	-
			$1360.00	$1.13			$50.00					
Total	50.00 ctn		1360 kg	1.1 kg			50.00 ctn	3200	1360.0 kg		$2.48/kg	$3372.80

Figure 13: Example of trim batching solver used to optimise total value of trim

5.7 Palletisation, Storage and Retrieval

The palletisation, de-palletisation and storage and retrieval of pallets were identified by all plants visited as a potential area for automation to be installed. This is due to the number of staff in these often congested areas as well as the OH & S issues associated with staff lifting cartons all day every day.

Pallet storage and retrieval is the main cold storage system used in the Australian red meat industry as compared with carton or crate storage in Europe. This system requires every carton to be moved at least twice. In some cases where plants have large product lists and limited pallet spaces, cartons could be manually handled up to 5 times prior to loadout. Having said this, the benefits of pallet based systems are:

- Pallet racking is already installed;
- Limited space is required per carton;

For existing pallet systems to be improved the following components, would incorporate the current infrastructure and automate manual operations of the plant.

5.7.1 Palletiser

An automated palletiser would need to be developed to maximise the rate at which cartons can be unloaded from the blast freezer or chiller. The rate the palletiser can operate at will affect the savings. This is a result of the palletiser currently being a bottle neck in the picking

and packing section. The return on investment may be greater than that presented in Table 13 as a result of the increased throughput.

The main capabilities and technical considerations are shown below:

1. Identify the number of cartons going onto each pallet;
2. Identify the products going onto each pallet;
3. Identify the cartoning configuration from the size of the cartons
4. Record the production dates and barcode number of each carton on the pallet;
5. Stack the pallet in an interlocking method;
6. Shrink wrap the pallet where required;

The main development considerations for this system are as follows:

- Rate at which cartons are loaded;
- Number of pallets which can be stacked at one time;
- The footprint of the system;

5.7.2 De-palletiser

The carton de-palletiser will minimise the amount of cartons being lifted by a manual operator. The savings could be maximised when the system is incorporated with a shipping container loader.

The main capabilities required by this system are:

1. Scan all cartons as loaded onto a conveyor;
2. The maximum rate of the system should be greater than the shipping container loader.
3. Cartons will need to be placed onto a conveyor belt;
4. Any damage carton should be identified and removed from the flow of product;
5. Record the cartons removed from the pallet;

The main technical features which need to be conducted by the de-palletising system are:

- Have a minimal footprint;
- Stack at a rate greater than 10 cartons a minute;
- Barcode reading;
- Provide QA with a percentage of cartons for testing;

5.7.3 Mixed Pallet Order Picking

A mixed order picking system would need the ability to be utilised for both the palletisation and de-palletisation of cartons. Ideally both of these processes can be conducted by the same system.

The main capabilities required of this system are:

1. Scan every carton when palletizing or de-palletizing cartons.
2. Inspect cartons for damage & remove any cartons from the lot to be re-worked.
3. Select a specific number of cartons for QA and AQIS checks.

4. Be able to handle wet, slippery and icy conditions.
5. Would ultimately be able to work in conditions to -40^{o}C.
6. Identify different cartons in the pallets from scanning the barcode,
7. Select the cartons in a particular order.

There are three possible opportunities for this type of system:

- Unload a number of pallets to supply the shipping container loader;
- Unload a number of pallets and load onto one pallet for domestic orders;
- Palletize multiple pallets with cartons from a conveyor belt;

5.7.4 Storage and retrieval of pallets

There are no prototypes currently being developed specifically for the red meat industry, for this reason the savings have not need included in the CBA. However there are a number of systems available which would utilised the current pallet racking by automate the storage and retrieval of pallets. The following systems are only a snapshot of systems available to the industry. Images and additional information on these systems can be found in section 8.4 on page 46.

Dexion - Automated crane stackers

Stacker Cranes are suited to operations with high density storage in confined spaces. Utilising the 'goods to man' principle, cranes offer a more productive alternative to forklifts in the management of a high number of storage and retrieval movements.

Cranes make better use of vertical space and can reach higher than forklifts, up to 35 metres. Furthermore, Cranes provide an additional benefit in the area of occupational health and safety by keeping pedestrian traffic separated from moving equipment. We design and deliver automated storage and retrieval systems (ASRS) for both pallet load and mini load applications. In these systems, the choice of crane type and its configuration are based on criteria such as the volume, weight and throughput of the load to be stored and moved.

Pallet Satellites by Dexion

Satellite Smart Carts run along rails in high density storage racks to store and retrieve pallets. They do this by moving full pallet loads in and out of the storage structure.

The Satellite Cart is manually placed in the designated rack position by a forklift, after which the cart operates automatically by remote control or RF. The Satellite Cart deposits and retrieve pallets within the system as required enabling forklift operators free to focus on bringing pallet loads to and from the racking face. Sensors along the storage channel determine where it must stop, deposit or retrieve the load and return. Satellites are ideal for applications with low SKU where there is a high movement rate of pallets. They can be configured for FIFO (first-in/first-out) or LIFO (last-in/first-out) operation. Our Satellite Smart Cart is an advanced satellite system that brings greater efficiency to multi-deep pallet handling in a high density environment.

Mecalux pallet stacker crane

Automatic trilateral stacker crane makes it very easy to automate warehouses with conventional racks where a man-operated elevator truck is used, both in pre-existing warehouses and in new facilities.

The stacker crane moves the pallets to the extremes of the passageway leaving the cargo on a rack or automatic transport system. This is possible since it has a rotating head enabling you to pick-up and leave pallets in three positions: one frontal and two lateral.

The automatic trilateral stacker crane, guided on three rails, only has four supporting points on the ground. It has no top guide, making it easier to install in any warehouse where elevator trucks are usually used. It also adapts to virtually all spaces for direct access to the pallets.

It is totally automatic and all the movements of the stacker crane respond to storage and extraction orders sent by a control system that optimizes these movements.

5.7.5 Integrated Storage and Retrieval System

The systems identified above are standalone processors, however if a live feed was established to link these systems they could be better utilised. The benefits of linking a number of systems together will allow for greater utilisation of the systems, through reduce time and increased throughput. The manual systems are currently collecting all the data required to link systems but this data would need to be utilised through a live feed to the robotic systems.

The technical capabilities will require additional feedback to the manual system as the robotic system will be required to be isolated from any manual operators. The following are the considerations required by each stage of the process to maximise the rate of product transfer:

1. Carton flow from the Blast chiller or freezer
    a. Order of cartons coming from the freezer or chiller.
    b. Notify the storage and retrieval process when there is a change in product line coming, thus to prepare to change all pallets.
2. Palletisation
    a. Identify carton;
    b. Read the carton barcode;
    c. Identify the product type;
    d. Place carton on the correct pallet;
    e. Count the number of cartons per pallet;
    f. Notify when the pallets are completely loaded;
3. Storage, this may still be conducted by a manual operator;
    a. Identify pallet;
    b. Select the ideal location for the pallet;
    c. Place the pallet and record the pallets location;
4. Retrieval
    a. Select the correct pallet for the order;
    b. Move pallet to the de-palletiser;

c. Record the pallet movement;

5. De-Palletisation
   a. Identify carton;
   b. Reject any damaged cartons;
   c. Place cartons onto a conveyer belt;
   d. Record the cartons unloaded;

5.7.6 Cost Benefit Analysis

The costing identified in the CBA has not included the storage and retrieval of pallets. It has maintained this process as a manual operation. The biggest considerations in the development of this system are as follows:

- Rate at which the robotic systems can load and unload pallets.
- The number of product skews coming out of the chiller or freezer.
- Buffering required to hold like SKU's to achieve single product pallets.
- The temperatures which the system can operate (greatest utilisation and payback if the pallet stacker could work in temperatures to -40°C).

The ROI presented in

Table 13 is an estimate including operators in the freezer.

Table 13: Required ROI for the development of a palletising & de-palletising system.

SUMMARY PERFORMANCE MEASURES*				
* Automation methods compared back to manual packing				
	Std Mkts - Part	Std Mkts - All Cuts	Complex Mkts - Part	Complex Mkts - All Cuts
Capital cost	$1,357,855	$1,629,697	$2,076,382	$2,492,472
Gross return Per head	$5.13	$6.16	$7.85	$9.42
Total costs Per head	$0.60	$0.72	$0.92	$1.11
Net Benefit Per head	$4.53	$5.43	$6.92	$8.31
Net Benefit / cobotic unit	$679,056	$814,850	$1,038,579	$1,246,241
Annual Net Benefit for the plant	$679,056	$814,850	$1,038,579	$1,246,241
Pay back (years)	2.00	2.00	2.00	2.00
NPV	$5,740,246	$6,888,042	$8,779,515	$10,534,657

The details in

Table 14 have been used to developing the costing's presented in Table 13.

Table 14: Details of the costing's presented in the CBA

	Std Mkts - Part	Std Mkts - All Cuts	Complex Mkts - Part	Complex Mkts - All Cuts
Head / Hour	39	39	39	39
Head / Day	600	600	600	600
Head / Annual	150,000	150,000	150,000	150,000
Cartons per day	6,918	6,918	6,918	6,918
FTE's saved	13	15	20	23
Rework improvement	0	0	0	0
Number of machines	1	1	1	1
Useful working life	15	15	15	15

Figure 14 shows the labour savings that can be achieved through the installation of a palletising and de-palletising system. The savings may be increased for the system if pallets can be stored and retrieved automatically which would increase loadout efficiency.

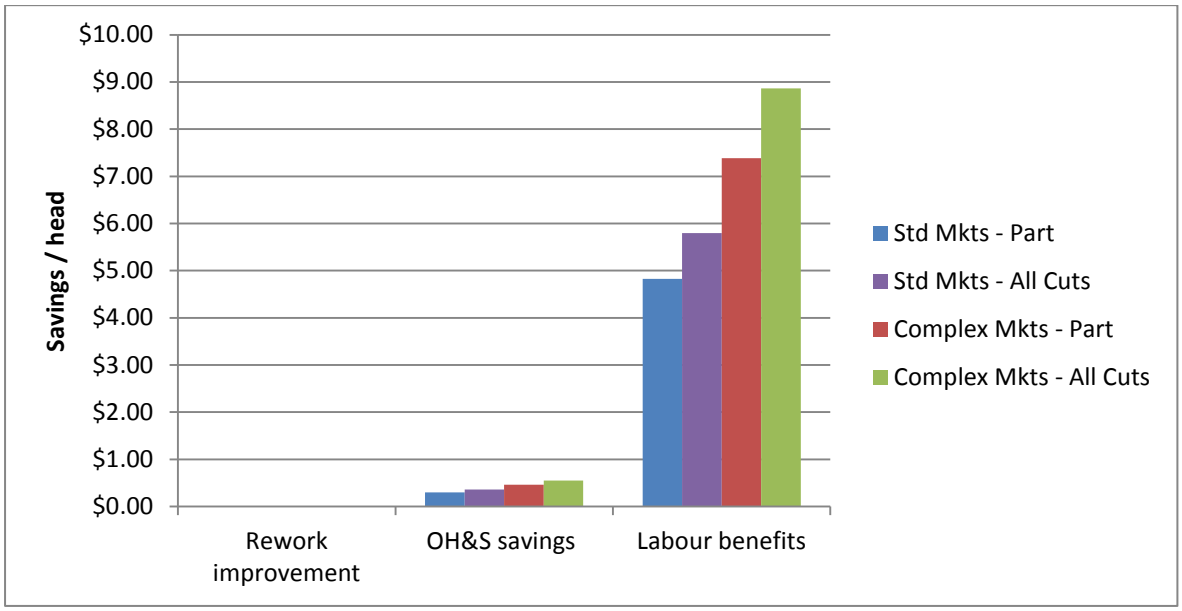


Figure 14: Savings attributed to the installation of a palletising and de-palletising system

5.8 Carton Storage & Retrieval

Abattoir's cold stores facilities in Australia currently incorporate the use of pallets as a method of storing cartons. This section identified the benefits of removing the use of pallets from the cold store completely and thus store and retrieve cartons on a per carton basis.

This type of system was only discussed with one abattoir as an option during the site visits. However it has been costed within this report for future developments of cold store facilities in abattoirs. The price of these systems is decreasing as the technology is increasing and thus may become a viable option for plants in the future.

The benefits of storing and retrieving cartons rather than pallets is it removes all double handling of cartons between the blast chiller or freezer and loading of shipping containers. The main benefits and constraints of this system are:

- Reduced handling of cartons on and off of pallets;
- Increased ability to select a specific carton;
- Increase space requirements per carton.

5.8.1 Systems Available

There are a number of systems available which have been developed for storing and retrieving cartons in cold store facilities. One of these systems has been installed in an American abattoir which has developed a system which cartons are only palletised when exiting the abattoir for domestic consumption. There are a number of products shown in section 0 on page 51 which have already been used in the storage and retrieval of cartons.

The main processes involved with this system are as follows:

- Storage and retrieval of cartons;
- Carton tracking;
- Operate at a rate greater than can be achieved by the output of the blast chiller.

5.8.2 Cost Benefit Analysis

Table 13 demonstrates the estimated cost of the system to provide a two-year payback in the four scenarios.

Table 15: Required ROI for the development of a carton storage and retrieval system

SUMMARY PERFORMANCE MEASURES*				
* Automation methods compared back to manual packing				
	Std Mkts - Part	Std Mkts - All Cuts	Complex Mkts - Part	Complex Mkts - All Cuts
Capital cost	$1,611,512	$1,880,583	$2,677,917	$3,088,436
Gross return Per head	$6.09	$7.10	$10.11	$11.67
Total costs Per head	$0.72	$0.84	$1.19	$1.37
Net Benefit Per head	$5.37	$6.27	$8.92	$10.30
Net Benefit / cobotic unit	$805,598	$940,283	$1,338,395	$1,544,451
Annual Net Benefit for the plant	$805,598	$940,283	$1,338,395	$1,544,451
Pay back (years)	2.00	2.00	2.00	2.00
NPV	$6,809,731	$7,948,340	$11,313,278	$13,055,617

The figures shown in Table 16 have formed the basis of the savings shown in Table 15.

Table 16: Assumptions used to form the CBA results shown in Table 15.

	Std Mkts - Part	Std Mkts - All Cuts	Complex Mkts - Part	Complex Mkts - All Cuts
Head / Hour	39	39	39	39
Head / Day	600	600	600	600
Head / Annual	150,000	150,000	150,000	150,000
Cartons per day	6,918	6,918	6,918	6,918
FTE's saved	16	18	27	30
Rework improvement	0	0	0	0
Number of machines	1	1	1	1
Useful working life	15	15	15	15

The savings displayed in Figure 15 is the expected payback for an automated storage and retrieval system for cartons. These costing's do not include the following:

- Costs of operating forklifts;
- Cheap pallet higher costs;
- Cartons damaged during storage and retrieval.

Therefore the savings for plants could be expected to be higher than that displayed in the CBA results.

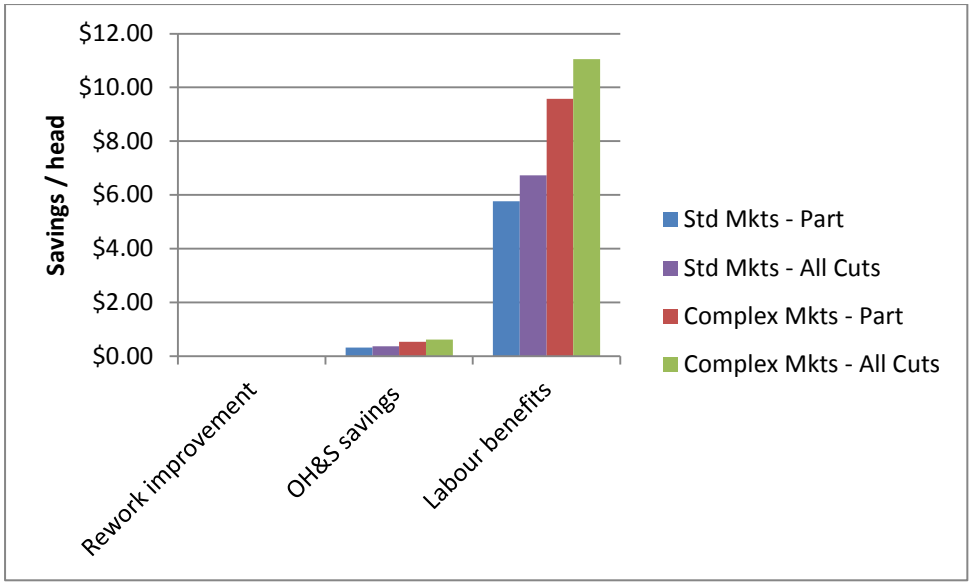


Figure 15: Savings attributed to the automated storage and retrieval of cartons

6 Existing Solutions

The following section provides a summary of the existing solutions for picking, packing and materials handling. Some of these systems may require some additional development to maximise the savings displayed.

6.1 Primal Bagging (#10)

The number of staff required varies between plants depending on the boning room setup. The systems available can wrap up to maximum of 40 primals per min with one operator required. The utilisation of the flow wrapper will be affected by the ability to automate the flow of products to the system. The boning room setup may limit the utilisation of this system.

In plants where the product is already being moved down a conveyor the savings will tend to be less than plants which are transferring product in cartons.

6.1.1 Cost Benefit Analysis

There are already abattoirs with primal bagging solutions installed. As can be seen in

Table 18 the installation of a flow wrapper or similar equipment would have a substantial payback for red meat boning rooms with the specifications displayed in Table 17.

Table 17: Details of the costing's presented in the CBA shown in

Table 18

	Std Mkts - Part	Std Mkts - All Cuts	Complex Mkts - Part	Complex Mkts - All Cuts
Head / Hour	39	39	39	39
Head / Day	600	600	600	600
Head / Annual	150,000	150,000	150,000	150,000
Cartons per day	6,918	6,918	6,918	6,918
FTE's saved	10	12	20	23
Rework improvement	0	0	0	0
Number of machines	1	1	1	1
Useful working life	15	15	15	15

The main constraints observed during the site visits affecting the uptake of flow wrappers are:

- Speed at which primals can be wrapped;
- The number of products which can be wrapped using the same piece of equipment;
- Room available in boning rooms for the equipment;
- Design of the boning room to allow primals to be moved down a conveyor belt;
- The number of product SKU's and the effect on the vacuum sealed bags used.

Table 18: Required ROI for the development of a primal bagging system.

SUMMARY PERFORMANCE MEASURES*				
* Automation methods compared back to manual packing				
	Std Mkts - Part	Std Mkts - All Cuts	Complex Mkts - Part	Complex Mkts - All Cuts
Capital cost	$1,077,484	$1,293,118	$2,127,570	$2,467,901
Gross return Per head	$4.07	$4.89	$8.04	$9.32
Total costs Per head	$0.48	$0.57	$0.95	$1.10
Net Benefit Per head	$3.59	$4.31	$7.10	$8.23
Net Benefit / cobotic unit	$538,858	$646,621	$1,064,276	$1,233,955
Annual Net Benefit for the plant	$538,858	$646,621	$1,064,276	$1,233,955
Pay back (years)	2.00	2.00	2.00	2.00
NPV	$4,555,123	$5,466,020	$8,996,800	$10,430,801

The results in Figure 16 shows there is a considerable saving per head attributed to the installation of a flow wrapper. Currently the pack off area is one of the main bottle necks in abattoirs visited throughout this project. Flow to be installed Australia abattoirs would need to operate quicker than the current boning room chain. This would provide the following benefits to the plant:

- Allow for future expansion of the boning room.
- Increase the payback of the system

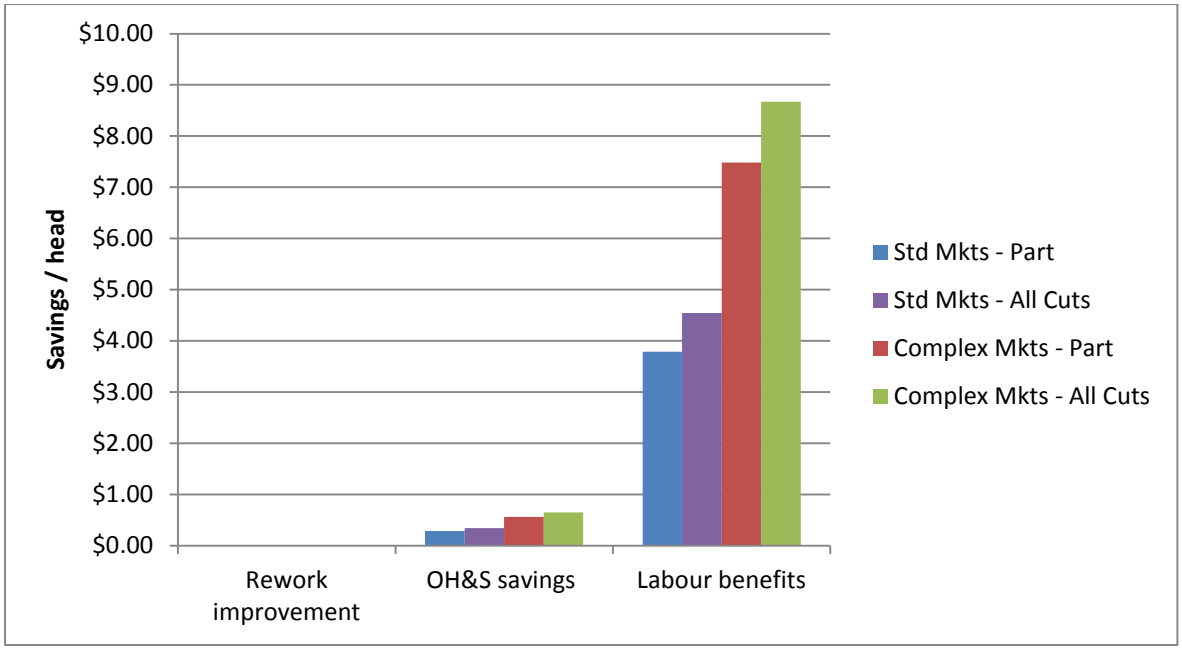


Figure 16: Savings attributed to the automation of primal bagging

The following systems are two options available for beef and small stock abattoirs to automate the vacuum sealing of primals.

6.1.2 FlowVac55

The Cryovac Flow Vac is designed to wrap fresh pork, lamb or cheese. This system conducts the following:

- Wraps primals with a vacuum seal plastic, forming its own bag.
- The film is vacuum sealed in a standard sealing machine.
- A belt feeds the primals into the machine.

Link: http://www.cryovac.com/eu/en/ProductsAndEquipment/automatic_shrink_loader.aspx

Equipment Capabilities	**Potential Plant Sections**
Vacuum sealing	Boning Room Product packaging

6.1.3 RoboLoaders

Cryovac® BLR1 & BLR2 bag loaders are fully automatic, high speed robotic bag loaders for loading a range of food products into Cryovac® taped bags. They automatically select from a range of 2-6 bag sizes.

Link: http://www.cryovac.com/ap/en/food-packaging-equipment/blr-roboloader.aspx

Equipment Capabilities	**Potential Plant Sections**

Vacuum sealing	Boning Room Product packaging

6.2 Real time Reporting (#15)

The current feedback system used in boning room provides supervises with the estimated yield from the day and the actual yield for the day on a daily basis. These systems do not allow the boning room to monitor yield benefits at real time. If a live stream feedback system could be developed it would allow boing room staff to assess yields during the day. This system would minimise the yield loss in plants when the boning room is not under tight control from the supervisors.

The savings attributed to real-time reporting will vary substantially between plants. The main benefits attributed to real-time reporting are associated with yield benefits. This will therefore vary the savings between low value small stock, lamb and beef plants.

The low value small stock plants will have very little, if any, benefit from real-time reporting as this product for commodity markets is driven around cost of production with little value difference between cuts. The lamb and beef plants which don't closely monitor the yield of products per day will have the most benefit of a reporting system.

The attention to detail of the boning room supervisors will greatly affect the yield sold of all primals. The following systems have the ability to reduce variation in different types of plants:

- Marel StreamLine Deboning & Trimming
- X-ray lamb boning solution,
- Aitch bone puller.

6.2.1 Streamline deboning and trimming solution

The Marel Streamline deboning and trimming system enables meat processors to monitor and collect data on yield, throughput and quality throughout the entire processing cycle. The system can monitor and track products and place accountability back to a particular boner or slicer. StreamLine can be configured for a variety of tasks, including deboning, trimming, membrane skinning, tying and sawing, and allowing processors to cater entirely to their customers' specifications.

Equipment Capabilities	**Potential Plant Sections**
Yield Monitoring	Boning Room

6.3 Labelling (#11)

There are a number of systems available to automatically label cartons. The biggest constraint with this area is the visual identification of primals. The development of visual identification systems would further enhance the following areas:

- Primal packaging;
- Carton labelling;
- Reduction in product claims;

Currently if an automated labelling system is installed there would have to be a manual operator to identify the products being labelled. This would decrease the benefit of an automatic labelling system.

6.3.1 Cost Benefit Analysis

There were a relatively low number of labour units labelling cartons in the abattoirs visited. However if a system was developed in conjunction with a primal packing system/unit, it would maximise the savings of both areas. The values presented in Table 19 are only attributed to the labelling of cartons.

Table 19: Required ROI for the development of an automated carton labelling system.

SUMMARY PERFORMANCE MEASURES*				
* Automation methods compared back to manual packing				
	Std Mkts - Part	Std Mkts - All Cuts	Complex Mkts - Part	Complex Mkts - All Cuts
Capital cost	$300,777	$360,912	$300,777	$360,912
Gross return Per head	$1.14	$1.36	$1.14	$1.36
Total costs Per head	$0.13	$0.16	$0.13	$0.16
Net Benefit Per head	$1.00	$1.20	$1.00	$1.20
Net Benefit / cobotic unit	$150,378	$180,455	$150,378	$180,455
Annual Net Benefit for the plant	$150,378	$180,455	$150,378	$180,455
Pay back (years)	2.00	2.00	2.00	2.00
NPV	$1,271,162	$1,525,413	$1,271,162	$1,525,413

There are a large number of automatic label printers available which are already used in the red meat industry. The main areas of development needed in this area are as follows:

- Primal identification
- Rejection of products if there is:
    - An incorrect number of product in the box;
    - Any defect of the primals;
    - If the packing of the primals in incorrect as per the customer requirements

The assumptions used to obtain the return on investment shown in Table 19 are shown in Table 20.

Table 20: Assumptions used in the calculations for the results shown in Table 19

	Std Mkts - Part	Std Mkts - All Cuts	Complex Mkts - Part	Complex Mkts - All Cuts
Head / Hour	39	39	39	39
Head / Day	600	600	600	600
Head / Annual	150,000	150,000	150,000	150,000
Cartons per day	6,918	6,918	6,918	6,918
FTE's saved	3	4	3	4
Rework improvement	0	0	0	0
Number of machines	1	1	1	1
Useful working life	15	15	15	15

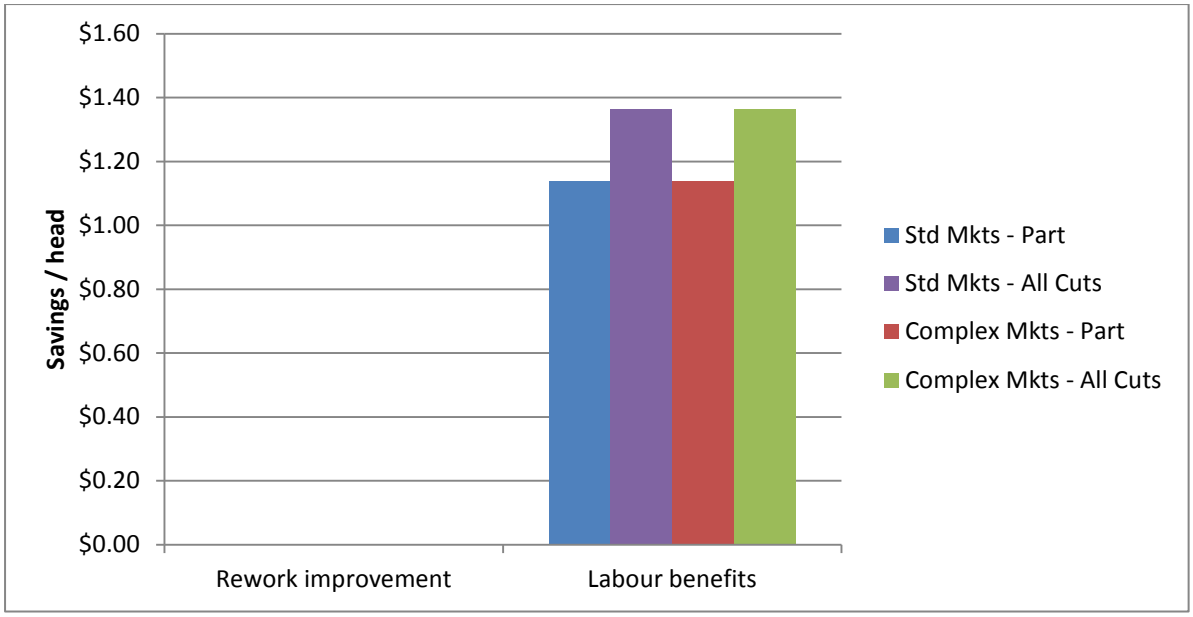


Figure 17: Savings attributed to the automation of carton labelling.

The development of an automated labelling system would have additional benefits throughout different areas of the picking and packing section. If this system could be developed it may also benefit other sections of abattoirs.

7 References

Green, P. & Bryan, K., (2013a)., Ovine X-ray Primal Cutting Systems, Ex-ante Review, Published by MLA, North Sydney MLA project code: P.PIP.0327

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Sentence, C., (2008)., Technical assessment of automated process for packing boneless beef, Published by: MLA North Sydney, MLA project code: A.TEC.0057

8 Appendix

8.1 List of Tables

8.2 List of Figures

8.3 Desktop Study Results

Table 21: The number of automotive solutions available in each capability type by supplier.

Supplier	Carton erection & sealing	Carton Handling	Carton Sortation	Grasping, Handling	Marking	Pallet Storage & Retrieval	Scanning	Shipping container loader	Traceability	Vacuum sealing	Visioning – primal ID
Invata intra-logistics		1									
Muratec		1									
Oystar Jones		1									
VISY Equipment	2	1	2	1	2	1				1	
ABB		1		2							
ATTEC		1	3	1					2		1
AWE		5									
CASI									2		1
Cognex							1		1		1
Dexion		1	2			2					
Marel				1					1		1
Mecalux						1					
Robotic Automation Systems		1							1		1
RSW		2	1			2			1		
Sealed Air										2	
SR Innova	2	2									
Stäubli		1		1							
TEUN								1			
Total	**4**	**18**	**8**	**6**	**2**	**8**	**1**	**2**	**8**	**3**	**5**

Table 22: The number of equipment solutions by equipment capability in each section of the abattoir process.

Equipment Capability	Boning Room	Chiller Carton Lidding	Cold Store	Picking & Loadout	Product aggregation /sortation /palletising	Product Inspection	Product packaging	Product tracking	Trim Packing
Carton erection & sealing		3					1		
Carton Handling			3	5	15				
Carton Sortation	2		1	2	6	1	1		
Grasping, Handling	2				1		5		1
Marking				2		1	1		
Pallet Storage & Retrieval			5	2	7				
Scanning				1			1	1	
Shipping container loader				2					
Traceability	4		1	4	1	3	3	2	
Vacuum sealing	2						3		
Visioning – primal ID	2			2		2	4	1	
Total	**12**	**3**	**10**	**20**	**30**	**7**	**19**	**4**	**1**

8.4 Palletising and De-palletising systems

The following is a list of the palletising systems identified in Milestone 2.

Dexion - Automated crane stackers

Equipment Capabilities	Potential Plant Sections
Pallet Storage & Retrieval	Product aggregation/ sortation/palletising Cold Store

Link: http://www.dexion.com.au/en/integrated_system/19

Pallet Satellites by Dexion

Equipment Capabilities	Potential Plant Sections
Pallet Storage & Retrieval	Product aggregation/ sortation/palletising Cold Store

Link: http://www.dexion.com.au/en/integrated_system/20

Mecalux pallet stacker crane

Advantages:

- Ideal to automate conventional racks of up to 15 meters in height.
- No need to modify the warehouse structure.
- Trilateral extraction integrated system.

Why use an automatic trilateral stacker crane?

- Adapts to all pallet warehouses with man-operated elevator trucks.
- Economical automating. The investment is paid off quickly.
- Easy to implement, both in new and pre-existing warehouses, since it doesn't require any changes to the warehouse structure.
- Decrease in personnel costs. It allows you to manage all the pallet movements without a man on board.
- Using all available space since it does not have a top guide and it can pick up pallets from level 0.
- Reduces errors since it is an automatic system.
- Improves safety in the facility.
- Operators do not work in the passageways meaning the system is safer and reduces the risk of accidents occurring.
- Low maintenance costs.

- Easy to integrate the automatic system connecting it to a warehouse management system like Easy WMS.

Link: http://www.mecalux.com/automated-warehouses-for-pallets/automatic-trilateral-stacker-crane

Equipment Capabilities	Potential Plant Sections
Pallet Storage & Retrieval	Cold Store

AWE - Two-column robot palletisers

The two-column robot palletiser features a pincer that moves along three Cartesian axes as oscillated around its vertical axis. This permits trouble-free handling of bags that are not completely filled or that contain aerated or powdery material, guaranteeing outstanding flexibility. The machine is composed of a rigid portal structure.

Link: http://www.awe.com.au/packaging-machinery/palletiser/robot-palletisers/two-column-robot-palletisers/

Equipment Capabilities	Potential Plant Sections
Carton Handling	Product aggregation/ sortation/palletising

AWE - Single-column robot palletisers

In the range of robot palletiser made by the Concetti Group, the single-column robot palletiser represents the simplest and most compact model. The single-column robot palletiser can handle bags containing stable, aerated or powdery products, permitting partial overlapping of the bags in the layer along both the top and sides, offering flexible format changes.

Link: http://www.awe.com.au/packaging-machinery/palletiser/robot-palletisers/single-column-robot-palletisers/

Equipment Capabilities	Potential Plant Sections
Carton Handling	Product aggregation/ sortation/palletising

AWE - Four-column robot palletisers

The four-column robot palletiser features a pincer that moves along three Cartesian axes as it rotates around its vertical axis. This permits trouble-free handling of bags that are not completely filled or that contain aerated or powdery material, guaranteeing outstanding flexibility.

Equipment Capabilities	Potential Plant Sections
Carton Handling	Product aggregation/ sortation/palletising

AWE - Robotic gantry palletiser

In the range of robot palletising systems manufactured by the Concetti Group, the gantry style robot palletising system PS-4A/10SP is the most compact model designed especially for confined spaces.

Equipment Capabilities	Potential Plant Sections
Carton Handling	Product aggregation/ sortation/palletising

AWE - Anthropomorphic palletisers

In the range of robot palletisers made by the Concetti Group, the anthropomorphic palletiser represents the fastest and most versatile model for the point – to – point moving. The machine features a long hinged arm installed on a rotating platform permitting a fast and accurate moving on the 4 axis. A multi-function revolving pincer, outfitted for different kinds of manufacturing, has been installed on the arm pit. Features:

- Versatility, flexibility and manoeuvrability thanks to its joystick-equipped operator keyboard
- Possibility of palletizing from several pickup points, in order to handle bags from different bagging lines in one or more palletizing points.
- Possibility of palletizing on pallets sitting directly on the floor.
- Very compact size. This system can be installed also in those premises where it wouldn't be possible the positioning of a standard palletiser.

Link: http://www.awe.com.au/packaging-machinery/palletiser/robot-palletisers/anthropomorphic-palletisers/

Equipment Capabilities	Potential Plant Sections
Carton Handling	Product aggregation/ sortation/palletising

Visy palletisers

The Visy palletisers containing a control system provides reliable and accurate diagnostics:

- Flexible / robotic and dedicated palletising solutions
- Single-line, end of machine palletising machines through to multi-line warehousing systems
- Reliable and innovative pallet and product handling solutions (distribution systems, pallet shuttles, pallet dispensers and conveying systems)
- Minimal setup time between stack configurations
- Intuitive and comprehensive machine operator interface

Benefits include:

- Automatic pallet dispensing and distribution
- Minimised pallet change over times
- Complete turnkey functionality and operability - no product size change or pallet pattern issues
- Sophisticated vacuum or servo mechanical gripping solutions
- Experienced in palletising a wide range of products in a wide range of packaging formats
- Minimal operator interaction Real-time production feedback data

Link: http://www.visy.com.au/automation/?id=345

Equipment Capabilities	**Potential Plant Sections**
Carton Handling	Product aggregation/ sortation/palletising

Oystar Jones's robot palletizing system

The Oystar Jones conventional palletisers are suitable for handling heavy weights at high speeds. The space-saving palletiser requires minimum floor space and provides a simple, but reliable solution with minimal space requirements.

Link: http://www.oystar-group.com/palettizing/robot-and-plate-palletizers.html

Equipment Capabilities	**Potential Plant Sections**
Carton Handling	Product aggregation/ sortation/palletising

RSW - High speed mixed case palletizing system

The capacity of palletizing is at 4000 cases per hour of varying size. The main segments to this system are:

- Spiral Sequencer, which follows the cartons in in a particular way;
- Layer forming Unit
- Gantry Robot, to stack boxes onto a layer
- Portal Robot, to stack layers onto a pallet
- Depending on the size of the Portal Robot will affect the number of pallets that can be stacked at one point in time.

Link: http://www.rswbv.nl/nl/welkom/

Equipment Capabilities	**Potential Plant Sections**
Carton Handling	Product aggregation/ sortation/palletising
Pallet Storage & Retrieval	

RSW - Layer de-palletiser/palletiser solution

The below image is a custom built systems to palletising, de-palletising, storage and revival. The following list of components could be adapted for the use in processing plants but may need to be modifications for cold store facilities.

- Layer Gripper-C
- Customer pallets
- Slip-sheet remover
- System pallet Indeed
- Empty pallet Infeed
- Customer pallet Outfeed
- System pallets
- Gantry robot

Link: http://www.rswbv.nl/nl/welkom/

Equipment Capabilities	**Potential Plant Sections**
Traceability	Product aggregation/ sortation/palletising
Carton Handling	Cold Store
Pallet Storage & Retrieval	Picking & Load out
Carton Sortation	

8.5 Carton Storage & Retrieval, Equipment Available

The following system is a subset of the available equipment for the storage and retrieval of cartons. There is a carton storage and retrieval system installed in an American beef abattoir which limits palletising cartons until the products are required to be shipped for domestic consumption.

Invata Technologies, mini load shuttles

Selecting and applying the optimal material handling equipment, including an automated storage and retrieval system (AS/RS), is a critical part of distribution centre design. Industry trends towards shortening order fulfilment cycle time, reducing labour, reducing space footprint, and minimizing on-hand inventory, all point towards increased use of automated storage and retrieval systems (AS/RS) approaches.

Equipment Capabilities	Potential Plant Sections
Carton handling (e.g. Robot stacking pallets) aggregation/sortation/palletising	Product Cold Store

Muratec's FX quad mini-loaders

The Muratec Quad mini loader has the following capabilities:

World-class high-speed Mini-Load Crane

- Travelling speed: 300m/min
- Hoisting speed: 180m/min

High-density storage and High-throughput operations

- Load capacities up to 300kg
- Multiple up to 4 cases utilizing Twin Fork & Double-deep capabilities

Flexible, Multiple case handling

- Flexible handling of 1, 2, and 4 cases
- Free rack location and Double-deep storage achieves Excellent storage efficiency

Multiple Load Handling Devices

- Rear-Hook Double-deep (Free-size)
- Single Fork
- Twin Fork with Belt Conveyor
- Twin Fork with Belt Conveyor (Double-deep)

Equipment Capabilities	Potential Plant Sections
Carton handling (e.g. Robot stacking pallets)	Product aggregation/ sortation/palletising

Cold Store

Carton Sortation by Dexion

Sortation systems are used primarily to direct outboard orders to different staging areas for despatch. The sorting process is one component of an overall distribution solution, delivering high throughput, quicker and more accurately, to handle the capacity and diversity of the load. As part of designing a Sortation System, the considerations are: what is being conveyed; its size, shape, condition, weight and the capacity that needs to be directed to despatch lanes.

A distinctive feature of the Sortation Systems is the provision of full track and trace visibility of every carton movement throughout the process. Equipment types available for sortation are as broad and varied as the shapes and volume of the goods being moved. Dexion have a wide range to cover all application scenarios as they both manufacture components and source from specialist original equipment manufacturers.

Link: http://www.dexion.com.au/en/integrated_system/18

Equipment Capabilities	**Potential Plant Sections**
Carton Sortation	Product aggregation/ sortation/palletising Picking & Loadout

Carton Conveyors by Dexion

Conveyors are used in distribution systems to quickly move anything from small cartons up to full pallets from point to point. There are many different types of conveyors available. Dexion apply their many years of experience and expertise to select the right equipment for each application. As part of designing a system, they consider what is being conveyed, its size, shape, condition, weight and the capacity that needs to be moved.

Other considerations include allowing for accumulation, a form of buffering to even out peaks and troughs on a conveyor to spread the load. Additionally, other equipment can be integrated including label printer/applicators, weigh scales and carton sealers. They have a wide range to cover all application scenarios as we both manufacture components and source from specialist original equipment manufacturers.

Link: http://www.dexion.com.au/en/integrated_system/4

Equipment Capabilities	**Potential Plant Sections**
Carton Sortation	Product aggregation/ sortation/palletising

Picking Packing and Materials Handling Review – Milestone 3 Report

MLA project code:	A.TEC.0093
MLA project title:	Picking Packing and Materials Handling Review
Project leader/ coordinator:	Phil Green and Beth Stretton
MLA project manager/coordinator:	Christian Ruberg
Milestone number:	3
MLA project code:	A.TEC.0093

Prepared by Greenleaf Enterprises: 31/07/13

Contents Page

1 Brief Summary

Milestone 3 has been comprised of the data collection and site visits. The following were the objectives of this milestone:

- Review the areas of "need" and key considerations and implications;
- Visit the sites (5 sites budgeted) to phsyically assess the data collected and expand on these considerations;

Both these objectives were completed successfully. The findings from the site visits and key areas for automation are presented in this report.

2 Site visits

This section aims to provide detailed information on the areas of improvement that can be placed into the different type of plants. The equipment researched in milestone two will be used throughout this discussion to detail what challenges there are currently in the adaptation of nonmeat solutions to red meat Abattoirs.

Five site visits were conducted across small and large beef, lamb and goat processors to identify common challenges in picking, packing and materials handling. To understand challenges unique to each site. One day site visits were conducted in the following plants:

Plant	Plant Type	Species	Notes
1.	Medium Volume	Beef /Lamb	
2.	Medium Volume	Beef	High number of product lines
3.	Medium Volume	Beef	Relatively low number of product lines
4.	High Volume	Beef	
5.	High Volume	Lamb/Goat	

2.1 Summary

Each of the plants used within this study have their own challenges which will be discussed on whether it is a site specific or an overall industry issue. This aims to focus the areas of which innovative systems can be developed using equipment currently available or developing new technologies and refine the current processes. The main areas identified for equipment to be included throughout the picking and packing of product is:

- The packing of primals into cartons.
- Storage and retrieval of pallets or cartons with in chillers and freezers.
- The packing of cartons into shipping containers.

Each section of the picking and packing process will now be discussed in detail to identify which type of plants will achieve the highest rate of pay back and the most OH & S benefits from the installation of new equipment.

2.1 Opportunity Matrices

Below are a range of summary tables from the site visits.

Opportunities - Total By Equipment Capability

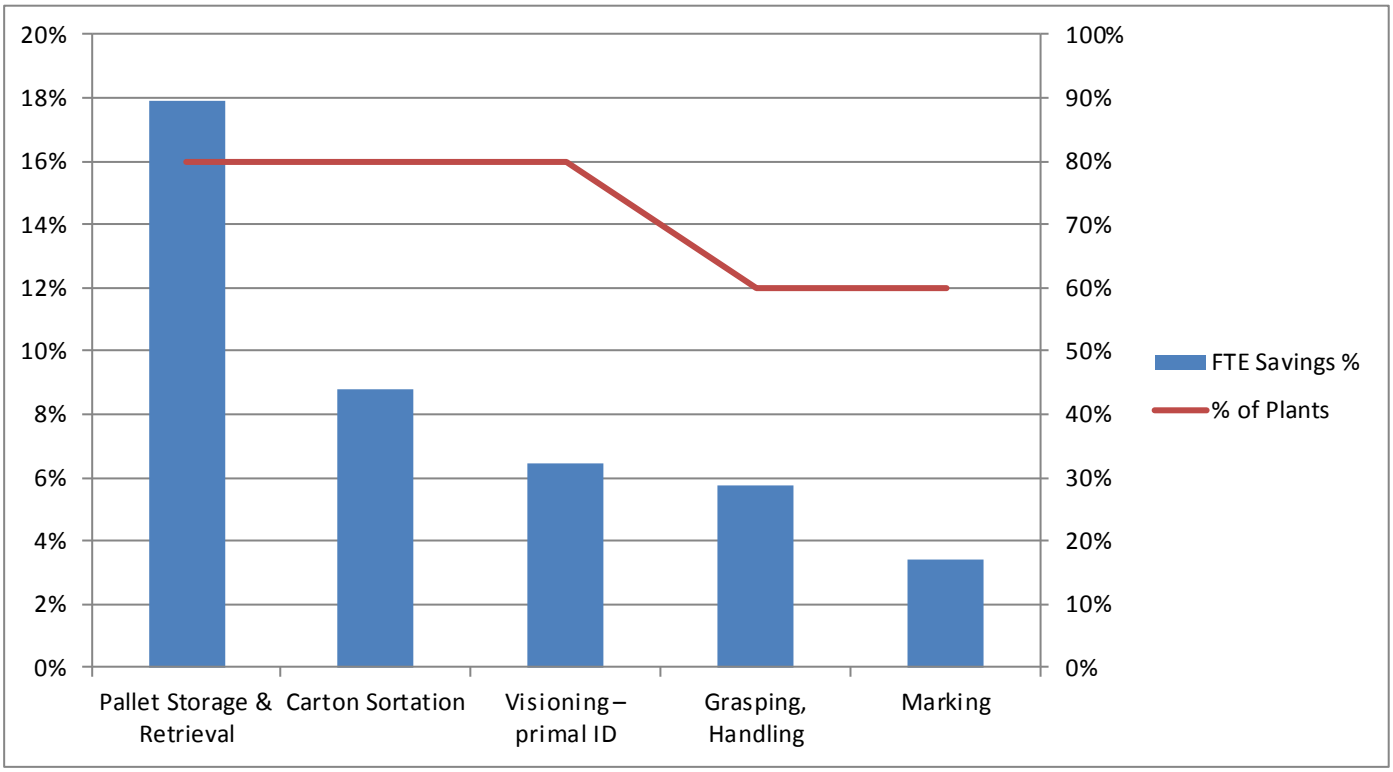

Figure 1: Opportunities by area of equipment capability

Table 1: The number of FTE's saved for each area in Figure 1

Equipment Capability	# Opportunities	# Plants	FTE Savings %
Pallet Storage & Retrieval	9	4	18%
Carton Sortation	7	4	9%
Visioning – primal ID	8	4	6%
Grasping, Handling	5	3	6%
Marking	3	3	3%

Table 2: Area of opportunity with number of plants that would benefits from the automation

Plant Section	Opportunity Area	# Plants	FTE Savings %
Boning Room	Boning yield	5	0%
Carcase Chiller	Chillers	3	5%
Carcase Chiller	Stringing	3	5%
Chiller	Labelling	2	4%
Cold Store	Cold Storage	1	0%
Picking & Loadout	Load Out	6	6%
Picking & Loadout	Picking	1	4%
Product aggregation/sortation/palletising	Palletising	8	6%
Product packaging	Cartonising	4	12%
Product packaging	Primal bagging	2	2%
Trim Packing	Trim packing	2	2%

Table 3: Individual areas of opportunities with the number of plants and FTE savings

Opportunities - Total By Opportunity

Plant Section	Opportunity Area	Opportunity	# Plants	FTE Savings %
Boning Room	Boning yield	#15 Real-time yield reporting	5	0%
Carcase Chiller	Chillers	#7 Auto carcass breaking (better accuracy)	1	7%
Carcase Chiller	Chillers	#8 Carcass stamping	1	2%
Carcase Chiller	Chillers	#9 Carcass bagging for freight	1	5%
Carcase Chiller	Stringing	#11 Lamb Stringing and hanging solution	1	7%
Carcase Chiller	Stringing	#14 Whole Lamb carcases stringing on slaughter floor	1	2%
Carcase Chiller	Stringing	#6 Beef Stringing and hanging solution	1	7%
Chiller	Labelling	#11 Auto labelling	2	4%
Cold Store	Cold Storage	#5 Cold storage sorting	1	0%
Picking & Loadout	Load Out	#4 Load out bottle necking (small area - no room for forklift)	2	9%
Picking & Loadout	Load Out	#5 Auto container loading	4	4%
Picking & Loadout	Picking	#9 Cold storage pallet and carton order picking	1	4%
Product aggregation/sortation/palletising	Palletising	#10 Stacking chilled cartons onto pallets	1	7%
Product aggregation/sortation/palletising	Palletising	#12 Sortation of mixed pallets into single product codes to reduce labour required for picking carton orders.	1	3%
Product aggregation/sortation/palletising	Palletising	#2 Existing plate freezer to pallet	1	16%
Product aggregation/sortation/palletising	Palletising	#4 Stacking cartons onto pallets	2	9%
Product aggregation/sortation/palletising	Palletising	#7 Auto palletizing frozen cartons after freezing	2	2%
Product aggregation/sortation/palletising	Palletising	#8 Auto stacking frozen cartons into blast (not on stillages)	1	1%
Product packaging	Cartonising	#6 Primal cartonising robot	4	12%
Product packaging	Primal bagging	#10 Auto bagging	2	2%
Trim Packing	Trim packing	#13 Trim CL content management	1	0%
Trim Packing	Trim packing	#3 Auto pack trim into boxes for weighing	1	4%

3 Observations and Areas of Opportunity,

The observations and areas of opportunity detailed throughout the next section of this report intends to use the discussions from the working group and the findings from the desktop study, to detail challenges with the development of equipment for beef, lamb and goat abattoirs in Australia. Due to the differences in the nature of issues facing the loadout of carcases versus cartons each type of loadout has been discussed separately.

3.1 Carcase Loadout

Lamb, beef and goat carcases are loaded out to domestic butcher shops or export markets can be as "hanging cuts". Beef carcases are broken into quarters while lamb carcases are broken into 3-way cut, 6-way cut, Saddles, Barrels, flaps, necks and hind quarters or some combination of these depending on the customer.

Depending on destination of the carcase (domestic or export) and weather the carcases are chiller or frozen the specifications of wrapping carcases will vary. The following section provides an insight into the labour requirements for the Loadout of carcases.

3.1.1 Manual Carcase Sorting

The manual sorting of carcases involves manual labour to sort and select carcases depending on the order specifications. This can be sorted on the slaughter floor for lambs but often involves further selection based on visual appearance in the chiller. For beef this is usually done in the chiller and based on meat quality grading results.

In some smaller processors, up to 50% of the carcases processed could be done as service kill for other vendors. This adds another chiller and load out management complexity to the process.

3.1.2 Manual Carcase Breaking

Once sorted lambs are pushed manually along rails to the point where they can be broken either by a hand saw or run across a table saw or bandsaw. Processors often have breaking saws some carcases are still cut by hand. The accuracy for both methods may not be good given breaking saws are setup in chillers and operated throughout the night in poorer lighting conditions. Loss in value by miss-splitting and leaving more meat on the lower value portions has shown to be a big opportunity to improve yield. However automation may not provide to be an option at this point for smaller plants due to the cost of the systems.

3.1.3 Lamb Carcase Stringing

The process involved for splitting and stringing lamb carcases for Loadout are as follows:

- A smaller hook replaces the plastic slaughter floor gambrel.
- A hanging string is placed through the hock as it leaves the slaughter floor. This is a manual process and would save one person if it could be automated.

- Every primal loaded at as hanging meat requires a hanging string. If this was automated it would save labour in the following areas:
    - 1 person for air freight,
    - 1 person in beef breaking,
    - 1 person in lamb breaking.

For lamb carcases the process of hanging the primals is also manual and happens at the same time as carcase breaking. Automating the hanging in conjunction with stringing would save lifting and OH&S risks. However, each part of a carcase has a different shape and requires a different entry point for the string. Picking up of hooks and placing on rails would also need to be part of this job. This combination of tasks makes the automation job dynamic and difficult

Robotic cutting systems are now being installed in plants to hold and cut carcases into primals. The mechanism that holds the primal might be able to integrate with an automated stringer and possibly a hanger if the hanging hook were consistently shaped.

Packing meat into boxes instead of hanging was tried a number of years ago but it was not possible to fit as much meat in a truck due to wasted headroom in stacked cartons.

Figure 2: Lamb carcases strung for Loadout, note the variation in the location of the hanging points

Figure 3: Lamb carcases strung for load out

3.1.4 Beef Carcase Stringing

Beef carcases are hung the same way but only as quarters. The string used is thicker and the process requires different types of activities and labour units.

In the plant visited, 7 FTE's were required for the process from the chiller to Loadout involving moving the carcases from the chiller, stringing, quartering and moving quarters from full rails to quarter rails and to the marshalling area for load out. This is a manual job but difficult to automate due to the stringing and re-hanging required.

Beef carcase and primal loadouts could be any combination of cuts like flanks, butts and rumps. The FTE's required were as follows:

- 4 FTE's were required to fill these orders including;
- 1 FTE is required to breakdown and mark cuts from carcases;
- 1 FTE strings;
- 1 FTE picks carcases and pushes product, 1 FTE loads the truck;

Cost of string for carcases ranges from $2-10/carcase depending on the number of cuts broken down.

Figure 4: Beef carcases stringing

3.1.5 Carcase Stamping

Carcase stamping is common to both lamb and beef plants. It is based on inspection requirements as well as destination specific marking requirements. This is applied manually and usually in the chiller after carcases have been selected for a particular market. At 12 lamb carcases per minute 1 full FTE is required to stamp carcases.

Automated stamping on the line would save 1 person, provided there was no visual assessment required by the person currently stamping to decide if stamping was required.

Figure 5: Carcases stamped ready for existing the abattoir

3.1.6 Carcase Bagging for Air Freight

A lot of lamb carcases are exported by airfreight to the Middle East. Preparing carcases for load out is a labour intensive job and involves:

1. Placing paper on the carcase neck;
2. Replacing the hanging hook with rope to hang the carcase;
3. Individual wrapping of carcases in stocking net and plastic bag;

The process is very manual and involves manual touching of carcases. If this process could be automated to remove cross contamination and reduce total plate counts on the carcase, it is expected shelf life would increase by another 3 days.

The automation of this process would reduce a number of labour units in plants which are processing a large number of carcases for fresh or frozen export. The process of stocking bagging and plastic bagging (Frozen carcases) would save between 2 and 12 FTE's but may require feeding of carcases to a fixed location and an alternative supply of bagging material to allow for automatic feeding.

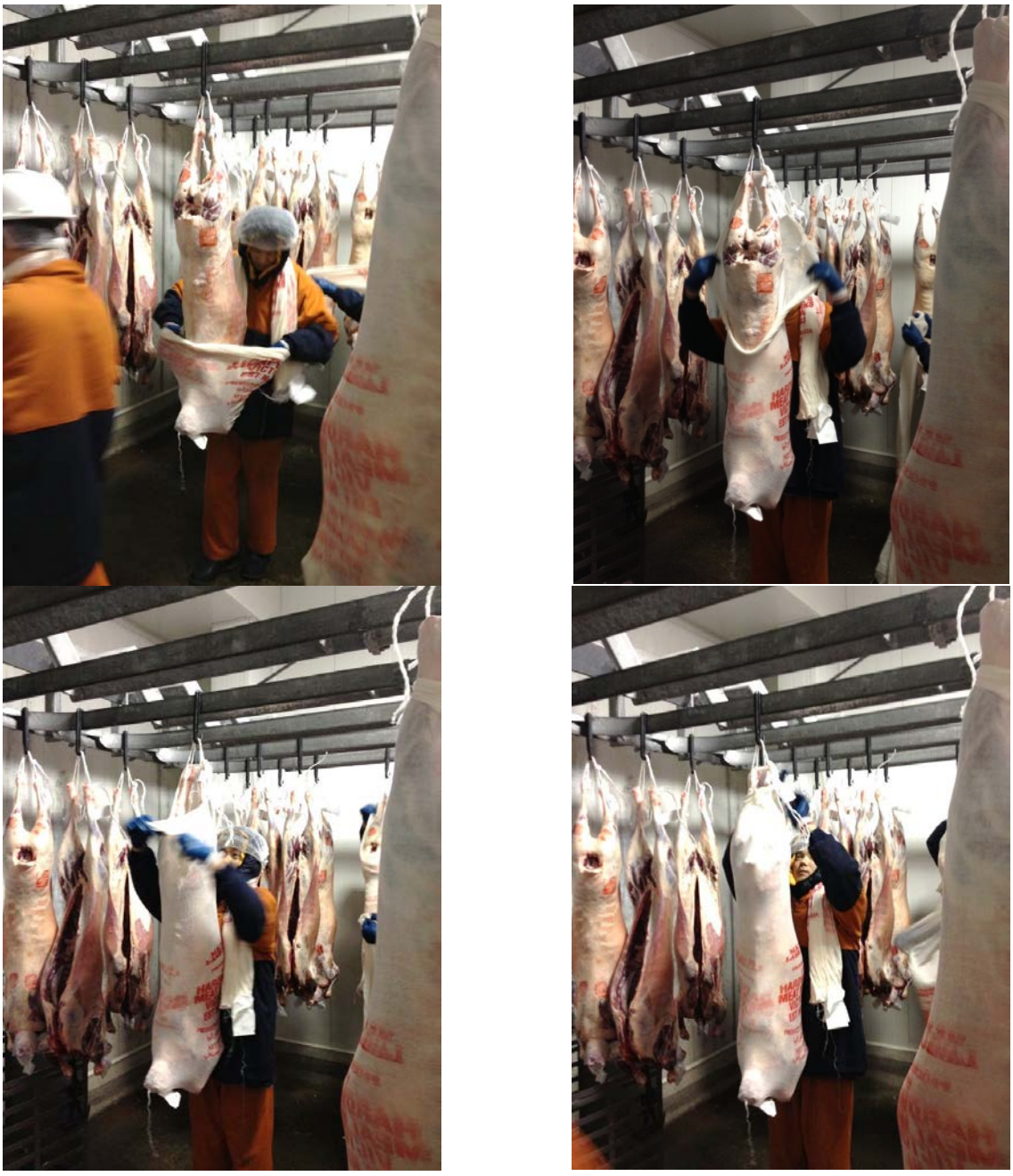

Figure 6: Process involved with bagging a carcase

The carcases Loadout was limited to only a few abattoirs which are selling whole lamb, goat or quartered beef. The abattoirs which were selling whole carcases would benefit from the development of automation in the areas discussed throughout this section of the report.

3.2 Boned Out Product

Handling of primals and cartons after they have left the boning room has a number of processors which could be automated. The following section details the areas identified as possible automation opportunities for smallstock and beef abattoirs in Australia.

3.2.1 Product Transfer

Through the automation of vacuum sealing primals there may be an opportunity to reduce the amount of staff between the boning belt and the vacuum sealing system. There are a number of areas which additional staff could be saved. They are as follows:

- Transfer of product from one room to another for vacuum sealing. This required meat to be packing into cartons and unpacked in the sealing room.
- There was also staff required to place bags in the correct orientation for the vacuum sealer.

3.2.2 Vacuum Sealing Primals

The number of staffing units being used varied between plants. The main variations between the plants occurred due to the setup of the boning room. The variation observed tended to be effected by if the product coming down the boning room chain or being placed onto the table by the slicer.

The main constraints that are observed between the plants visited tended to be space available in the boning room. In some of the plants products were packed into cartons and relocated to another room for vacuum sealing.

There is equipment available to reduce the number of employees in this section of the plant. The main issues faced by the inclusion of a bagging or flow wrapping machine are as follows:

- Speed at which primal's can be wrapped.
- Design of the boning room to allow primals to be moved down a conveyor belt.
- The Number of products which can be wrapped using the same piece of equipment.

The main benefits that will be achieved through the inclusion of a flow wrapper into plants that don’t have one installed are:

- Reduction in OH&S issues from people lifting cartons.
- Reduction in labour units required in the boning room.
- Reductions in number of products rejected for air in the vacuum sealed bags.

From the figures above in table 1 it can be seen that plants currently not using a flow wrapper could have a substantial decrease in labour if the equipment is installed.

The packing of primals has the added difficultly that some primals need to be wrapped in particular ways and bone guard added.

In one of the plants visited lamb racks were automatically weight ranged and packed at weighing stations based on product specification. Packers inspect primarily for rib length, rib number and tail length. Product rework is usually a result of wrong rib number and is reworked by the slicers. The root cause is the breaking bandsaw that separates between the shoulder and rack and between the rack and shortloin pair.

Bone guard is required on most vacuum packed racks and involves about 20% of the labour in this area depending on product specifications plus the cost of bone guard. The follow areas may be possible to automate in the future:

- Automating the inspection process with image analysis is difficult but could be done in conjunction with weight ranging. However, the assembly of frenched rack pairs is quite difficult to automate. Product inspection could be done in conjunction and limits benefit of automation.
- Automation of bagging in lamb using a flow wrapper would save people for boneless products such as whole legs and shoulders. It would be more difficult for bone in products like these unless the plastic was robust enough to avoid puncture from bones.

Figure 7: Bone Guard covers shown in vacuum sealed bags

3.2.3 Packing Primals into Cartons

The packing of primal into cartons once they have been vacuum sealed shows potential to be an area of investment for the red meat industry. It was identified through the desktop study that the mechanical equipment is available to lift, rotate and place products into cartons. Although it has not currently been calibrated or designed to be used on beef or lamb cuts.

There may be an area of opportunity to calibrate and design a piece of equipment to sort primal's and place them into cartons. The equipment will be required to handle the following variations. The requirements for these sections may differ between species.

1. Variation in product consistency,
2. Variation in product weight

3. Correct products into a carton,
4. Dividers placed into cartons,
5. Number of products placed into cartons

There is the opportunity for any of the plants incorporated into this study to be part of the development of such a system.

Placing primals into cartons can be a complex process depending on the amount of work involved. Configuration of primals, cardboard inserts or other customer specific requirements can make this a complex job.

For example at one plant visited the product differences are not complex and it takes 4 people to place vacuum cuts in boxes. This could be automated and would save 4 people. This assumes 1 person weighing on scales and 1 person still labelling cartons.

Figure 8: Orientation of a number of primals in cartons

3.2.4 Scale Operator and Label Cartons

The operator conducting this job is required to inspect the final product in the carton with the lid off for the following:

- Fits the customers Specification;
- The vacuum sealed bags are air tight;
- There is minimal air in the vacuum sealed bags;
- There is the current number of products in the carton;

Depending on process quality upstream at bagging and carton packing, this job could be automated.

3.2.5 Trim Packing

A few people in the trim area were pushing trim in the boxes for weighing. It is straight forward to be able to automate push and weigh of trim into a box and move on to save 3 people.

There were a number of cartons being rejected from the primal sortation area that were being directed into the freezer which then caused people working in the freezer to have to manually remove these cartons from that area and bring them back into the main area of the boning room.

3.2.6 Blast Chiller

The blast chillers installed at the sites visited required minimal labour inputs of any sections of the plants visited. Modification to blast chillers unless a more energy efficient system is developed would be of a lower importance to invest industry funds.

3.2.7 Chilled Carton Lidding

In most plants visited there are automated carton lidder installed so there is minimal labour required. However this section of plants visited still has capacity to increase the product flow. The main concern identified by the staff in this area is there are a number of bottle necks downstream which limits their productivity.

At one plant visited it was identified that if the carton stacking area was automated so it could operate at the same rate as the carton lidder, they could reduce to one shift. This would therefore increase the savings due to increased efficiencies of the current labour and also decreases the labour required.

Plants which process medium volume with a higher number of product lines would require a substantial increase in the rate of palletisation or storage capacity of cartons to reduce this process to one shift.

This identifies that where automation is installed in abattoirs the effect on the processors before and after the system needs to be established.

3.2.8 Freezer

Frozen cartons are hand stacked on pallets using egg carton liners between each layer or placed on stillage's. There appears to be a substantial amount of double handling on and off stillage's which are used for product requiring fast chilling to meet load out orders.

There may have been room to save about 12 unit of labour in the plate freezing area. The technology to move cartons from the plate freezer to the pallets is pretty established. This may be a site specific improvement rather than relevant to the AMPC funding.

3.3 Cold Store & Loadout

Due to the variation numbers in product lines between the plants their specific requirements for storage of product tended to be site-specific. There are a number of opportunities available using current technology form nonmeat solutions to store and retrieve either cartons or pallets. There are a number of areas of opportunity within the storage and retrieval of chilled and frozen products which are:

- The storage of chilled cartons to be held and loaded directly into a shipping container;
- Automated palletisation and de-palletisation of cartons;
- Automated storage and retrieval of pallets;
- Order picking and port marking;
- Loading of shipping containers;

Each of these areas has their benefits and disadvantages but the equipment installed in particular plants will vary depending on space and number of product lines.

The number of labour units and operational savings will vary between plants; however this appears to be an area which causes a number of bottle necks throughout all the sites visited.

3.3.1 Chilled Carton Storage Area

The plants visited during the site visit did not have the ability to store chilled cartons after they came out of the blast chiller prior to being palletised or loaded into a shipping container. There are a number of options available with the equipment can be used to sort and store cartons prior to palletising. However the system installed at abattoirs in Australia will vary depending on the product flow from the boning room.

The 2 main types of Carton storage systems that would be applicable to be installed in Australia abattoirs are either an accumulation or storage system.

The accumulation system would be designed to sort then hold a tonne of product prior to palletisation. This would reduce the number of split pallets being stored in the chillers, with this type of system it would also be possible to divert product straight to the order picking station to be port marked. This system would decrease the inputs required in the palletisation and storage of pallets area, as well as reducing downtime.

The reduction in downtime would be caused by maintaining a continuous workload for people palletising cartons. This would also improve the rate at which a robot could palletise product in confined spaces. By ensuring the products coming in can be stacked rapidly onto the same pallet. The equipment available for palletisation of product will be discussed in the next section.

The storage system would be developed to allow products to be sorted and stored with only minimal palletising of product occurring. This would require the installation of a Carton storage facility to track product within the cold store at the plant. Through the installation of this system it should reduce double handling of product completely. If it was installed and designed correctly the carton should be able to be delivered directly to a shipping container. Without products being handled after it has been removed from the blast chiller.

The main considerations for this system are:

- Number of product lines.
- Number of products per minute able to be sorted and stored.
- Room available in chiller to fit the required number of cartons for the plant.

The savings from the installation of this type of system would reduce the number of employees required in the palletising and storage and retrieval sections of the plant.

3.3.2 Palletisation and De-palletisation

The palletisation of cartons is currently conducted by hand by all plants visited, with a number of personnel having to stack numerous pallets at one time. If a carton storage facilities were installed it would reduce the number of products being palletised at one time.

The development of a palletisation system which can be used in a cold store and a -40°C freezer would be beneficial for the Australian red meat industry. This equipment would reduce the number of people working in environments which are ergonomically unsafe.

The main OH&S concerns with the current practices are:

- People lifting product greater than 25 kg;
- People twisting after lifting a carton;
- Placing cartons at varying heights constantly;

In addition to these OH&S concerns and employees double handle product a number of times before it is shipped. For fresh product a carton is lifted a minimum of 2 times prior to being loaded into a shipping container. Without the installation of a robotic palletisation and de-palletisation system cartons will still have to be lifted twice.

Figure 9: Sample of a technology to reduce OH & S issues with stacking pallets

3.3.3 Pallet Storage and Retrieval

The storage and retrieval of pallets is currently conducted using electric forklifts within all plants visited. There are facilities available to replace these forklifts with automated guided vehicles (AGV) or an automated warehouse.

The main considerations through the installation of either of these systems will be:

- Number of movements required per hour.
- Space availability.
- Other equipment which require pallets to be removed or supplied.
- The ability of the equipment to be used in cold store facilities and at -40°C.

The benefit of using and incorporating AGV's into the Abattoirs is that they could replace forklifts as forklifts are replaced. Thus the cost of the AGV would only need to be offset by the cost of a new forklift with the additional benefit that it would not require a skilled operator.

3.3.4 Order Picking

The order picking area in the plants visited during this project appeared to be cluttered with cartons and pallets. There appears to be a substantial amount of double and triple handling of products during this process.

There are 2 main sections to this area of the plants 1st needs to retrieve of product from the cold store, freezer or blast chiller, the 2nd is port marking barcode reading and identification of products before it is loaded into shipping containers. These 2 sections if developed in the same plants will be required to work in conjunction with each other and supply the load out with products as required.

Requirements of an order picking system:

Hardware:

- Barcode reader
- Stamp for port marking
- Conveyor belts

Software:

- Technology to pick cartons from:
    - The freezer
    - The blast chiller
    - The cold store
- Bring order to shipping container.
- Select product by production date.
- Calculate weight of shipping container.
- Print port documents.

3.3.5 Loading Shipping Containers

The loading of shipping containers currently occurs by hand for chilled product and by forklift for frozen product. Due to the chilled product being loaded by hand it is a very labour-intensive exercise and places excessive strain on workers caused by the nature of the work.

There is currently only one shipping container loader commercially available in the world which is developed by TEUN. The main issue with this piece of equipment is that it grabs the products by the lid. This would reduce the capacity for shipping containers to be filled to the ceiling.

The overall benefits for the inclusion of an automated shipping container loader are a reduction in:

- OH & S claims;
- Number of damaged cartons;
- Number of people working in a confined space;
- The Number of people working in areas with high traffic flow;

The development of a shipping container loader by an Australian automation company would have benefits for beef, lamb and goat plants.

4 Conclusion

The key areas of automation developed identified through this project will have a high level cost benefit analysis completed on them in milestone 4.

5 Appendices

5.1.1 List of Tables

5.1.2 List of Figures

Picking Packing and Materials Handling Review – Milestone 2 Report

MLA project code:	A.TEC.0093
MLA project title:	Picking Packing and Materials Handling Review
Project leader/ coordinator:	Phil Green, Ken Bryan, Beth Stretton
MLA project manager/coordinator:	Christian Ruberg
Milestone number:	2

Prepared by Greenleaf Enterprises: 16/08/2013

Contents Page

1 Background

This project is intended to identify opportunities for improvement of processes around picking, packing and materials handling post the carcase chiller in red-meat processing plants. The scope is focusing at a high level on the risks, costs, potential opportunities for improvement, and likely benefits that could be achieved through development of new solutions or the adaptation of solutions from other industries. To be useful at an industry level, opportunities need to be prioritised (based on risk and benefit) relative to species, plant type (high/low volume, domestic/export), and plant configurations.

Given the wide range of activities included in this section of a plant, it is important that plants critical issues are included as part of the broader review.

2 Purpose

This report is desk top study of available equipment solutions related to picking, packing and materials handling. It is intended to identify equipment that may be adapted to the red meat industry. It includes details on equipment from both red meat and non-red meat solutions.

These systems are only a subset of information available to the industry. The main purpose of this list was to identify current capabilities which are available to the industry for high level costing of opportunities in milestone 4.

3 Objectives

The primary objective of milestone 2 was to detail the equipment available for automation post the chillers in red meat processing plants.

Milestone activities have progressed as follows:

- Conduct a desktop study into the equipment available.
- Identify red meat solutions already available.
- Identify non-meat meat solutions which could be adapted to the red meat industry.
- Compile information for dissemination to the red meat industry.

4 Desktop study

The initial search conducted has identified a substantial amount of equipment available that can be utilised for automation in the red meat industry. Table 1 below identifies the companies and their capabilities. The list should be considered representative rather than exhaustive.

Table 1. The number of automotive solutions available in each capability type by supplier.

Supplier	Carton erection & sealing	Carton Handling	Carton Sortation	Grasping, Handling	Marking	Pallet Storage & Retrieval	Scanning	Shipping container loader	Traceability	Vacuum sealing	Visioning – primal ID
Invata intra-logistics		1									
Muratec		1									
Oystar Jones		1									
VISY Equipment	2	1	2	1	2	1				1	
ABB		1		2							
ATTEC		1	3	1					2		1
AWE		5									
CASI									2		1
Cognex							1		1		1
Dexion		1	2			2					
Marel				1					1		1
Mecalux						1					
Robotic Automation Systems		1							1		1
RSW		2	1			2			1		
Sealed Air										2	
SR Innova	2	2									
Stäubli		1		1							
TEUN								1			
Total	**4**	**18**	**8**	**6**	**2**	**6**	**1**	**1**	**8**	**3**	**5**

Table 2. The number of equipment solutions by equipment capability in each section of the abattoir process.

Equipment Capability	Boning Room	Chiller Carton Lidding	Cold Store	Picking & Loadout	Product aggregation /sortation /palletising	Product Inspection	Product packaging	Product tracking	Trim Packing
Carton erection & sealing		3					1		
Carton Handling			3	5	15				
Carton Sortation	2		1	2	6	1	1		
Grasping, Handling	2				1		5		1
Marking				2		1	1		
Pallet Storage & Retrieval			5	2	7				
Scanning				1			1	1	
Shipping container loader				2					
Traceability	4		1	4	1	3	3	2	
Vacuum sealing	2						3		
Visioning – primal ID	2			2		2	4	1	
Total	**12**	**3**	**10**	**20**	**30**	**7**	**19**	**4**	**1**

The next section provides details on each piece of equipment included in the Table 2 above.

4.1 VISY equipment

Visy specialises in the design and implementation of automated systems to increase plant profitability, productivity and safety.

4.1.1 Pallet & carton conveyors

The conveyors are equipment with the following flexibilities:

- Height angle adjustable legs
- All stainless steel widths of 300 to 800mm

Link: http://www.visy.com.au/automation/materials-handling/

Equipment Capabilities	Potential Plant Sections
Carton Sortation	Product aggregation/sortation/palletising

4.1.2 Case erectors, VC10 & VC20

Developed for the food industry for the erection of cartons, the benefits include:

- Tape seal standard included
- Glue option available
- 10 to 20 cartons a minute (depending on the model installed)
- Compact footprint
- Cost-efficient forming solution

Link: http://www.visy.com.au/uploads/Visy_Erector__VC10r.pdf?phpMyAdmin=4RIegbyXhwBCz-YYUafWvk%2C6qI6

Equipment Capabilities	Potential Plant Sections
Carton erection & sealing	Chiller Carton Lidding

4.1.3 Case packers, VR30/MP

This piece of equipment would need some modifications to allow its adaption in the red meat industry. However the following points are the capabilities of the VR30/MP:

- More than 30 pack cycles a minute depending on product, packing format and gripper.
- Compact footprint
- Superior reliability
- Rapid changeovers
- Flexible product in-feed presentation
- Optimum product handling

- Flexible-to-handle product, sleeves and promotional inserts
- Easy operator and maintenance access
- Intuitive and comprehension machine operator interfaces

Link: http://www.visy.com.au/automation/packaging-machinery/

Equipment Capabilities	Potential Plant Sections
Grasping, Handling	Product packaging

4.1.4 CAB - label printers

Visy Automation provides a wide range of label applicator with some of the benefits including the following benefits:

- Smart label placement
- Automatically issues, checks, applies and confirms pallet labels
- Adapts to varying product dimensions
- Allows you to avoid product printing and artwork
- Data integrity and placement validation
- Possible to integrate to real-time production reporting
- Fully integrated with thermal transfer printers
- Verification of print quality at source

Link: http://visytech.com/wp-content/uploads/2012/03/spec_sheet_cab_a+.pdf

Equipment Capabilities	Potential Plant Sections
Marking	Product Inspection Product packaging Picking & Load out

4.1.5 Hitachi Inkjet printer

Which is designed for the high-speed application of print data direct to products?

- Low solvent consumption
- Low maintenance
- Large touch screen display
- No external compressed air
- Automatic self-cleaning at start-up and shut-down

Equipment Capabilities	Potential Plant Sections
Marking	Picking & Load out

4.1.6 HSAjet Inkjet Printer

This system is ideal for high-resolution image reproduction:

- Prints graphics, barcodes and fonts
- High resolution, high contrast print quality
- Customised touch screen operation
- Uses blank cartons and prints online

Link: http://visytech.com/wp-content/uploads/2012/03/spec_sheet_hsajet_tipc.pdf

Equipment Capabilities	Potential Plant Sections
Marking	Picking & Load out

4.1.7 REAjet Inkjet Printer

Designed for large character printing of industrial products:

- High-speed printing
- Designed for industrial applications
- Versatile print options
- Modular multi-head configuration
- Ink options include fast dry and vivid colours

Link: http://www.visy.com.au/automation/index.php?id=262

Equipment Capabilities	Potential Plant Sections
Marking	Picking & Load out

4.1.8 DYNAC 6400 series conveyor system

The Dynac 6400 allows systems to be developed reducing the footprint of equipment on the floor by holding products on spiral conveyors. The following are some of the benefits of the equipment:

- Reduced line pressure metered downstream products Sequential first-in/ first-out accumulation
- Zero-pressure handling
- Easy-to-use line controls
- Smaller footprint
- Quick and simple changeover
- Low maintenance and operational costs

Link: http://hartness.com/dynac6400.php

Equipment Capabilities	Potential Plant Sections
Carton Sortation	Product aggregation/sortation/palletising

4.1.9 Visy palletisers

The Visy palletisers containing a control system provides reliable and accurate diagnostics:

- Flexible / robotic and dedicated palletising solutions
- Single-line, end of machine palletising machines through to multi-line warehousing systems
- Reliable and innovative pallet and product handling solutions (distribution systems, pallet shuttles, pallet dispensers and conveying systems)
- Minimal setup time between stack configurations
- Intuitive and comprehensive machine operator interface

Benefits include:

- Automatic pallet dispensing and distribution
- Minimised pallet change over times
- Complete turnkey functionality and operability - no product size change or pallet pattern issues
- Sophisticated vacuum or servo mechanical gripping solutions
- Experienced in palletising a wide range of products in a wide range of packaging formats
- Minimal operator interaction Real-time production feedback data

Link: http://www.visy.com.au/automation/?id=345

Equipment Capabilities	**Potential Plant Sections**
Carton Handling	Product aggregation/sortation/palletising

4.2 Oystar Jones's robot palletizing system

The Oystar Jones conventional palletisers are suitable for handling heavy weights at high speeds. The space-saving palletiser requires minimum floor space and provides a simple, but reliable solution with minimal space requirements.

Link: http://www.oystar-group.com/palettizing/robot-and-plate-palletizers.html

Equipment Capabilities	**Potential Plant Sections**
Carton Handling	Product aggregation/sortation/palletising

4.3 ABB

4.3.1 IRC5 robot controllers

ABB's industrial robot controllers offer superior motion control and enable quick integration of additional hardware. Its motion control technology, featuring True Move & Quick Move, is key to the robot's performance in terms of:

- Accuracy,
- Speed,
- Cycle-time,
- Programmability
- Synchronization with external devices.

Other features include Flex pendant with touch screen and joystick programming, flexible RAPID language, and powerful communication capabilities.

Link: http://new.abb.com/products/robotics/controllers

Equipment Capabilities	**Potential Plant Sections**
Grasping, Handling	Product packaging
	Product aggregation/sortation/palletising

4.3.2 IRB 260 the packing robot

The IRB 260 is designed and optimized primarily for packing applications. It is built to meet your reach and payload requirements whilst being small enough to fit into compact packing machines. Combined with ABB motion control and tracking performance, the robot is ideal in flexible packing systems. The features of this system include:

- Reliable – High production up time, The IRB 260 is based upon the world's most popular industrial robot, IRB 2400, with an installed base >14,000 units.
- Fast – Short cycle times, Design optimized for packing in combination with ABB unique motion control ensures short packing cycle times.
- Accurate – Consistent parts quality, The robot has best in class accuracy and superior ABB conveyor tracking performance resulting in excellent pick and place accuracy, both when working with fixed positions as well as on the fly.
- Strong – Maximized utilization, the robot is optimized for packing application and combines compactness and high speed with a 30 kg payload capacity.
- Robust – Harsh production environment, Durable in tough environments - IP67.
- Versatile – Flexible integration and production

Low on weight and height, the robot easily fits into compact packing machines. With a work envelope optimized for packing applications, the robot becomes the natural choice for robot automation. The robot comes fully equipped with integrated air and signals all the way to the gripper. Combined with the ABB packaging SW, Pick Master, the robot is not only easy to integrate from a mechanical point of view but also extremely simple to program.

Link: http://www.abb.com/product/seitp327/9727dbd18e84d3e7c1257061002b3c1b.aspx

Equipment Capabilities	**Potential Plant Sections**
Carton Handling	Product aggregation/sortation/palletising

4.3.3 IRB 360 Flex Picker

Flex Picker IRB 360 is the "second generation" robot for pick and place applications. This type of robotic arm may be useful in the development of a primal packing system as it has already been installed into several food processing facilities. The attachment on the end of this robot would be required to be able to pick up primals without damaging the vacuum seal bags

Link: http://new.abb.com/products/robotics/industrial-robots/irb-360

Equipment Capabilities	Potential Plant Sections
Grasping, Handling	Boning Room
	Product packaging
	Trim Packing

4.4 RSW

4.4.1 High speed mixed case palletizing system

The capacity of palletizing is at 4000 cases per hour of varying size. The main segments to this system are:

- Spiral Sequencer, which follows the cartons in in a particular way;
- Layer forming Unit
- Gantry Robot, to stack boxes onto a layer
- Portal Robot, to stack layers onto a pallet
- Depending on the size of the Portal Robot will affect the number of pallets that can be stacked at one point in time.

Link: http://www.rswbv.nl/nl/welkom/

Equipment Capabilities	Potential Plant Sections
Carton Handling	Product aggregation/sortation/palletising
Pallet Storage & Retrieval	

4.4.2 Layer de-palletiser/palletiser solution

Contains:

- Layer Gripper-C
- Customer pallets
- Slip-sheet remover
- System pallet Indeed
- Empty pallet Infeed
- Customer pallet Outfeed
- System pallets
- Gantry robot

Link: http://www.rswbv.nl/nl/welkom/

Equipment Capabilities	Potential Plant Sections
Traceability	Product aggregation/sortation/palletising
Carton Handling	Cold Store
Pallet Storage & Retrieval	Picking & Load out
Carton Sortation	

4.5 CASI

4.5.1 Warehouse automation: print and apply systems

CASI offers print and apply systems for:

- Automatic labelling of license plate barcodes,
- Shipping labels,
- Compliance labels

Link: http://www.cornerstoneautosys.com/automation.htm

Equipment Capabilities	Potential Plant Sections
Traceability	Product packaging
	Picking & Load out

4.5.2 Warehouse automation: picking systems

CASI order picking systems reduce errors in package contents. Protects from unwarranted claims against what was received.

Link: http://www.cornerstoneautosys.com/automation.htm

Equipment Capabilities	Potential Plant Sections
Traceability	Picking & Load out

4.5.3 Warehouse Automation: shipping systems

Inline shipping systems for:

- Common carrier compliance labelling,
- Verification,
- Dimensioning and more.

Link: http://www.cornerstoneautosys.com/automation.htm

Figure 1. Inline shipping system

Equipment Capabilities	Potential Plant Sections
Visioning – primal ID	Product packaging Picking & Load out

4.6 TEUN's shipping container loader

Shipping container loader with the following specifications:

- The loading capacity depends on the dimensions of the cases.
- Cycle time is ±15 seconds. Per cycle we can pick multiple cases.
- The adaption of this system to a cold store will require modification, depending on temperature
- The TEUN will require an extendable conveyor to "follow" PAQR1's movements.
- The cost of the equipment is € 350K.

Link: http://www.teun.com/en/applications/loading-of-boxes/

Equipment Capabilities	Potential Plant Sections
Shipping container loader	Picking & Load out

4.7 Invata Technologies, mini load shuttles

Selecting and applying the optimal material handling equipment, including an automated storage and retrieval system (AS/RS), is a critical part of distribution centre design. Industry trends towards shortening order fulfilment cycle time, reducing labour, reducing space footprint, and minimizing on-hand inventory, all point towards increased use of automated storage and retrieval systems (AS/RS) approaches.

Equipment Capabilities	Potential Plant Sections
Carton handling (e.g. Robot stacking pallets)	Product aggregation/sortation/palletising Cold Store

4.8 Muratec's FX quad mini-loaders

The Muratec Quad mini loader has the following capabilities:

World-class high-speed Mini-Load Crane

- Travelling speed: 300m/min
- Hoisting speed: 180m/min

High-density storage and High-throughput operations

- Load capacities up to 300kg
- Multiple up to 4 cases utilizing Twin Fork & Double-deep capabilities

Flexible, Multiple case handling

- Flexible handling of 1, 2, and 4 cases
- Free rack location and Double-deep storage achieves Excellent storage efficiency

Multiple Load Handling Devices

- Rear-Hook Double-deep (Free-size)
- Single Fork
- Twin Fork with Belt Conveyor
- Twin Fork with Belt Conveyor (Double-deep)

Equipment Capabilities	Potential Plant Sections
Carton handling (e.g. Robot stacking pallets)	Product aggregation/sortation/palletising Cold Store

4.9 Marel

4.9.1 Trim management system

Marel's trim management system is designed to analyse beef and pork trim for fat/lean ratio, and give processors the ability to manage their trim and hit target fat percentage. The main features of this system include:

- X-ray technology for accurate chemical lean measurements
- Batching into desired chemical lean ratio
- Available as stand-alone unit or integrated with a Marel StreamLine
- Superior bone and other contaminant detection

Equipment Capabilities	Potential Plant Sections
Visioning – primal ID (e.g. X-ray, Pallet stacking)	Boning Room

4.9.2 Streamline deboning and trimming solution

The Marel Streamline deboning and trimming system enables meat processors to monitor and collect data on yield, throughput and quality throughout the entire processing cycle. StreamLine can be configured for a variety of tasks, including deboning, trimming, membrane skinning, tying and sawing, and allowing processors to cater entirely to their customers' specifications.

Equipment Capabilities	Potential Plant Sections
Yield Monitoring	Boning Room

4.9.3 Marel RoboBatcher

The Marel RoboBatcher is unique for this type of equipment because not only does it batch fast with high precision, but it also communicates with other equipment in the processing line.

RoboBatcher is designed for the poultry industry and is used to pack chicken fillets into trays. It can handle fixed weight batching, catch weight and counting jobs. The RoboBatcher can batch into four different types of trays and two types can be handled at the same time.

Furthermore, a discharge solution for additional tray packing makes it possible to batch in bulk for catering, which results in minimal giveaway.

Link: http://marel.com/poultry-processing/systems-and-equipment/broilers/grading-and-batching/batching/batchers/robobatcher/415?prdct=1&pc=2

Equipment Capabilities	Potential Plant Sections
Grasping, Handling	Boning Room Product packaging

4.10 ATTEC

4.10.1 Tray transport

Using plastic trays for transporting the products gives great flexibility and possibilities for individual yield and process control together with storage and sorting possibilities.

Identification of each tray and the product within this is very important. Therefore the logistic system uses RFID or barcodes as identification on each tray. The tray handling system is controlled by a PLC control system, which also provides on-line information through the SCADA system on the functionality.

ATTECK Denmark A/S provides a wide range of logistic possibilities, which all is in stainless steel, and designed to be used in the hard environment of the meat plant.

Equipment Capabilities	Potential Plant Sections
Traceability	Boning Room
	Product packaging
	Product tracking

4.10.2 Belt transport of products

Transporting products directly on belt is still needed in some areas of the production. Because there is direct contact between the product and the belt, the design and clean ability are often very important during the complete work shift.

ATTEC Denmark A/S offers a complete range of belt conveyors, all designed for transport of all kinds of products, packed or not packed. The conveyors for product transport are designed either as soft belt-conveyors or module chain-conveyors, with easy cleaning facilities and durable operation.

Link: http://attec.co.uk/logistics-belt-conveyor.html

Equipment Capabilities	Potential Plant Sections
Carton Sortation	Boning Room
	Product packaging

4.10.3 Palletizing

As the last part of the packing process, palletizing is a vital part. ATTEC Denmark A/S provides a range of solutions including manual or automatic palletizing. The robot palletizing is either based on a free arm robot or portal solution. The solutions can handle cartons and plastic trays and different types of pallets. The solutions consist of pallet transport, PLC control and communication with warehouse management.

Link: http://attec.co.uk/logistics-palletizing.html

Equipment Capabilities	Potential Plant Sections
Carton Handling	Product aggregation/sortation/palletising
	Picking & Loadout

4.10.4 Empty trays

Uniform container systems like e.g. euro standard container etc. make a high degree of automation for in-plant logistics possible. Piling and unstacking systems are in the area of the empty container logistics a state of the technology.

Optimal cleaning and drying of standard and large containers, including the necessary transportation logistics.

Different arrangement types are available according to targeted application. Different equipment variants make integration into the individual logistics of your enterprise possible. Dirtied containers fully automatic go through the cleaning systems and afterwards are handed over to the empty container storage.

Within the production the supply of empty containers is compelling necessarily to avoid losses of production. Individual solutions ensure the transport of the cleaned containers to the production workplace, where there are available to the employees.

Link: http://attec.co.uk/logistics-empty-trays.html

Equipment Capabilities	Potential Plant Sections
Traceability	Boning Room
Carton Sortation	Product Inspection

4.10.5 Logistic units

With the logistic system, units for horizontal and vertical movement are often needed. ATTECK Denmark A/S provides a wide range of units including elevator, slides and vertical driven conveyors.

Link: http://attec.co.uk/logistics-components.html

Equipment Capabilities	Potential Plant Sections
Carton Sortation	Product aggregation/sortation/palletising

4.11 FANUC Robotics' M-1iA Genkotsu robot

The FANUC M-3iA offers the same unique parallel-link structure and moderate footprint, and accommodates payloads up to 6kg. In addition, it has the largest work envelope of any robot in its class (1350mm x 500mm). Benefits of the Genkotsu Robot include:

- Four- and six-axis versions
- Lightweight design
- Multiple installation orientations accommodate a wide range of work areas
- Ultimate parallel link
- A built in camera for iRVisioning software
- Attachable and detachable robotic arms,

Link: http://www.fanucrobotics.com/cmsmedia/datasheets/M-1iA%20Series_11.pdf

Equipment Capabilities	Potential Plant Sections
Visioning – primal ID Grasping, Handling	Product packaging

4.12 AWE

4.12.1 Two-column robot palletisers

The two-column robot palletiser features a pincer that moves along three Cartesian axes as oscillated around its vertical axis. This permits trouble-free handling of bags that are not completely filled or that contain aerated or powdery material, guaranteeing outstanding flexibility. The machine is composed of a rigid portal structure.

Link: http://www.awe.com.au/packaging-machinery/palletiser/robot-palletisers/two-column-robot-palletisers/

Equipment Capabilities	Potential Plant Sections
Carton Handling	Product aggregation/sortation/palletising

4.12.2 Single-column robot palletisers

In the range of robot palletiser made by the Concetti Group, the single-column robot palletiser represents the simplest and most compact model. The single-column robot palletiser can handle bags containing stable, aerated or powdery products, permitting partial overlapping of the bags in the layer along both the top and sides, offering flexible format changes.

Link: http://www.awe.com.au/packaging-machinery/palletiser/robot-palletisers/single-column-robot-palletisers/

Equipment Capabilities	Potential Plant Sections
Carton Handling	Product aggregation/sortation/palletising

4.12.3 Four-column robot palletisers

The four-column robot palletiser features a pincer that moves along three Cartesian axes as it rotates around its vertical axis. This permits trouble-free handling of bags that are not completely filled or that contain aerated or powdery material, guaranteeing outstanding flexibility.

Equipment Capabilities	Potential Plant Sections
Carton Handling	Product aggregation/sortation/palletising

4.12.4 Robotic gantry palletiser

In the range of robot palletising systems manufactured by the Concetti Group, the gantry style robot palletising system PS-4A/10SP is the most compact model designed especially for confined spaces.

Equipment Capabilities	Potential Plant Sections
Carton Handling	Product aggregation/sortation/palletising

4.12.5 Anthropomorphic palletisers

In the range of robot palletisers made by the Concetti Group, the anthropomorphic palletiser represents the fastest and most versatile model for the point – to – point moving. The machine features a long hinged arm installed on a rotating platform permitting a fast and accurate moving on the 4 axis. A multi-function revolving pincer, outfitted for different kinds of manufacturing, has been installed on the arm pit. Features:

- Versatility, flexibility and manoeuvrability thanks to its joystick-equipped operator keyboard
- Possibility of palletizing from several pickup points, in order to handle bags from different bagging lines in one or more palletizing points.
- Possibility of palletizing on pallets sitting directly on the floor.

- Very compact size. This system can be installed also in those premises where it wouldn't be possible the positioning of a standard palletiser.

Link: http://www.awe.com.au/packaging-machinery/palletiser/robot-palletisers/anthropomorphic-palletisers/

Equipment Capabilities	Potential Plant Sections
Carton Handling	Product aggregation/sortation/palletising

4.13 Sealed Air

4.13.1 FlowVac55

The Cryovac Flow Vac is designed to wrap fresh pork/lamb or cheese. This system conducts the following:

- Wraps primals with a vacuum seal plastic to be sealed, forming its own bag.
- The film is the vacuum sealed in a standard sealing machine.
- A belt feed feeds the primals into the machine.

Link: http://www.cryovac.com/eu/en/ProductsAndEquipment/automatic_shrink_loader.aspx

Equipment Capabilities	Potential Plant Sections
Vacuum sealing	Boning Room Product packaging

4.13.2 RoboLoaders

Cryovac® BLR1 & BLR2 bag loaders are fully automatic, high speed robotic bag loaders for loading a range of food products into Cryovac® taped bags. They automatically select from a range of 2-6 bags sizes.

Link: http://www.cryovac.com/ap/en/food-packaging-equipment/blr-roboloader.aspx

Equipment Capabilities	Potential Plant Sections
Vacuum sealing	Boning Room Product packaging

4.14 Robotic Automation Systems

4.14.1 Vision inspection automation

Robotic Automation Systems specializes in vision inspection automation employed in plastic moulding operations, including online, offline and cleanroom applications. Applications of this equipment are:

- Short Shots
- Flashing
- Assembly
- Defects
- Insert / Part Verification
- Presence (correct insert / part)
- Orientation
- Function
- Dimension / Tolerance

Link: http://www.roboticautomationsystems.com/vision.html

Equipment Capabilities	Potential Plant Sections
Visioning – primal ID	Product Inspection
Traceability	Picking & Loadout

4.14.2 Direct drive automated rotary tables

Robotic Automation Systems direct drive rotary tables are versatile, maintenance free, long life, cost effective solutions for automated box or tote filling of plastic injection moulded parts.

Link: http://www.roboticautomationsystems.com/rotarytables.html

Equipment Capabilities	Potential Plant Sections
Carton Handling	Picking & Loadout

4.15 Dexion

4.15.1 Automated crane stackers

Stacker Cranes are suited to operations with high density storage in confined spaces. Utilising the 'goods to man' principle, cranes offer a more productive alternative to forklifts in the management of a high number of storage and retrieval movements.

Cranes make better use of vertical space and can reach higher than forklifts, up to 35 metres. Furthermore, Cranes provide an additional benefit in the area of occupational health and safety by keeping pedestrian traffic separated from moving equipment. We design and deliver automated storage and retrieval systems (ASRS) for both pallet load and mini load applications. In these systems, the choice of crane type and its configuration are based on criteria such as the volume, weight and throughput of the load to be stored and moved.

Link: http://www.dexion.com.au/en/integrated_system/19

Equipment Capabilities	**Potential Plant Sections**
Pallet Storage & Retrieval	Product aggregation/sortation/palletising
	Cold Store

4.15.2 Sorters

Sortation systems are used primarily to direct outboard orders to different staging areas for despatch. The sorting process is one component of an overall distribution solution, delivering high throughput, quicker and more accurately, to handle the capacity and diversity of the load. As part of designing a Sortation System, we consider what is being conveyed, its size, shape, condition, weight and the capacity that needs to be directed to despatch lanes.

A distinctive feature of our Sortation Systems is the provision of full track and trace visibility of every carton movement throughout the process. Equipment types available for sortation are as broad and varied as the shapes and volume of the goods being moved. We have a wide range to cover all application scenarios as we both manufacture components and source from specialist original equipment manufacturers.

Link: http://www.dexion.com.au/en/integrated_system/18

Equipment Capabilities	**Potential Plant Sections**
Carton Sortation	Product aggregation/sortation/palletising
	Picking & Loadout

4.15.3 Conveyors

Conveyors are used in distribution systems to quickly move anything from small cartons up to full pallets from point to point. There are many different types of conveyors available. We apply our many years of experience and expertise to select the right equipment for each application. As part of designing a system, we consider what is being conveyed, its size, shape, condition, weight and the capacity that needs to be moved.

Other considerations include allowing for accumulation, a form of buffering to even out peaks and troughs on a conveyor to spread the load. Additionally, other equipment can be integrated including label printer/applicators, weigh scales and carton sealers. We have a wide range to cover all application scenarios as we both manufacture components and source from specialist original equipment manufacturers.

Link: http://www.dexion.com.au/en/integrated_system/4

Equipment Capabilities	**Potential Plant Sections**
Carton Sortation	Product aggregation/sortation/palletising

4.15.4 Satellites

Satellite Smart Carts run along rails in high density storage racks to store and retrieve pallets. They do this by moving full pallet loads in and out of the storage structure.

The Satellite Cart is manually placed in the designated rack position by a forklift, after which the cart operates automatically by remote control or RF. The Satellite Cart deposits and retrieve pallets within the system as required enabling forklift operators free to focus on bringing pallet loads to and from the racking face. Sensors along the storage channel determine where it must stop, deposit or retrieve the load and return. Satellites are ideal for applications with low SKU where there is a high movement rate of pallets. They can be configured for FIFO (first-in/first-out) or LIFO (last-in/first-out) operation. Our Satellite Smart Cart is an advanced satellite system that brings greater efficiency to multi-deep pallet handling in a high density environment.

Link: http://www.dexion.com.au/en/integrated_system/20

Equipment Capabilities	**Potential Plant Sections**
Pallet Storage & Retrieval	Product aggregation/sortation/palletising Cold Store

4.15.5 Robotics

Robotic applications are an alternate solution to manual handling for speeding up repetitive processes to increase productivity in high volume distribution systems

The use of robotics provides a number of benefits. One is in the area of OH&S through automation of tasks that may be hazardous, tedious or fatiguing. Another is in the reduction of product damage. The choice of robotic type and configuration is based on criteria such as volume, size, weight and shape of the products to be handled. We design and deliver Robotic Systems that can be applied successfully for palletising and de-palletising applications.

Link: http://www.dexion.com.au/en/integrated_system/21

Equipment Capabilities	**Potential Plant Sections**
Carton Handling	Product aggregation/sortation/palletising
	Picking & Loadout

4.16 Cognex

4.16.1 DataMan 300 code reader

The DataMan® 300 series of readers was developed to handle the most difficult-to-read DPM (Direct Part Mark) codes as well as challenging 1-D linear barcodes and 2-D Data Matrix codes and for indexed or high-speed lines. The benefits include:

- Unmatched read rate performance
- Decode the most challenging 1-D and 2-D barcodes with enhanced 1DMax+™ and 2DMax+™ code-reading algorithms
- 2DMax+™ algorithm reads DPM codes no matter the mark type or surface
- 1DMax+ with Hotbars™ technology provides higher read rates of damaged 1-D linear barcodes at a faster pace than ever before

Link: http://www.cognex.com/factory-id-reader.aspx?langtype=2057

Equipment Capabilities	**Potential Plant Sections**
Scanning	Product packaging
	Picking & Loadout
	Product tracking

4.16.2 Computer vision system

VisionPro® has been set free. Now you can get the world's top vision software with its robust tool library—no matter what camera or frame grabber you use—even non-traditional sources such as such as 3D profilers, thermal cameras and X-ray imagers. That means all applications benefit from this broad-based, industrial-grade tool set from Cognex.

- Proven in more than 700,000 installations worldwide, the VisionPro tool library spans all vision needs including:
- Geometric object location
- Inspection
- Identification
- Measurement

Combined with flexible and powerful PC-based development, VisionPro makes it faster than ever to create and deploy solutions for the most challenging machine vision applications.

Link: http://www.cognex.com/visionpro-machine-vision-software.aspx?langtype=2057

Equipment Capabilities	Potential Plant Sections
Traceability	Boning Room
Visioning – primal ID	Product Inspection
	Product packaging
	Product tracking

4.17 Stäubli

4.17.1 Stäubli robotics suite

Ergonomic and easy-to-use VAL3 Studio is the perfect environment for developing your VAL3 applications. Cells

Manager gives you the ability to work on multiple robot systems by creating virtual cells matching the actual systems in terms of software version, options, system configuration and robot model. Emulator (controller emulation) and 3D Studio (robot arm visualization) provide full emulation of the robot system for fine-tuning and testing your programs prior to receiving your robot system.

Link: http://www.staubli.com/en/robotics/robot-software/pc-robot-programming-srs/

Equipment Capabilities
Carton Handling
Grasping, Handling

4.18 SR Innova

4.18.1 Case erector

The case formers integrate the latest innovations in components and construction details, making a very rigid machine.

The closing of flaps is achieved by applying hot melt, obtaining speeds of up to 40 cartons per minute.

Changeover is achieved without the use of tools.

Link: http://www.srinnova.com/en/case-packing-solutions/case-erectors/case-erector-b1/

Equipment Capabilities	Potential Plant Sections
Carton erection & sealing	Product packaging

4.18.2 Carton sealer

The closing of the flaps is done by applying Hot Melt. The adjustments for changing formats are performed easily and quickly.

Also, a display allows for an automatic programme change for glue and speed data and gives information about machine status.

The machine is equipped with multiple sensors for correct performance (case and product presence, magazine minimum level, exit build back, etc.)

Link: http://www.srinnova.com/en/case-packing-solutions/case-sealers/b1series/

Equipment Capabilities	Potential Plant Sections
Carton erection & sealing	Chiller Carton Lidding

4.18.3 De-palletiser

Specially built to handle glass bottles or plastic crates, the model STAR-150 fulfils the strictest requirements of the market it has been built with the following abilities:

- Medium and high speeds,
- Positive transfer of the complete layer,
- Container discharge without pressure

Optional equipment includes:

- Automatic system for cutting
- Removal of strap from each layer of containers.
- Empty pallet storage

Link: http://www.srinnova.com/en/palletising-solutions/depalletisers/star150/

Equipment Capabilities	Potential Plant Sections
Carton Handling	Picking & Loadout

4.18.4 Bulk palletiser

The complete bulk palletising system has been based on an automatic tray erector (600×800mm) and 2 axes for product in bulk, such as bottles and bricks. The whole system has been carefully designed to work in 24h industrial environment.

Robot has 2 servomotor driven axes which are conceived with the latest guiding systems mainly applied in robotics. The head is adapted to different kind of containers, being its configuration variable in number of units and rows. It also has a centre self-correction between both pick and place points.

The system incorporates a pallet elevator which allows working to a constant loading level, significantly reducing the vertical robot movements and, thus, optimising the cycle speed.

While product is being positioned onto the tray, a centring device ensures the tray opening.

Link: http://www.srinnova.com/en/category/palletising-solutions/palletisers/

Equipment Capabilities	Potential Plant Sections
Carton Handling	Product aggregation/sortation/palletising

4.19 Mecalux stacker crane

Inexpensive automating, Simple to implement, Reduction of errors and improves security on the premises. Low maintenance costs.

Advantages:

- The perfect solution to automate conventional racks of up to 15 meters in height.
- No need to modify the warehouse structure.
- Trilateral extraction integrated system.

Why use an automatic trilateral stacker crane?

- Adapts to all pallet warehouses with man-operated elevator trucks.
- Economical automating. The investment is paid off quickly.
- Easy to implement, both in new and pre-existing warehouses, since it doesn't require any changes to the warehouse structure.
- Decrease in personnel costs. It allows you to manage all the pallet movements without a man on board.
- Using all available space since it does not have a top guide and it can pick up pallets from level 0.
- Reduces errors since it is an automatic system.
- Improves safety in the facility.
- Operators do not work in the passageways meaning the system is safer and reduces the risk of accidents occurring.
- Low maintenance costs.
- Easy to integrate the automatic system connecting it to a warehouse management system like Easy WMS.

Link: http://www.mecalux.com/automated-warehouses-for-pallets/automatic-trilateral-stacker-crane

Equipment Capabilities	**Potential Plant Sections**
Pallet Storage & Retrieval	Cold Store

5 Summary

The list of equipment included in this report is from companies that specialise in the development of picking and packing solutions. Companies such as Banss and FPE have been investigated but have not been included as they don't develop systems for the picking, packing and material handling equipment.

6 Next Steps

The information in this report is to be used in milestone 4. This list of equipment will be used to estimate the potential FTE savings through the introduction of automated systems and the likely return on investment possible for a number of the challenges identified during the plant visits in Milestone 3.

- Identify the equipment throughout this list that is the most applicable to the red meat industry.

7 Appendices

7.1.1 List of Tables

7.1.2 List of Figures