Final Report

RFID in the Meat Industry

Review of slaughter floor, chiller, and boning room RFID deployments in industry

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Contents

Contents 2

1.0 Executive Summary 3

2.0 Introduction 6

BACKGROUND 6

3.0 Project Objectives 8

4.0 Methodology 9

4.1 Data Collection Approach 9

4.2 Teleconference Interviews 10

4.3 Confidentiality 11

5.0 Project Outcomes 12

5.1 THE USE OF RFID EAR TAGS IN AUSTRALIA 12

5.1.1 Industry experience of RFID Ear tag use 13

5.2 THE USE OF RFID FOR HOOKS/GAMBRELS TRACKING 15

5.2.1 Industry experience using RFID for Hooks/Gambrels 15

6.0 Discussion 18

IDENTIFICATION OF TECHNICAL GAPS 18

6.1 RFID Ear Tags 18

6.2 RFID Hook/Gambrel Use 19

7.0 Conclusions / Recommendations 20

8.0 Bibliography 24

9.0 Appendices Error! Bookmark not defined.

9.1 Appendix 1 **Error! Bookmark not defined.**

9.2 Appendix 2 **Error! Bookmark not defined.**

1.0 Executive Summary

RAMP Holdings Pty Ltd, a company specializing in RFID technology solutions, was contracted by AMPC to conduct a review of slaughter floor, chiller, and boning room RFID deployments in the Australian meat processing Industry.

The review is based on information gathered from companies within the Australian meat processing industry that have volunteered to share information on their experience with RFID technologies.

Particularly the review reports on the use of RFID ear tags and RFID hook/gambrel tagging. The report documents industry's experience, both the successes and challenges with deployments of this type of solution within the Australian meat processing industry.

Key findings of the review are presented below.

The findings are grouped as they relate to the two topics of the review: the use of RFID ear tags and RFID hook/gambrel use.

RFID Ear Tags

OBSERVATIONS

- RFID ear tags do allow meat processors to efficiently collect NLIS data at the point of entry to the processing facility. This benefit applies mostly to beef processors who benefit from the mandate of RFID ear tags for beef nationally. Processors of small stock (Sheep and Goats) outside of Victoria typically require more manual operations to record visual ID data due to a current lack of a national requirements for RFID electronic tags.

- Industry is interested in RFID and see the potential benefits especially in yield data and feedback to the farmers.

- Efficiencies within the industry would flow from mandating RFID ear tags for small stock nationally.

- Some processors implement a policy of not accepting animals without RFID electronically tags. This avoids issues with lost tags and streamlines operations.

- Several processors use electronic tag presence to facilitate feedback to the producers on yields and pathology. Individual animal ID offers a granularity of data which can be used to monitor and enhance farming processes to improve overall meat quality.

- Several processors leverage from the presence of electronic NLIS ear tags to input data identifying the carcass directly into their processing plant traceability systems. These overall remain paper based. With identification (ID) data from the NLIS tags being printed to paper labels which are used throughout the processing of the carcass.

- There may be scope to collect the NLIS ID data for the carcass and implement a full electronic traceability solution.

- The entrenched use of Low Frequency (LF) RFID technology throughout the industry from Producers through to Processors and the existing widespread infrastructure deployed to read these tags will likely limit the introduction of the alternative and more performant Ultra High Frequency (UHF) RFID ear tags.

- Should it be possible to move the industry to the use of UHF tags, their ability to read at longer ranges and at higher speeds could offer new data collection opportunities for stock yard management.

- Safety for Operators can also be improved as UHF longer read range will allow ear tags to be read from a safer distance from the animal.

RECOMMENDATIONS

- Encourage the national adoption of NLIS electronic RFID ear tagging for small stock.

- Investigate the use of UHF as an alternative RFID technology for Ear tags including testing large sample sizes and different weather conditions.

RFID Hook/Gambrel Use

OBSERVATIONS

- The meat processing industry is in the early adoption phase of the use of RFID technology to track product through the slaughter, chiller, and boning room processes.

- Trials have been conducted with Low Frequency (LF) and High Frequency (HF) systems. No examples of the use of UHF RFID hook tracking systems were encountered.

- RFID has been poorly implemented due it being retro fitted to older sites
    - Infrastructure not able to support it without making changes to accommodate the RFID equipment
    - Integration of software and hardware inadequate
    - A lot of sites do not have a platform to integrate RFID solutions

- Key requirements for an RFID traceability solution are system reliability and redundancy in the case of tag failures.

- Problems experienced during trials related to RFID tag failures. Mechanical wear and tear on the hooks will cause tags to fall out/fail and therefore reduce read rates/accuracy. Most notably experienced with LF Tags. Other problems reported related to software integration issues.

- Most meat processors interviewed indicated a strong interest in the use of RFID technology to enhance product traceability through their plants.

- Benefits communicated were:
    - Improved, more granular, traceability data.
    - More automated feedback to producers of yields, quality, and pathology data.
    - Chiller shrinkage and yield data.
    - Chiller sortation.
    - Chiller real-time carcass inventory data.
    - Improved meat management process flows.

RECOMMENDATIONS

- Trial the use of UHF RFID Hook tagging to establish its suitability for the meat processing traceability application.

- Testing to determine what RFID infrastructure is required to achieve a reliable traceability system. This will also assist in calculating cost vs benefits.

2.0 Introduction

BACKGROUND

Livestock identification with RFID tags is one of the earliest uses of applications of RFID technology. RFID ear tags and bolus tags have been deployed in Australia for more than 25 years. During this time RFID technologies have developed significantly resulting in both performance and capability enhancements.

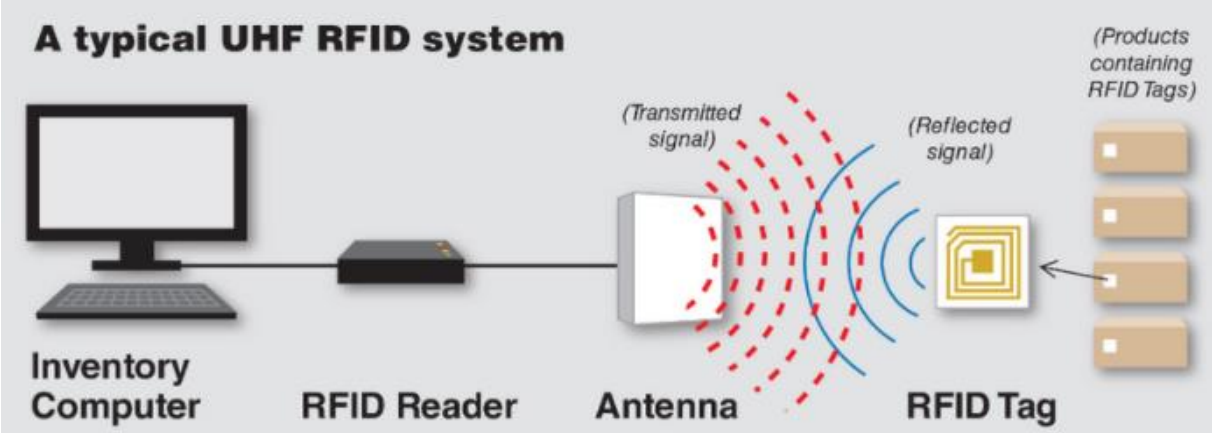

Figure 1: A typical RFID system

An illustration of a passive RFID system is shown in Figure 1, above. Passive RFID solutions use harvested energy from The RFID Reader to energise the electronic circuity of an RFID Tag allowing the communication of tag data stored to be sent to the RFID Reader. Communication between the Tag and Reader is contactless via Radio Frequency waves.

The earliest RFID technology to be deployed for animal identification operated in the 125-134kHz, Low Frequency (LF) range. Some years later RFID systems operating at 13.56MHz, High Frequency (HF) range were deployed and most recently, systems which communicate in the 866- 950 MHz range, Ultrahigh Frequency (UHF), have been used.

Each family of RFID solutions, LF, HF and UHF have different strengths and weaknesses. The primary differences are read range and speed of tag reading. Read range increases as one moves from LF to HF to UHF systems, as does the speed of tag interrogation.

Both LF and HF RFID solutions were standardised in the 1980's and 90's. During this time, UHF solutions were all proprietary with each vendor competing with their own RF communication protocols. For this reason, UHF technology, although offering higher performance than either LF or HF technologies, lagged the market adoption of either LF or HF solutions.

The lack of international standards meant that UHF RFID was more expense and confined to small niche markets. In 2005 an international standard was published for UHF RFID systems. Tags and RFID readers from different vendors became interchangeable, vendor supply increases, tag prices reduced significantly, and mass market opportunities began to increasingly use UHF solutions.

In the domain of livestock farming and meat processing, the use of all three RFID frequency types (LF, HF and UHF) exists. The wide variety of RFID technologies deployed has led to different experiences with the adoption of RFID technology. In addition, the performance, robustness, and competitiveness of RFID technologies has increased dramatically over the last 25 years, during which the technology has been trialled and adopted within the meat processing industry.

The range of experience both good and bad, suggested there could be benefit to the industry to understand and document current approaches to the use of RFID technology.

Insights to roadblocks and challenges experienced by meat processing operators relating to the deployment and operation of various RFID solutions within they operations, along with an understanding of the current RFID technology advancements and capabilities may allow for improved RFID solutions to be tested and adopted in the industry.

- The scope of the research, including any previous research that is relevant to this project
- The purpose of the research project, including any background information
- The scope of the research, including any previous research that is relevant to this project

3.0 Project Objectives

The primary objective of this report is to understand and document current approaches to:

A. the use of livestock RFID ear tags in meat processing operations, and secondly,
B. to the use of hook/gambrel RFID solutions within meat processing facilities.

The report has been structured to address each of these topics independently based on the consolidated feedback and data collected from Industry participants what have volunteered to contribute to this review.

The report will also document technical gaps in industry including evaluate new RFID gambrel/hook approaches if required under a stage 2 project which may follow this review

4.0 Methodology

4.1 Data Collection Approach

The originally methodology proposed for this review was for RAMP to visit 5 beef and 5 small stock facilities to understand current processes with regards carcass tracking via hooks/ gambrels and to evaluate perceived benefits from using RFID tracking on hooks/gambrels as well as understand the use of ear tags.

Unfortunately, Government travel and border restrictions imposed due to COVID-19 conditions limited any extensive site visit program.

With the approval of AMPC, RAMP replaced the physical visits to many of the meat processing facilities with teleconferences with key staff from participating companies who volunteered to be interviewed as part of this review.

Although the dominant data collection process was via teleconferences, there were two opportunities where plants visits were conducted.

The following 9 companies participated in this review, several with participation of staff from multiple operating sites.

- TEYS, Corporate (QLD), Biloela (QLD), Naracoorte (SA) - teleconferences
- JOHN DEE, Warwick, (QLD) - teleconference
- THE MIDFIELD GROUP, Warrnambool, (VIC) - teleconference
- FLETCHER, Dubbo (NSW) and Albany (WA) - teleconferences
- AUSTRALIAN MEAT GROUP, Dandenong, (VIC) - teleconference
- JBS, Dinmore (QLD) and Bordertown (SA) - teleconference
- CEDAR MEATS AUSTRALIA, Brooklyn (VIC) – site visit
- JUNEE LAMB, Junee (NSW) - site visit
- TALLANGATTA MEAT PROCESSORS, Tallangatta, (VIC) - site visit

RAMP thanks each of the participating companies for their willingness to share their experiences and collaborate to broaden the industry’s understanding of the use and benefit of RFID technologies in meat processing within Australia.

4.2 Teleconference Interviews

For each telephone conversation RAMP used the following interview questions to guide discussion. For many of the interviews, discussion moved beyond these base questions to other topics. Also, for some companies, questions were less relevant based on their involvement with RFID. Nevertheless, the overall structure of the interview questionnaire was followed where possible.

Interview RFID QUESTIONNAIRE- (used to guide discussion only)

Background

RAMP RFID has been contracted by AMPC to conduct a review of slaughter floor, chiller, and boning room RFID deployments in the industry.

Particularly the review will look at RFID hook tagging to explore industry's experience, both the successes and challenges with deployment of this type of solution.

The key objective of the review for AMPC is to better understand:

A. The current approaches to using existing RFID livestock ear tags in the industry.
B. The existing use or failed attempts of using RFID hook/gambrel solutions for traceability through the processing plant

Touching on the first area of investigation, can you please let us know:

1. If and how, [company being interviewed] uses the existing RFID livestock ear tags in your operations? *If yes, can you advise what vendor or RFID solution was implemented to read the ear tags? How is the data used?*

2. How does the use, add value to [company being interviewed]? *Use Case and desired Benefit(s)/Functions that it performs.*

3. Are there any problems/ concerns with the current use? *Do ear tags fail? What happens in this case? What is the reliability of the RFID read solution*?

4. Have you any recommendations for how the use could be improved?

With regard the second area of investigation (the Hooks), can you please let us know:

1. If [company being interviewed] currently uses RFID Hooks/Gambrel solutions for traceability in your operations? *If Hook tracking is not used, does* [company being interviewed] *use any other methods for tracking individual carcasses as they are broken down*?

   Some of the areas that would be very useful to discuss/understand are:

   a) What were the key motivations for introducing RFID Hook tracking?
   b) What were the expected benefits that the RFID hook tagging would bring?
   c) What RFID technology was used? LF, HF, UHF? Solution provider?
   d) When was the solution(s) commissioned?

e) *Scope of implementation – number of readers, located where? Number of hooks (new/retrofitted?)*
f) *What were the key functional requirements for the solution?*
g) *Understand your RFID implementation challenges. Operational Challenges*
h) *Understand user reaction/change management issues related to the solution.*
i) *What was good about the solution? What was bad about the solution*

2. If no, has [company being interviewed] previous trialed or implemented but discontinued the use of such systems?

   a) *How long was it operational for?*
   b) *Why was the solution abandoned?*

3. If yes, to either of above, what was [company being interviewed] experience with the solutions? *Reliability, Maintainability, Performance etc*.

4. What are the key business drivers for introducing or trialing RFID Hook tracking?

5. If no, has [company being interviewed] any interest or plans for implementing such a solution in the next 2 years?

Just to conclude the call, does [company being interviewed] use RFID technology, or is thinking of using RFID technology in any other parts of its operations? *Where might RFID add value*?

4.3 Confidentiality

During several the Industry interviews, participants identified some parts of the discussion which where Company confidential and requested that these details not be incorporated in the review.

5.0 Project Outcomes

5.1 THE USE OF RFID EAR TAGS IN AUSTRALIA

The purpose of this section of the report is to document current use and attempts of RFID reading of ear tags on slaughter floors.

The National Livestock Identification System (NLIS) was introduced in 1999 to meet European Union requirements for traceability and food safety purposes. It was first adoped in New South Wales (NSW) in 2004 and since 2006 all cattle movements must be recorded on the NLIS database, to acomplish this breeders must attach an ear tag (either visual or electronic) to the animal at birth, the tag remains with the animal for life.

The beef industry in Australia has made it mandatory in all states for cattle to have electronic radio frequency identification (RFID) ear tags. The use of the electronic RFID ear tags has streamlined data flow and allowed the tracking of animals across Australia seamlessly.

For sheep and goats the NLIS system requires either an electronic (RFID) or visual (NLISID) ear tag. This has caused some inconsistencies as different suppliers would use different ear tags making it difficult to streamline the data, with some requiring manual data entry and others requiring RFID equipment. Victoria is currently the only state that as made electronic ear tags compulsory and all lambs or kids born since January 2017 are fitted with RFID tags.

To date the electronic RFID ear tags have been mandated to use Low Frequency (LF) tags and has widely been accepted internationally as the standard.

The main reasons for why LF tags are preferred over other frequencies are:

- The technology has been tested and proven to work on animals.
- Ability to be scanned on objects with high water content.
- Better penetration of non-metallic substances and biological materials.
- The wide availability of LF handheld wand and fixed panel readers.

Despite LF being widely adopted there are some limitations including slow data transfer and short read range. These limitations mean animals need to go through single file and scanned in one at a time slowing down the process. Due to these limitations, there have been a rising case for the use of ultra-high frequency (UHF) RFID technology which has a significantly greater data transfer speed and read range (metres vs LF's centimetres). With increase in speed and range multi livestock can be scanned at the same time going through an alley speeding up the process and reducing labour.

Despite the advantages of UHF technology, it is not adopted due to several reasons, some of the key arguments against using UHF technology are:

- Performance to read through biological materials is lower.
- Performance compromised by high water content.
- Not enough testing done on livestock to prove reliability.
- Infrastructure already in place for LF solutions.

There have been extensive studies on the use of UHF tags on animals from around the world including Scotland (ScotEID field team, 2021) , Germany (Nora H. et al, 2016), and New Zealand (Erik and Grant, 2008) all showing promising results. The studies highlight UHF's main advantage of read speed and ability to process multiple animals at the same time. However, the studies tend to recommend further testing and research.

Although ear tags are effective in tracking an animal's movement from birth to processing plant, the tags do not provide a way to track the animal through the processing system. Once the animal is slaughtered the ear typically is cut off and the electronic RFID tag is scanned into the NLIS database. For visual tags the data is entered manually.

5.1.1 Industry experience of RFID Ear tag use

In Australia the usage of Electronic RFID ear tags at the processing plant may vary. RAMP RFID has set out to investigate the current use of RFID in the meat processing industry. By interviewing key personnel from processing plants, it is possible to find out the limitations and potential use cases for RFID technology in the industry.

Site 1: Currently do not have the infrastructure to scan cattle off the truck when they arrive. Once the animal is slaughtered, they are manually scanned into the NLIS system using a LF handheld wand reader. The RFID tag is then assigned to a carcass number and is no longer needed. The carcass number is applied to the carcass via paper tag with a barcode which is used to scan the carcass into the boning room. Traceability on the animal is then based on time it was scanned into the boning room. A major flaw in this process is if the carcass number was applied to the wrong carcass resulting in the wrong animal being traced.

Site 2: also, do not scan the cattle off the truck, the first and only time the RFID tags are scanned is after the animal is "knocked" and slaughtered. The ear (with the RFID tag) is cut off and scanned into the NLIS database using a LF panel reader. The RFID tag is then associated with the carcass and are not used anywhere else. A paper label is then used throughout the processing of the carcass. There is also an issue noticed with missing tags ranging from 1 to 25 (worst case) missing tags per day. Notable benefits of RFID would be to monitor cattle movement in the yard reducing mixing of cattle which could invalidate documentation, this is currently managed by yardmen.

Site 3: processes both small stock and beef, all cattle are scanned off the ramp as they arrive on site. There is a relatively smart system implemented to scan tags that allows for count of animals per load as well as ability to separate loads based on time. For beef ear tags are scanned into the NLIS database at the knocking box allowing for correct sequence on the chains and correct tracking on the kill floor. For small stock there are panel readers to scan the animals that go into the slaughter floor some manual recording is required as it is not compulsory to have electronic ear tags in other states. Challenges experienced are missing tags and sometimes smaller vendors providing rough data due to creating tags as the animals are sold.

Site 4: only processes sheep where electronic ear tags are not compulsory. Previously used an optical camera solution to capture an image of the visual ear tags as it goes by on a fix chain, the image is then associated with the position on the chain for traceability purposes. The issue with the optical solution is that it can be falsely triggered, and missing tags can make the image useless.

Site 5: processes beef and will not accept cattle if there is no ear tag on it. Ear tags are scanned at the scales into a cedar creek system and data is transferred to a paper ticket that stays with the carcass for traceability through the meat processing procedure. The ear tag is removed and scanned into the NLIS system once the animal is slaughtered. Sees Value in RFID technology in reducing labor and increasing accuracy and less emphasis on traceability as it can be accomplished by paper tickets.

Site 6: only processes sheep and lamb from many suppliers across different states where electronic ear tags are not compulsory. Animals are scanned in through lots and ear tags are scanned into the system and tracked to change over point where the RFID system gets initiated. From the changeover point the carcass goes through evisceration and then inspected for health and pathologies the feedback is then sent back to producers. Animals without electronic ear tags are tracked through lots matched with an RFID via hook when they get to the changeover point. Sees most value in providing feedback on yields and pathology to improve quality.

Site 7: processes only sheep and lamb. Being based in Vic, electronic ear tags are compulsory. The electronic ear tags are scanned into the NLIS database via RFID reader in the bleed tunnel after the animal has been slaughtered, the ear tags are no longer used. Once the head and skin has been removed the carcass in then assigned a body number and placed on the fixed chain hooks, there is a RFID system in place however it is not used and instead a paper tag is used. Sees potential benefits in RFID for tracking and assigning where each carcass goes for processing compared to the current system where assumptions are made if the paper tags are missing.

Site 8: are a sheep processing site, the sheep and lamb generally do not have electronic ear tags. When mobs come into the factory they are separated and only one mob is processed at a time. The last sheep of each mob going through the racetrack gets tagged to let the operator know the next animal is the start of the next mob. The data is recorded manually, and the animals are tracked based on their position on the hook using indexing and a paper tag.

Site 9: only processes lamb and sheep from Victoria and NSW. Lamb from Vic have electronic ear tags, so a RFID ear tag reader is used with a 90% read rate on the ear tags (working toward 95% read rate). Ear tag errors typically occur if a farmer does not reassign a tag and instead puts a new tag on. For mobs from NSW there are no electronic ear tags, so they are identified through the PIC (Property identification code) and tracked manually via paper tags. Mobs are separated in the yard and when they go through the race track the start and end of each mob is tagged.

5.2 THE USE OF RFID FOR HOOKS/GAMBRELS TRACKING

Traceability of product through the meat processing plant is an increasingly desired requirement. The use of RFID embedded in hooks which transport carcasses through the production process has been trialled and, in some cases, adopted to improve product traceability.

5.2.1 Industry experience using RFID for Hooks/Gambrels

The purpose of this section of the report is to document the current use and attempts of RFID tags/readers for beef and sheep hooks/rollers/gambrels and slides through the slaughter, chiller and boning room networks.

Site 1: have trialled RFID hook tracking systems at several sites and Dot matrix hook tracking at one site. The RFID tracking system involved retrofitting the hooks by drilling and then having the RFID tags (encased in a glass tube) moulded in. Difficulties experienced with RFID were primarily caused by vigorous hook handling. The hooks come out the boning room and drop off the chain onto a conveyor belt and into baskets which are picked up by a forklift and then transported to the other side of the plant where the hooks are subjected to acid dip and thorough cleaning process before being put back on the chain. This cycle involves a lot of rough handling causing the RFID chip embedded into the hooks to fall out, the cleaning process also caused ingress in the RFID glass tubes resulting in decreased read rates. The combination of RFID chips falling out and ingress formation in the glass tubes resulted in high maintenance and a read rate of approximately 85%. The main advantage the RFID system had over the Dot matrix system was readability in that the system does not need to slow down to be read whereas for the Dot matrix system the system had to slow down for the camera to reduce swinging. Main advantage Dot matrix has over the RFID system is the ability to get an image log which can easily be recalled and the use for the weight calculations. There may be value in a hybrid system where the RFID can be used at the chillers where an image is not required, and dot matrix can be used in other areas.

Site 2: have not tried RFID tracking on hooks however are interested in the technology, however, have some concerns regarding reliability. Currently the RFID ear tag is read at the boning room intake a paper label is then applied to the carcass for traceability through the rest of the system. The current process relies heavily on the carcasses being in order on the hooks and traceability is achieved using time slots in combination with carcass labels. After research on previous case studies the main areas of concerns are losing RFID tags due to handling and tag failures resulting in poor reliability, for example if a tag is read on the kill floor but falls out or fails in the boning room there is no way to then identify the carcass. The hooks will also need to go through QA checks every time it goes back into the system to ensure tags are still there and functioning. The team at site 2 is currently exploring different methods to achieve a reliable solution to traceability and have yet to find something suitable.

Site 3: have implemented RFID hook tracking at their site, with difficulties initially with tags falling out or getting damaged during handling however they have since rectified these issues and have the hardware in a satisfactory state. Current issue is mainly software integration and organising the data in a meaningful way. Once the system is reliable enough the RFID hook tracking system can be utilised in automating loading the carcass in and out of chillers into the boning rooms. Ideally automation of the chillers to be able to determine what is currently in the chillers and the logging of weights, this will help reduce time workers spend in the chillers. Effective implementation of the RFID hook system will lead to better processes and efficiency.

Site 4: previously used an optical system and is currently trialling RFID hook tracking on their fixed chain and looking to move to tagging plastic hooks in the next phase. The optical system would take an image of the ear tag and use an index system for the carcass when they are placed on the hooks, however once carcases are taken out of the main chain for inspection and then merged back into the system the ability to track the carcass is lost. The RFID system does not have the same issue as product can easily be identified and tracked at a read point. For the fixed chain system, a high frequency (13.5 MHz) RFID tags is secured by a nylon case and screwed onto the stainless hooks. Initially there was an issue with the read range however upon further testing it was found that a larger tag (25mm) resolved the issue. The RFID system on the fixed chain is currently working well and Fletchers is looking to move to the next phase implementing the RFID onto plastic hooks. The preliminary testing on plastic hooks presented issues with tags falling out due to handling, shock, and cleaning processes. For the next phase instead of embedding the RFID tags in the hooks they will be attaching the RFID tags by screwing into the hooks. Once successfully implemented the hook tracking will be able to provide better counts, traceability, and data gathering during processing of the animal.

Site 5: currently uses a barcode ticket system and have not tried RFID hook tracking but are interested in the technology and proposing to implement it at a new site. Sees potential in RFID technology in traceability internally using the information to improve yield, shelf life and managing meat more effectively. Believes it is difficult to retrofit RFID technology regarding space limitations and read ranges possibly compromising the system, however having a new site built with RFID in mind the technology can be utilised more effectively. By building a new plant with RFID in mind more space can be allocated and read points can be incorporated in the layout of the process lines potentially allowing for a more automated system especially in the chillers reducing time spent in there by staff.

Site 6: are currently trialling RFID hook tracking on sheep and lamb product. Early in the trial there was difficulty in getting the system to work and found the RFID chip was at fault and not suitable for the job. Eventually found a RFID chip that can withstand the vigorous handling and wash process at the site, over a trial period of 3-4months only 3 chips were lost out 25. The new chip is larger than the previous chip and is screwed into the hooks which they have found is not sufficient and is looking to explore screwing and gluing the RFID chip to the hooks. The trial takes the data from the ear tags at the changeover point where the RFID hook tracking is initiated and allocated to a carcass. RFID tracking very useful for when carcass is taken for health inspection which allows to trace the animal back to the producer. RFID also makes tracking of carcasses put on the retain rail easier as they usually get lost once, they are put back on the main chain. RFID is also effective in keeping track of lots, counts, and gathering data such as yield which is then used to generate feedback to producers to help improve produce.

Site 7: Have previously implemented RFID hook tracking approximately 7-8 years ago, however due to staff changes there was no one to take ownership and drive the project. The RFID hardware installation was completed by one company and the software integration was completed by another resulting in a solution that never worked properly. The system works in theory however if a body is removed from the chain and moved onto a retain chain (to check for any defects or animal health issues) then placed back into the main chain it can cause errors such as carcass doubling up. This is caused since at Cedar Meats there is typically a fixed space between carcasses however when carcasses are returned from retain chain they get inserted in-between two other carcasses, this results in the system seeing 2 carcasses when it was expecting 1. The hooks also go through rigorous usage used 1-3 times a day and if RFID tags fall out the failure rates will potentially cause too many issues for instance the reader and scale should produce a ticket accordingly, if there are hooks without tags it may cause the wrong allocation of tags. The RFID system was deemed as having too many points of failure that are not easily fixed and therefore is not being used at the site except to read the ear tags into the NLIS database.

Site 8: have not tried RFID hook tracking and currently have a manual process utilizing indexing and paper tags to keep track of carcasses. The manual process is effective and only requires operator to input data on the system. There is no real need for an RFID tracking system as the current manual process is sufficient with the animal data tracked relatively accurately throughout the process (even the innards are tracked with a conveyor moving in sync with the carcass). There is currently a desire to automate the chiller to get yield data however there is no platform to implement that yet.

Site 9: are currently still working on the RFID system installed in 2020 and ironing out some issues. The system is primarily used on sheep from Victoria as they have electronic ear tags. At the health inspection station RFID reader first reads the ear tag, the operator scans a hook before putting the animal on the hook and then a photo electric sensor assigns the hook to a body number. The hook is then used to track the animal all the way through to the grading station where a paper tag is produced and attached to the body before going into the chiller. Key issues experienced at site 9 are not necessarily RFID specific issues main problems encountered involve the counts between what was killed, ID station and grading station not matching which can be caused to ghost bodies generated by the photo electric sensors being falsely triggered or bodies not saving correctly on the inspector stands. Hooks with faulty or missing tags causing bodies and ear tags to be recorded by no RFID data associated for tracking. Another major issue the site is experience is the system not saving the data in a timely matter due to possible network or software issues. When successful the RFID data will be mainly used for providing feedback to farmers. Site 9 have also identified potential benefits of RFID in grading the carcass off the hook, chiller sortation and yield data.

6.0 Discussion

IDENTIFICATION OF TECHNICAL GAPS

The purpose of this section of the report is to identify any potential to close any RFID hardware/reader technical gaps identified from industry feedback.

The technical gaps that could potentially be closed are grouped as they relate to the two topics of the review: the use of RFID ear tags and RFID hook/gambrel use.

6.1 RFID Ear Tags

The entrenched use of Low Frequency (LF) RFID technology throughout the industry from Producers through to Processors and the existing widespread infrastructure deployed to read these tags will likely limit the introduction of the alternative and more performant Ultra High Frequency (UHF) RFID ear tags.

The use of LF tagging limits read speeds and requires almost direct contact of the RFID wand reader or panel reader to collect tag data. This has the advantage of unique identification each animal but limits the use of the RFID tags to broader range of applications,

The benefits from introducing UHF RFID ear tags include scanning multiple animals simultaneously within a significantly increased read zone. Also scanning animals at much faster read speeds.

Participants in the interviews saw potential increased use of these capabilities for stock counting, receipt and tracking of animals and general yard management.

A further technical opportunity identified by the review is the scope for Industry to better leverage the presence of the NLIS Tag. Many operators simply use the tags to enter data into the NLIS database. There may be scope to use the NLIS ID data to link to a fully electronic traceability solution within the processing plant. This may be an area for further investigation.

6.2 RFID Hook/Gambrel Use

The meat processing industry is in the early adoption phase of the use of RFID technology to track product through the slaughter, chiller, and boning room processes.

Trials have been conducted with LF, HF systems. But many problems have been encountered relating to the implementations. Issues with tag survivability, complex integration with existing systems and infrastructure and poor implementation.

Although many challenges were identified by this review, there was a strong belief held by many of the industry participants, that RFID tracking has the potential to dramatically enhance their operations. Benefits identified were:

- Improved, more granular, traceability data.
- More automated feedback to producers of yields, quality and pathology data.
- Chiller shrinkage and yield data.
- Chiller sortation.
- Chiller real-time carcass inventory data.
- Improved meat management process flows.
- Improved speeds vs manual input and other data capture methods (such as camera systems)

There may be value in investing in an AMPC project in collaboration with an industry participant to specify and trial a “state of the art” RFID Hook tracking solution based on the lessons currently learnt within the industry.

7.0 Conclusions / Recommendations

Key findings and recommendations of the review are presented below.

The findings are grouped as they relate to the two topics of the review: the use of RFID ear tags and RFID hook/gambrel use.

7.1 RFID Ear Tags

OBSERVATIONS

- RFID ear tags do allow meat processors to efficiently collect NLIS data at the point of entry to the processing facility. This benefit applies mostly to beef processors who benefit from the mandate of RFID ear tags for beef nationally. Processors of small stock (Sheep and Goats) typically require more manual operations to record visual ID data due to a current lack of a national requirements for RFID electronic tags.

- Efficiencies within the industry would flow from mandating RFID ear tags for small stock nationally.

- Some processors implement a policy of not accepting animals without RFID electronically tags. This avoids issues with lost tags and streamlines operations.

- Several processors use electronic tag presence to facilitate feedback to the producers on yields and pathology. Individual animal ID offers a granularity of data which can be used to monitor and enhance farming processes to improve overall meat quality.

- Several processors leverage from the presence of electronic NLIS ear tags to input data identifying the carcass directly into their processing plant traceability systems. These overall remain paper based. With ID data from the NLIS tags being printed to paper labels which are used throughout the processing of the carcass.

- There may be scope to collect the NLIS ID data for the carcass and implement a full electronic traceability solution.

- The entrenched use of Low Frequency (LF) RFID technology throughout the industry from producers through to processors and the existing widespread infrastructure deployed to read these tags will likely limit the introduction of the alternative and more performant Ultra High Frequency (UHF) RFID ear tags.

- Should it be possible to move the industry to the use of UHF tags, their ability to read at longer ranges and at higher speeds could offer new data collection opportunities for stock yard management.

- Improved Safety as operators will be able to read ear tags from further distances from the animal.

RECOMMENDATIONS

- Encourage the national adoption of NLIS electronic RFID ear tagging for small stock.

- Investigate the use of UHF as an alternative RFID technology for Ear tags including testing large sample sizes and different weather conditions.

7.2 RFID Hook/Gambrel Use

OBSERVATIONS

- The meat processing industry is in the early adoption phase of the use of RFID technology to track product through the slaughter, chiller, and boning room processes.

- Trials have been conducted with LF, HF systems. No examples of the use of UHF RFID hook tracking systems were encountered.

- Key requirements for an RFID traceability solution are system reliability and redundancy in the case of tag failures

- Problems experienced during trials related to RFID tag failures. Most notably experienced with LF Tags. Other problems reported related to software integration issues.

- Most meat processors interviewed indicated a strong interest in the use of RFID technology to enhance product traceability through their plants.

- Benefits communicated were,

- Improved, more granular, traceability data.
- More automated feedback to producers of yields, quality, and pathology data.
- Chiller shrinkage and yield data.
- Chiller sortation
- Chiller real-time carcass inventory data.
- Improved meat management process flows.
- Reduced manual handling and data input, improving efficiency

RECOMMENDATIONS

- Trial the use of UHF RFID Hook tagging to establish its suitability for the meat processing traceability application.

- Testing to determine what RFID infrastructure is required to achieve a reliable traceability system. This will also assist in calculating cost vs benefits.

Conclusion

Through the site visits and interviews this review shows that there is strong interest in RFID technology, however adoption rate is low. Meat processing companies can see the potential benefits of the RFID improving efficiency, traceability, data processing, automation, and sortation. Despite the benefits, meat processing plants are struggling to implement reliable RFID systems, many of these difficulties stem from poor infrastructure and integration of hardware and/or software primarily due to the RFID solution being retrofitted on to existing process lines. The other significant problem faced is RFID tag failures in the hooks/Gambrels due to harsh mechanical wear and tear, the RFID chip can be damaged or fall out of the hooks making the system unreliable. These issues are holding the technology back with many sites who have trial RFID solutions still optimizing or completely give up on the solution. Investigation into what RFID infrastructure is required for a reliable system should be conducted ideally at a new plant built from the ground up with RFID technology in mind.

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