Final report

Establishing new integrity system approaches and technology

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Abstract

This project sought to identify the requirements of a future state traceability system. The project team undertook desktop research, consultation through workshops and interviews and regular liaison with ISC project team and other consulting parties to explore this issue.

The project identified issues with system governance that require clarification so that the proposed technology improvements recommended in this report can be made effectively.

System participants identified a range of requirements that a future traceability system would either provide or interact with to promote benefits to all those who contribute to meat and livestock production.

In summary the project identified opportunities to:

1. Leverage the clear strengths of the current system and migrate it into a more modern technical environment
2. Take advantage of the new capabilities a new technical environment and digital platform would offer and to provide value added services and data insights to producers and other supply chain participants to help improve their businesses and operations
3. Develop and implement data standards for interoperability and data exchange across the supply chain
4. Create and foster opportunities for innovation across the value chain e.g. tag and gate technology, smartphone apps, etc.

Executive summary

Background

This report was prepared to examine the requirements of a future state traceability system for Integrity Systems Company and its key industry and regulatory stakeholders in order to inform decisions on system improvements.

Objectives

This project sought to begin scoping out the high-level requirements of a future traceability system.

Methodology

The project used the following methods to generate findings and draw conclusions:

- literature review
- workshops with industry, regulatory and subject matter experts
- interviews with key industry bodies
- data visualisation to document the integrity system.

Results/key findings

The project identified opportunities to improve overall system governance and upgrade the system's technology infrastructure to support efficient and effective collection, storage and exchange of data.

Benefits to industry

A high level, end-to-end visualisation of the integrity traceability system that allows for the design of improved data collection and sharing for greater efficiency and wider benefits was created. The visualisation is complemented by industry consultation that identified requirements from a future traceability system categorised by industry segment.

Future research and recommendations

This project demonstrated that there is an opportunity for ISC to provide leadership to clarify the traceability system governance arrangements. ISC's ownership of the NLIS database positions it well as it can use the transformation of the system's primary data platform as a basis for confirming governance and mapping out the opportunities for improvement.

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1. Background

Australia is one of the world's largest red meat producers. In 2018-19 Australia produced 3.1 million tonnes of red meat from a livestock inventory of around 25 million cattle and 65 million sheep (1). In addition to supplying the domestic market, Australia is a significant exporter to global red meat markets. In 2019, Australia was the third largest beef and veal exporter and the largest exporter of sheep meat (2). Australia's red meat supply chains are complex. They service more than 100 export markets through various logistics channels including road, rail, sea and air (3).

Australia's red meat supply chain is also dispersed, with primary production often geographically isolated from other parts of the supply chain. Around 60% of cattle farms (approx. 13,200 farms) are classified as small (running between 100 to 400 head), (4) and some beef production (around 20%[1]) is sourced from farms over 400 km from the abattoir (5). Adding to this complexity, several related industries are integrated into Australia's red meat supply chain, including dairy (bobby calves and cull cows make up a significant portion of sale yard activity and meat production, particularly in Victoria (6)) and live exports (in 2019, Australia was the world's largest exporter of live animals by sea, exporting 1.3 million cattle and 1.1 million sheep (1)).

Product integrity underpins Australia's position as a world leader in red meat. Australia's current integrity system is overseen by Integrity Systems Company (ISC) and comprises three programs: on-farm assurance, animal identification, and traceability. This system protects the disease-free status of Australian red meat and underpins the marketing of its products as clean, safe and natural.

The base regulatory requirements of the system are governed by a mix of state and federal regulations that relate to market access, biosecurity and food safety:

- Red meat exports are regulated under the Commonwealth Export Control Act (1982) and the Australian Meat and Live-stock Industry Act (1997) with the objective of meeting import country requirements and supporting the integrity of Australian exports to facilitate continued access to export markets.
- Traceability regulations targeted at biosecurity are mostly governed at the state level, although the Commonwealth does have some reporting requirements for livestock animal products moving across Australia's borders (e.g. Biosecurity (Human Health) Regulation 2016).
- Meat food safety forms part of a series of national standards that Food Standards Australia New Zealand (FSANZ) developed to strengthen food safety and traceability throughout the food supply chain from paddock to plate.

Australia's current integrity system was steadily developed through the mid-1990s to early 2000s and was initially driven by a need to meet market access requirements in the European Union. This saw the introduction of the National Livestock Identification System that enabled individual animals to be traced from birth to slaughter. Since then the system has evolved to

[1] "The ACCC found approximately 80 per cent of cattle acquired for processing travelled less than 400km to reach an abattoir after purchase. However, the ACCC acknowledges that some portion of cattle will be transported further than 400km and considers this finding to be a starting point rather than a strict rule for future competition analysis."

include the Livestock Production Assurance Program (LPA), which outlines a set of on-farm practices designed to ensure Australian livestock farmers are producing red meat that is safe for consumption and the National Vendor Declarations (NVDs), which ensure relevant information captured by NLIS and LPA is recorded and shared across the value chain.

Given the passage of years, the progress made in other countries to develop stronger integrity systems, and the opportunities that advances in technology provide to use traceability systems to improve on-farm productivity, Australia must continue to improve its traceability system to maintain and expand market access opportunities and generate additional benefits that accrue from new data-driven insights.

In this context this report explores ways in which a future traceability system can deliver these improvements and maintain the advantages of its integrity system.

2. Objectives

This Project sought to achieve the following objectives:

1. Conduct desktop research to begin scoping out the high-level requirements of a future traceability system.
2. Prepare a brief discussion paper to summarise findings from desktop research and use this to guide discussion at workshops and interviews to follow (items (3) and (4) below).
3. Facilitate three workshops with stakeholders from the industry, customer groups and Deloitte's global agriculture traceability experts to test and build on the high-level requirements identified in item (1) above and begin developing a view of the risks associated with implementation.
4. Conduct one-on-one interviews with 6-8 leading authorities in the public sector on traceability systems to ensure their requirements are incorporated into the high-level model developed from the research and workshops (to be attended by Partners).
5. Engage Deloitte's data analytics team to develop a visualisation of the future traceability model highlighting what will be required from all of the impacted parties in the value chain, to facilitate understanding of what the future system will look like.
6. Summarise the risks associated with the successful implementation of the model and test these in a workshop with Deloitte practitioners that have implemented similar systems around the world.
7. Summarise the project findings in a report and accompanying Power Point presentation.

The Project has achieved some of its set objectives recognising the following changes in context and understanding during project delivery:

- The concept of the 'requirements of a future traceability system' was discussed with the ISC project team on several occasions in terms of understanding what that meant to ISC. In particular, the fact that the current traceability system had not been previously detailed in an end-to-end visualisation meant that there was debate about what the system was intended to achieve and who it needed to serve. These questions are addressed in our findings and recommendations.
- Objective 5 was revised to engage Deloitte's data visualisation specialists to document a high-level visualisation of the current traceability system including identification of data and information flows.

- Some detail around 'Risks associated with the successful model' can be found in section 3.2 of the Discussion Paper which forms Appendix 8.1 to this report.

3. Methodology

3.1 Literature review

A literature review based on documentation provided by ISC along with other publications sourced by the project team established an overarching view of the current state of the traceability system and issues and opportunities for a future state system. The literature review was summarised in a Discussion Paper (see Appendix 8.1) which was shared with stakeholders prior to consultation through workshops and interviews, as noted below.

3.2 Workshops

Three workshops were conducted to explore views from key stakeholder groups with a focus on participants in the traceability system and their needs and requirements. Workshop Participants are summarised in Appendix 8.2.

3.3 Interviews

A series of interviews were conducted to complement the literature review and workshops which focused on identifying themes that in turn inform our conclusions and findings in section 5. Interview Participants are listed in Appendix 8.2.

4. Results

4.1 Workshops – summary of findings

The workshops with system participants and specialists allowed us to identify what they saw as the requirements of a traceability system from a whole of system perspective and from their perspective within the system. The summary below shows that there are clear themes arising from the workshops that inform our findings. In particular: ease of use; reduction in manual handling of information; linking of information to create better value; collection and storage of new information; consideration of future system/industry requirements.

Each section summarises the ideal requirements stakeholders seek from a traceability system and then calls out the minimum or essential requirements for that stakeholder.

4.1.1 Producers - requirements/needs from a traceability system

- Ease of use
- Linking process to value (linking a system to a real application of value)
- Registering animal birth (i.e. enabling recording of animal birth as part of the traceability system)
- Eliminating paper-based systems
- Low cost/cost effective (tags, readers, IT systems)
- Low administrative burden

- Informed decision making based on data (centralised leadership of data)
- Safety of consumers as a result of comprehensive integrity processes
- Interoperability with other on farm software applications.
- Providing visibility of their stock (e.g. track and trace from farm to processor/sale yard) in the supply chain (e.g. with carriers, sale yards, abattoirs etc)
- Benchmarking (e.g. by breed, location/region of origin, age, gender, sire/genetics) and other value-added insights from other data sources that can interact with the traceability system e.g. animal quality and condition scores, live and dressed weights etc
- Date, time and location information of when ownership and/or responsibility for an animal changes.

4.1.1.1 Requirements that the system must meet for producers:

- Individual animal identification
- Capture of animal centric information
- Traceability and data integrity to the farm (for market access, food safety and biosecurity)
- Data standards (having one data standard nationally).

4.1.2 Saleyards and Transport - requirements/needs from a traceability system

No transporters or saleyards were interviewed as a part of the workshops and what follows are assertions from other supply chain participants interviewed. Some of these points have obvious application and some will require additional verification.

- Safety
- Accuracy and ease of use (high frequency transactions)
- Low cost for transport operators
- Lessening the large administrative burden
- Animal welfare
- Use of data to improve performance of transport (i.e. calculating fuel usage) and regulatory compliance e.g. chain of responsibility and mass (weight) management of freight under road transport regulations - requires additional verification
- Electronic Scanning of the animal at load/unload (i.e. not manual) - requires additional verification
- Real-time track and trace to the producer and abattoir- requires additional verification
- OHS issues in the sale yards (potential for transactions to move online)
- Biosecurity
- Temperature at which products are transported (i.e. cold chain integrity/HACCP compliance for consumer product).

4.1.2.1 Requirements that the system must meet for saleyards and transport:

- Bringing in panel readers on the tail gates of trucks - requires additional verification
- Generate automatic manifest (e.g. Bluetooth scanner on phones) - requires additional verification

- Monitoring/compliance requirements for how many animals are transported on a truck/ship (i.e. animal welfare and biosecurity requirements) - requires additional verification
- Passive data collection - requires additional verification
- Vehicle tracking - requires additional verification
- Being able to track the conditions in which animals are shipped and transported - requires additional verification
- Electronic receival, tracking and dispatch of animals to/from farms, sale yards, abattoirs - requires additional verification

4.1.3 Abattoirs - requirements/needs from a traceability system

These assertions are based on a limited number of interviews.

- Carcase data including animal health and defects
- End to end tracking of meat cuts and products from each individual animal
- Eating quality (such as pH levels of good eating quality meat, temperature etc.)
- Point of origin of animal
- Electronic receival of animals from farms, carriers
- Data standards for information sharing/interoperability across the value chain
- Food-safe edible microdot to trace animal (potential possibility).

4.1.3.1 Requirements that the system must meet for abattoirs:

- Traceability through and beyond the disassembly process
- National data standards for tags and readers; all systems and scanners in the industry to use standard communication for the tags (leveraging existing/common protocols in available industry e.g. GS1)
- Low cost, value added provision of data back to producers through one industry standard platform e.g. condition scores, live and dressed weights to the individual animal that systems such as Livestock Data Link can provide
- Data standards for information sharing/interoperability across the value chain.

4.1.4 Wholesalers and Exporters - requirements/needs from a traceability system

- Exporters need to satisfy customer and market requirements, which means they need to:
  - Meet relevant criteria
  - State authorities work closely with exporters to ensure that the criteria are being met
- System needs to be electronic, standardised and carry a low overhead burden vs the current system to satisfy Australian Government requirements which is paper-heavy and laborious, with a lack of standardisation
- Administrative load is considerable in current system; reducing admin load
- Cold chain integrity
- Needs to meet quarantine, customs clearance, and specific requirements around food products
- Option to be able to manage both live and box trade traceability requirements in the same system

- Quality tracking that can validate provenance and brand story
- Adaptability to various countries' needs
- Clear and standardised data definition and interoperability using already available industry standards e.g. GS1.

4.1.4.1 Requirements that the system must meet for wholesalers and exporters:

- Reduction in administrative burden, automation of processes and the ability to leverage pre-existing information (GS1 labelling)
- Real time information, with industry standards for access of information, that provides competitive advantage
- Traceability to animal through farm/property, producer, breed and region data.

4.1.5 Retailers[2] - requirements/needs from a traceability system

- Traceability and provenance, providing customers with brand awareness
- Real-time information capture, with industry standards for the access of information
- Competitive advantage (ability to differentiate product based on breed, area of origin, feeding system etc.).

4.1.5.1 Requirements that the system must meet for retailers:

- The ability to track temperature throughout the transport to retail process (unit level traceability), as well as the integrity of the cold chain
- Direct supply of data scanned in real time to retailers
- Ability to differentiate product based on quality perception and other factors (not just price) e.g. breed, feed system, provincial origin, etc., and hence extract higher margins/willingness to pay from consumers
- Time from processing to delivery at retail outlet, and storage time including:
    - How long is it stored for?
    - What condition did it arrive at the retail outlet in?
    - What temperate was it collected, transported, received, and stored in?
    - Have the products been mishandled/damaged in transit (accelerometer)?

4.1.6 Consumers[3] - requirements/needs from a traceability system

- Providing assurance to customers that they got what they paid for i.e. product integrity assurance
- Provenance, for example; origin (e.g. "Tasmania"), breed (certified angus), organic certification etc
- Price, health concerns (quality of product, packaging and marketing), environmental concerns, animal welfare, taste
- How and where meat is transported
- Pre-processing information (what have the animals eaten, what treatments have they received).

[2] Drawn from desktop research, sources noted in Section 7.
[3] Drawn from desktop research, sources noted in Section 7.

4.1.6.1 Requirements that the system must meet for consumers

- Ability of the system to provide assurance and the prevention of fraud
- Ability to differentiate product and the relative value of offerings and hence influence willingness to pay.

4.2 Interviews - summary of findings

Themes	Summary	Quotes
Positive aspects of the current system	Stakeholders identified some key positives of the current system as being: • Australia's red meat traceability system drives the industry's recognised strong international brand. • Data/information requirements are reasonably simple • Is consistent across Australia – i.e. is not jurisdictionally dependent • System requires and enables a good relationship between government and industry • LPA accreditation is widely used, recognized, and has a good reputation both domestically and internationally • System is built on collaboration with each stakeholder (responsible for the animal) is a signatory, and legally recognised in the system	"Australian meat and livestock have a good reputation and quality, and are sought after and preferred even though they have an expensive supply chain management in place" "In terms of data fields, how many are there and is it clear why they're being collected? In the existing system, it is quite simplistic. Individual properties, animal codes, property transfers and carcass records". "(The current red meat traceability) system is built on a culture of industry collaboration with government to get the system right"
Negative aspects of the current system	Stakeholders consulted identified several negatives of the current system: • Despite simple data/information requirements, the system is complex, confusing and relies heavily on manual data collection with enormous amounts of time spent rectifying associated errors. • Cumbersome nature of the current system, often leading them to lose sight of the value that such a system adds (i.e. driving compliant behaviors) • Significant information gaps including an inability trace animals through the "disassembly process" in meat establishments (i.e. boning room floor) • At times the 'value' proposition of the system is disconnected from the system tasks • System has few 'teeth' to drive compliance. As such 'the can gets kicked down the road'.	"Within industry, there is a general understanding that we need to have this, but meeting requirements as a day to day activity can be laborious and can lose sight of the value the system adds. Old technologies like paper, dropping tags in the mud, etc. all contribute to industry frustrations with the system." "There are a lot of people out there who find the existing system too complex as it currently stands. Future system needs to be simple use to encourage greater compliance rates." "Gaps in the traceability system from the time where the tag comes off the animal, to the point where it is placed in a large box with other pieces of meat, to be transported to a distributor. The boning room is a gap."

4.2.1 Compliance

Sub-Themes	Summary	Quotes
Authority to enforce system compliance	• One stakeholder suggested that compliance throughout the system could be better regulated and enforced if the body setting traceability standards were different to the body enforcing them. • Several stakeholders indicated that an overarching authority governing enforcement across all jurisdictions (i.e. a national system) would assist in improving compliance. Jurisdictional inconsistencies can create confusion in the system. One peak industry council stakeholder even suggested traceability be enforced more consistently across different production animal species. • Several stakeholders also noted that there are currently few avenues for regulating authorities to hold stakeholders accountable for system non-compliance. • Compliance is often enforced (or processes corrected) by the last link in the supply chain.	"AusMEAT is a good example, they set the standards and AusQUAL conducts audits to determine adherence to those standards. Whilst both AusMEAT and AusQUAL are related, they operate as separate entities" "Main pinch points are the lack of consistency across jurisdictions (not having a national system) as well as disparities w traceability in other species. There is also a reluctance for some factions of industry to change." "Very little recourse to put accountability onto people when they do the wrong thing"
Industry perceptions of traceability and factors likely to drive cultural change	• Heavy reliance on paper-based forms was broadly viewed by stakeholders as tedious. Many saw this as a factor reducing incentives for stakeholders to correctly complete NVDs. Correcting mistakes in NVDs is currently a time consuming and labour intensive process. • Several stakeholders thought educating farmers to better understand the benefits Australia's red meat traceability system can bring to the industry would help incentivise better system engagement / compliance. • Stakeholders saw non-compliance as often resulting from poor stakeholder understanding, the disparate sophistication and scale of stakeholders in the supply chain, and ineffective communication from government and regulating bodies when describing changes in the regulatory environment. • Some stakeholders understood that there is a culture of non-compliance in certain pockets of the supply chain (some abattoirs and livestock agents) • There was a general view amongst stakeholders that some factions of the industry will likely be reluctant to change	"Paperwork is currently a concern because there is a lack of commitment to doing it properly. There has always been pushback from some parts of industry. There are minimal compliance frameworks to incentivise system engagement. ENVD should have built in triggers to catch incorrect information / poorly completed paperwork as it happens." "Is non-compliance driven by time/difficulty or lack of understanding re value generated by the system? Both are right. Another part is that they [some farmers] just don't understand why they have to do it." "Some stakeholders are ignorant to what they need to do or don't know how to do it. Then there are those who actively negate system processes to keep product (livestock) moving through the system." "Agents are probably the most problematic stakeholders. Misinformation, untimely manner, not correcting things. Agents interact with everyone throughout the supply chain."

4.2.2 Biosecurity, food safety and market access

Sub-Themes	Summary	Quotes
Biosecurity	• There was broad consensus across stakeholders that the current integrity system delivers positive biosecurity outcomes for Australia's red meat industry. • One stakeholder cited past ABARES analysis that estimated an outbreak of foot-and-mouth disease in Australian livestock could cost as much as $100 billion. It was suggested that this would likely be substantially higher today. Most of this cost is attributed to restrictions on market access. Only a small proportion of the cost to clean up the outbreak. • Government is perceived to collect an awful lot of data on biosecurity. But stakeholders suggested they had no idea what happened to it.	"The primary reason for the traceability system is for biosecurity, this needs to be retained in a future system." "2013 ABARES report looking at FnM outbreak ~50 billion. This would mostly be through loss in market access. Clean up cost would be relatively negligible. Today this could look more like ~100 billion."
Food safety and Market Access	• Government was also perceived to collect significant food safety data with stakeholders uncertain as to the data's final use other than as a 'record'. • Often food safety data is generated at the processing stage (e.g. residue survey testing). This information doesn't' feed back up the supply chain (i.e. to producers), despite being part of broader product integrity • Some stakeholders suggested requirements to access international markets are only going to become tighter. As a result, it was suggested that Australia's future red meat traceability system needs to be sufficiently flexible to meet these changing needs. • Individual animal traceability for some products and by-products (e.g. blood) aren't currently required by end markets and capturing this information is highly costly. • In some developing markets (where preference for product integrity systems is softer) the system can be interpreted as a burdensome cost on the supply chain.	"Requirements to access international markets are only going to become tighter into the future." "System needs to be robust to accommodate future changes to required information. Food safety and animal welfare concerns are changing. So too are sustainability and environmental concerns. Lending institutions are also getting pressure put on them about who they lend to as well. Need to have information to meets these needs at every level, to demonstrate that the cattle industry is an ethical one. There is increasingly pointed scrutiny on the industry. " "as a producer I should be able to log on [to the system] and identify any potential residue issues through the survey data collected at abattoirs. The data exists, it is just hard to access and not integrated".

4.2.3 Consumer preferences

Sub-Themes	Summary	Quotes

Consumer preferences	• In general, stakeholders saw a role for the traceability system in ensuring consumers get what they believe they are purchasing. Traceability provides a mechanism to hold producers accountable and ensure that the products they purchase embody the features they are advertised to possess.
	• There is significant variation in consumer demand for the level of information the integrity system can provide. This includes across countries and supply chains, as well as products. For example, food service and retail are considerably different from 'wet market' customers. Similarly products such as 'tendons' or blood have vastly different preference profiles than bone-out cuts.
	• However there were conflicting views as to how much emphasis the system should place on meeting the consumers' needs.
	  ◦ Some stakeholders believed that shaping the system around consumer preferences should not be a priority. Rather, the focus should be on food safety, biosecurity and market access only.
	  ◦ Others favored including provenance type information. But acknowledge that this would come at considerable cost and only if consumers were willing to pay.
	• One stakeholder even saw little benefit in providing detailed provenance information to some international markets. They believed that this sort of information might not be valued by the final consumer.
		"'The consumer got what he paid for.' Being able to assure consumers that this is true is important."
		"A lot of high-end markets want the provenance story. If a future traceability system misses out on being able to capture that information, this would be a disservice to industry."
		"Cattle should be traceable to the point at which is sufficient to satisfy customers expectations (based on price point of the meat). Very costly to trace a piece of meat back to a specific cow but should be able to narrow it down to a few farms of origin. Production system is often where traceability becomes complex."
		"Consumer buying meat in Indonesia is not very concerned about where the animal grazed last in Australia, markets are not benefitting much from traceability, especially at a consumer level. Indonesians are not benefiting much from an Australian traceability system (not looking at weight or etc.), other than it allows them to import Australian red meat."

4.2.4 Traceability

Sub-Themes	Summary	Quotes
On-farm location	• Some stakeholders believed that traceability should be sufficient to the point where it meets consumer expectations. • Consumer demands are an important consideration here. Consumer are increasingly requiring demonstration of provenance. • Some stakeholders believed that consumer demands should not be a primary consideration – food safety and biosecurity are what needs to be prioritised.	"It is very costly to trace a piece of meat back to a specific cow but should be able to narrow it down to a few farms of origin. Production system is often where traceability becomes complex." "Cattle should be traceable to the point at which is sufficient to satisfy customer's expectations based on the price point of the meat." "Some people are buying grass-fed beef because they believe it's a healthier alternative."
Ideal functionality of the future state system	• Stakeholders generally thought the future traceability system should be easy to use, autonomous, and largely happening in the background. • Future state system should be incorporate robust technology that can last the length of the supply chain and have no issues with connectivity. • Future state system needs to have flexibility and be able to accommodate future changes to required information. • Future system needs accurate labelling that is consistent with global standards, allowing a clear view of what markets the meat can access. • However some stakeholders expressed concern on the push for "full automation" and adoption of "new technologies". Their concerns centered around: > The cost > How automation could potentially cause stakeholders to outsource their compliance obligations to the system – which may undermine one of the strengths of the current system 'stakeholder ownership' > Whether the technology would work in all the diverse conditions/situations that information gathering is required (e.g. hobby farms at one end and large stations in outback Australia on the other)	"Food safety and animal welfare concerns are changing. So too are sustainability and environmental concerns. Lending institutions are also getting pressure put on them about who they lend to as well. Need to have information to meets these needs at every level, to demonstrate that the cattle industry is an ethical one. There is increasingly pointed scrutiny on the industry." "The ideal situation for the system in the future is: 1. Having price grid based on grade of animal, 2. Send the farmer a contract, NVD number, 3. Standardised information could be extracted from various APIs that ISC would host Have links to PIC, LPA, National feedlot accreditation scheme number, ABN, address number. There would be automation of the eNVD that would otherwise contain mistakes. System would request minimal input from farmer outside of ticking boxes and signing the form. Then random samples are taken by the government to audit quality – independent verification process."

4.2.5 Technology

Sub-Themes	Summary	Quotes
Inter-operability of systems	• A uniform messaging language where structure is kept the same will be useful in creating interoperable systems. • Message structures need to be future-proofed with spare data fields. These fields can be updated in the future. There are examples of this elsewhere in the commercial world (e.g. banking). • One stakeholder noted that some lending institutions are considering ethical metrics related to sustainability and animal welfare when assessing investment opportunities for funding. Transparent sharing of information captured by the traceability system may contribute to meeting the needs of these institutions and attracting additional funding in the future.	"Barcodes could be applied to cartons of meat, containing information to do with the animals. Allows communication in a uniform language. Cartons now have international standard barcode that can be read all around the world." "Feedlots and meat processors receive eNVDs, 8-9 different software licenses for eNVDs, they want one format for this information. The eNVD is the wrong design for multiple users."
Reliability/Accessibility	• A system that requires minimal maintenance and can serve both large and small producers is ideal. • Needs to be applicable to producers who 'go to market' twice a week, or once every two years. • A system with costs that are universal for all producers and operators (from the 20 head producer to the 2000 head producer) and is applicable for everyone along the supply chain is necessary. • A system that can reliably collect information in the vast array of conditions in which primary production and transport occurs. • Automating the system and removing humans along the supply chain would strip human knowledge and responsibility.	"Need a reliable system that does not require a lot of downtime. Need a system that services both large and small producers, processor needs to host the system for the producers to make it accessible." "If you go and look at the NLIS database now, it is too hard for farmers to use now. Need to make the system as simple and seamless as possible. Service providers have a huge role to play in how we use this data on farm. Need commonality of data language." "People who aren't involved in the system would not actively try to understand the system properly, producers would be unaware of what they are certifying and would be relinquishing their responsibilities." "There are a lot of people out there who find the existing system too complex as it currently stands. Future system needs to be simple use to encourage greater compliance rates."

4.2.6 Productivity

Sub-Themes	Summary	Quotes
Transport operators	• A future state system could bring value-added by providing more efficiency through improving labour-heavy and paper-based information transfers. • Technology can automate processes that were previously reliant on humans, and therefore reduce the possibility of human error. • Thorough tracking and data collection of transportation along the value chain could be used to improve performance of transport and regulatory compliance. For example, freight providers' ability to track temperatures at load level could reduce costs of potential spoilage of meat.	"Value add as a transport operator – the `manifest` is a key piece of paper – if this could be constructed automatically as animals enter the vehicle, it would save time and cost. `Manifest` is a declaration of freight being carried on the truck. X head of cattle, so many pellets." "Freight providers track temperatures at the load level. Holy grail is traceability down to the box or unit level. Can imagine uneven temperature distribution throughout the carriage. Prohibitive thing here is cost. There are lots of insurance claims based on poor quality meat being delivered – reducing this would save money."
On farm performance	• A future state traceability system that has centralised leadership of data could inform more productive decision making, such as improving agronomy practices.	"Stud breeders could be able to single out high performing beasts and breed them producing genetically superior cows." "Information needs to be fed back to producers so that they are able to look at their own management practices. Feedback can help build value back into the system. Information should travel both up and down the supply chain."

4.2.7 Supplementary themes

Sub-Themes	Summary	Quotes
Branding and price premiums	• Red meat traceability is foundational to establishing a strong global brand for the industry. • A future state traceability could have the potential to collect and depict marketable traits such as "grass-fed", "hormone free" and "organic". • However, other stakeholders believe that the integrity system should not be collecting data that could be used as "marketing claims"; a traceability system should only be capturing industry system requirements that are non-negotiable to trade. • Some stakeholders believed the focus should be on the fundamentals (food safety, biosecurity and market access) and removing the inefficiencies that exist in the current system (i.e. removing existing manual processes).	"There is pressure from consumers at the end of the day – welfare, provenance? Consumers are looking for the demonstration of provenance. Some people are buying grass-fed beef because they believe it's a healthier alternative." "Company requirements and benefits (such as marketing) should not be considered within the industry integrity system and not something to be used for to identify and market things such as "organic"." "Collecting data for market claims in an industry integrity system will mess up the system framework." "The system should be doing the minimum, and minimizing costs to meet the basic requirements for food safety, biosecurity and market access… efficiency is key, and system must uphold industry standards for traceability and not cater to extra benefits (such as marketing "organic") that may add costs into the system."
Productivity benefits	• Many stakeholders envisaged a future state where the information provided by an integrity system could be used not just to assure food safety and biosecurity, but also assist producers and other stakeholders improve their operations and drive productivity. • Not all stakeholders subscribed to this view – many felt the primary objective should continue to be food safety, biosecurity and market access and any new system should aim to address some of the inefficiencies and manual handling associated with the existing system.	"Information needs to be fed back to producers so that they are able to look at their own management practices. Feedback can help build value back into the system. Information should travel both up and down the supply chain."

5. Concluding observations

The current traceability system must be recognised for its strengths before reflecting on the opportunities that exist to improve the system.

The primary programs for which ISC is responsible that underpin integrity in the meat and livestock system appear largely effective and did not receive criticism in our consultation in terms of their validity and relevance. For a national system across species and incorporating a complex supply chain this is to be applauded. A future traceability system can therefore build on the existing programs and their requirements by focussing on the processes and mechanisms by which these and other assurance arrangements are recorded, stored, accessed and exchanged.

A future state traceability system should have one fundamental feature that underpins any change to the system: data integrity and accessibility based on an interoperable platform to house system information.

The current NLIS database as a technology stack is now approximately 15 years old and consultation with stakeholders highlighted issues with its functionality and suggested that there are more sophisticated platforms available that would enable the exchange of data more efficiently. This is consistent with findings from other reports commissioned by MLA (*Isaacs, Collier, Meacham, Scott and Gow, Hamish. Supporting industry compliance and productivity gains through. Sydney: Meat and Livestock Australia Limited, 2018. V.DIG.0011*) that highlight the importance of transforming the foundational data platform to enable system-led innovation, while establishing a more efficient and user-friendly data repository of compliance information.

The Paddock to Plate Visualisation prepared as part of this review has documented the traceability system and the type of information collected, recorded and shared (where this occurs). This is a first step towards informing a detailed design of a future traceability system. The visualisation identifies a series of strengths and weaknesses in the system that emerged from consultation. Consistent with other reports prepared for ISC[4] the need for an easy to access system, removal of paper-based and manual data collection and storage, and exchange of system data are highlighted in the visualisation. The visualisation, along with the insights summarised in our consultation also highlight the lack of a detailed map of existing system data and how this addresses the requirements of system participants. For instance, we know that residue information is collected at abattoirs but the ability to access that information and link it with baseline system information (by animal for beef or mob for sheep) back to PIC information is not automated and often not easily accessible. Such a detailed mapping was not possible within this project, but the initial Paddock to Plate Visualisation provides an example of what is possible to document in a short amount of time. Our work identified at least 77 opportunities across the system (see Section 8.3) to collect integrity data. This reflects all the production participants - from producers to retailers - and the primary integrity programs. A more detailed system journey map could use this insight along with a wider exploration of participant requirements to provide a more specific set of requirements for the future traceability system.

The challenge and the opportunity highlighted in the findings of our work are to:

1. Leverage the clear strengths of the current system and migrate it into a more modern technical environment
2. Take advantage of the new capabilities a new technical environment and digital platform would offer and to provide value added services and data insights to producers (such as LDL as one example) and other supply chain participants to help improve their businesses and operations
3. Develop and implement data standards for interoperability and data exchange across the supply chain
4. Create and foster opportunities for innovation across the value chain e.g. tag and gate technology, smartphone apps, etc.

[4] Isaacs, Collier, Meacham, Scott and Gow, Hamish. Supporting industry compliance and productivity gains through. Sydney: Meat and Livestock Australia Limited, 2018. V.DIG.0011; Integrity Systems. Integrity Systems Strategy 2025 - Stakeholder Workshop Summary. s.l.: Integrity Systems, 2018; Crooks, Regan, et al. Livestock Traceability & Monitoring Project Report. Melbourne: Integrity Systems, Xinova, Asymmetric Innovation, 2019

However, these changes require additional incremental improvements to provide an agreed operating environment from which to establish a new or enhanced platform. These changes are discussed in the findings set out below.

Finally, the systemic and evolutionary changes proposed require a change in behaviour from system participants and system managers. An optimal system will only generate benefits to participants across the value chain when all contribute and interact to deliver optimal outcomes in their part of the system. To achieve this, participants need to be able to clearly see the benefits as sanctions for non-compliance are unlikely to be a sufficiently strong driver of behavioural change. For example, because systems allow them to improve their own efficiency or increase market access or price. Importantly, the upstream and downstream movement of data – as highlighted in our Paddock to Plate Visualisation – can bring new insights that strengthen integrity and create benefits that may enable higher returns based on increased quality and safety. Communication and change management, and with the producers will be critical to the successful migration to a new platform.

5.1 Key findings

5.1.1 System definition

Risk: That system participants do not understand the components or participants involved in establishing and maintaining an integrity system leading to lack of effective engagement and support for the integrity system.

Before looking to change any system, a good place to begin is to define it. Specifically, what is its purpose, where are its boundaries and how is it structured. In our review of the literature and engagement with stakeholders, although there was a clearer understanding for some of these elements relative to others, we were unable to find a clear articulation of them.

This finding is critical because underpinning this is an assumption that the traceability system is the foundation and backbone of an industry data repository upon which other use cases could be developed based on industry needs. To get the traceability system 'right' then allows for the design of data repository system/s that informs other activities.

With regard to purpose, there were multiple views on what purpose the integrity system should serve. At one extreme, there were some who felt the sole purpose is to protect and enable food safety and biosecurity. At the other extreme there were stakeholders who felt the integrity system serves a broader purpose, which includes helping producers drive profitability, satisfying the needs of discerning consumers and driving productivity across the supply chain. Landing on a clear purpose is obviously important for informing its future design. Our view is that the purpose should remain focused on food safety and biosecurity as the first priority, but that the opportunity to explore ways in which this baseline data can complement other data collected across the system to produce additional benefits must be acknowledged in the design of a roadmap for the future traceability system. Not only was this a clear message in many of the stakeholder engagements, but it is possible through the design of the system to stay true to this purpose while allowing for participants to find ways to drive productivity, profitability and satisfy customer needs. This reinforces the recommendation that the existing NLIS database requires updating to enable it to store and exchange system information which can be used by system participants for value adding activities. This is beyond user access rules but goes to design and functionality requirements.

Which brings us to the next elements associated with system definition – boundaries and structure. That is, who are the participants? And what role do they play? In our stakeholder engagements, we developed a schema for the structure of the integrity system (refer Figure 1). The objective was to provide some definition around boundaries and structure. While the diagram is high level – some reports suggest there are anywhere up to 30 actors or participants in the system – it is a good way to illustrate who the primary participants are and, more importantly, the boundaries, intersections and structure of the system.

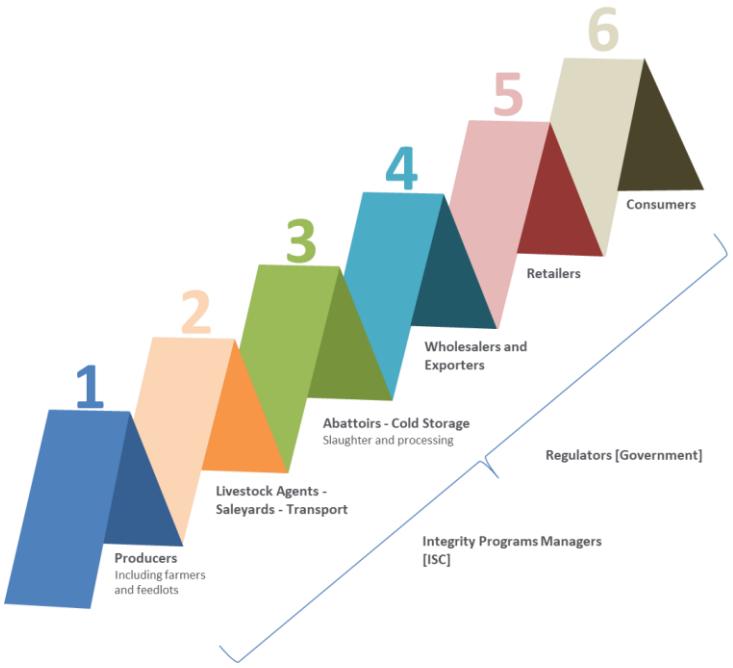

Figure 1: Integrity System - participant overview

What the simple diagram illustrates is the interdependencies in the system. If the purpose of the system is to enable food safety and biosecurity, there is no single participant who plays a predominant role. This means that to be effective, the system requires "buy in" from all participants. In addition, although government (regulators) are not an active participant (in that they do not sit in the supply chain), they are heavily reliant on the system for the information it provides. Furthermore, they can also significantly influence the system given the role they play.

Defining the system (i.e., identifying its purpose, structure and boundaries) is the first step towards being able to effectively determine how it should be designed to make it effective. But before considering design, there are other factors that need to be considered. The first is governance. That is, what are the processes put in place to ensure the system can achieve its purpose and who has the authority to act and make decisions that impact on the system's operation. Our consultation highlighted that several system participants were unsure of the role ISC played and the extent of their powers or responsibilities. As such there is a need to implement communication and engagement processes that are agreed by key system participants (regulators, industry bodies, standard setting entities) that describe the role, responsibilities and benefits delivered by system participants, with particular emphasis on ISC and government regulatory bodies.

5.1.2 System roles and responsibilities

Risk: That system participants do not understand the role and responsibility of ISC in the custodianship of the integrity system leading to a lack of engagement and confidence in the integrity system.

Governance is fundamental to any system, entity or program because it sets in place "the framework of rules, relationships, systems and processes within and by which authority is exercised and controlled". For the traceability system, the range of participants and their separate roles across the lifecycle creates an added issue that they may not see themselves as active and interdependent participants in a system, but rather stand-alone components of a transactional supply chain.

This is a critical distinction, as improving integrity and traceability in the system requires behaviours from participants that are consistent with the rules put in place. Despite all the controls and compliance that could be brought to bear, the complexity and scale of the system will never achieve optimum outcomes without participants who see themselves as interdependent actors in the integrity system who derive benefits from that system.

As a result, system governance becomes fundamental. As we found in our consultation, system participants often operate as independent actors primarily pursuing their own objectives rather than giving equal consideration to system objectives. This can only change when there is: clarity about system responsibility between regulators, industry and participants.

Much work has been done in this regard, including the 2015 SAFEMEAT report 'Towards an integrated integrity system' which recommended the establishment of ISC. As the summary in Figure 2 shows, SAFEMEAT provides strategic direction and policy settings whereas ISC operates as a 'program manager'.

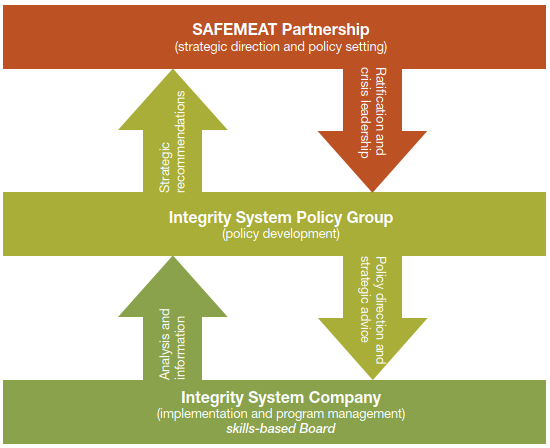

Figure 2: Proposed Integrity System Governance (2015)

5.1.3 System objectives and outcomes

Risk: That system participants do not understand or engage effectively with the integrity system based on a lack of clarity about its purpose and benefits.

The other feature of governance that has emerged consistently are the varied objectives of system participants. This is common and may seem unremarkable, but in terms of requirements for a future system there should be clarity about what the system objectives are as distinct from the outcomes it produces. ISC's Strategic Plan recognises that "ISC plays a central role in equipping industry with the tools that ensure the food safety, animal welfare, biosecurity and traceability of Australian red meat for our domestic and international customers." (14)

Through stakeholder consultation these same references were made when objectives were discussed. We would propose that in the context of integrity traceability the objectives and outcomes are articulated as shown below in Figure 3.

Figure 3: Integrity System Objectives and Outcomes

Confirming these objectives provides clarity about what the future traceability system must do, it does not define what it can achieve (outcomes). What we know from other sectors that have transformed their systems is that the outcomes and related benefits of the system are not necessarily all foreseeable. Thus, those that govern the system should be clear about the objectives first, understand the outcomes they are seeking and then design any changes with that at the forefront of their mind.

The consultation throughout this engagement identified a series of additional benefits that system participants wished to derive either through the system or in other ways.

The following information would offer benefits for system participants if designed into the integrity system so that it was available to all relevant participants:

- Carcase /residue data collected at processing
- Product temperature during transport
- Measures for eating quality.

What these require however is not that ISC mandate collection of this information, but that the system's baseline information provides animal, location and movement history in a form that allows other data to be integrated, either within the traceability system database (i.e. residue data) or outside in other proprietary platforms that system participants create.

Similar approaches occur in the water and energy systems. These large, complex infrastructure systems are now monitored in real-time with a range of technology solutions. What has emerged from the experience of the energy sector and is now underway in water, is the importance of establishing the backbone technology that stores base information which holds personal customer information securely while allowing for access to system data for other uses. That is, the utilities are collecting base information such as usage, and store that by date, time and location. Other system participants can access system data and use it to generate additional insights and benefits for customers or system participants.

5.2 Benefits to industry

The results of this project have produced the following recommendations (which contribute to addressing the risks summarised in each of the findings):

1. Retain the existing integrity programs managed by ISC.
2. Agree on a clear definition of the Integrity System, its participants, objectives.
3. In partnership with other system participants document the Integrity System governance and define clear roles and responsibilities that reflect an agreed future state traceability system

4. Establish a register of Integrity System data documented to reflect (as a minimum): data ownership, privacy status, collection process, storage, integrity program and system objective.
5. Develop detailed technical specifications for a revised system platform to replace the NLIS database.

6. Future research and recommendations

The major challenge confronted during this project was in relation to system governance. It is understood that the traceability system requires change, however, who is responsible and has a mandate to undertake change and bring industry along was unclear.

Our consultation highlighted that there is a recognition that ISC has role in providing industry leadership in relation to integrity, but a lack of clarity about the nature of the role ISC should play particularly in relation to jurisdictional authorities. From our experience, while the system is complex, the critical integrity activities and responsibilities can be mapped to provide role clarity.

ISC's ownership of the NLIS database positions it well as it can use the transformation of the system's primary data platform as a basis for confirming governance and mapping out the opportunities for improvement.

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8. Appendix

8.1 Discussion Paper

1 Introduction and project background

1.1 Australia's red meat integrity system

Australia is one of the world's largest red meat producers. In 2018-19 Australia produced 3.1 million tonnes of red meat from a livestock inventory of around 25 million cattle and 65 million sheep (1). In addition to supplying the domestic market, Australia is a significant exporter to global red meat markets. In 2019, Australia was the third largest beef and veal exporter and the largest exporter of sheep meat (2).

Australia's red meat supply chains are complex. They service more than 100 export markets through various logistics channels including road, rail, sea and air (3). Australia's red meat supply chain is also dispersed, with primary production often geographically isolated from other parts of the supply chain. Around 60% of cattle farms (approx. 13,200 farms) are classified as small (running between 100 to 400 head), (4) and some beef production (around 20%) is sourced from farms over 400 km from the abattoir (5).

Adding to this complexity, several related industries are integrated into Australia's red meat supply chain, including dairy (bobby calves and cull cows make up a significant portion of sale yard activity and meat production, particularly in Victoria (6)) and live exports (in 2019, Australia was the world's largest exporter of live animals by sea, exporting 1.3 million cattle and 1.1 million sheep (1)).

Product integrity underpins Australia's position as a world leader in red meat. Australia's current integrity system is overseen by Integrity Systems Company (ISC) and comprises three programs: on-farm assurance, animal identification, and traceability. This system protects the disease-free status of Australian red meat and underpins the marketing of its products as clean, safe and natural.

The base regulatory requirements of the system are governed by a mix of state and federal regulations that relate to market access, biosecurity and food safety:

- Red meat exports are regulated under the *Commonwealth Export Control Act (1982)* and the *Australian Meat and Live-stock Industry Act (1997)* with the objective of meeting import country requirements and supporting the integrity of Australian exports to facilitate continued access to export markets.
- Traceability regulations targeted at biosecurity are mostly governed at the state level, although the Commonwealth does have some reporting requirements for livestock animal products moving across Australia's borders *(e.g. Biosecurity (Human Health) Regulation 2016).*
- Meat food safety forms part of a series of national standards that Food Standards Australia New Zealand (FSANZ) developed to strengthen food safety and traceability throughout the food supply chain from paddock to plate.

Australia's current integrity system was steadily developed through the mid-1990s to early 2000s and was initially driven by a need to meet market access requirements in the European Union. This saw the introduction of the **National Livestock Identification System** that enabled individual animals to be traced from birth to slaughter. Since then the system has evolved to include the **Livestock Production Assurance Program** (LPA), which outlines a set of on-farm practices designed to ensure Australian livestock farmers are producing red meat that is safe for consumption and the **National**

Vendor Declarations (NVDs), which ensure relevant information captured by NLIS and LPA is recorded and shared across the value chain.

1.2 Drivers of change and risk for integrity systems

There are five main driving forces disrupting Australia's red meat supply chain and ISC's mission. A summary of these change drivers is provided below.

Consumers are increasingly demanding more information about the goods and services they purchase. Modern consumers have access to more information about the products they purchase than ever before (7). As concerns regarding health, animal welfare and the environment become increasingly important, consumers will continue to seek assurance that the meat they consume is produced in a way that is safe, and aligns with their ethical standards (8).

Government continues to play a greater role in preventing and responding to the risk of biosecurity incursion. Australia is free from many of the pests and disease that are endemic around the world, including from Foot and Mouth Disease (FMD) and Bovine Spongiform Encephalopathy (BSE). This underpins much of Australia's advanced access in export markets. Expanding global trade and travel (as well as climate change) are increasing the risk of Biosecurity incursions in Australia. In order to prevent and respond to these risks, Governments will need improved information around the red meat supply chain.

Industry requires greater supply chain transparency. The red meat industry has evolved considerably in recent decades, from a commodity-based proposition to one underpinned by product features. Today, many consumers derive value in knowing that the food they eat has been produced ethically and to a certain quality. Industry participants from farm to slaughter continue to be more transparent, providing more information about the production process. The goal is to deliver value to the end consumer and satisfy their needs.

Australia's red meat supply chain is becoming increasingly complex. Since the 1990s, Australian red meat exports have almost doubled, increasing the need for logistics operators to coordinate and manage supply chain throughput. (1) The red meat supply chain is also becoming increasingly specialised and interconnected. Today, cattle are moved on average an estimated 2.3 times for every animal slaughtered as specialisation has required movements to additional properties (9). In addition, previously niche components of the supply chain such as feedlots are playing a more prominent role. In the December quarter of 2019, more than 1.2 million head of cattle were located in Australian feedlots, effectively double that a decade ago (10).

Technology is advancing at a faster rate than ever before. Recent technological innovations have driven profitability and sustainability across Australia's agriculture industry (11). Australian farmers and meat processors are beginning to integrate leading technologies, such as drones and digital cameras, in their operations. Similarly, devices available to monitor and track livestock and red meat products have evolved substantially since integrity systems were first introduced in Australia (12) (13). New technologies (e.g. the Blockchain) can also be harnessed to reduce costs and improve transparency in product integrity systems (14).

1.3 Project background

In acknowledging the emerging changes and risks to the current integrity system, ISC has developed the Integrity System 2025 and Beyond Strategy (IS2025 Plan) to prepare industry for the future and guide investment into the integrity system and its programs. The IS2025 Plan outlines key strategic initiatives that aim to ensure that beyond 2025, the integrity system:

- Meets customers' needs
- Can be efficiently used by the whole value chain
- Uses available technology to deliver a responsive, easy to use and effective system.

The IS2025 Plan aims to deliver the vision:

"that our integrity system remains recognised and trusted globally as delivering a quality red meat product that is produced to rigorous standards, is valued by industry, and is embedded in the culture of Australian livestock management."

The plan is built on three strategic pillars with six strategic areas for prioritising investment. These are outlined below in figure 1.

Figure 1: ISC System 2025 and Beyond Strategy strategic pillars and priority investment areas

ISC has engaged Deloitte to deliver some of the projects that will help inform ISC's approach towards delivering the desired future state outlined in the IS2025. One of these projects requires:

Defining overarching requirements for the future state traceability systems in terms of objectives, data points, collection, storage and analysis (Project 1).

The relevant objectives of this project are to:

1. Scope the high-level requirements of the future integrity system, in terms of traceability and verification
2. Determine the system requirements, engaging with key industry and customer stakeholders
3. Engage with state jurisdictions and the federal Department of Agriculture, Water and Environment to scope out their requirements for the future system
4. Develop visualisation tools of the realistic future traceability and verification system
5. Conduct a risk assessment for implementation

As part of the initial phase of this project, Deloitte has completed a scan of relevant literature to document the overarching requirements of the future traceability system. A summary of this exercise is provided below by outlining:

(a) the expected requirements for select stakeholder groups across the supply chain (Section 2), and

(b) the potential risks associated with implementing a traceability system (Section 3).

2 Initial scan of stakeholder views

2.1 Producers (including farmers and feedlots)

Within this stakeholder category there is considerable variation. For example, farms and farmers differ greatly across numerous attributes including geography and climate, cattle breed, age of owner, structure of business and production system. These attributes influence how producers' value and utilise an integrity system and how the system shapes their behavior.

Overwhelmingly the literature identified that producers require an integrity system that is effective, efficient and reduces operational burden (14) (15) (16) (17). This includes a system that is consistent across jurisdictions and makes adhering to any legal or regulatory requirements straightforward. For example, the current manual scanning processes for ear tags is considered tedious and may introduce human error (16). Producers would prefer a system that is robust, tamper-proof and can be read automatically.

Along a similar vein, producers also have a requirement that any solution be easily adopted and accessed by all farms and businesses, noting that the technological literacy across producers can vary considerably. Looking into the future, some producers envisage how an integrity system could aid strategic decision making and assist with record keeping, industry wide benchmarking, breed selection and, ultimately, long-term profitability (18).

Little information was identified that spoke to when producers need information from an integrity system. One report noted that the timeliness of information was critical for responding to biosecurity risks (19).

2.2 Supply chain facilitators (Logistics, sale yard, cold storage providers)

Logistics operators are an essential component of Australia's red meat supply chain, especially given the vast geographic spread and scale of producers across the continent. They facilitate trade and transport of livestock and red meat between across the supply chain. Literature describing their relationship with product integrity systems is relatively scarce as much of the focus is placed on primary producers. However, given their key role in the supply chain, they will stand to benefit from the information it captures.

Product traceability data that captures information about the location of goods and timing of transport movements has been observed to improve the management and operating efficiency of some logistics operators. One study, which followed a sample of logistics operators after real time traceability systems were introduced, found that small to medium sized operators realised several benefits including cost savings, increased revenue generation and improved customer satisfaction (20).

Some large logistics operators capture information on the type of cargo they transport and how it is transported. However, the process for many is often manual and time consuming. As a result, these stakeholders (particularly those operating at scale) are likely to benefit from greater automation in data collection processes (21). Of central importance to them will be consistency in the requirements of an integrity system across Australia's jurisdictions as many operators cross state borders when delivering cargo (15).

Another important consideration for this part of the supply chain is ensuring operators meet compliance requirements associated with transporting livestock and red meat (e.g. animal welfare standards) (15). Approaches that capture information that monitors this (e.g. temperatures that animals are exposed to during transport) could be used to monitor compliance.

One source also noted the emergence of online livestock auctions, in place of physical sale yards (15). An integrity system could abet this innovation by capturing the type of information a buyer who cannot sight the goods (e.g. overseas purchasers) would need. Capturing the right information across the supply chain will help provide buyers confidence that the products they purchase meet their required standard of quality (22).

2.3 Meat establishments

Meat establishments (such as abattoirs) are an intermediary in the red meat supply chain and ultimately function to meet consumer preferences. To be able to do this, abattoirs must ensure processing information is captured correctly and accurately, and that all relevant product attributes are correctly carried forward throughout the supply chain (14). Further details on the relationship between consumers and red meat integrity is provided below in Section 2.5.

Abattoirs are also required to meet minimum standards regarding public health and food safety. This is typically regulated by State governments across Australia. In the event of an emergency, or in response to a biosecurity outbreak, abattoirs must be able to locate and dispose of contaminated products. Capturing information about management practices (including animal health programs) can help protect abattoirs against liability as it can validate the conditions in which an animal was reared and confirm the locations were an adjustment occurred (23).

Being high volume operations, Australian abattoirs would also benefit if an integrity system captured information that would help them make decisions that improve efficiency, throughput and ultimately profitability (15). For example, capturing and sharing the right data can allow processors to identify farmers that are consistently supplying high quality cattle, thus enabling them to source produce that will generate greater value in the marketplace (24).

2.4 Product outlet channels (e.g. retailers, wholesalers, food service and exporters)

As retailers are positioned late in the red meat supply chain, they capture very little new information on product integrity (17). Instead, they are more likely to use information produced by the system in marketing their products, meeting customer needs and protecting their brand name. To illustrate, information captured at earlier points in the supply chain can help retailers protect their brand by enhancing product quality control, reducing the frequency and severity of product recalls (3) and ensuring fewer substandard products reach consumers (12).

2.5 Consumers

The consumers serviced by the red meat industry are diverse and geographically dispersed. The needs of Australian consumers are considerably different from those in developing export markets (such as Indonesia or China) and even other developed markets (such as the United States). In addition, consumer needs differ markedly across food service, retail supply chains and across products (e.g. chilled cuts compared with frozen grinding beef).

Consumers are demanding more information about the goods they consume. Providing too little information (e.g. what is available on product labels) has been shown to adversely affect purchasing habits (25). The literature suggested that future integrity systems will need to provide consumers with information relating to the following types of issues: food quality, provenance, health and safety risks, animal welfare and treatment, production methods (e.g. organic, grass fed, carbon footprint etc.) and product treatment (e.g. genetic modification, hormone treatment, etc.) (19) (14) (25) (26).

The primary method used to provide consumers with the information from an integrity system is through food packing and labeling (be they paper or electronic based). There are cases where consumers have a preference for loose produce (particularly in the case of fresh produce). Few such

cases exist for red meat (outside wet markets) but when they do they present a challenge in facilitating the flow of information from integrity systems to consumers (25).

There is significant literature on how consumers respond to the way product information is provided. In general, consumers need labels that are understandable and not overloaded with information. This presents a challenge given the finding highlighted above that too little information can adversely affect purchasing behaviour. Similarly, there is contradictory evidence on electronic labels – they are considered to be less convenient (as they require a device to retrieve information) but at the same time paper labels are usually considered less credible or reliable (25).

2.6 Government

The government (coordinated across both federal and state) regulates Australia's red meat industry aiming to support market access, biosecurity and food safety (19).

With respect to food safety, much of the literature suggests that the government should largely play an assurance role. As a result of an increasingly complex supply chain with many potential food crises, better capture of information (such as animal health records, disease occurrence records, and vaccination management and tracking) will help facilitate swift responses in the event of emergencies.

Biosecurity risks often have large socio-economic impacts and are a critical reason for the need to have an effective traceability system. It is estimated that a small Foot and Mouth outbreak, controlled in 3 months, could have an estimated cost around AUD $7.1 billion (27). Having real time tracking would allow for an efficient response to any disease outbreak. Contact traceability is also important for managing the spread of a biosecurity event (and, as we are experiencing, also for managing human pandemics).

Furthermore, traceability systems are increasingly important for access to export markets. Increasingly foreign governments seek an established traceability system in trade negotiations that meets the standards producers in their own countries adhere to. The European Union as an example legislates animal traceability as an assurance of food safety (28). Ultimately market access is a public good that requires careful management by the government – non-compliance by one stakeholder can potentially disrupt market access for the entire industry (29).

Another important consideration for the government is having governance and oversight over the red meat market. The data captured from an integrity system could potentially allow the government to monitor compliance and provide assurance across a range of broader issues. One pertinent example is the ability to potentially eliminate existing non-compliance (due to the manual processes involved) of the tracking of livestock. It would also enable information to be captured on evolving consumer trends that could be used to inform policy decisions and improve economic outcomes (30).

3 Benefits and risks in the future state integrity system

As can be seen, the needs of stakeholders across the supply chain vary greatly. Delivering on these needs will obviously provide considerable benefits to them. However, as with the implementation of any complex system, there are risks involved. Some of these benefits and risks are discussed below.

3.1 Benefits

Simple and easy to use system that improves supply chain productivity

The future integrity system will increasingly employ automated technologies, sparing the need for stakeholders to enter data manually (31). This will provide numerous benefits to stakeholders. Amongst these are more accurate and timely data, less time lost on compliance, and greater insight into operations and performance. Stakeholder's perception of the system will improve markedly. Rather than being seen (by some) as an impost, it will become a tool that provides insight and creates significant value.

Data that informs business decision making

A broader scope of information will be captured by the future integrity system. This will support stakeholders in making more informed business decisions as they will have access to information that will enable them to improve cost management and better forecast production inputs. It will also allow for more sophisticated data analytics that combine multiple data sets across the supply chain (31). Stakeholders will be able to benchmark themselves against others operating in the sector.

For producers, real time traceability data describing the location and health of livestock will allow them to better monitor their assets and performance. The integrity system could also act as the backbone of other data systems that promote better farm management, even if these other data systems don't necessarily relate to traceability per se, providing producers with a central repository of all the information they need to manage their farm.

As mentioned in Section 2, producers won't be the only stakeholders who could potentially use the integrity system to improve productivity and profitability. Processing plants and companies working in transport and logistics will also be able to use the data it provides to improve performance (15) (20). In addition, the increased transparency throughout the supply chain will assist in identifying and addressing non-compliance issues as they arise.

Building confidence in Australian red meat

A state-of-the-art integrity system will ensure that Australian red meat continues to uphold its reputation for quality. This will ensure continued access to key export markets, especially as product integrity is becoming increasingly important in global trade policy. In addition, the information and transparency a future integrity system can provide will mean customers can be confident Australian red meat meets their ethical and quality standards (31).

3.2 Risks

Stakeholder engagement

Some stakeholders may be reluctant to engage with the future state integrity system. Factors identified as likely drivers of this behavior, include (15):

- Low levels of technological literacy and fluency
- Unclear messaging around system benefits creating mixed incentives for stakeholders
- Insufficient telecommunications infrastructure in some rural areas
- Unwillingness to share information with other stakeholders.

Although the level of automation will increase, stakeholder engagement will still be essential to ensuring the system runs efficiently and data is collected accurately. Compliance will likely be driven by stakeholders being made aware of the benefits they can derive from the system. These benefits should be well-articulated and communicated clearly. Involving stakeholders in the system design plays an important role in achieving this (32).

Consumer preferences and international requirements for market access

As mentioned in Section 2.5, consumers are increasingly demanding more information about the goods they consume. As the world becomes increasingly interconnected, trends in food consumption will drive these information requirements and influence the preferences of large consumer groups. The future state traceability system should be flexible and able to accommodate changes to consumer preferences as they emerge.

Data integrity, security, access and governance

While automation is likely to improve the quality and completeness of data in the future integrity system, industry-wide data governance standards will still be required. For example, for ease of usability and to increase engagement, industry standards clearly defining terminology should be created. In addition, consistent software with easy to access user interfaces will improve engagement and data integrity.

Data security is a key concern for many industry stakeholders, especially where the information is commercially sensitive (17). To ensure data is stored and transferred securely, rigorous standards and measures will be required. Stakeholder perceptions will present a barrier here as many believe data sharing exposes them to malicious actions from third parties (17). Ensuring stakeholders feel confident in the system's security is critical to mitigating this risk.

Ensuring the integrity system can integrate with existing systems used by stakeholders will be crucial if they are to derive benefits from the data collected. When the traceability system collects data, it needs the appropriate functionality to integrate the data with the various stakeholders' proprietary systems (e.g. processors, exporters, retailers) so they can undertake more sophisticated data analytics.

Technology

At present, 43% of farmers report issues with internet coverage and battery life (16). Continued investment to improve telecommunications infrastructure in rural areas, alongside ongoing research into improvements in battery life and energy efficiency in communications technologies will assist in managing these risks.

Financial risks

Ensuring the effectiveness of the future integrity system will likely come at a cost. Large retailers and meat processors could seek to shift compliance costs onto producers. This may cause financial pressures for smaller producers (23). Securing long-term sources of funding could reduce the cost burdens on smaller operators in the supply chain, limiting the financial risks involved in implementing and operating the new integrity system.

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8.2 Consultation Summary

Format	Name	Date
Workshop	Deloitte Industry Specialists	10-July-2020
Workshop	ISC Project Consortium	22-July-2020
Workshop	Jurisdictional Traceability Group	24-July-2020
Interview	Australian Livestock Exporters' Council	20-July-2020
Interview	Australian Lot Feeders' Association	21-July-2020
Interview	Cattle Council of Australia	24-July-2020
Interview	Teys Australia	29-July-2020
Interview	Sheep Producers Australia	17-July-2020

8.3 Summary of data points across the Integrity System

	Information and actions required to achieve outcome....	Producers			Livestock agents / saleyards / transport			Abattoirs			Wholesalers / exporters			Retailers		
		Biosecurity	Food safety	Market access	Biosecurity	Food safety	Market access	Biosecurity	Food safety	Market access	Biosecurity	Food safety	Market access	Biosecurity	Food safety	Market access
1	Personal and business administrative details	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
2	Livestock production and breeding processes		x	x												
3	Physical attributes of live animals			x			x			x			x (live export only)			
4	Live animal locations	x		x	x		x	x		x	x		x			
5	History of stockfeed and medical treatments given to animal throughout its lifecycle	x	x	x	x	x	x									
6	Transport details and conditions of transport	x	x	x	x	x	x				x	x	x			
7	Meat processing details								x	x		x	x			
8	Physical attributes of meat products									x			x			
9	Presence of defect or disease in meat	x	x	x				x	x	x	x	x	x	x	x	x
10	Timestamps	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x