Integrity Systems
red meat customer assurance

MEAT & LIVESTOCK AUSTRALIA

Establishing new integrity system technology and approaches: The Foundational Projects

Executive summary

1 Synopsis and key learnings

Four independent research and development (R&D) providers simultaneously examined the potential for significant improvements to the red meat integrity system by examining:

- Establishing new integrity system approaches and technology
- Overarching requirements for automated product verification and developing key industry standards
- Assessing real time tracking technologies to integrate with identification methods and national traceability requirements
- Barriers to adoption and extraction of value from agtech in the Australian livestock industry.

The aim of these integrated projects was to develop recommendations that would enable the Integrity Systems Company (ISC) to fast-track investments that accelerate improvements to and benefits from the current integrity system.

All projects identified that industry stakeholders were focussed on obtaining more effective, efficient and less complex advantages from traceability and ancillary outcomes from the current system. In other words, fix the existing system first before embarking on implementing a new system.

The value proposition of investments in technologies, interoperable software and data solutions needs to be clearly defined and articulated for all stakeholders. Investments in next generation innovations, tools and technologies are only recommended after the point where industry is extracting (and recognising the value of) optimal services from the current system.

The four projects identified a range of barriers to technology and system implementation. The importance of clear value propositions for each industry sector and clear standards and definitions for data management should be considered as priorities for ISC to consider in a refresh of the current IS2025 strategic plan and its priorities. Case studies and targeted extension and

communication activities will be advantageous to ensure that all stakeholders are fully engaged and invested in outcomes / impacts from the integrity system.

2 Background

The Australian red meat integrity system is critical in underpinning market access for products from the Australian red meat value chain. The integrity system provides traceability from paddock to plate that underpins food safety and product assurance. The integrity system is fundamentally based on ensuring continuing improvement, maximum compliance, and overall confidence in the key platforms of the National Livestock Identification System (NLIS), Livestock Production Assurance (LPA) program and National Vendor Declarations (NVDs).

To underpin the technological development and further enhancement of the integrity system, the ISC developed a strategic plan in 2018 that identified a range of investment priorities and opportunities. That plan is known as the IS2025 strategic plan[1].

Within the IS2025, there are three pillars that focus on:

1. Ensuring our integrity system continues to deliver;
2. Pursuing and adopting new integrity approaches and technologies; and
3. Leveraging integrity data to add value through the chain.

In April 2020, the Integrity Systems Company (ISC) commissioned a series of interrelated projects known as the ISC foundational projects (four in total) to provide ISC with a compendium of reports focussed on improving the current integrity system and to provide more informed decisions on potential investments to develop next generation opportunities from the integrity system. These projects were focused primarily within pillar two of the IS2025 plan (Pursuing and adopting new integrity approaches and technologies) and had the clear objective of identifying opportunities and solutions for the future integrity system, whilst also improving utilisation, efficiency and effectiveness of the current system.

Each project was completed independently by a mixture of public and private consultancy teams. However, as industry consultation was a key component of all projects, a coordinated approach across projects to engaging with key industry stakeholders was established to ensure that there was little or no duplication but wide opportunities for industry participants to contribute to consideration of current and future integrity system challenges and opportunities.

[1] https://www.integritysystems.com.au/globalassets/isc/pdf-files/integrity-system-2025-strategic-plan.

3 Objectives

The broad objective of the foundational projects was to identify and characterise industry requirements for current and future integrity system functionality and technological advancements that improve the effectiveness and efficiency of the system for all red meat industry stakeholders. Specific objectives of each project are shown in Figure 1. In summary, the first three projects had objectives that were directed towards identification of future state technologies and processes that could ultimately lead to a fully automated integrity system for the Australian livestock sector. Next generation interoperable integrity solutions and technologies were examined and compared to recognised global systems. Key barriers and investment priorities were also identified. Case studies were constructed around emerging tag technologies to demonstrate impact of innovation on integrity system compliance and performance.

The fourth project considered what barriers exist to value chain evaluation and use of agtech innovations and technologies. Adoption frameworks to address those barriers using the eNVD as a case study were created to assist ISC in planning industry extension investments.

4 Methodologies

In April 2020, ISC through an open call competitive process, released a series of Requests for Quotation (RFQs) for the four foundational projects. Independent R&D providers were selected for each of the four projects by an ISC internal evaluation process. The foundational projects were contracted in May-June of 2020. The consultancy team from project four was selected to provide an overarching coordination role for the projects to ensure that there was effective communication between the four projects and to ensure that stakeholder engagement and consultation was coordinated to obtain whole of industry connection, whilst minimising time burdens on key industry individuals.

A diagrammatic representation of these four inter-related projects is shown in Figure 1 below.

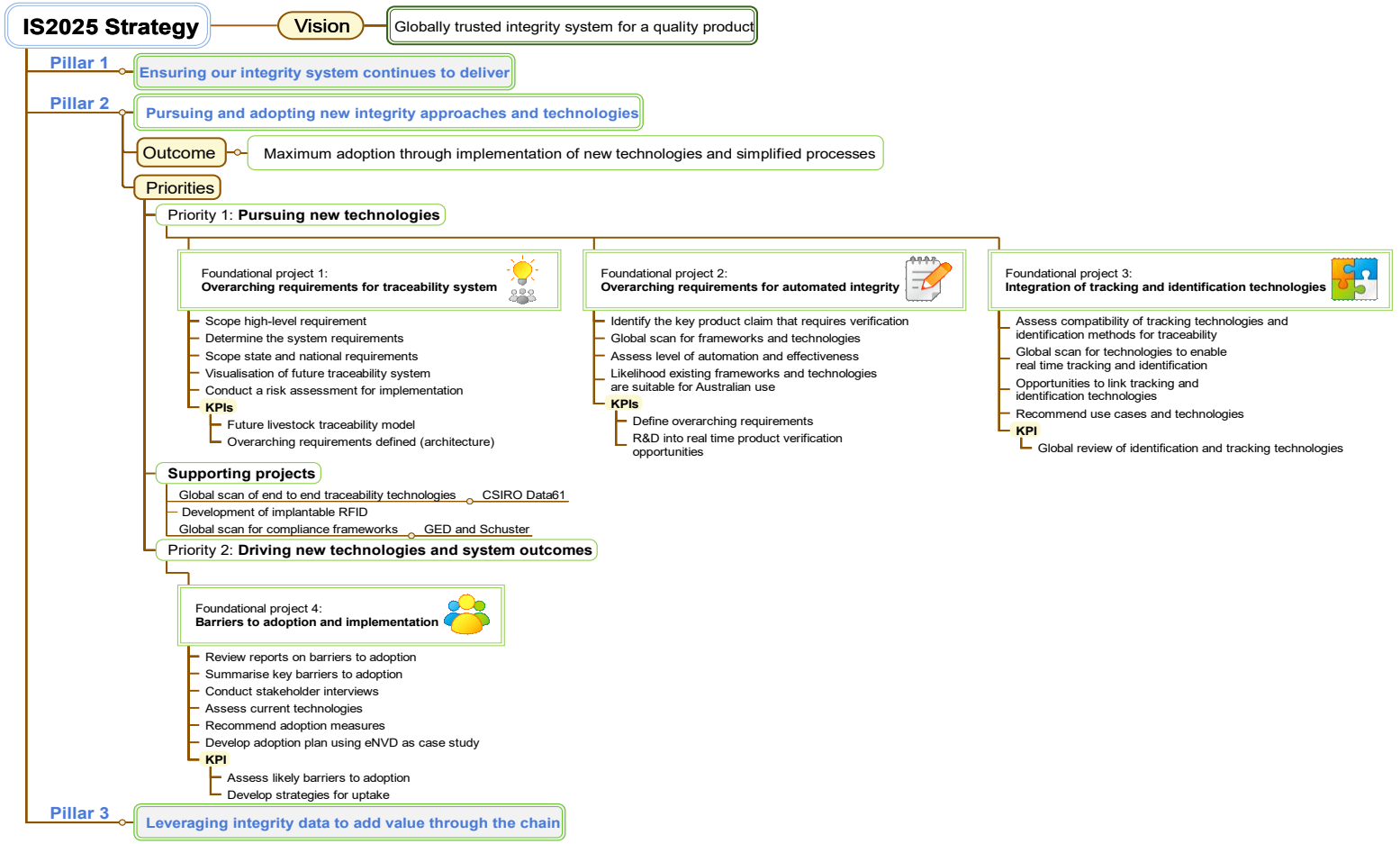


Figure 1. Objectives of the four foundational projects relative to the pillars within the IS2025 strategic plan.

5 Results / key findings

The following summaries of the outputs and outcomes of the four projects have been constructed to provide a high-level synopsis. Each table provides the objectives, learnings and key findings, recommendations, timelines, and key stakeholders (value chain participants) that need to be engaged or are impacted by the issue. In addition, schematic diagrams presenting the objectives and outcomes from the four foundational projects are provided in an appendix at the end of this document.

5.1 Project 1 – V.RDA.2007 Establishing new integrity system approaches and technology.[2]

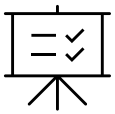
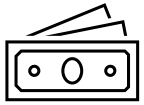
This project was undertaken to scope the future integrity system, and to propose the roadmap for the Integrity Systems Company to operationalise the IS20205 strategic plan. The project identified a misalignment between the ISC strategic horizons and the future roadmap from a stakeholder perspective. The project proposed two solutions which are a two-step process of

1) resetting the roadmap over the 2021-2021 to deliver the *primary value propositions* for the existing integrity system; and
2) minor adjustments to the overall strategy.

These recommendations, if followed, are likely to position ISC for success over the short-to-medium term. Importantly, industry is likely to benefit as the Integrity Systems Company starts to implement practical solutions aligned with industry value propositions. It is expected that after the basic integrity system is fully developed there will be opportunity to innovate and out-compete integrity systems from other countries.

[2] Establishing new integrity system approaches & technology - Foundation Work Project 1b | Meat & Livestock Australia (mla.com.au)

Table 1. Summary of Project 1 'Establishing new integrity system approaches and technology'.

Objectives / Aims 	Learnings and key findings 	Focus timelines 	Stakeholders impacted by outcomes 	Investment potential and risks 
With reference to the IS2025 strategic plan: • **Scope the over-arching requirements of a future integrity system, in terms of traceability and verification.** • **Engage with key industry and customer stakeholders to determine the system requirements including standards, and data collection, storage, and analytics.** • **Engage with external stakeholders to identify what will work best for Australian red meat supply chains.** • **Develop visualisation tools that show the users what it**	Poor alignment between industry expectation and ISC strategy remains a barrier to adoption and compliance. The primary value proposition is an integrity system that underpins market access. • It needs to be able to provide data rapidly to respond to biosecurity threats on a localised level, based on changing requirements. • ISC's role is to provide independent systems that increase customer's trust in Australian red meat. Secondary value propositions are for food safety, animal health and welfare, and sustainability. To rapidly deliver on the primary value proposition, ISC should: • Develop and communicate an explicit data management policy,	1-2 years	ISC, Livestock producers, lot feeders, service providers Processors, brand owner's peak industry councils (PICs), government (state and federal)	• Case studies to determine value proposition for current traceability and ancillary benefits. • Communication and extension projects focussed on promotion of the benefits of traceability. • Communication on data standards and on data management across the integrity system. • Key risk is that industry does not obtain full benefits of integrity system and that efficiency and functionality of the system reduces engagement, compliance and therefore value proposition.

will look like, how it will work and what is required for success. • **Complete a risk assessment for implementation and success including a mitigation strategy.**	• Keep and enforce integrity standards, • Develop partnerships with other organisations accountable for the integrity system, • Enable solution providers to easily integrate with the integrity system, and • Maintain a non-commercial role. Industry stakeholders are highly motivated toward using data to support decision making, but there is concern about the accuracy of data and use of unverified information within the integrity system. • Red meat industry investment appetite for integrity systems remains low to medium. • Misalignment between IS2025 strategy and stakeholder expectations has resulted in a several high-risk areas.			

Recommendations from Project 1

1. Establish a high-calibre governance board with a mandate from government as soon as possible.
2. Reset the IS2025 strategy to align with governance and industry expectations.
3. Focus and prioritise ISC key activities to deliver the primary value propositions.
4. Develop and hold the key resources to deliver on the primary value propositions.
5. Develop and strengthen key partnerships with organisations delivering parts of the integrity system.
6. Communicate with industry about the strategic shift in focus, how ISC will deliver the primary value propositions, and how ISC will relate to the different user segments of the integrity system.
7. Design and manage a set of key performance indicators to ensure delivery of the primary value propositions.
8. Develop and communicate policy on how ISC will: 1) manage industry data, 2) promote and enable data exchange, and 3) keep and enforce integrity standards.
9. Undertake baseline commercial analysis at an operational level on the impact and benefit of the integrity system on the Australian red meat industry.

5.2 Project 2. V.RDA.2004 Defining the overarching requirements for automated product verification and developing key industry standards.[3]

This project identified the key product claim attributes of Australian red meat that require product verification and undertook a global scan of Regulatory Technology (regtech) and other digital solutions. Both industry and MLA's 'in-market teams' underscored the need to complete the digitisation and interoperability of Australia's current red meat integrity system before embarking on a transition to new technologies, such as regtech and block chain, or seeking to fully automate data acquisition and verification across the supply chain. The sentiment was firmly that significant value can be obtained from optimising the existing system, and from communicating its strengths to trading partners and the global base of consumers.

[3] Requirements for automated product verification and key industry standards | Meat & Livestock Australia (mla.com.au)

Table 2 Summary of Project 2: Defining the overarching requirements for automated product verification and developing key industry standards.

Objectives / Aims	Learnings and key findings	Focus Timelines	Stakeholders impacted by outcomes	Investment potential and risks
• **Identify product attributes of Australian red meat requiring verification across markets now and in future.** • **Report frameworks and technologies used in other industries and countries for verifying market and legislative requirements. Indicate those that are automated and used effectively to manage market compliance.** • **Review regulatory technology (regtech) applications required to ensure automated regulatory monitoring, reporting and compliance.** • **Determine the likelihood that identified frameworks and technologies will be applied to the red meat and livestock integrity system. Indicate risks to success and mitigation factors.**	• Emphasis should be placed on completing the digitisation of the existing red meat integrity system before contemplating automation. • Enhanced data transfer will lead to improved regulatory efficiency and better information for all stakeholders in the red meat supply chain. • Opportunity exists to gain substantial value from optimising the existing platform and communicating its strengths to both trading partners and overseas consumers. • Australia's export markets are varied. Some are more receptive to existing technologies (e.g., product inserts and QR codes), while others are more attuned to product attributes (e.g., sustainable production, animal welfare and the ethical treatment of staff). • Integration between existing systems (including the NLIS, LPA and NVD) was perceived to be insufficient, due to inconsistencies around regulatory and other requirements.	1-2 years	ISC, Brand owners, processors, software providers, government (state and federal).	• Development of interoperability and data standards. • Case studies that demonstrate value of interoperability in data transfer and utilisation. • Pilot studies into digitalisation and applied digital technologies. • Continue scanning of emerging technologies that further effectiveness and efficiency of the integrity system.

	• Improving the interoperability of the components of the current red meat integrity system is considered a key opportunity. • Central to this is the need for standards and an effective data ontology. • Adding standard health treatments (to NLIS) is widely viewed as the next logical step in the development of global integrity systems for red meat and agricultural products more broadly. • Regtech can be useful where the regulatory environment is complex or otherwise difficult to navigate or monitor. Regtech can improve regulatory compliance and support supply chain audits. • Regtech developments are not simple to implement, and would require an improvement in the consistency, standardisation and interoperability of the red meat industry's data streams and structures. • Although regtech is at, or near commercialisation, integration within Australia's red meat supply chain is likely to be deferred to the later stages of ISC's Strategic Plan for the Integrity System 2025 and Beyond.			

Recommendations from Project 2

1. Define the key global standards and ontologies that facilitate integration and interoperability of the verification systems currently underpinning Australia's red meat integrity systems.
2. Develop a more compelling and equitable value proposition for the current verification systems before incorporating new elements.
3. Identify and evaluate opportunities to adopt technologies/solutions that provide enhanced digitalisation and digital interoperability.
4. Pursue and adopt new technologies that enable a whole-of-supply-chain traceability system but only after 1, 2 and 3 are achieved and there is clear and compelling return on investment.

5.3 Project 3. V.RDA.2005. Assessing real time tracking technologies to integrate with identification methods and national traceability requirements.

This report presents a comprehensive review of identification and tracking technologies that have relevance for the livestock industries. Focusing on the live animal aspect of the supply chain (from birth to arrival at the abattoir or export centre), this report examines both current and anticipated future technologies that may be of value for integration into the National Livestock Identification System (NLIS) and broader integrity systems in Australia. On-animal sensor systems appear to be the most appropriate for future application, based on the ease of deployment, their established acceptance within the industry (in terms of form factor) and the valuable information they can provide. To illustrate how these technologies may be incorporated into future integrity systems, four approaches, each with increasing complexity, are detailed and discussed, including a critical evaluation of their strengths, weaknesses and technical feasibility. Three case studies were explored including how such technologies may influence future system accuracy and value propositions.

Table 3. Summary of project 3: Assessing real time tracking technologies to integrate with identification methods and national traceability requirements.

Objectives / Aims	Learnings and key findings	Focus Timelines	Stakeholders impacted by outcomes	Investment potential and risks
• **Identification of relevant tracking technologies that could be integrated to meet national identification, tracking and traceability requirements.**	• The development of a new generation of technologies that can support traceability could significantly improve the functionality of the integrity system and provide benefits to the Australian red meat industry. On-animal sensors • An on-animal sensor, preferably in ear tag form factor, with absolute location (GNSS) and activity sensing (accelerometer or similar) will be of significant value for future integrity system functionality. • The success of any on-animal sensor system is dependent on its long-term reliability and retention rates. This will need to match or exceed the performance of current NLIS ear tags. As at the time of reporting, no long-term tests (>3 months) of any emerging on-animal sensor systems have been reported. • The costs of device and system implementation need to be considered against the benefits to the industry	3-5 years	Livestock producers, lot feeders, on-farm software providers, tag technology developers.	• Case studies that develop the value proposition of data and information obtained from advanced tag telemetry and technologies. • Case studies to identify ancillary benefits of advanced tag technologies. • Communication and extension focus on utilisation of data from advanced tag technologies.

	broadly as well as the value the system might bring to individual producers. DNA testing • DNA testing and tissue sampling is a potentially valuable addition for identification through the entire value chain. Remote sensing, image analysis • Satellite-based remote sensing and image analysis could be of value in extensive beef systems where on-animal sensor deployment is not feasible. This data could be used to augment current and future on-animal systems to provide critical insights for the various integrity system functions. Sentinel approaches. • Sentinel approaches could provide key information for NLIS functions (particularly biosecurity), but implementation may be complex and needs further conceptual development and evaluation. Hybrid systems • Hybrid systems (integration of two or more platforms) could provide significant benefits; for example, integrating remote sensing-based cow counting with current NLIS RFID tags could validate reported PIC numbers and report anomalies. The integration of an on-animal sensor with DNA identification could provide detailed whole of animal/product traceability.			

Recommendations from Project 3.

1. On-animal sensors
    a. A long term (>3 years) independent study exploring the likely retention rates of sensor ear-tags of varying weights and pin configurations could inform their value to a future integrity system.
    b. An independent economic analysis of the device and system implementation is recommended.
    c. Due to the investment and development time required for on-animal sensors, other suitable technologies should also be considered independently as part of a staged rollout.
2. Other technologies
    a. DNA testing and tissue sampling requires conceptual development followed by economic evaluation.
    b. Remote sensing, image analysis, sentinel approaches, combined with existing NLIS technologies might provide critical insights. Further conceptual development and evaluation with stakeholders is required.
    c. Benefits to producers outside the NLIS functionalities could be significant and these should be considered in terms of cost reduction of the NLIS implementation.
    d. Producer perceptions of the use of data need to be managed to avoid significant push back. Strategies will need to be considered to overcome this risk.
    e. The in-depth case studies undertaken in this study highlighted several key impediments for industry participants. Barriers to compliance with the NLIS need to be identified and collated to enable improved evaluation of future sensor systems.

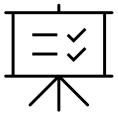
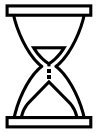
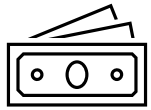
5.4 Project 4. V.RDA.2008. Barriers to adoption and extraction of value from agtech in the Australian livestock industry.[4]

This project focussed on the identification of barriers to the adoption of agtech (digital technologies) with emphasis on real time traceability in the red meat livestock industry. Barriers identified from a review of Australian and international literature were characterised into seven key themes – value proposition, data issues, infrastructure, policy and regulation, skills, social and technology – and these were confirmed through stakeholder consultation. The thematic review and analysis provided the rationale for the development of a logic framework of adoption barriers and potential solutions including attitudinal considerations and constraints.

Based on information collated within the logic framework a non-sequential stage-gate plan of adoption strategies was developed to assist the implementation of agtech for real-time traceability. The stage-gate adoption plan was then customised for the eNVD as a case study of agtech adoption.

[4] https://www.mla.com.au/research-and-development/reports/2021/barriers-to-adoption-and-extraction-of-value-from-agtech-in-the-australian-livestock-industry/

Table 4. Summary of project 4: Barriers to adoption and extraction of value from agtech in the Australian livestock industry

Objectives / Aims 	**Learnings and key findings** 	**Focus Timelines** 	**Stakeholders impacted by outcomes** 	**Investment potential and risks** 
• **Provide an inventory of current and emerging technologies that are used on farm.** • **Describe identified barriers to adoption of on-farm technologies and recognised approaches to optimising adoption.** • **Create a logic map of attitudinal considerations and constraints to the identified technologies.** • **Construct an adoption logic plan for the eNVD**	**Barriers to adoption** were categorised into seven themes: 1. Value proposition – agtech needs to address and effectively solve a customer's problem. 2. Data issues – covers the critical areas of data collection and storage, ownership, privacy, and quality. 3. Infrastructure – that enables the technology. 4. Policy and regulation – include intellectual property protection, safety standards, government constraints, and regulations to ensure proper use. 5. Skills – include those needed to understand and operate the technology, and / or local access to expertise and support services. 6. Social – trust between the producer and the agtech provider, and trust in the technology by the community. 7. Technology – ease of adoption, interoperability, useability, and the need for further R&D.	1-2 years	Livestock producers, lot feeders, processors agtech providers and developers, extension and adoption staff	• Case studies to identify and quantify the value proposition of investment in agtech. • Development of interoperability and data standards. • Accreditation and extension programs for service providers. • Next generation digital NVD that improves interoperability of systems and enhances data flow throughout the integrity system.

as an appropriate industry case study.	**Adoption logic** • Agtech adoption is considered in a non-sequential and often quite varied order. That is, stakeholders were motivated by a range of factors and evaluated different elements of the agtech driven by their individual current and future circumstances. • The three proposed phases of the stage-gate adoption framework are: 1. **Product evaluation**: Support through development of case studies and commercial trials that generate awareness and allow for transparent, independent financial assessment of the value proposition of agtech. Models to assist with evaluation of value proposition both in financial and non-financial terms may also need to be developed. 2. **Confidence in the product's future**: Developing confidence in the technologies maturity and assurance that there is sufficient company robustness for on-going product support. 3. **Availability of enablers**: Gaining access to a network of technical expertise to provide support in evaluation and implementation of the technologies.			

Recommendations from Project 4:

1. To make a technology appealing, promote the capability of the technology, how it functions and how it can be incorporated into the farming operations of users.
2. A clear value proposition needs to be articulated. It should include the benefits of the technology, how it operates and how it is better than current alternatives.
3. A clear and easily understood agreement on how data will be collected, stored, and used should be integral to the process of deploying the agtech. This agreement should comply with industry developed and agreed codes of practice.
4. Data standards should be developed, published, and adopted to enable broad interoperability between applications and devices.
5. Whenever possible, applications should offer an off-line mode to circumvent the absence (or unreliability) of internet connectivity.
6. Agtech needs to ensure that any additional or perceived regulatory burden is proportionate to the value of the technology.
7. A range of support services are required to facilitate widespread adoption of Agtech. Consideration should be given to training a network of support providers, noting that approaches that work well in urban areas with reliable broadband may not be suitable in rural and remote areas.
8. Where appropriate, use respected individuals and trusted organisations to support and promote the case for adoption of the agtech.
9. In design decisions, agtech should tend toward simplicity rather than complexity. This applies not just to the interface, but to how the agtech is embedded into farm operations.
10. ISC should consider increased investment in case studies and commercial trials where public versions of financial metrics are generated within key production systems and across different geographic locations.
11. ISC should consider a segmentation analysis to determine whether there are defined clusters of producers or feed lotters that enter a given stage-gate at the same point and follow either logical or arbitrary sequences of activities in the evaluation phase.
12. ISC and MLA should consider an ‘eBook’ concept that effectively positions all eNVD’s sent and received within a format that has the equivalent functionality of the current paper book.
13. ISC and MLA should consider developing a next-generation integrated livestock data platform including a 2nd-generation digital NVD.

7 Overall foundational project recommendations

In summary, the recommendations presented by the foundational projects group into the following key areas:

- Reset the IS2025 strategy to align with governance and industry expectations and fix issues with the current system first.
- Develop services to support and drive adoption and compliance within the current industry system.
- Address barriers to adoption of current integrity system.
- Develop and maintain data standards and ontologies that facilitate integration and interoperability.
- Develop and communicate agreements on ownership and use of data.
- Evaluate and promote value of integrity system including secondary benefits or opportunities.
- Pursue and adopt new technologies that enable a whole-of-supply-chain traceability system (if there is a clear and compelling return on investment).

8 Industry benefits and outcomes for stakeholders

All four projects identified the need for ISC to consider a refocus on priorities within the current IS2025 strategic plan. In response ISC in April 2021 have developed a refreshed plan for the Integrity System Strategic plan 2025 and beyond. That refreshed plan provides a more targeted set of tasks, outcomes and activities that are designed to fast track investments that lead to greater awareness and understanding of the current inherent value proposition of the integrity system. The refreshed plan highlights three objectives:

Making sure our integrity system services meet the needs of today

Transforming our core services to deliver an integrated integrity system

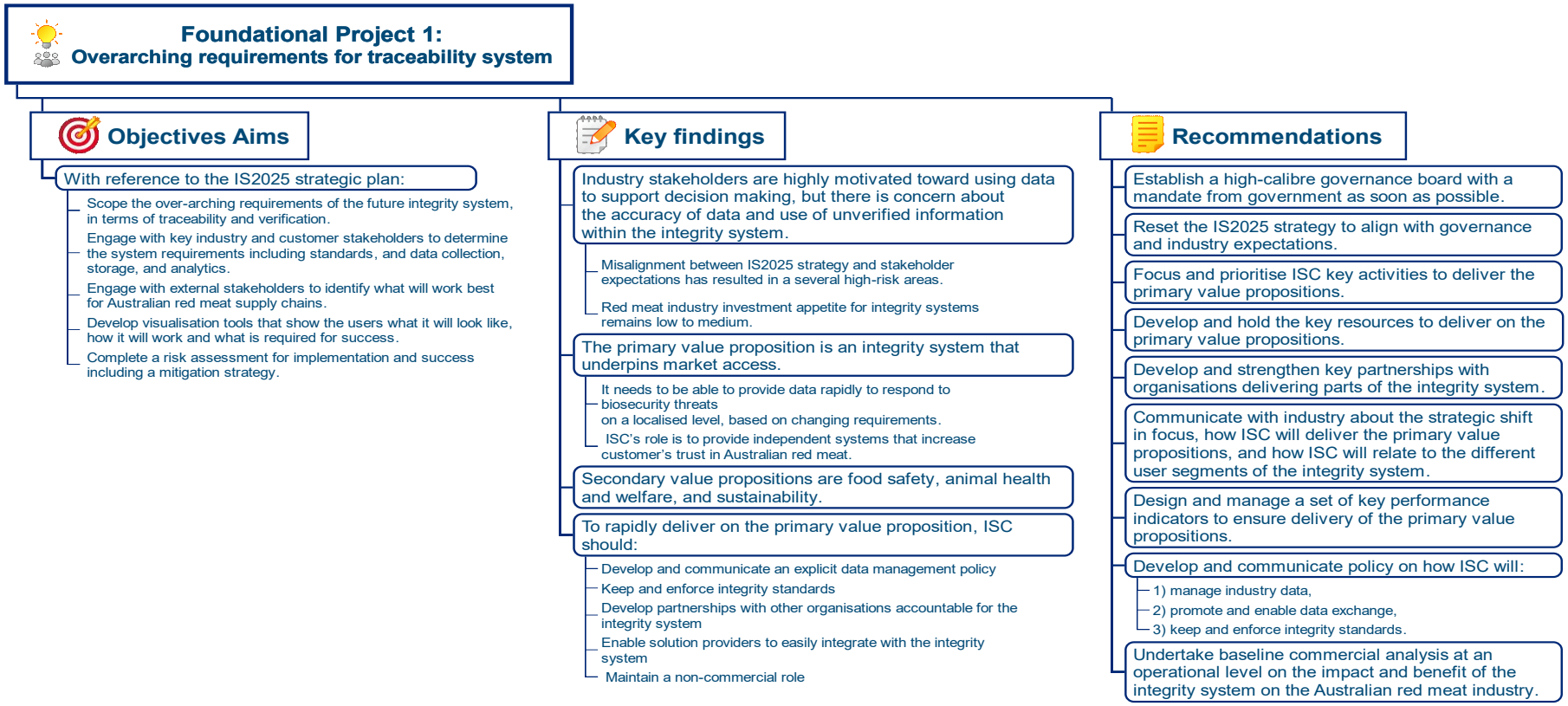
Leveraging the integrity system to add value through the supply chain

Stakeholders need to be convinced of the value proposition of the current integrity system through communication and extension activities that revolve around well designed case studies. Those case

studies need to pinpoint opportunities for improvements in the interoperability of components within the current integrity system and reduce barriers to technology and data utilisation / transfer. There is a strong industry sentiment that investments over the next 1-2 years should be directed towards improvements in interoperable systems, and technologies / tools that optimise the current integrity system for all stakeholders. The release of clearly defined data sharing principles[5] is a strong step forward to achieving this outcome.

[5] See https://www.integritysystems.com.au/data--feedback/data-management/

Appendix: Schematic diagrams of objectives and outcomes from the four foundational projects



Foundational Project 2: Overarching requirements for automated integrity

Objectives Aims

- Identify product attributes of Australian red meat requiring verification across markets now and in future.
- Report frameworks and technologies used in other industries and countries for verifying market and legislative requirements. Indicate those that are automated and used effectively to manage market compliance.
- Review regulatory technology (RegTech) applications required to ensure automated regulatory monitoring, reporting and compliance.
- Determine the likelihood that identified frameworks and technologies will be applied to the red meat and livestock integrity system. Indicate risks to success and mitigation factors.

Key findings

- Emphasis should be placed on completing the digitisation of the existing red meat integrity system before contemplating automation.
- Enhanced data transfer will lead to improved regulatory efficiency and better information for all stakeholders in the red meat supply chain.
- Opportunity exists to gain substantial value from optimising the existing platform and communicating its strengths to both trading partners and overseas consumers.
- Australia's export markets are varied. Some are more receptive to existing technologies (e.g. product inserts and QR codes), while others are more attuned to product attributes (e.g. sustainable production, animal welfare and the ethical treatment of staff).
- Integration between existing systems (including the NLIS, LPA and NVD) was perceived to be insufficient, due to inconsistencies around regulatory and other requirements.
- Improving the interoperability of the components of the current red meat integrity system is considered a key opportunity.
  - Central to this is the need for standards and an effective data ontology.
- Adding standard health treatments (to NLIS) is widely viewed as the next logical step in the development of global integrity systems for red meat and agricultural products more broadly.
- Regtech can be useful where the regulatory environment is complex or otherwise difficult to navigate or monitor. Regtech can improve regulatory compliance and support supply chain audits.
  - Regtech developments are not simple to implement, and would require an improvement in the consistency, standardisation and interoperability of the red meat industry's data streams and structures.
  - Although RegTech is at, or near commercialisation, integration within Australia's red meat supply chain is likely to be deferred to the later stages of ISC's Strategic Plan for the Integrity System 2025 and Beyond.

Recommendations

- Develop and communicate policy on how ISC will:
  - 1) manage industry data,
  - 2) promote and enable data exchange,
  - 3) keep and enforce integrity standards.
- 1. Define the key global standards and ontologies that facilitate integration and interoperability of the verification systems currently underpinning Australia's red meat integrity systems.
- 2. Develop a more compelling and equitable value proposition for the current verification systems before incorporating new elements.
- 3. Identify and evaluate opportunities to adopt technologies/solutions that provide enhanced digitalisation and digital interoperability.
- 4. Pursue and adopt new technologies that enable a whole-of-supply-chain traceability system but only after 1, 2 and 3 are achieved and there is clear and compelling return on investment.

Foundational Project 3:
Overarching requirements for automated integrity

Objectives Aims

- Identification of relevant tracking technologies that could be integrated to meet national identification, tracking and traceability requirements.

Key findings

- The development of a new generation of technologies that can support traceability could significantly improve the functionality of the integrity system and provide benefits to the Australian red meat industry.
- On-animal sensors
  - An on-animal sensor, preferably in ear tag form factor, with absolute location (GNSS) and activity sensing will be of significant value for future integrity system functionality.
  - The success of any on-animal sensor system is dependent on its long-term reliability and retention rates. This will need to match or exceed the performance of current NLIS ear tags. As at the time of reporting, no long-term tests (>3 months) of any emerging on-animal sensor systems have been reported.
  - The costs of device and system implementation need to be considered against the benefits to the industry broadly as well as the value the system might bring to individual producers.
- DNA testing
  - DNA testing and tissue sampling is a potentially valuable addition for identification through the entire value chain.
- Remote sensing, image analysis
  - Satellite-based remote sensing and image analysis could be of value in extensive beef systems where on-animal sensor deployment is not feasible. This data could be used to augment current and future on-animal systems to provide critical insights for the various integrity system functions.
- Sentinel approaches
  - Sentinel approaches could provide key information for NLIS functions (particularly biosecurity), but implementation may be complex and needs further conceptual development and evaluation.
- Hybrid systems
  - Hybrid systems (integration of two or more platforms) could provide significant benefits; for example, integrating remote sensing-based cow counting with current NLIS RFID tags could validate reported PIC numbers and report anomalies. The integration of an on-animal sensor with DNA identification could provide detailed whole of animal/product traceability.

Recommendations

- On-animal sensors
  - A long term (>3 years) independent study exploring the likely retention rates of sensor ear-tags of varying weights and pin configurations could inform their value to a future integrity system.
  - An independent economic analysis of the device and system implementation is recommended.
  - Due to the investment and development time required for on-animal sensors, other suitable technologies should also be considered independently as part of a staged rollout.
- Other technologies
  - DNA testing and tissue sampling requires conceptual development followed by economic evaluation.
  - Remote sensing, image analysis, sentinel approaches, combined with existing NLIS technologies might provide critical insights. Further conceptual development and evaluation with stakeholders is required.
  - Benefits to producers outside the NLIS functionalities could be significant and these should be considered in terms of cost reduction of the NLIS implementation.
- Producer perceptions of the use of data need to be managed to avoid significant push back. Strategies will need to be considered to overcome this risk.
- The in-depth case studies undertaken in this study highlighted several key impediments for industry participants. Barriers to compliance with the NLIS need to be identified and collated to enable improved evaluation of future sensor systems.

Integrity Systems

red meat customer assurance

MEAT & LIVESTOCK AUSTRALIA

Foundational Project 4:
Barriers to adoption and implementation

Objectives Aims

- Provide an inventory of current and emerging technologies that are used on farm.
- Describe identified barriers to adoption of on-farm technologies and recognised approaches to optimising adoption.
- Create a logic map of attitudinal considerations and constraints to the identified technologies.
- Construct an adoption logic plan for the eNVD as an appropriate industry case study.

Key findings

Barriers to adoption were categorised into seven themes:

- **Value proposition** – agtech needs to address and effectively solve a customer's problem.
- **Data issues** – covers the critical areas of data collection and storage, ownership, privacy, and quality.
- **Infrastructure** – that enables the technology.
- **Policy and regulation** – include intellectual property protection, safety standards, government constraints, and regulations to ensure proper use.
- **Skills** – include those needed to understand and operate the technology, and / or local access to expertise and support services.
- **Social** – trust between the producer and the agtech provider, and trust in the technology by the community.
- **Technology** – ease of adoption, interoperability, useability, and the need for further R&D.

Adoption logic

Agtech adoption is considered in a non-sequential and often quite varied order. That is, stakeholders were motivated by a range of factors and evaluated different elements of the agtech driven by their individual current and future circumstances.

Three phases of the stage-gate adoption framework are proposed.

- **Product evaluation:** Support through development of case studies and commercial trials that generate awareness and allow for transparent, independent financial assessment of the value proposition of agtech. Models to assist with evaluation of value proposition both in financial and non-financial terms may also need to be developed.
- **Confidence in the product's future:** Developing confidence in the technologies maturity and assurance that there is sufficient company robustness for on-going product support.
- **Availability of enablers:** Gaining access to a network of technical expertise to provide support in evaluation and implementation of the technologies.

Recommendations

1. To make a technology appealing, promote the capability of the technology, how it functions and how it can be incorporated into the farming operations of users.
2. A clear value proposition needs to be articulated. It should include the benefits of the technology, how it operates and how it is better than current alternatives.
3. A clear and easily understood agreement on how data will be collected, stored, and used should be integral to the process of deploying the agtech. This agreement should comply with industry developed and agreed codes of practice.
4. Data standards should be developed, published, and adopted to enable broad interoperability between applications and devices.
5. Whenever possible, applications should offer an off-line mode to circumvent the absence (or unreliability) of internet connectivity.
6. Agtech needs to ensure that any additional or perceived regulatory burden is proportionate to the value of the technology.
7. A range of support services are required to facilitate widespread adoption of Agtech. Consideration should be given to training a network of support providers, noting that approaches that work well in urban areas with reliable broadband may not be suitable in rural and remote areas.
8. Where appropriate, use respected individuals and trusted organisations to support and promote the case for adoption of the agtech.
9. In design decisions, agtech should tend toward simplicity rather than complexity. This applies not just to the interface, but to how the agtech is embedded into farm operations.
10. ISC should consider increased investment in case studies and commercial trials where public versions of financial metrics are generated within key production systems and across different geographic locations.
11. ISC should consider a segmentation analysis to determine whether there are defined clusters of producers or feed lotters that enter a given stage-gate at the same point and follow either logical or illogical sequences of activities in the evaluation phase.
12. ISC and MLA should consider an 'eBook' concept that effectively positions all eNVDs sent and received within a format that has the equivalent functionality of the current paper book.
13. ISC and MLA should consider the developing a next-generation integrated livestock data platform including a 2nd-generation digital NVD.