MEAT & LIVESTOCK AUSTRALIA

final report

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Development of a Single Processor Data Feed

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Executive summary

Meat & Livestock Australia (MLA) and Integrity Systems Company (ISC) receive carcase feedback data feeds from processors to support industry programmes and producer tools. Programmes that utilise this data include the National Livestock Identification System (NLIS), Livestock Production Assurance (LPA), Meat Standards Australia (MSA), and Livestock Data Link (LDL).

Processors deliver carcase data to MLA and ISC in a variety of ways, including automated delivery between systems, manual file upload through the web site, and even file transfers. This variety of data transfer mechanisms for similar data sets causes challenges:

- It increases costs for MLA programmes, processors, and software providers to support and maintain different delivery processes;
- It impacts data quality and security, particularly where manual uploads occur;
- Delivery of data to producers through LDL can be compromised when manual data uploads are delayed; and
- Processors and software providers perceive there is duplication and are less willing to participate in further MLA programmes that would require more data transfers.

Integrity Systems Company is investigating the use of a consistent process that all MLA programmes could leverage to receive and process carcase data. This could substantially reduce the maintenance overhead for MLA programmes, processors, and software providers. It would also encourage automation and support data validation.

The process that is envisaged would in turn require a standardised way of describing and representing the carcase data to be transferred. This project set out to:

a. Compile a specification for a carcase data model that could be used in a replacement process for receiving carcase data. The specification was to be developed as a *Data Dictionary* that documents the meaning of the data items, and a *JSON Schema* that software developers can use to build data exchanges.
b. Understand the potential costs and benefits of transitioning to a single carcase schema for processors, software providers, and MLA and ISC programmes, and to recommend factors that need to be considered when implementing the changes.

Rezare Systems interviewed representatives from six MLA and ISC programmes, three processors, and five software providers. Documentation and materials from the MLA and ISC programme teams were used to develop a draft data dictionary and schema.

Processors and software providers were supportive of the move to a single schema and data transfer mechanism. The toolsets proposed were a good fit with current or future technology directions.

All parties, particularly processors and software providers, reinforced the need for a well-planned and managed transition process that provided a clear roadmap for change with expected implementation timeframes. Software providers proposed or endorsed using staged "proof of concept" steps to learn and reduce rework.

This final report summarises the challenges and opportunities observed from conversations with processors, software providers, and MLA and ISC programme teams. It also provides recommendations that should be considered when planning and implementing a consistent process for receiving carcase data.

Table of contents

1 Background

Meat & Livestock Australia (MLA) and Integrity Systems Company (ISC) receive carcase feedback data feeds from processors to support industry programmes and producer tools. Industry programmes that utilise this data include the National Livestock Identification System (NLIS), Livestock Production Assurance (LPA), Meat Standards Australia (MSA), and Livestock Data Link (LDL). New and future programmes could also make use of carcase and related data; these include the Dual-Energy X-Ray Absorptiometry (DEXA) programme, Carbon Neutral 2030 (CN30), and potentially relationships with the Market Information programme.

Processors deliver data to MLA and ISC in a variety of ways, including automated delivery through Application Programming Interfaces (APIs), manual file upload through the web site, and even file transfers using file transfer protocol (FTP). Processors also perceive that there is a level of duplication, for instance between NLIS data and MSA data.

The need to support and maintain five or six different delivery variations places a costly burden on MLA and ISC programmes, and on the processors and their software providers. Changes to required data fields or formats must be reproduced consistently in multiple places, otherwise data sets may diverge based on the transfer mechanism that a processor uses.

The variety in delivery mechanisms also impacts data quality and security. Manual interventions to transfer data run the risk of data not being sent or duplicate transfers. Manual data entry increases the possibility that important information is mis-typed. Multiple delivery mechanisms limit the enforcement of a single security policy and data checking process.

Finally, the current state of data delivery impacts on the timeliness with which data is provided to producers through LDL. Manual data uploads are often delayed until near the end of the time window under which processors must comply. Batch data transfers between MLA systems (often called ETL – extract, transform, load) then take place to cleanse and deliver data to LDL. The combination could cause several days delay from the processing of an animal until the data appears in LDL.

ISC is considering development of a replacement data ingestion service that will streamline the flow of data from processors and its delivery into MLA programmes. A single data model for carcase data will facilitate the replacement service development and use of the data by MLA and ISC programmes. Over the longer term, it will also lower the maintenance burden that multiple delivery mechanisms place on processors, their software providers, and the MLA and ISC programmes themselves.

2 Project objectives

This project had two primary purposes:

a. To compile a specification for a carcase data model that could be used in a replacement data ingestion service and across MLA and ISC programmes. This is called the "Single Carcase Schema". The single carcase schema must cover the data that is currently being delivered by processors for the NLIS, MSA and LDL programmes.

b. To document the potential costs and benefits of transitioning to a single carcase schema for processors, software providers, and MLA and ISC programmes, and to recommend factors that need to be considered when implementing the changes. The project identified implications of a replacement data ingestion service for MLA and ISC systems, and engagement and transition considerations for processors and software providers.

3 Methodology

When proposing the methodology for this project, the Rezare Systems team considered how best to, identify the current data flows and their contents; understand the current situation and its limitations; and conceptually test the implications of change and transition with stakeholders including processors and their software providers.

Rezare interviewed three different audience groups to ensure that relevant stakeholders were canvassed. These includes MLA and ISC programme teams, processors and software providers.

3.1 MLA and ISC programme teams

Teams were interviewed using a mixture of in-person meetings and videoconferences, in order to:

- Identify and obtain information on existing data transfer mechanisms (including data formats, attribute definitions, and timings);
- Understand the dependencies and limitations of current data transfers and processes;
- Identify opportunities that the programme teams could envisage from future improvements to data transfers and the data collected (including gaps in current systems); and
- Understand the implications of changes (including existing commitments) that would need to be considered when planning any transition to a new model.

3.2 Processors

Processors were interviewed via videoconference to understand the data transfer mechanisms used to transmit carcase data from their premises to MLA and ISC programmes. The interviews explored the historic or logistic reasons for using the current mechanisms, and how the timing of data transfers relates to other processor activities. The meetings also offered opportunities to understand processors appetite for changes to a single schema and a replacement data transfer process, as well as the transition considerations for such changes.

3.3 Software Providers

Software Providers were interviewed via videoconference to understand the data transfer mechanisms currently implemented and how these are used by their clients.

Significant focus was placed on the process for transition to a single schema and new service. Software Providers were asked to provide examples of previous experiences implementing such integrations, their feedback on the level of effort that would be involved for them and their clients, and the timelines and communication that would be required.

4 Results

4.1 Carcase data model and schema

The single carcase schema was modelled using a class diagram and a data dictionary. These accompany this document as Appendix 1. The schema was also developed for representation in the modern JSON (JavaScript Object Notation) format, as a JSON Schema (see https://json-schema.org). The class diagram for the data model is shown in Figure 1. Class diagrams are described at https://www.uml-diagrams.org/class-reference.html.

Object data model – Carcase information

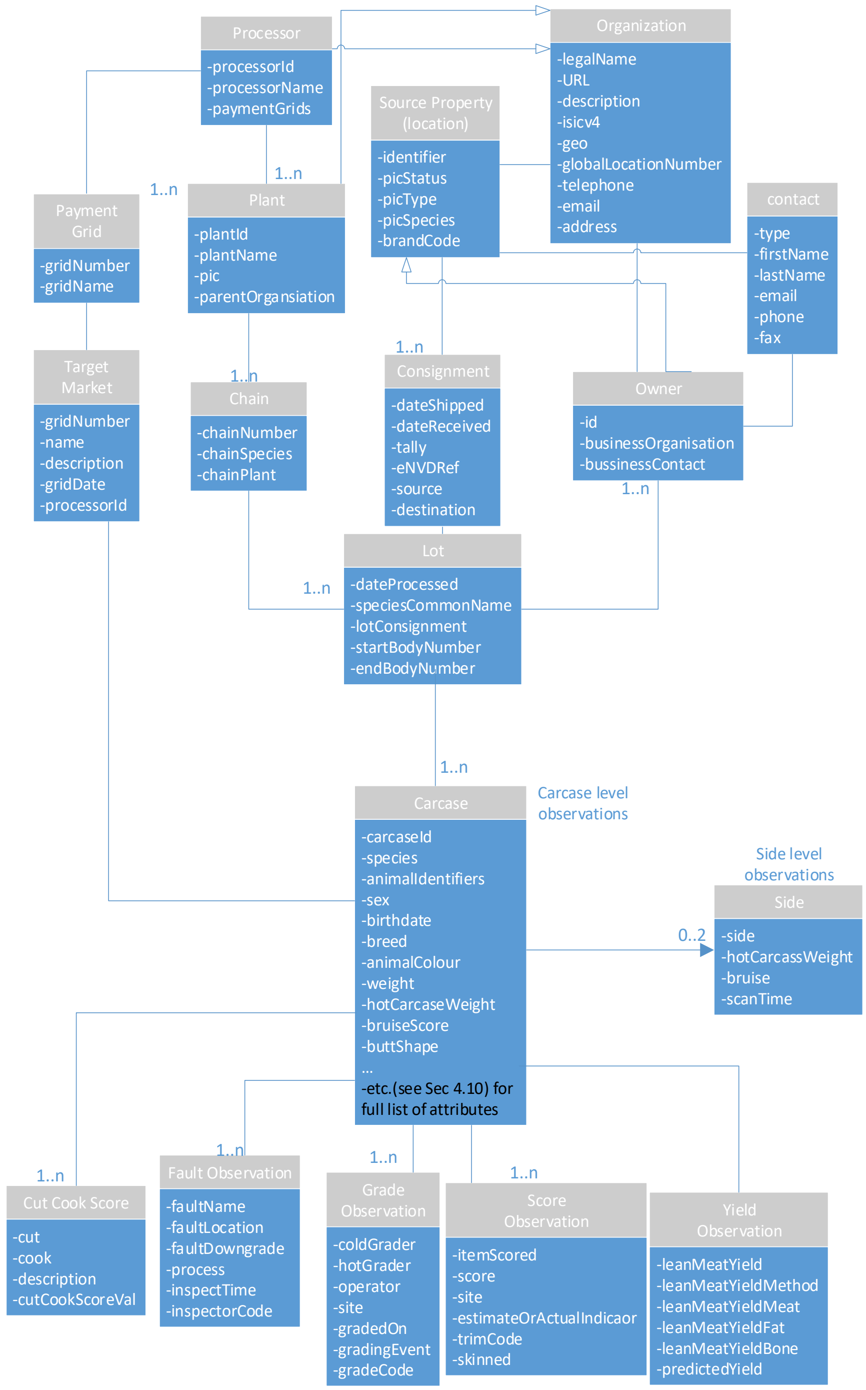


Figure 1: Class diagram for the Carcass data schema

Feedback on the overall data model and included fields was sought from the MLA and ISC programme teams. It was agreed that some feedback received after project completion would not be included in this report but should be addressed in future iterations of schema refinement.

4.2 Results from interviews

Internal and external interviews were undertaken. MLA and ISC staff representing six MLA programme teams were interviewed that covered:

- Livestock Data Link (LDL);
- Meat Standards Australia (MSA);
- Electronic National Vendor Declaration (eNVD);
- National Livestock Identification System (NLIS);
- Market Information team; and the
- Animal Disease project.

Six processors were approached for meetings, but only three were available to meet within the timeframe of the project. While five software providers participated in videoconference interviews. The software providers interviewed jointly cover a substantial proportion of the Australian processing industry.

The interviews showed substantial areas of common feedback. MLA programme team members were also aware of most of the concerns of the processors and software providers. Common issues were:

- Different data formats and uploads are required for MSA and NLIS;
- Software uses a variety of upload methods, including some that are officially not supported but which still work;
- Data is often reviewed and uploaded manually, with attendant time and effort, and occasional errors;
- Operators uploading data do not always understand exceptions they may receive from MLA systems and the actions that they should take;
- MSA and NLIS have slightly different models for data visibility, which means that some data which can be seen in MyMSA may not be viewed in LDL;
- Software providers have sometimes implemented one upload mechanism, to find they have rework when a new or updated mechanism is announced;
- There are delays in providing data to NLIS and then batch processing it for LDL that may result in several days' delay for producers;
- Software providers support a variety of plant implementations with different versions and connectivity, and coordinating releases to these can be challenging;
- Making the investment case for changes to plant software can be challenging.

The interview results are analysed in the Discussion (section 5).

5 Discussion

The workshops with MLA and ISC programme teams, and one-on-one meetings with processors and software vendors provided insights into their desired outcomes and expectations of the project. As noted earlier, there was substantial commonality between the outcomes desired by MLA and those desired by the other industry participants. These are categorised into the following discussion areas.

Opportunities:

1. Potential to improve data quality and integrity;
2. Opportunity to manage long-term maintenance and upgrade costs;
3. Enabling increased speed of feedback for producers and efficiency and utility for processors; and
4. Improving the ability to innovate and support adoption of initiatives.

Challenges:

5. Necessity to standardise identity and permission models;
6. Requirement to support a variety of processor implementations and levels of use;
7. Issues with deployment to, and connectivity from, processor sites.

5.1 Opportunities

5.1.1 Improve data quality and integrity

All participants agreed there was potential to increase the quality of data (completeness and accuracy of data fields), and data integrity (correct relationships between entities – such as animals, properties, and owning businesses).

There is also an opportunity to standardise timing, error and exception handling across MLA systems; which will benefit both those systems, and the processors and vendors interacting with them. Processors would also benefit from seeing improvements in handling higher carcase numbers. Sometimes current data transfer mechanisms fail with larger batches of animals, so processors may manually break down the data they send into small batches.

Improved integration of data and reduction of manual re-entry of data are key methods by which improved data quality could be achieved. Examples include data entered manually into hardware Data Collection Units (DCUs) and accompanying software, and the potential to use property identification codes (PICs) from eNVD to populate both NLIS and MSA data transactions.

Improved data validation through rules declared in the schema would also assist with data quality. Processors and software providers also recommended that MLA should document how systems should handle errors and exceptions. Processor staff need to know the processes to be used when exceptions occur.

It was noted that while PICs are standardised and utilised by all systems, other identifiers for interested parties (such as livestock owners, accredited operators and transporters) are not available or used in a standardised way across all systems.

5.1.2 Manage long-term maintenance and upgrade costs

Historically, the development of integration between processor software systems and MLA systems has been driven by a combination of State and Federal regulatory requirements, and industry initiatives and innovation. This has resulted in a somewhat fragmented approach to data interchange.

Regulatory requirements typically target very specific data fields in order to minimise administrative burden and control regulatory reach. In practice, this can sometimes increase regulatory burden by requiring processors and software providers to implement additional interfaces or processes for other related data.

Industry innovation projects may also have their own requirements and timetables, often aligned to outcomes from research and funding programmes. The overall impact for processors and software vendors participating in multiple programmes and initiatives can sometimes include duplication of effort or competing development and release cycles.

The single-schema approach could be used to coordinate project data requirements and provide software vendors and processors (as well as MLA business unit) with a shared but flexible roadmap that supports better planning of development, testing, training of resources and managing the impact on plants.

5.1.3 Increase speed of feedback and utility for producers and processors

Current regulatory, process, and technology restrictions mean that there may be several days delay between the processing of animals, and the data for those animals being available in MLA data programmes. For example, data may not be available in LDL for producer analysis until several days after the animal is processed. During this time, the processor will ensure that the correct PIC is recorded, that there are no outstanding issues regarding the traceability and LPA status of the animals, and finally may manually upload the data at a quiet time of day to minimise the possibility of failures. A batch process may then transform data received into NLIS and MSA, loading this into LDL up to 24 hours after its receipt. In a small subset of cases, data is not available to the owner of animals sent directly from another person's PIC – an additional manual process may be required to deliver this data.

Providing a common data model and ingestion process that uses data from and provides data for eNVD, NLIS, LDL, and MSA, and a move from manual to more automated data management, could substantially increase the speed at which data became available to producers.

Processors and software vendors also stated that current processes which involve sending files are inherently "one way". A more integrated "API" (Application Programming Interface) approach would be inherently two-way. Processors may see more value in data collection and delivery if they can also benefit from return of traceability data and prompt notification of errors, exceptions, and livestock status.

5.1.4 Support innovation and adoption of initiatives

New industry data initiatives (such as the disease pilots currently underway) have historically needed to provide their own data collection and management infrastructure, including arranging file transfers or data connections from processing plants where required. A standardised and extensible data schema and API model will allow extensions and new initiatives in data collection and analysis to be "plugged in" to the existing framework.

Organisations spoken to expect a single common schema would extend to support the development and adoption of further industry initiatives, including DEXA carcase composition, animal health and welfare initiatives, and initiatives supporting carbon emission efficiency. It may also support the more rapid release and adoption of existing industry programmes – for instance, revisions to the MSA model, or updates to eNVD. This is not to say that the processors and software providers expect a sudden change to freely provide data for any purpose. Instead they hope that the same data delivery mechanism and format could be used to avoid setting up more processes for new initiatives. They would still expect processors (and even producers) to explicitly opt in to extend use of their data.

5.2 Challenges

Consultation with processors, software vendors, and MLA business units also identified some potential challenges or issues that need to be considered as part of implementing standardised data schemas and interchange models. These challenges are discussed in detail below.

5.2.1 Standardise identity and permission models

NLIS has typically used the PIC of the source property to identify movements of livestock data and have handled receipt of animals at a plant level. This is entirely appropriate for a traceability system.

LDL primarily provides feedback to producers or feedlots based on the consignee PIC – the property from which animals were sent to the processor. LDL can also provide basic feedback to beef breeders by identifying an animal's RFID to its breeding herd (these breeders do not receive carcase compliance feedback).

In the future, LDL data could be used to deliver data back to genetic analysis (through Sheep Genetics or Breedplan). Detailed MSA data could also in future be used to supplement LDL, especially for Sheep, as it already includes MSA for Beef now. Using data in these ways might require greater flexibility in identifier and permission models than NLIS and LDL data models currently support.

Currently processors decide whether to participate in an MLA programme (such as LDL) and then implement the necessary data delivery processes. In a future situation with a single carcass data schema and common data transfer mechanism, an explicit opt-in process will be necessary. An opt-in/opt-out process could also be extended to producers. A common schema and greater granularity in participation and permissions might lower the overall barriers to participation for processors and producers.

Accordingly, this report recommends:

- Considering how to standardise the identification of people or businesses that own or control livestock. This would be distinct from (though usually defaulting to) the PIC of the source property.
- Allowing for data transfer and use permissions to be granted or revoked at both processor and an owner/PIC level. Availability of a mechanism to incrementally 'opt-in' to release data for different uses (LDL vs genetic analysis, for instance) could also be considered.

5.2.2 Support a variety of processor implementations and levels of use

As Rezare Systems interviewed software providers it became apparent that:

- Different processors (and even plants owned by a processor), used different data delivery methods and processes (including some that are deprecated);
- Some processors and plants participated in LDL and some did not;
- Some processors and plants used MSA using an MSA-supplied DCU, some had their own implementation of the MSA model (a licenced implementation), and some did not participate in MSA.

At face value, moving to a single schema and delivery mechanism would provide substantial benefit for industry in:

- Removing duplication, cost, and complexity caused by the variety of systems;
- Lowering the technical barriers to participation in LDL, MSA and other future MLA programmes.

Despite this, processors also use the variety of processes and mechanisms for genuine reasons. Some plants are constrained by in-plant facilities and processes (for instance, hot boning vs. cold boning), and limited opportunity to collect data. Some plants implement manual processes to meet State data checking requirements. Some processors choose not to participate in some MLA programmes for other than technical reasons.

When implementing the single schema, care will need to be taken that it does not become "yet another interface to be supported" (so that cost benefits can be realised), and that the reasons why processors and plants make use the processes they do are carefully considered and addressed.

5.2.3 Consider issues with deployment and connectivity at processors

The software providers that Rezare Systems interviewed pointed out that there would be a variety of time and cost implications for deploying this to industry. This is because:

- Some plant software systems deliver data to a central hub maintained by the processor or the software provider. These hubs can readily support the replacement data transfer mechanism by upgrading the central hub, and "turning on" transfers once authorised. Such hubs are typically built with modern tools that already align with the proposed single schema model.
- Some systems operate only at a plant level. These systems need to be upgraded at the plant, with associated plant-level planning and logistics. Software providers prefer to deploy upgrades remotely, but in some cases a plant visit is necessary.
- Some plants do not operate the latest software, perhaps because of cost, or because of the computer hardware or other equipment they employ, or because plant systems have been in use and unavailable for upgrades. Upgrades will need to be negotiated with processors.
  A few processors protect their industrial systems from intrusion by maintaining a physical "air gap" between these systems and the internet. In these systems, manual processes have been employed to take data from the plant systems for use in the corporate network and delivery to MLA programmes. In order to benefit from the automation benefits of the single schema, IT teams at these processors may need to consider alternative security approaches.

The variety of implementation and deployment models reinforces the need for careful planning, a collaborative approach to support processors and software providers, and clear communication of the roadmap, expectations, and dependencies. This is addressed further in the recommendations for transition in section 6.

6 Recommendations for the transition to a single carcase schema

The consultation with processors and software providers showed they would welcome change to a single carcase data schema, but that the process needs to be well signalled, planned and delivered. Rezare Systems provides four key recommendations as detailed below.

1. Create a roadmap for the process and effectively communicate this to relevant stakeholders.
2. Ensure that the schema, replacement data transfer mechanism, and process are well documented, and that feedback from the participants is used to improve the documentation.
3. Use an iterative approach for the transition and later evolution of the data model. Proof of concept and phased implementation allows feedback, learning, and confidence building before the new schema becomes mandatory.
4. Actively support adoption by processors and their software providers and consider contribution to costs.

6.1 Create and communicate a roadmap for the process

Effective stakeholder engagement and change management will play an important role in the rollout of the single data feed initiative.

Processors, software providers, and representatives of MLA programmes reinforced the need for a coherent roadmap and advance communication that they can use to plan resourcing, understand how the changes fit with their priorities, and schedule activities that impact plant processes.

Interviewees emphasised that timelines for adoption need to be finite, clearly communicated, and allow practical timeframes for development, testing, parallel running and transition. They also noted that timelines should include close-out dates for deprecated services, so that these are not supported forever.

Based on these timelines, processors and vendors will then need to develop their own plans for software changes, testing, initial in-plant testing, and wider rollouts (including plant visits in some cases, and upgrades to supporting software systems in other cases).

As a result, we recommend a plan that operates at two levels:

- A high-level roadmap that communicates intent, priorities, and longer-term timeline; and
- Collaboratively developed timelines for specific implementation activities or changes.

The table below provides an initial framework that could be developed into a more complete roadmap, with each phase in turn supported by more detailed project plans. The table describes three main horizons:

1. Initial planning, communication, and proof of concept;
2. Extension and industrialisation of the proof of concept (formalising the specification, data validation, scalability, and flow of data across MLA programmes); and
3. Formal integration, including setting implementation dates for processors and software vendors, and decommissioning dates for deprecated interfaces.

Activity	H1		H2			H3	
Initiation Obtain commitment to staged delivery of the roadmap with an adaptive or agile process.							
Test Proof of Concept Demonstrate concept with NLIS data and one or two software providers. Connect to existing NLIS ingestion processes. Learn and adapt.							
Demonstrate LDL and data platform support Extend the concept to demonstrate how data could be delivered in near-real-time to LDL and ISC Data Platform.							
Demonstrate MSA Ingestion Work with one or two software providers to deliver the additional fields required by MSA and demonstrate connection to MSA data ingestion.							
Industrialise the Proof of Concept Develop a documented and scalable version of the new process and agree timelines for implementation by software providers and processors.							
Industrialise internal MLA data delivery Fully convert LDL and Data Platform population to use the new single schema feed.							
Fully integrate with NLIS and MSA Complete the data ingestion process so the single schema is the primary route for processor data.							

Actual timelines will depend on delivery capacity, support levels and expectations of processors and software vendors. Rezare Systems' assessment is that an overall timeframe of 30 months from initiation to end-of-life decommissioning of old interfaces is feasible.

Achieving this timeframe will require strong engagement from both MLA programmes and processors. It will also be dependent upon the level of resource that is available for allocation to the process, and the existing committed milestones for MLA programmes such as NLIS, LDL, and MSA.

Rezare Systems recommends that the roadmap should be developed in conjunction with, and supported by, a stakeholder communications and engagement plan. This plan should identify:

- The affected stakeholders, including MLA programme teams, processors, and software providers;
- The desired outcomes and success criteria for each stakeholder or stakeholder group;
- The risks that need to be actively managed for each stakeholder or group;
- The cadence, theme, and responsibility for communications;

- How the communications will be kept consistent and coordinated across MLA programmes (so that processors and software providers receive consistent messages); and
- How detailed plans will be developed for support and communication during testing and adoption activities.

6.2 Create documentation to support collaboration

Software providers emphasised that clear documentation of data structures, requirements, process flows, and API specifications would be required to support successful implementations.

- A data dictionary is essential to explain the purpose of fields, and to relate field names back to names previously used for similar data in prior systems. The data dictionary created to support development of the single carcase schema is included as Appendix A to this document.
- Required fields for different transactions or purposes should be clearly communicated in the messages or documentation for those APIs.
- API documentation should be provided when APIs are developed, including samples that make the API easier to adopt.

Within this documentation area, Rezare Systems specifically recommends that:

a. Both documentation and specifications should be made available in GitHub and through the ISC developer portal.
b. For current REST-based architectures we recommend using the Open API standard to describe interfaces, because tools exist to generate sample code for most languages and frameworks.
c. During proof of concept development, collaborative contributions should be welcomed from processors and software vendors. This can be achieved using GitHub through its *Issues* database and by software providers submitting *Pull Requests* with suggested improvements to API specifications.
d. If contributions from processors and software providers are accepted during proof of concept activities, guidelines for those contributions (including MLA ownership of the submitted issues and Pull Requests) must be clearly understood from the outset.
e. Regular reviews of the technical specifications should be scheduled during development. These should involve MLA programme stakeholders as well as interested processor and software vendor representatives. Such reviews typically reduce inconsistencies, improve the quality of documentation, and encourage greater engagement and adoption by participants.

6.3 Use a phased process and demonstrate proof of concept

Given the variety of support and roll-out models, the preference of both processors and software vendors is for a staged rollout, where the system can be proven at a single plant, tested in parallel operation, before committing to a rollout plan.

This approach should happen in at two levels:

- For a new API, MLA programme integration, or future feature: a single processor, vendor, and plant could undertake a first proof of concept to avoid the industry carrying excess costs for changes.
- Once wider implementation is underway, vendors and processors should still prove their own software changes at one plant, probably in parallel, before releasing more widely.

Software vendors noted that there could be competition concerns if the same vendor was always chosen to carry out proof of concept activities. Therefore, proof of concept involvement might need to be by rotation, or by randomised selection from a pool of willing participants.

6.4 Support adoption and contribute to costs

Costs will be incurred in both proof of concept and wider implementation of API changes. In the past sometimes a processor has absorbed the cost of development by their software vendor. In other cases, vendors have needed to invest and hope they can pass on the costs to processors through maintenance or upgrade costs.

- For proof of concept development, vendors and processors thought it appropriate that industry funding should be available.
- For formal API changes, vendors considered that a contribution to development costs would help with prioritisation and adoption. They offered recent examples of the AgVIC contribution to sheep NLIS changes.

7 Conclusion

This project has delivered a Single Carcase Data Schema that integrates the current data requirements of NLIS (and hence LDL), MSA, and animal disease reporting. The schema has been delivered through:

- A data dictionary, developed in both Microsoft Word and as GitHub Wiki documentation;
- Messages in JSON Schema format, delivered into the Integrity Systems GitHub repository.

During the project, MLA programme team members and representatives of both processors and processing software providers were interviewed. The focus of the MLA interviews was to ensure that the structure of the schema would enable business outcomes for the MLA programmes. All interviews also sought to understand the desirability of a single schema model, and the effort and timelines needed to transition to this model.

Section 6 provides recommendations that MLA and ISC should consider when planning a transition to a single carcase schema and standardised methods for ingesting data into MLA and ISC programme systems. The transition is likely to be more successful if stakeholders feel that they are consulted and engaged, and that a clear roadmap with timelines and responsibilities is developed. Both processors and software providers expressed their desire to collaborate with MLA and ISC to achieve effective outcomes.

Rezare Systems has completed an initial form of the data dictionary and JSON schema for carcase data. However, if schema specifications are to be relevant to the industry they must continuously evolve. For instance, after completion of this project's timeline, several changes were submitted to support sheep genetic analysis. Rezare Systems can assist MLA with further maintenance of the data dictionary and schemas if required.

Appendix

Appendix A: Data Dictionary

The data dictionary developed to support the Single Carcase Schema is available in GitHub at https://github.com/integritysystemscompany/carcase_data_standard/wiki/3.-Data-Dictionary

Rezare Systems

MLA Data Standards

Carcase Data Standard

Version 0.4

9 May 2019

Contents

1 Document Management

1.1 Referenced Documents

- NZ Farm Data Standards Animal Data Standards V1.0.1
- Schema.org business vocabularies developed through an open community process
- MSA Webservices and File specification documentation
- NLIS reference documentation - http://developer.integritysystems.com.au/nlisapi.html
- eNVD reference documentation - http://developer.integritysystems.com.au/envdapi.html
- Australian National Standard for the Development, Collection and Reporting of Animal Health Data through the Supply Chain
- Meat Ante-Mortem and Post-Mortem Data Standards

1.2 Review of this document

The intended audience of this document is requested to review and provide suggestions and feedback for improvement of this document. Please submit your comments to the authors mentioned in the Version Updates section below.

1.3 Version updates

Version No.	Section	Change
Version 0.1	Full document	Document created by Rezare Systems. anita.nagaraj@rezare.com andrew.cooke@rezare.com
Version 0.2	Data Dictionary	Used Organization from schema.org to represent a variety of organisational references.
Version 0.3	Full document	Internal review – Andrew Cooke
Version 0.4	Full document	Initial review - MLA

2 Introduction

2.1 Overview

Currently, MLA receives several carcase feedback data “feeds” from processors and other sources that are used to support industry programs and tools including but not limited to NLIS, LPA, MSA, LDL, DEXA, Market Information, CN30 activities, etc.

These data feeds are delivered to MLA via multiple delivery mechanisms (CSV, etc.) and much of the information included in the data feeds is duplicative. This places a costly burden on data providers (processors, software providers) to maintain and therefore has a negative effect on their ability to support change requests, as changes often must be made in multiple places, even for small updates.

The fragmented nature of the provision of feeds also increases the risk of defects and failure across systems and creates multiple security concerns and data management overheads.
MLA is developing capability to support these kinds of scenarios, providing infrastructure to among other benefits, bring duplicative data sets together. Therefore, there is an opportunity to develop functionality to create a single feed channel for processor data within MLA programs accessible by all MLA systems and with development to broader industry stakeholders.

This document is a deliverable from an MLA initiative that aims to create a common data schema for carcase and livestock processing data.

2.2 Approach and Outcome Statement

Adoption of a common vocabulary and data dictionary for exchange of carcase and processing information will:

- Allow programmes and initiatives to reference the common schema to reduce the burden of reinventing and maintaining data dictionaries;
- Support more integrated and standardised methods of data exchange that reduce development and maintenance costs for MLA and processors and may lead to more timely delivery and use of information.

This document drafts a common data model and defines a common data dictionary for current and anticipated MLA systems. Once reviewed by stakeholders, this document will be complimented by technical artefacts (such as JSON Schema) that make the information easier for software developers to use.

2.3 Abbreviations

For the purposes of this standard, the following definitions shall apply:

Term	Definition
NLIS	National Livestock Identification System
MSA	Meat Standards Australia
LDL	Livestock Data Link

LPA	Livestock Production Assurance
PIC	Property Identification Code
URN	Uniform Resource Name

3 Data Model

The set of data that is generally considered "Carcase Data" describes several physical entities. These include:

a. Information about the processing environment: the plant and chain, and the date and times of processing;
b. Information about consignments of animals received at the processor, and lots or batches of animals processed, including relationships with other entities, such as the source property and the owning consignee of the animals;
c. Information about individuals, including animal identification and "life data" characteristics of animals (such as species, breed, and sex); and finally
d. Observations or measures captured as visual scores and observations or by using objective measurement devices.

The UML Class diagram in

Object data model – Carcase information

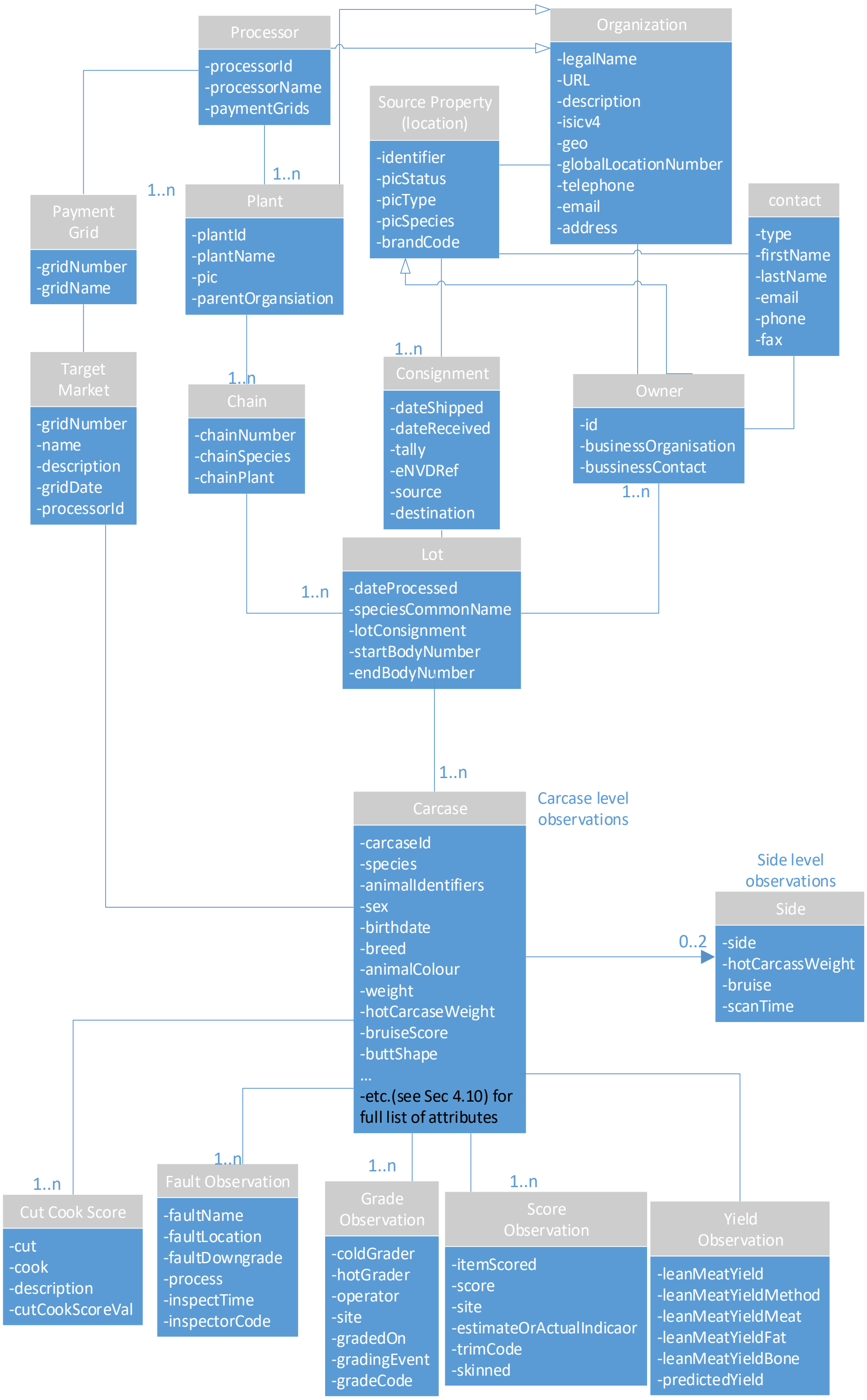


Figure 2 shows the classes and their attributes. The association in terms of multiplicity has been mentioned between the classes where possible.

Object data model – Carcase information

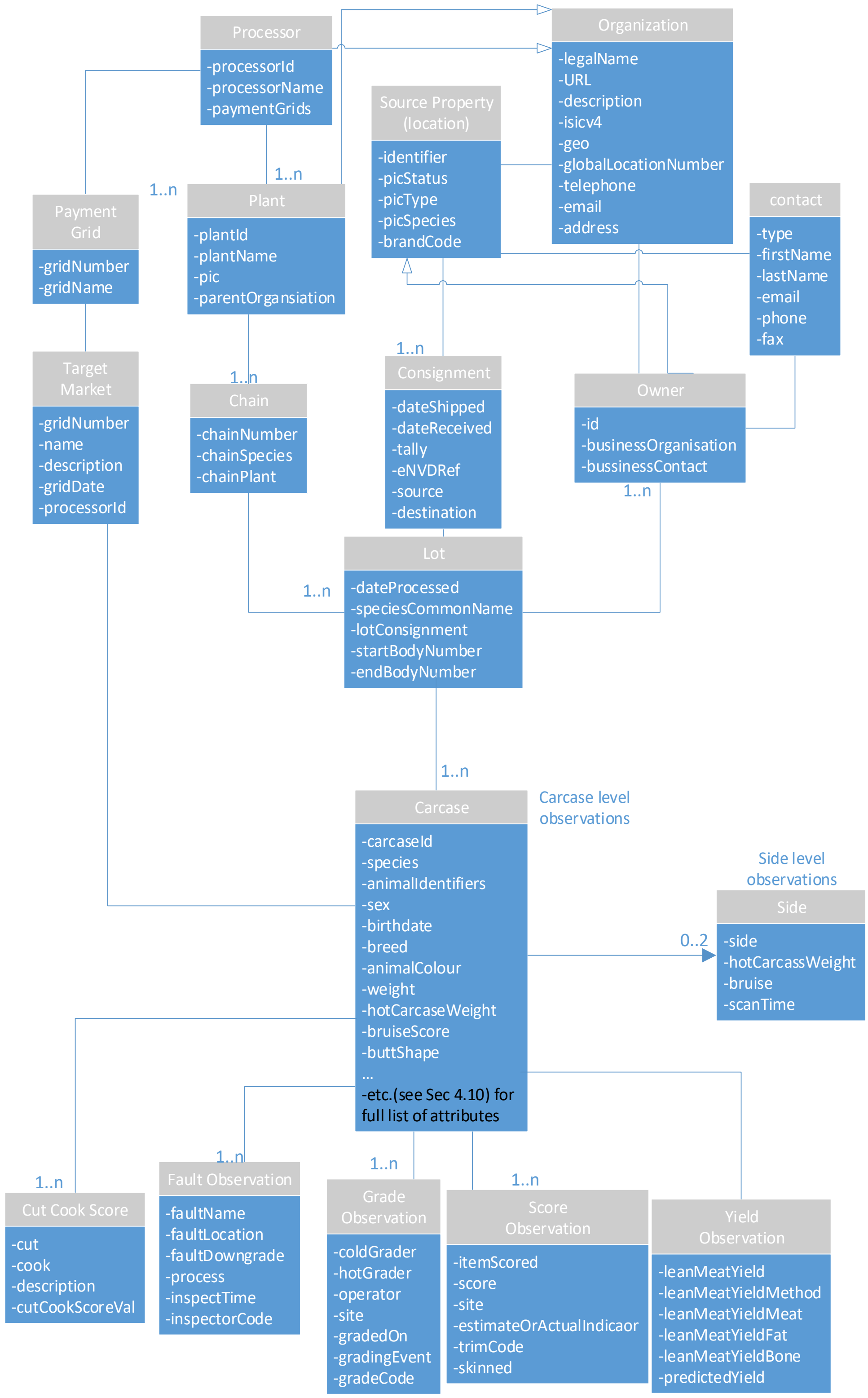


Figure 2: Class diagram for the carcase data schema. (Refer https://www.uml-diagrams.org/class-reference.html). Data Dictionary

The below items list the attributes relating to Carcase Data.

3.1 Organisation

An Organisation object (https://schema.org/Organization) was used to represent organisations and facilities. It forms a “base class” that can be used in specific roles to represent processors, plants, supply properties (PICs), and owners of livestock.

Attributes	MLA mapping attribute	Description	Data Type
			Organisation object https://schema.org/Organization
legalName		Legal Name of the organisation	String
url		URL available for the organisation	URL
description		Description field for the organisation	String
isicv4		The International Standard of Industrial Classification of All Economic Activities (ISIC), Revision 4 code for a particular organisation, business person, or place.	String
geo		Geo co-ordinates of the place. As described in schema.org	String
globalLocationNumber		The Global Location Number (GLN, sometimes also referred to as International Location Number or ILN) of the respective organisation, person, or place. The GLN is a 13-digit number used to identify parties and physical locations. Refer schema.org	String
telephone		Telephone number for the organisation	String
email		Email ID of the organisation	String
addresses		Physical, Business or Postal Addresses of the organisation	Array of Address objects https://schema.org/address
contactPoint		A contact point for a person or organisation	https://schema.org/ContactPoint

3.2 Processor

A Processor is a specific instance of an Organisation. It extends the organisation class as follows:

Attributes	MLA mapping attribute	Description	Data Type
		Extends the Organisation object. Refer Organisation object for all the attributes.	https://schema.org/Organization
identifiers *	MSA processor code, NLIS Slaughter processor code	Identifies the processor. Could use this attribute to record other types of identifiers e.g. Operator code – a person or business who owns cattle/carcases but does not own the abattoir.	Array of identifiers of type String (organisation.identifier)
name *		Name of the processor	String (organisation.name)
paymentGrids	grid	Describes the payment grids for the processor	Array of paymentGrid objects

3.3 Plant

A Plant a specific instance of an Organisation. It describes a registered location where livestock may be processed. A processor has one or more Plants.

Attributes	MLA mapping attribute	Description	Data Type
		Also, an organisation, a sub-organisation of a processor. Extends the Organisation object	https://schema.org/Organization
identifier *	Plant, State Establishment Code	Identifies the processing plant or establishment. AUS-MEAT Accredited Establishment Number	String (organisation.identifier)
name *		Name of the processing plant or establishment	String (organisation.name)
pic		PIC of the plant	String
parentOrganisation		Processor to which the plant belongs	Organisation.parentOrganisation

3.4 Chain

A chain within a Plant identifies the processing chain by number and may optionally specify the species that the chain processes.

Attributes	MLA mapping attribute	Description	Data Type
chainNo	chainNo (MSA)	Chain number used for the carcase. Valid values are 1-9	Integer
chainPlant		Reference to the plant to which the chain belongs	Plant object
chainSpecies		Species processed by the chain (optional)	String

3.5 Target Market

A target market identifies a domestic or export market with a specific set of requirements. Procurement may be taken to fulfil the requirements of a target market, or carcases may be allocated to a target market. A target market may define a unique payment grid for a processor.

Attributes	MLA mapping attribute	Description	Data Type
gridNumber *		Unique identifier that identifies the market grid	String
name *		Name given to the grid	String
description		Placeholder to describe the details for the grid	String
gridDate		Date on which the grid was published	Date
processorId		Identifier for the processor	Processor.identifier

3.6 Source Property

The source property (or source location) is usually identified by its Property Identification Code (or PIC). A source property is a specific instance of an organisation, with these specific fields:

Attributes	MLA mapping attribute	Description	Data Type
		Extends the Organisation object with a few additional attributes	https://schema.org/Organization
identifier *	PIC	Property Identification Code. Identifies the property.	String(organization.identifier)

Attributes	MLA mapping attribute	Description	Data Type
picStatus		Status of the PIC	String
picType		Type of the PIC	String
picSpecies		Indicates the animal species that the property houses	Array of strings
brandCode		Stock brand identifier. Used only in WA	String

3.7 Owner

The owner of a consignment of animals may be an Organisation (https://schema.org/Organization) or a Person (https://schema.org/Person). For the purposes of this document, an Owner is a specific instance of an Organisation. In the processing context, the owner may be:

- The organisation that owned the animals prior to their sale to the processor (often, but not necessarily the Source Property); or
- The organisation that has retained ownership of the animals and contracted their processing.

Attributes	MLA mapping attribute	Description	Data Type
		Owner – is an Organization or Person	
businessID *		Identifier of the owner business organisation	String(organization.identifier)
businessOrg *		Name and other details of the owner organisation	Organisation object https://schema.org/Organization
businessContact		Contact details	ContactPoint object https://schema.org/ContactPoint

3.8 Consignment

A Consignment documents a specific set of animals delivered from a source property to a processing plant. In the Open Applications Group business language, a Consignment is represented by a “Shipment”. A consignment is expected to be accompanied by a National Vendor Declaration.

Attributes	MLA mapping attribute	Description	Data Type
dateShipped *		Date on which the consignment of animals was sent from the supply property	Date

Attributes	MLA mapping attribute	Description	Data Type
dateReceived *		Date on which the consignment of animals was received at the processor	Date
tally *		Number of animals in the consignment	Integer
eNVDRef *		Electronic National Vendor Declaration reference number Refers to the Consignment with the reference number or Serial Number of the NVD Document or international equivalent in which animals were delivered to the processor	String
source		Provides the property details of the source of the consignment. This acts as a location sub-object whose identifying information is an identifier such as a PIC of the source property.	Organisation object
destination		Provides the details of the destination of the consignment. This acts as a location sub- object whose identifying information is an identifier such as a PIC of a plant	Organisation object

3.9 Lot

A Lot describes a group or batch of animals from a single Consignment that are processed together. A Lot is therefore linked to the National Vendor Declaration that accompanied the Consignment but may represent a subset of animals that are processed at a time to meet logistical requirements.

Attributes	MLA mapping attribute	Description	Data Type
dateProcessed *		Date on which the animals were processed	Date
speciesCommonName	Species	Name of the Species the animal belongs to	String
startBodyNumber	bodyNumber	Lot start body number (matching values across same establishment, kill date, and chain)	Integer
endBodyNumber	bodyNumber	Lot end body number (matching values across same establishment, kill date, and chain)	Integer
lotConsignment *	Lot	Reference to the Consignment in which animals were delivered to the processor	Consignment object

3.10 Carcase

A carcase (also called carcase) identifies a single animal which is processed at a plant. A carcase has identifying information, attributes describing the animal, and then a number of observations. This table has a column for Species, which is filled when an attribute is only applicable to a single species, such as beef cattle or sheep.

Attributes	Species	MLA mapping attribute	Description	Data Type
carcaseID *		bodyNumber	Identifier assigned to carcase by processor	Integer
species *		species	Species of the animal	Enumeration (Cattle, Sheep, Goat, Pigs) (Refer NLIS Interface Specs https://www.nlis.com.au/Files/1/Pdf/nlis-interface-specification-Part2%20(190416).pdf)
animalIdentifiers *			URN identifier of an externally meaningful ID such as EID, birthTag, currentTag, birthHerdCode etc	Array of identifiers
sex			The gender or sex of the animal. This may be combined with state information to indicate the fertility status of the animal.	Enumeration: M(Male), F(Female), B (bull or entire) NULL for unknowns.
birthdate			The date on which the animal was born	Date
breed			Array of string values indicating the breed of the animal.	Array of Strings (For Breed Codes, Refer Appendix C https://www.nlis.com.au/Files/1/Pdf/nlis-interface-specification-Part1%20(190416).pdf
animalColour			The colour of the animal	String

weight			Live animal weight prior to slaughter in kg.	Float
hotCarcaseWt		HSCW (Beef), CWT (Sheep)	Hot Standard Carcase Weight	Float
bruiseScore	Beef (could be used for Sheep in future)	Bruise Score - beef	Where muscle is bruised, it qualifies as a scorable bruise if; an area of muscle (exposed) by trimming into the muscle tissue to the extent that it cannot be covered by a 100mm diameter circle or an irregular shaped equivalent area.	Float
buttShape	Beef		Optional feedback for Beef assessed from A - E. A being most convex and E being most concave	Enumeration (A, B, C,D,E) (optional)
grfatDepth	Sheep		Tissue depth (fat + muscle) in mm at the GR measurement site	Float
fatScore			Score assigned to the fat	Integer (1 to 5)
fatGrade			Species-specific coding of fat grade at plant. This is derived from fat depth or assessed separately	String
fatColour		FC	From 1 (pure white) to 9 (yellow)	Enumeration (1,2,3,4,5,6,7,8,9)
fatDistribution			Distribution of the fat	Float

conformationGrade			Species-specific coding of conformation at plant	String
hangMethod		Hang	Hang Method employed	Enumeration (TX,TL,AT,TC)
hormoneGrowthPromotant	Beef	Hgp	Indicates if HGP has been used on the animal.	Enumeration (Y, N)
meatColour		MC	Coding for the colour of the meat.	Enumeration (1A, 1B, 1C, 2, 3, 4, 5, 6, 7)
marblingMSA	Beef	MSAmb	The MSA marbling system provides an indication of the fineness of distribution and the size of marbling pieces. The AUS-MEAT Marbling system provides an indication of the amount of marbling in beef. MSA marbling reference standards and AUS-MEAT Marbling reference standards can be used in harmony to provide more detail about the product. Marbling is the fat that is deposited between individual muscle fibres of the longissimus dorsi muscle. The assessment of marbling provides an indication of distribution and	Integer

			piece size as well as the amount of marbling. The steps between the MSA marbling standard are judged to tenths for grading, creating a score range from 100 to 1100 in increments of ten.	
IMF			Intra Muscular Fat measured as a percentage	Float
marblingAUS	Beef		Marbling is an assessment of the chilled carcase and scored by comparing the proportion of marble fat to meat at the surface of the assessment site which lies within the M. logissimus dorsi boundary.	Integer
MSAIndex			A composite index calculated by MSA based on predicted scores for multiple cut and cooking methods.	Float, 2 decimal places
plantBoningRun		plantBoningRun (MSA)	MSA Plant Boning Run	String (optional field)
eyeMuscleArea	Beef (could apply to Sheep also)	EMA	Eye Muscle Area Measuring in square cm using an AUS-MEAT grid	Float
p8Fat	Beef		Assessing the fat depth of cattle at the P8 (rump)	Float

			site, which reflects the percentage of fat in the carcase and the likely yield of saleable meat.	
bosIndicus	Beef		Estimated % bos indicus	Float
residueFree			Boolean value indicating presence or absence of residue	String
ribFat			Measurement in millimetres of the thickness of Subcutaneous fat at a specified rib.	String
pHu		pHu	Ultimate pH is a measurement of lactic acid within the muscle. Measurements are taken from a pH probe that is calibrated daily before each grade. The optimum pH level of meat is 5.70 and below, with levels above this being downgraded to non-MSA product. When measured correctly, pH is one of the most accurate indicators of eating quality and is an essential part of the grading process. The Ultimate pH is affected by treatment,	Float

			temperament and condition of the live animal. The speed at which pH declines from the live state (approx. pH 7.0) to the Ultimate pH affects eating quality. This is affected by post-slaughter treatments such as quantity of electrical inputs and temperature."	
dentition			Development of teeth and their arrangement in the mouth	String (Optional)
humpCold	Beef		Height of the hump when cold	Float
humpHot	Beef		Height of the hump when Hot	Float
ossificationCold			Estimated age of the animal based on ossification assessed in the carcass when cold. Maturity scoring provides a scale for the assessment of physiological age of a bovine animal. The term refers to the cartilage turning to bone in the spinous processes in three sections along the backbone - sacral (tail), lumbar (loin) and thoracic (head). The process starts in	Float

			the sacral region in the form of red spots and as the process increases turns to hard, yellow bones. The shape and colour of the rib bones are also used to determine scores. Maturity is measured in increments of ten with the lowest being 100 and the highest being 590.	
ossificationHot			Estimated age of the animal based on ossification assessed in the carcass when hot. Maturity scoring provides a scale for the assessment of physiological age of a bovine animal. The term refers to the cartilage turning to bone in the spinous processes in three sections along the backbone - sacral (tail), lumbar (loin) and thoracic (head). The process starts in the sacral region in the form of red spots and as the process increases turns to hard, yellow bones. The shape and colour of the rib bones are also used to	Float

			determine scores. Maturity is measured in increments of ten with the lowest being 100 and the highest being 590.	
loinTemperature			Temperature assessed at the site of loin	Float
rinse			Indicates if the carcass has been rinsed or not	Boolean
Rib	Beef		Quarter site of carcase for assessing	Integer (Min value 5 , Max value 13)
targetMarket			The market (or grid) the processor purchased the animal for	String
feedType			Type of feed the animal was on	String
daysOnFeed			Number of days the animal was on feed	Integer
milkFedVealer	Beef		Indicates whether the veal was fed or milk or not	Boolean
hidePullerDamage			Indicates the degree of damage.	Integer - Valid values 0 to 4.
sides				Array of Side object
scoreObservations			Scoring details for fat or muscle	Array of scoreObservation objects
gradeObservations			Provides grading details for the carcase. Relevant carcase attributes will be entered during different grading events. Possible values for grading events could be - Carcase,	Array of gradeObservation objects

			Veterinary/Inspector, Meat Quality.	
carcaseYieldObservation			Describes details about the meat yield	yieldObservation object
cutCookScores			Provides for specifying collection of cut cook scores	Array of cutCookScore objects
faultObservations			Describes primary faults in the carcase assessed by the processor	Array of faultObservation objects

3.11 Side

Where large carcases (typically beef cattle) are split into sides, some observations may be recorded on each Side.

Attributes	MLA mapping attribute	Description	Data Type
side		Indicates the side of the carcase- left, right. 1 or 2, OR L or R	String
hotCarcaseWeight	LeftHSCW or RightHSCW	Describe the weight of an animal, particularly when the animal is sold over the hooks.	Float
scanTime		Time when the scan was conducted	String (HH:MM format) (Optional)
bruise		Number that describes the category of bruising.	Integer (values 1 to 9) (Optional)

3.12 Score Observation

The Score Observation describes the measurement or observation of a single score, including details of the code or mechanism involved.

Attributes	MLA mapping attribute	Description	Data Type
itemScored		Item being scored – Fat or Muscle	Enumeration (Fat, Muscle)
score		Score assigned to the muscle or fat	String
site		Indicates the fat site or muscle site	Enumeration: Fat, Muscle

Attributes	MLA mapping attribute	Description	Data Type
estimateOrActualIndicator		Specifies if this is an estimate or actual indicator	Enumeration: Estimate, Actual
trimCode		Trim Code assigned	String
skinned		Boolean to indicate if the carcase is skinned or not	Boolean

3.13 Grade Observation

The Grade Observation allows recording of grades by an operator.

Attributes	MLA mapping attribute	Description	Data Type
coldGrader		Name of the person conducting the grading event	String
hotGrader		Name of person assessing carcases hot.	String
operator		Name of the person operating the chain	String
site		Indicates the fat site or muscle site	Enumeration (Fat, Muscle)
gradedOn		Date and Time when the grading event was conducted	Datetime(schema.org)
gradeCode		Grading Code assigned	String. (Minimum – 0, Maximum – 999999999) e.g. 0,1,3,4,7,8,9 or a combination of values in ascending order eg 3, 24, 139, 134789, etc
gradingEvent		Relevant carcase attributes will be entered during different grading events.	Enumeration (Carcase, Veterinary/Inspector, Meat Quality)

3.14 Yield Observation

A Yield Observation supports the recording of yield predictions or estimates using a variety of methods.

Attributes	MLA mapping attribute	Description	Data Type
leanMeatYield		Final meat yield (in %) after boning out.	Float

Attributes	MLA mapping attribute	Description	Data Type
		It is the value describing the proportion of a carcase that is lean meat (muscle) Lean meat yield comprises of 3 things – the proportion of meat, fat and bone.	
leanMeatYieldMethod	lmyMethod (MSA)	MSA related fields for lean meat measurements	String
leanMeatYieldMeat	lmyMeat (MSA)	It is the value describing the meat portion of the lean meat yield value above.	Float
leanMeatYieldFat	lmyFat (MSA)	It is the value describing the fat portion of the lean meat yield value above.	Float
leanMeatYieldBone	lmyBone (MSA)	It is the value describing the bone portion of the lean meat yield value above.	Float
predictedYield		The predictive LMY% algorithm is based on hot standard carcase weight and GR tissue depth (sheep) or P8 fat (beef).	Float

3.15 Cut-Cook Score

The MSA model predicts Cut-Cook scores for a range of cut and cooking combinations, for each carcase.

Attributes	MLA mapping attribute	Description	Data Type
cut		Cut name	String
cook		Cooking method name	String
description		Description for the cut cook score	String
cutCookScore		Value for Cut Cook Score	Float

3.16 Fault Observation

One or more fault observations may be recorded for a carcase. Where data is aggregated, these may be reported for a Lot instead.

Attributes	MLA mapping attribute	Description	Data Type
faultName		Specifies the fault or defect in the carcase. This could be different from bruising score. Fault can be any disease or fault. E.g. Arthritis, pleurisy, bruising, refer list on farm data standards website. http://www.farmdatastandards.org.nz/wp-content/uploads/2016/03/DINDS-Animal-Standard-V1.0.1-2014-11-20.pdf.	String
faultLocation		Body part or system affected for FaultName	String
faultDowngrade		Carcase value downgraded due to Fault. Value: True/False	Boolean
inspectionProcess		Production process. Typically indicating Post Mortem inspection or Ante Mortem inspection. (Referenced from Slaughter Disease and Defect Standards)	Enumeration (postmortem, antemortem)
inspectTime		Inspection date and time. (Referenced from Slaughter Disease and Defect Standards)	DateTime (schema.org)
inspector		Code number to identify inspector - Unique number as issued by the processor for the inspector. (Referenced from Slaughter Disease and Defect Standards)	String

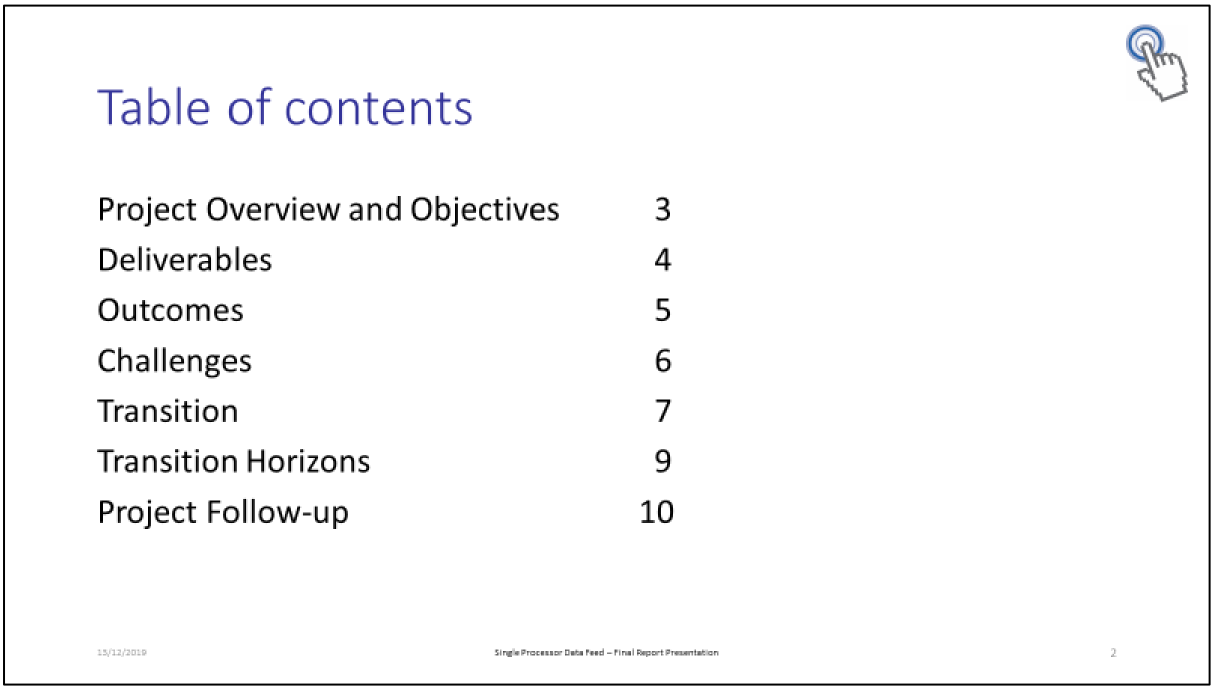
3.17 Payment Grid

This entity describes a payment grid used to deliver payments between a processor and the owner of the animals. When used for market intelligence, a payment grid has additional information (potentially including price by grade information).

Attributes	MLA mapping attribute	Description	Data Type
gridNumber		Identifies the payment grid	String
gridName		Name of the payment grid	String

- End of document

Appendix B: Final Report Presentation



Project Overview and Objectives

- Explore the opportunity for a single schema and route for data from processors to be used for multiple MLA business outcomes;
- Document an initial common data model and schema;
- Propose approaches that could be used to transition to a common schema; and
- Understand the level of effort (internal and external) that would be involved.

15/12/2019 Single Processor Data Feed – Final Report Presentation 3

Deliverables

- Meet with MLA stakeholders to understand existing data and requirements.
- Meet with processors/software vendors to understand their needs and challenges.
- Draft carcase data dictionary and an initial JSON schema.
- Document approaches and transition options.
- Final Report and Presentation.

15/12/2019 Single Processor Data Feed – Final Report Presentation 4

A single schema could deliver:

- Better data validation, quality and integrity
  - Self-documenting schemas, better error correction, clearer relationships between PICs, owners, and other interested parties.
- Improved communication of roadmap and more manageable maintenance
  - Coordination across MLA teams, reduction of legacy maintenance.
- Increased timeliness in data delivery, processing, and analysis
  - Easier to deliver data as it becomes available, earlier delivery to LDL.
- A framework for iterative delivery of new initiatives
  - Easier to extend, and to integrate new data sets and functionality.

15/12/2019 Single Processor Data Feed – Final Report Presentation 5

But faces these challenges:

- Improve identity model and consider permissions.
  - Handle PIC, owner or interested party, and users without PICs.
  - Consider how to incrementally "opt-in" to release data for different uses.
- Transition from variety of legacy interfaces across MLA
  - Processors and vendors support a variety of interfaces for different MLA systems, and different operating models.
- Implementation and rollout considerations
  - A variety of different plant, processor, and security configurations to manage.
- Cost and support of transition
  - Transition includes not just "who pays" but how to support changes.

15/12/2019 Single Processor Data Feed – Final Report Presentation 6

Transition approach

- Communicate the timeline
  - Greater detail in near-term/specific projects.
  - Include "end of service" dates.
- Formal learning and feedback approach
  - Use "proof of concept" to test new approaches and incorporate feedback.
  - Incorporate lessons into wider releases.
- Contribution to costs
  - Incentivise participants in proof of concept and early adoption.
- Make it easy to learn and adopt
  - Use tools that make APIs and schema "self documenting".
  - Document and demonstrate best practice implementation approaches ("how to").

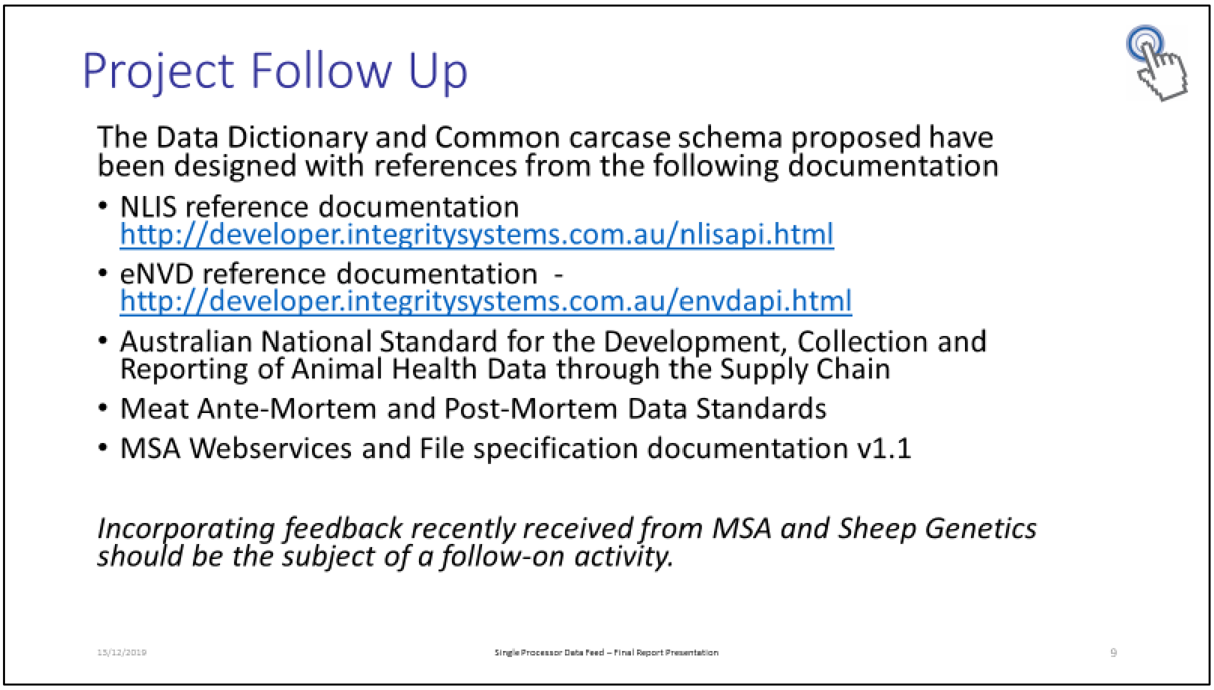
15/12/2019 Single Processor Data Feed – Final Report Presentation 7

Indicative timeline

Activity	H1		H2			H3	
Initiate	■						
Proof of Concept interface		■					
Extend to MLA Data Platform and LDL		■	■				
Industrialise the POC interface			■	■	■		
Industrialise MLA Data Platform and LDL flows					■	■	■
Mandate for NLIS use, communicate transition						■	■

Actual timelines will depend on delivery capacity, support levels, and expectations of vendors/processors

15/12/2019 Single Processor Data Feed – Final Report Presentation 8


Project Follow Up
The Data Dictionary and Common carcase schema proposed have been designed with references from the following documentation
• NLIS reference documentation http://developer.integritysystems.com.au/nlisapi.html
• eNVD reference documentation - http://developer.integritysystems.com.au/envdapi.html
• Australian National Standard for the Development, Collection and Reporting of Animal Health Data through the Supply Chain
• Meat Ante-Mortem and Post-Mortem Data Standards
• MSA Webservices and File specification documentation v1.1
Incorporating feedback recently received from MSA and Sheep Genetics should be the subject of a follow-on activity.
13/12/2019
Single Processor Data Feed – Final Report Presentation
9