

final report

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Red Meat Co-investment Committee: Lamb supply chain & animal information RD&E plan

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Executive summary

Overview

This plan presents a draft RD&E strategy to improve efficiency of the lamb value chain including the role of individual animal information (IAI). The plan is aligned with other national sheep meat RD&E strategies.

The present supply chain for Australian lamb from seedstock through to retail product is somewhat disjointed with very little information flowing between sectors in either direction. This RD&E plan presents a strategy to improve efficiency and information flow with the aim of developing a true value chain for the industry.

Individual animal identification for the Australian sheep industry is the subject of considerable debate, conjecture and angst for some, whilst for others it creates excitement about opportunities it creates. While the two are not inextricably linked, the topic of individual animal identification almost immediately turns to electronic identification (EID), a subject upon which opinions again vary significantly.

This report does not seek to dictate industry policy on the adoption of EID or any other form of individual identification. However, it does recognise that the adoption of EID by some or all of the Australian sheep industry is a high probability, in part to improve value chain efficiency. Accordingly, this report provides a plan for RD&E to enhance existing sheep identification systems and for new initiatives to facilitate further implementation of EID depending on policy and industry support.

The following are key findings from the review of the present situation and previous RD&E, discussions with many current and potential participants and independent consideration of all the issues:

1. Over the last decade, there has been a significant body of work undertaken, by regulators, researchers, extension staff, processors, leading farmers and other commercial entities on individual and mob identification.
2. There is strong support for the role of animal identification from a traceability, biosecurity and market access perspective. The debate arises as to whether individual electronic identification is needed (noting that IAI systems currently have very limited adoption) or whether mob identification is sufficient.
3. The commercial sector (software and hardware systems) is highly active and competitive. There is little market failure in this space. It will be important not to crowd out commercial operators in any future activities.
4. Fundamental research (i.e. starting again) should not be a priority for RMCiC Partners. Emphasis should be placed upon building on what has already been done – that is, on development and extension.
5. State agencies all support mob identification and their support for IAI / EID depends on the type of information that can be transferred using IAI and its benefit versus cost. Some agree that IAI is inevitable, but their commitment to invest specific resources at this time, while the industry position is unclear, varies.

6. Individual lamb identification does have a potential role in value-based marketing, for example facilitating producers to be paid on meat yield.
7. The benefits of IAI are not clear to all sectors and can only be determined after present systems are improved and more efficient systems are developed including better transfer and interpretation of data.

The vision for this Plan is of a streamlined lamb value chain along which information on animal management, genetics, health status, carcass yield and product quality flows freely in both directions, increasing the overall productivity and efficiency of lamb production, as well as delivering other potential benefits such as improved market access, increased biosecurity, reduced costs and increased consumer satisfaction and loyalty.

This Plan foresees an RD&E investment of approximately \$13.5 million over four years across three key outcome areas. It also makes recommendations in relation to a governance structure to oversee implementation of the Plan and the appointment of a part-time project officer (\$0.4 million) for a total investment of \$13.9 million. The Plan is designed to contribute to the increased information flow, management and utilisation that is targeted to deliver an increase in lean meat yield of 0.2% pa whilst maintaining or improving eating quality.

The plan – at a glance

Three key outcome areas (investment strategies) form the basis of this RD&E Plan. They are:

Outcomes	Projects
1. Collect and transform data into information of value to participants	1.1 Develop technology for real-time assessment of meat quality attributes and meat yield in the live animal (leverage off beef work if successful)
	1.2 Develop and/or demonstrate better technologies for in-abattoir measurement of sheep meat and carcasses based on specification, meat yield and meat quality attributes, especially the linkages between NLIS and carcass tags
	1.3 Develop expert systems that integrate information to assist producers to interpret and utilise data collected on farm and via processors as a result of projects 1.1 and 1.2
	1.4 Develop systems to collect animal health data and interpret and transfer this data to producers and animal health / biosecurity agencies
2. Improve sharing of information along the value chain	2.1 Analyse the lamb value chain and points for value-add and intervention; quantify benefits of tracking animals from farm to processing to retail at each point in the chain
	2.2 Investigate social, commercial and financial opportunities and barriers to information collection, sharing and use throughout the value chain
	2.3 Develop and extend national standards for information exchange along the pipeline – language, formats

Outcomes	Projects
	2.4 Develop technology to allow processors / consumers to establish the 'provenance' (origin, at property or individual animal level) and credence of sheepmeat products
3. Demonstrate, communicate and extend the benefits of improved information flow	3.1 Establish a forum for the exchange of information and improved communication between participants in the value chain
	3.2 Design, implement, demonstrate and evaluate a number of integrated information systems; quantify costs and benefits of these
	3.3 Develop and implement a national extension / education program on lamb value chain, linked to 3.2 but also including stand-alone modules (e.g. through Making More from Sheep)
	3.4 Examine role of IAI in enhancing industry logistics

It is envisaged that the successful completion of these projects would lead to the following outputs:

- System(s) to allow interpretation and use of data by producers;
- System(s) to collect and communicate animal health data from abattoirs;
- Understanding of the 'what's-in-it-for-me' for individual participants of interventions to improve information exchange, incorporating both economic and cultural/social factors;
- Standardised definitions and rules to facilitate information exchange along the chain;
- Technology to allow retailers/consumers to establish the provenance (source, environmental and welfare credentials) of a lamb product;
- Establishment of a vehicle (a forum) by which value chain participants can exchange information and ideas – acknowledging that there will be commercial constraints to the information that is shared;
- Demonstration and validation of integrated value chain(s) systems;
- Delivery of extension and training programs; and
- Establishment of baseline data that can be used to monitor progress of IAI.

A benefit/cost analysis of the R,D&E Plan, focusing only on technology to collect and transform data along the chain and the price premiums realised as a result, estimates a benefit/cost ratio of between 6.52 (pessimistic) and 8.73 (core scenario).

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Abbreviations used in this document

ALPA	Australian Livestock and Property Agents
AMPC	Australian Meat Processor Corporation
ASBV	Australian Sheep Breeding Value
BCA	Benefit/cost analysis
CCW	Chilled carcase weight
CIS	Client and Innovation Services (of MLA)
CRC	Cooperative Research Centre
CRRDC	Council of Rural Research & Development Corporation Chairs
DAFWA	Department of Agriculture and Food Western Australia
DEEDI	Department of Employment, Economic Development and Innovation (Qld)
DPI	Department of Primary Industries
DPIPWE	Department of Primary Industries, Parks, Water and Environment (Tas)
EID	Electronic identification
EMD	Eye muscle depth
H(S)CW	Hot (standard) carcase weight
IAI	Individual animal information
LDL	Livestock Data Link
LMY	Lean meat yield
LPA	Livestock Production Assurance
MLA	Meat & Livestock Australia
MSA	Meat Standards Australia
NAHIS	National Animal Health Information System
NAIT	National Animal Identification and Traceability (scheme, NZ)
NLIS	National Livestock Identification Scheme
NLRS	National Livestock Reporting Service
NVD	National Vendor Declaration
OTH	Over-the-hooks
PIC	Property Identification Code
PIMC	Primary Industries Ministerial Council
PISC	Primary Industries Standing Committee
PIRSA	Department of Primary Industries and Regions South Australia
RFID	Radio frequency identification
RD&E	Research, development & extension
RMCiC	Red Meat Co-investment Committee
SAMRC	Southern Australian Meat Research Council
SARDI	South Australia Research & Development Institute
RTO	Registered Training Organisation
SG	Sheep Genetics
TIAR	Tasmanian Institute of Agricultural Research
UNE	University of New England

1. Rationale

1.1 Planning context

This Plan has been prepared for the Red Meat Co-investment Committee (RMCiC), representing the major players in red meat research, development and extension (RD&E): Meat & Livestock Australia (MLA); State Departments of Primary Industries; CSIRO; CRCs for Beef Genetic Technologies and Sheep Industry Innovation; Department of Agriculture, Fisheries & Forestry; and member faculties of the Australian Council of Deans of Agriculture.

The Plan is one of 4-5 implementation plans for key program areas arising from the **National Sheepmeat Production RD&E Strategy**. The National Sheepmeat Production RD&E Strategy was developed by the RMCiC under the leadership of the NSW Department of Primary Industries (NSW DPI) and MLA and published by the Primary Industries Standing Committee (PISC) in January 2010. The Strategy identifies seven strategic imperatives for sheepmeat RD&E that align with Government and industry priorities.

The **Sheepmeat Industry Strategic Plan (SISP) 2010-2015** captures industry priorities. It contains a number of deliverables, relevant to this Plan, that are related and additional to those of the National Sheepmeat Production RD&E Strategy.

Finally, the **MLA Strategic Plan 2010-15** contains several imperatives and strategies of relevance to this Plan.

The specific elements of each of these plans with relevance to this Plan are reproduced in 'Appendix 1: Relevant excerpts from related industry plans'.

1.2 Objective

This RD&E Plan aims to describe a path which will lead to a streamlined lamb value chain along which information on disease, carcass yield and product quality flows freely, increasing the overall productivity and efficiency of lamb production as well as delivering other potential benefits such as increased biosecurity and on-farm animal welfare. The Plan is designed to contribute to the increased information flow, management and utilisation that is targeted to deliver an increase in lean meat yield of 0.2%¹ pa whilst maintaining or improving eating quality.

¹ Target agreed with Project Development Team, 25 June 2012.

2. Situation analysis

2.1 Overview of the sheepmeat value chain

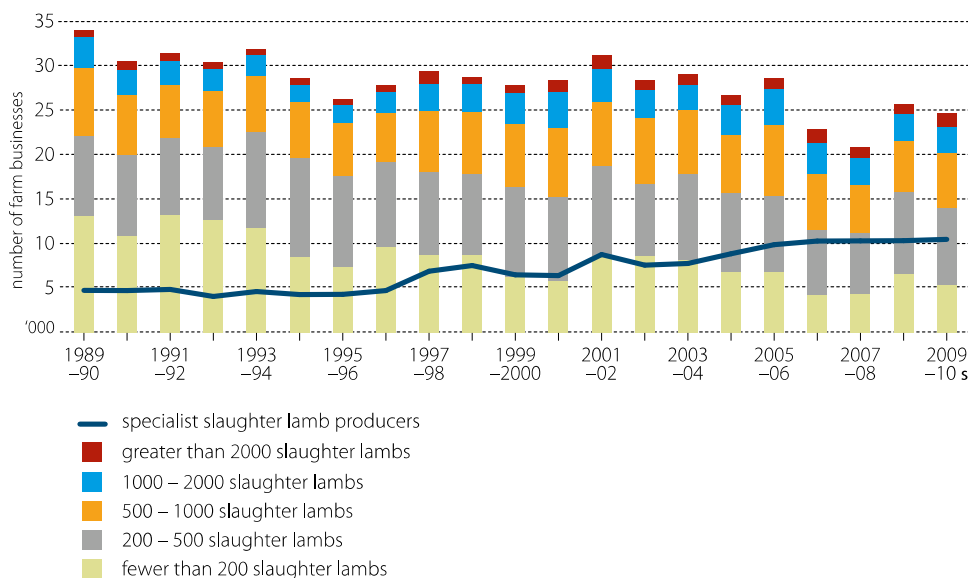
Production

The Australian lamb industry is now a profitable and growing industry that has changed significantly in the last 20 years. These changes are well documented (e.g. ABARES 2011, CIE 2008a, MLA 2009, PISC 2010) and are not repeated here.

However, there are some key statistics pertinent to the development of an RD&E plan for improved use of individual animal or mob information. This information has been referenced from the above documents, plus others such as Goers & Craig (2008) and Martin & Phillips (2011).

- Around 19,240 Australian broadacre farms are classified as slaughter lamb producers (those farms that sold more than 200 lambs for slaughter in 2009–10).
- Around 9,400 slaughter lamb producers earn more than 20% of their total farm receipts from the sale of slaughter lambs and are classified as specialist slaughter lamb producers.
- The scale of lamb producers varies significantly – there are few large producers (>1,000 lambs per year) but many smaller producers (< 500 lambs per year). The number of producers with less than 200 lambs has declined in the last 20 years.

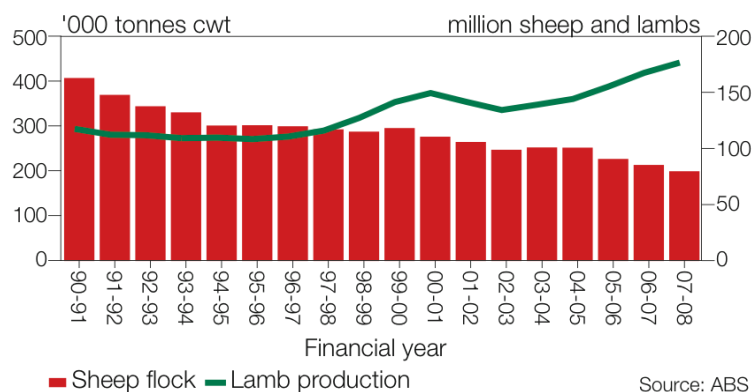
Figure 1 – Number and size of slaughter lamb-producing farms 1989-90 to 2009-10



- Lamb producers' average income has increased markedly over the last three years and in real terms is the highest it has been for over 20 years (as is the level of investment in new equipment).

- The total sheep flock is approximately 74 million, having increased slowly over the last couple of years from its lowest point since the early 1900s. Numbers by state are NSW 25m, Victoria 15m, WA 16m, SA 10m, Qld 4m and Tasmania 2m. However, the proportion of ewes is at record levels, which provides an opportunity for some flock rebuilding depending on seasonal conditions and relative commodity prices.
- Despite the low total sheep numbers, the number of slaughter lambs has remained fairly constant (increased by 4% over the last 10 years), with the slaughter number in 2011-12 expected to be 18.4m.

Figure 2 – Sheep flock (millions) and lamb production '000 tonnes cwt



- Average carcase weight has increased by 10% over the last 10 years (20% over 20 years), while total lamb production increased by 14% over the same period.
- There is no doubt that leaner lambs are being produced but there is limited industry data on fat scores or other measures of fat, nor on how many producers sell and meet preferred buyer specifications. It is an AUSMEAT mandatory requirement for accredited abattoirs to provide feedback on fat and hot standard carcase weight to vendors, but no summary data is available and there is no central reporting.
- The National Livestock Reporting Service (NLRS) collects data on weight and fat cover from pens of lamb sold at saleyards but there is no data collected for direct sales to processors. In recent years, data collected by NLRS has not been collated. If individual animal identification (IAI) was used throughout the industry and was linked to weight and fat measures within the abattoir, there would be data available to determine weight and fat on a regional and seasonal basis and over time. This could be used to assess industry progress in meeting required market specifications.
- Lamb consumption per head in Australia was about 18kg in 1980, declined to about 12kg in 1993 and now appears to have stabilised at a level between 11 and 12kg.
- The total value of the sheepmeat industry is \$4.32b, a 93% increase since 1998-99.

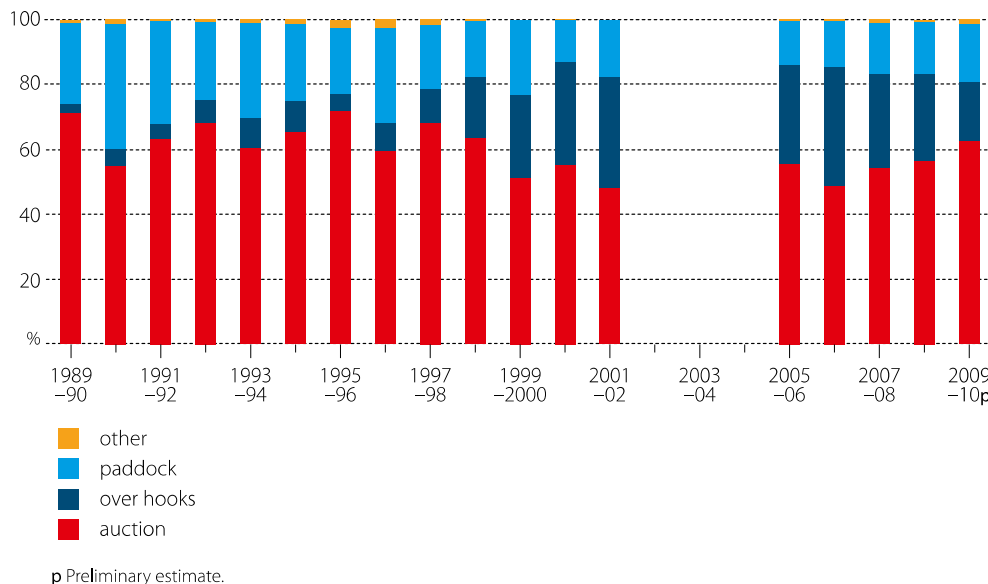
- Total exports in 1994 were \$190m compared to \$823m in 2007, with exports increasing from 15% to 45% of production over the period.

There are a large number of processors in Australia that slaughter lambs, but accurate data on the numbers of lambs killed by key processors is difficult to obtain. However it seems that about half the lambs are killed at abattoirs owned by T & R (SA & NSW) and JBS (Vic & SA) with the dominant WA processor being WAMMCO.

Lamb selling systems

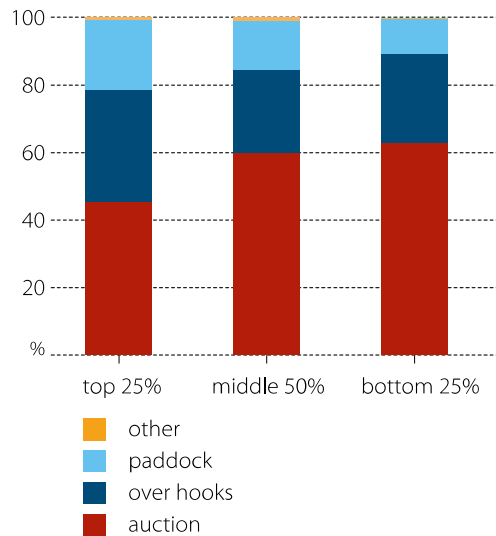
At present most lambs in Australia are sold through saleyards. The proportion of lambs sold over the hooks (OTH) increased from 3% in 1989-90 to 36% in 2006-07 but has declined since to an estimated 18.2% in 2009-10 (Martin & Philips 2011). Anecdotal information suggests that the percentage of lambs sold direct is higher than shown below.

Figure 3 – Lamb selling methods for farms that slaughter more than 200 lambs



The selling method employed varies with farm financial performance, with higher performing producers being more likely to sell direct to processors (i.e. OTH or in the paddock).

Figure 4 – Lamb selling methods used by farm performance groups



Note: Farms ranked by rate of return excluding capital appreciation.

In any of the lamb-selling systems, the sale could be per head or could include an actual or estimated carcass weight and/or price variations for actual or estimated fat levels. There are generally penalties for lambs being overfat or being too lean. Ideally, payment should be on lean meat yield to reward producers who have slaughter lambs with preferred weight, muscle and fatness levels. Two Australian and eight New Zealand processing plants have systems that can pay on lean meat yield. It is more likely saleyard prices will be on a per head basis, with weights and any fat levels being estimated on an average sale-mob basis.

Only in direct sales to a processor, or OTH, will prices vary with hot carcass weight and often also with fat level. A range of grids is used by processors with prices varying according to where the lamb fits into the grid by weight and fat depth. Direct selling has been promoted to producers over many years because it provides the best way to link price to performance against buyer specifications and to allow feedback to the producer on the most valued attributes.

Saleyards do not provide any carcass or other feedback to the producer. Theoretically this would be possible but it is unlikely that once ownership has passed from the producer at the saleyards that the new owner will see any advantage in providing (say) carcass information to the previous owner.

2.2 Processes and systems

National Livestock Identification System (NLIS)

The unique identification of livestock has been a hotly debated subject for many years. Recent demonstrations of this debate have included the introduced requirement for full traceability of cattle exported live to Indonesia to enable the continuation of the trade

and the need of the horse industry for a system to identify and manage horse movements in case of a disease outbreak (such as Hendra virus).

The ability to identify and monitor sheep in Australia has similarly been the subject of much discussion and research over many years. There seems little disagreement that a system to identify and monitor sheep and other livestock movements is crucial to support Australia's biosecurity and market access efforts. Thus there is a regulatory need, but not necessarily a domestic marketing need. Opinions differ as to how that should best be managed.

Many argue that radio frequency identification (RFID) provides the most comprehensive approach to animal identification. It is also argued that RFID can provide benefits to producers through enhanced ability to manage individual animal information (genetics, production, management, health) and to processors. However, very few Australian sheep producers seek to keep detailed production information at a mob level, let alone at an individual animal level. In addition, while the costs are reasonably clear (electronic tags, readers, scales, computer hardware and software), the benefits are less well clarified and may not be equitably allocated along the pipeline (see below).

There is currently no regulatory requirement for sheep producers to use an electronic identification system. However, all sheep and farmed goats must now be identified with an approved NLIS (Sheep – visual) tag prior to dispatch to a saleyard, abattoir, or property with a different Property Identification Code (PIC). NLIS (Sheep) tags must be stamped with the Property Identification Code (PIC).

Sheep and goat producers are also required to:

- Ensure their properties have a PIC; and
- Provide a National Vendor Declaration (NVD) when dispatching sheep or farmed goats of any age to a saleyard or abattoir, or to another property.

There are two types of visual NLIS (Sheep) tags approved for the permanent identification of sheep and farmed goats:

- NLIS breeder tags (colour coded for year of birth); and
- NLIS post breeder tags (always pink).

Sheep producers also have the opportunity to purchase electronic tags for use as part of the NLIS (Sheep & Goats). The use of electronic sheep tags is voluntary. The cost of these tags has recently been reduced to \$0.90 in Victoria (through a Government subsidy) and is approximately \$1.10 – \$1.20 in other states. To support those wishing to use EID, an NLIS Device Standard for Sheep RFID was finalised in early 2009.

In relation to the uploading of information onto the NLIS database:

- All mob-based movements of sheep and goats between properties have been required to be uploaded to the NLIS database since 1 July 2010 (WA commenced in 2011). Uploading of the information contained on the movement document to the NLIS database is the responsibility of the person receiving the sheep or goats at that property. This must be done within 7 days of the arrival of the sheep or goats.

- For saleyards, mob-based uploads to the NLIS database for sheep and goats have been occurring since 1 September 2009. The mob-based upload is done by the owner or person in charge of the saleyard and usually within a day after the sale.
- For abattoirs, feedlots, goat depots and export depots, mob-based uploads to the NLIS database have occurred since 1 January 2010.

NLIS identification ceases to accompany the individual animal once the head is removed from the carcass. Individual traceability can only continue through the chain if the NLIS identifier is transferred from the eartag to the carcass. This has been achieved in some abattoirs by attaching an electronic device to the gambrel on which the carcass hangs and linking this device to the NLIS code.

Livestock Data Link

Livestock Data Link (LDL) is a pilot project being run by MLA, NSW DPI and Victorian DPI to use the NLIS database to deliver carcass feedback to beef and lamb producers. It will allow participating processors to upload carcass feedback, which can be accessed by producers via their NLIS account. Carcass performance data can be benchmarked against regional performance and also mapped for compliance against industry generic grids (e.g. 100-day grainfed). The system will calculate the cost of non-compliance against the relevant grid and will also provide links to sources of information to address identified problems – for example, where carcasses are too light, it will refer to 'More Beef from Pastures' on finishing systems.

Phase 2 of LDL will incorporate data from Meat Standards Australia (MSA – see below) into the system and will also provide an interface to assist processors. LDL will also be expanded to include sheep, at both mob and individual level, using weight, fat, yield and dentition. One of the challenges for Sheep LDL will be that sheep grids are far less defined and are more linear than for cattle. Once the sheep system is established there are plans to incorporate data on skins, on health issues and from MSA.

Sheep Genetics

Sheep Genetics (SG) is the sheep industry's national database of estimated breeding values (Australian Sheep Breeding Values, or ASBVs). ASBVs exist for a wide range of traits relating to meat and wool production as well as reproduction, parasite resistance and other traits with economic value. ASBVs can be combined in weighted indexes to provide a summary of an individual's genetic merit according to an identified market objective.

Sheep Genetics is a joint program of Meat & Livestock Australia and Australian Wool Innovation and on its creation brought together previously unlinked databases from Merino and non-Merino breeds. SG operates as both a wholesaler and retailer of genetic analyses. Sheep breeders or consultants provide data files in certain agreed formats (including spreadsheets) that are checked by SG staff before being uploaded to the database and analysed by the Animal Genetics and Breeding Unit (AGBU) at the University of New England.

ASBVs are calculated using Best Linear Unbiased Predictor (BLUP) algorithms which estimate the genetic merit of an individual from its own measured characteristics (e.g.

growth rate) and the measured characteristics of animals related to that individual (e.g. brothers, sisters, parents, offspring). The greater the number of relatives and the closer the relationships the more accurate the ASBV. The ASBV provides a prediction of performance relative to the average; for example, a particular sire may produce offspring that grow 25% faster than the average across all sires.

ASBVs are now used by a significant proportion of maternal and terminal sire seedstock breeders when purchasing outside genetics and when making internal selection decisions. ASBVs are also made available at sale where they influence the purchasing decisions of a proportion of commercial producers and possibly the management decisions of an even smaller number of producers. However, the link between ASBVs and other data stops at this point. Data on the performance of commercially-bred sheep is not collected and fed into the ASBV calculation process, where it would increase the accuracy of ASBVs, nor is the ASBV 'heritage' of commercially-bred sheep used to predict their performance.

A recent review showed that the SG database can accommodate NLIS identifiers so that individuals on the SG database could be linked to the NLIS database.

Precision sheep management

With the advent of EID over the last decade or so there has been increased interest in individual animal-based – as distinct from mob-based – performance management on farms. The Sheep CRC was established with this opportunity, in both wool and meat production systems, as a major focus of its RD&E. The concept is also known as 'precision sheep management'. Precision sheep management does not require EID but has been facilitated by it and by developments in the associated equipment (weighing, recording and drafting systems).

The potential benefits of precision sheep management include:

- More efficient allocation of resources – for example, scanning ewes and removing non-pregnant ones to lesser-quality pasture or out of the flock altogether;
- Increased accuracy of retain / cull decisions within the flock, from both lifetime production and breeding perspectives; and
- Increased returns from marketing, for example by segregating animals on bodyweights for targeted sale and/or by objective classing of wool.

Information gained from precision sheep management stays on the individual farm where it may be captured in a proprietary software system or simply in spreadsheets. It does not become available for any purpose further down the chain (fattening, processing or retail) or up the chain (seedstock).

Meat Standards Australia and Livestock Production Assurance

Meat Standards Australia (MSA) is the red meat industry's eating quality program. It provides a system by which meat can be graded according to its optimal cooking method and resultant eating experience. The gradings are based upon extensive research linking juiciness, tenderness and other aspects of consumer preference with a wide range of cattle and sheep management practices, processing systems, cuts, ageing periods and cooking methods.

Lamb (and beef and goat) producers must register with MSA to have their product graded. For beef, a range of three gradings is available, while sheepmeat either meets the standard or it does not. To meet the standard, a producer must meet several basic criteria:

- Lambs are consigned with a national vendor declaration which must continue to the processor;
- Lambs must be minimum fat score 2;
- Lambs are recommended to have a growth rate of at least 150g/day at least one month prior to processing;
- Lambs must not be shorn within one month prior to processing;
- Different age groups of lambs must be penned separately;
- Merino and Merino-cross breeds must be penned separately;
- Lambs must have access to water at all times other than time required for sale; and
- Lambs must be processed within 48 hours off-feed.

Market acceptance of MSA for sheepmeat has accelerated in recent years. In 2009/10 approximately 0.5m lambs were presented for MSA grading, whereas the corresponding figure for 2011/12 is approximately 3.3m carcasses².

Summary

Various 'islands' of data are produced along the lamb value chain. These provide useful information on:

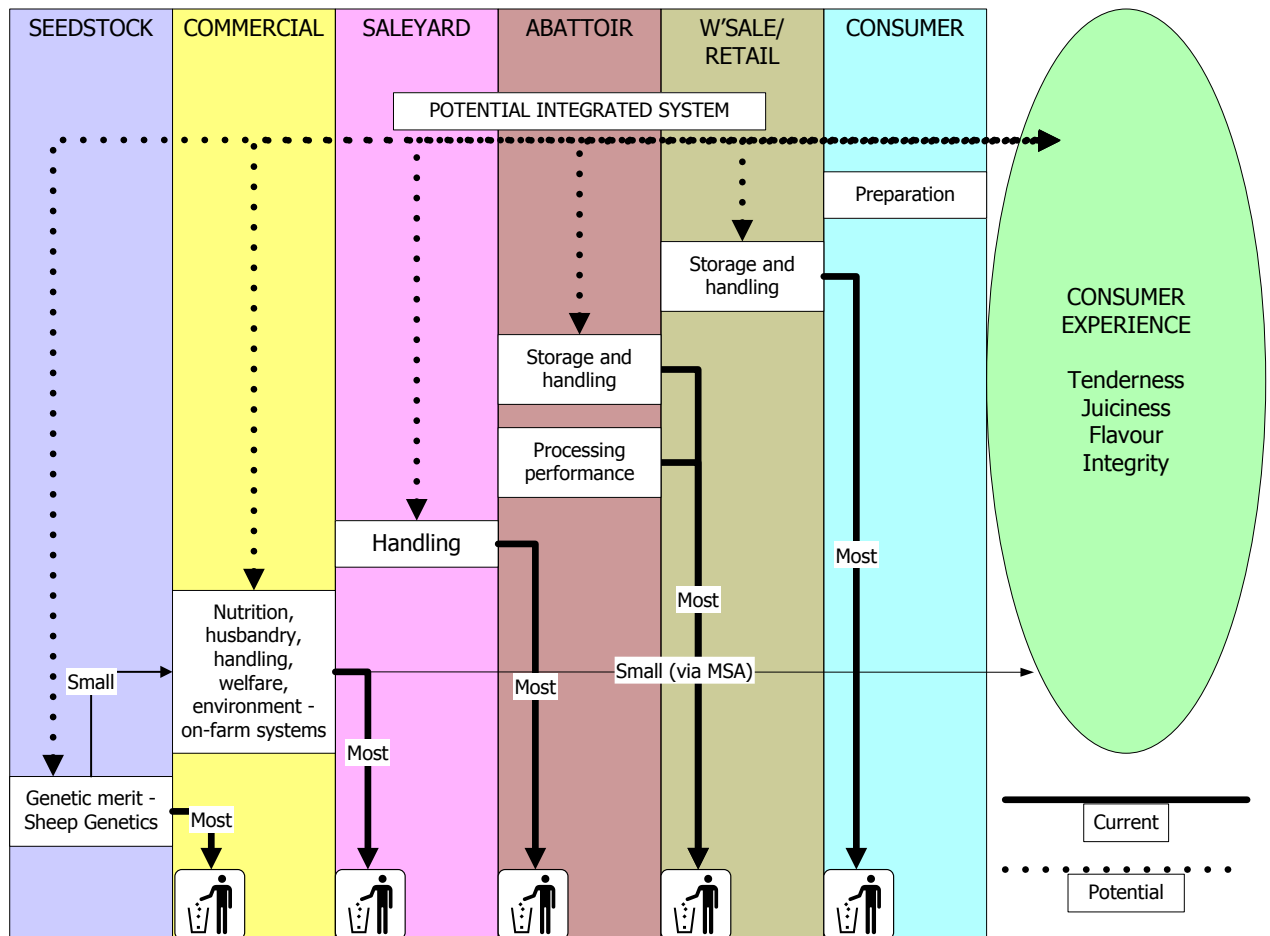
- Individual identity;
- Genetic merit;
- On-farm performance and management; and
- Performance at processing.

However, as the term indicates, there is limited communication between these 'data islands', which diminishes the value of the data. The NLIS database provides a mechanism by which this communication could occur and there are moves through the Livestock Data Link project to establish these linkages.

The various information systems are shown in overview in Figure 5, which emphasises the disconnectedness between them.

² David Jones, MLA, personal communication.

Figure 5 – Simplified diagram of current data generation and flows along the lamb value chain



2.3 Analyses of the value of EID / IAI

There have been a large number of analyses and case studies on the benefit/cost of specific elements of the sheepmeat value chain from the introduction of IAI or EID for the sheep industry in Australia. While these analyses focus on the likely area of benefit (enhanced genetic progress, reduced costs etc) it is evident from discussions with industry that there are also numerous 'benefits' that may apply to an individual's circumstances as distinct from the generic benefits accruing to the industry or a sector of it. So-called 'light bulb moments' can cover a variety of situations, such as making it easier to sort 'boxed' mobs of sheep, guarding against or monitoring diseases such as OJD, facilitating drafting of sheep in inclement weather, and so on. Thus, many of the concepts inherent in the Precision Sheep Management program of the Sheep CRC depend on IAI as do programs to assess the actual value of sires.

More formal analyses include:

- A comprehensive examination of NLIS Technical and Operational Barriers from farm to abattoir commissioned by the Sheep CRC (O'Halloran et al, 2008). This review identified the practicalities, limitations, indicative costings and technical development required for the implementation of a full RFID system. While the

integrated use of RFID is possible along the sheep value chain, several barriers exist particularly in relation to arrangements in saleyards and the cost of gearing up for processors.

- A study of sheep identification options to meet National Livestock Traceability Performance Standards (NLTPS) for biosecurity, food safety / integrity and market access by CIE (2010a). The study found that the existing arrangements as currently applied for sheep identification in Australia (mob-based visual tags) did not meet NLTPS. A disease outbreak such as FMD may cost \$1 to \$2 billion. While EID was a more costly option than enhancements to the current system (0.5% to 1% of GVP), CIE concluded that EID also provided greater potential benefit (BCA of 1.6 to 3.8 for EID options).
- A similar analysis for DPI Victoria (PWC 2010a), which arrived at very similar conclusions.
- An evaluation of the Victorian DPI NLIS (Sheep & Goats) Extension project. Within this review, PWC (2010b) modelled the costs and benefits (such as labour saving and genetic improvement) of EID and, similar to the MS&A (2010) report described below, found that benefits were dependent upon the size and type of enterprise. Producers with less than 500 sheep (wool producers) to 1000 sheep (non wool producers) were unlikely to receive net benefits under the assumptions made.
- A comprehensive study by MS&A (2010) for DPI Victoria which showed that the economic benefits of RFID were property-specific and dependent on scale of operation, enterprises run and level of production. On-farm benefits included quantifying the characteristics of individual animals, culling of poor performing individuals, selection of elite sheep, flexible allocation of sheep to different mating groups and within-season management for different feeding/breeding strategies. RFID was found to be ideal for any flocks/studs using measurement, while the benefits for commercial flocks (especially first-cross) were less clear. The management of data collected from the RFID system was considered the weakest link.
- An analysis by Greenleaf Enterprises (2010) that examined the potential value of individual carcase identification and automated chiller sortation for a lamb processing plant. This 'preliminary scoping study' indicated that there is a return on investment of 12.6% pa to processors through reduced costs, better occupational health and safety and enhanced traceability. It also suggested that EID provided the basis for the integration of other technologies, such as objective carcase grading, for total benefits estimated at \$2.73 per head.
- A report by the Victorian DPI (Anon 2009) on the costs for an abattoir to install a small stock carcase correlation system. This report documented the benefits of RFID, but did not include any dollar values.
- An evaluation of MLA's lamb production RD&E, specifically 'Clear Market Signals and LIDS (Livestock Identification and Description System)' by Agtrans (2008).
- An evaluation of the benefit/cost (GHD 2011) of e-surveillance for a small stock chain in Australian abattoirs so as to identify (and provide information to producers and processors on) ten important diseases able to be detected by routine meat

inspection. The study estimated a benefit/cost ratio of 3.3 : 1, 80% of which would be gained by producers, although this does not necessarily depend on EID.

- A summary of 'Individual animal ID, monitoring & traceability' for sheep which estimated benefits from increased productivity in Merino breeding of \$2.50 - \$3.50/head and wool marketing of \$0.60 - \$2.40 /head, but unclear benefits in specialist prime lamb flocks. The value in abattoirs was assessed as less clear (Anon 2010).
- Numerous studies showing the benefits of selecting various ram types and following progeny through to the processor sector which requires IAI. For example, selection of flock rams for large eye muscle depth improved boning room profitability of their progeny by 2.4% (McLeod et al 2007) and selecting high growth rate lambs improved profitability by \$11.26 per lamb (McLeod & White 2005). Industry benefits will follow the use of IAI.

2.4 Models from other agricultural industries

Beef

RFID tags for cattle have been required for many years under NLIS. The following process takes place:

- Cattle producers apply a white NLIS device (either an ear tag or a rumen bolus/ear tag combination) to cattle bred on their property.
- When cattle move from one PIC to another, devices are scanned electronically with a tag reader, or the NLIS ID number printed on the outside of the device is read visually and the numbers noted. The transaction details are then recorded on the database and automatic notifications are sent to the appropriate account holders and authorities via email.
- If cattle are bought or sold through a saleyard or sold to an abattoir, the saleyard or abattoir records the transaction.
- If cattle are bought or sold privately, the person who receives the cattle is responsible for notifying the database.
- If cattle move between properties with a different PIC, the movements must be recorded on the database, even if the properties have the same owner.
- If cattle move to an agistment property owned by someone else, the movement off the owner's property and onto the agistment property must be recorded on the database.

Despite the use of RFID tags for several years, few producers or processors use them to enhance management. The challenge for the lamb as well as beef industries is to capitalise on what EID can offer. There are examples of integrated value chains in beef that capitalise on animal traceability. One such example is meat processor Greenham Tasmania Pty Ltd which has established several premium beef brands (including Cape Grim, Pure South and Greenham Tasmania). Producers are paid according to MSA and other quality gradings (such as organic certification) achieved by their cattle.

Pork

All pigs over 20kg in SA, 25kg (NSW and Vic), 30 kg (Qld) or over 10 weeks of age (Tas and WA) must be tattooed with the owner's registered swine brand. Pigs under the minimum branding weight are recommended to be ear tagged with the PIC of property of origin prior to property movement but this is not mandatory, creating a gap for traceability. The tattoo identification is lost at skin removal during processing unless another tracing system is in place.

The PIC must be included on the NVD form that is part of the PigPass System, which is equivalent to NLIS. The PigPassNVD serves two purposes:

- It enables traceability of pigs in the event of an animal disease outbreak; and
- It identifies areas of potential risk for processors in supplying their markets.

The PigPassNVD can be electronic or paper-based. An individual pig carcass number or batch number can be attached as a label to the carton of pork cuts / products in the boning room so traceability through to retail is possible. PigPass is not designed to provide carcass feedback to the producer. However, abattoirs provide kill sheets with carcass data and most pigs are sold direct.

For improved traceability the pork industry is developing the Physi-Trace system which allows traceback from a retail pork cut to the slaughter establishment and subsequently to the farm where the animal was raised. Physi-Trace uses trace element and isotopic analysis together with the PigPassNVD. Physi-Trace is in the final evaluation stages before being implemented.

Australian Pork Limited is working with one of the most integrated chains in the Australian pork industry to improve objective measurement, buyer/seller relationships and the flow of market signals in the industry, with the ultimate objective to provide a much more efficient value chain with better links between value and quality.

Thus there is a chicken-and-egg situation with EID: it may only have a place when the lamb value chain is well integrated, but on the other hand, it could help to create this integration.

2.5 Models from overseas

New Zealand

The National Animal Identification and Traceability (NAIT) project in NZ dates back to August 2004 when industry approached the Government to work together to improve animal tracing in New Zealand.

New Zealand's mandatory NAIT scheme (based on RFID) is set to commence for cattle on 1 July 2012 and for deer on 1 March 2013. The Ministry of Agriculture and Forestry have previously advised that if sheep were to be included at some time in the future, it would likely be at a flock or mob level rather than at an individual animal level. It believes the addition of any other species to NAIT should only be considered once the system is up and running for cattle and deer.

Livestock companies (including saleyards and stock and station agents who act on behalf of farmers) and meat processors will have to invest in tag readers to record individual animals entering their premises. In addition, they may need to modify their premises and amend their processes and management systems. One-off costs for New Zealand's 45 meat processors to set up for NAIT are estimated to be \$1.2 million in total. For New Zealand's saleyards and stock and station agents, set-up costs will be an estimated \$6 million in total. Annual costs for livestock companies and meat processors are estimated to be \$1.3 million and \$250,000 respectively.

We understand there are some 250,000 sheep and 40,000 cattle on the NAIT system linked to Silver Fern Farms (Peter Bailey, personal communication).

European Union (EU)

In the EU, rules on the identification of sheep and goats were reviewed and reinforced after the outbreak of foot-and-mouth disease (FMD) in 2001. The system, which was adopted in December 2003 and entered into force in July 2005, was based on the principle of individual traceability and included animal identification, maintaining an up-to-date register on each holding; a movement document for each movement of groups of animals; and a central register of all holdings or computer database at a national level.

Following a report from the European Commission, electronic identification has become obligatory, although the degree of implementation across member states is unclear.

In the UK, for example, electronic tagging for all animals born after 31 December 2009 is required as follows:

- For breeding sheep, or any sheep intended to be kept beyond 12 months of age, two identifiers are required, one of which must be electronic and both must have the same number.
- For sheep intended for slaughter under 12 months of age, only one tag is required which can be electronic or non-electronic, with only the flock number shown visually.
- Recording of individual animal codes during movements (individual tracking) is required from 1 January 2011 for all animals born after 31 December 2009, and from 1 January 2012 for all animals.

USA

In the USA, sheep identification is driven largely by the scrapie control program. However, in early 2010 USDA announced a new, flexible framework for animal disease traceability in the United States. The program:

- Only applies to animals moved interstate;
- Is administered by the States and Tribal Nations to provide more flexibility;
- Provides a number of options for identification, including electronic implants, ear tags and tattoos; and
- Includes requirements for various travel documents and records.

Canada

The Canadian Sheep Identification Program is a traceback system that began in 2004. National legislation now requires livestock industries to mandate traceability, using radio-frequency identification tags, for the purposes of disease control.

Key timeline events are:

- From 1 Jan 2012, all sheep producers must use an RFID CSIP tag (current minimum cost \$1.65 – the Allflex RFID tag or the Shearwell RFID tag) and the appropriate applicator. An incentive is available to reimburse CSIP RFID tags for all lambs born after 1 December 2010.
- After 31 Dec 2012 visual tags will no longer be accepted at sales, abattoirs or by the Canadian Food Inspection Agency (CFIA) for shipping, transfer or sale of sheep in Canada.

2.6 SWOT of present value chain and value of individual animal information (IAI)

The following SWOT is a summary and distillation of discussions with a number of stakeholders. Respondents were asked to consider IAI in the context of improving value chain efficiency. This assumption does not necessarily imply that EID or even IAI is inevitable.

Strengths of IAI to improve value chain efficiency

- A number of sectors see IAI as inevitable;
- Many components of the system exist;
- Market access and biosecurity will drive IAI; and
- There will be cost savings / benefits for processors and producers if fully implemented.

Weaknesses of IAI systems

- The costs of tags and associated hardware are seen to be too high compared with the possible benefits, particularly for farmers;
- Saleyard systems are not yet conducive to efficient RFID data transfer;
- Many farmers do not presently capture or utilise mob or individual data nor do they have a desire to use such data;
- Mob-based identification has to be functional first, followed later by IAI;
- Mandatory IAI may deter implementation, but may be necessary for whole-of-industry benefits; and
- Systems need to be integrated along the value chain before significant industry adoption.

Opportunities for IAI to improve value chain efficiency

- With traceability from farm to consumer, markets may be maintained or expanded in the future;

- IAI could allow more product branding and price premiums for quality product;
- IAI allows feedback on carcass quality parameters to producers including studs, assisting with breeding and management;
- IAI provides the opportunity for producers to be paid on a direct proportion of the retail / wholesale value of each lamb;
- Producers can more accurately supply lamb to markets with different specifications and predicted product knowledge will empower growers;
- IAI will increase efficiency and rigour of quality assurance schemes and biosecurity programs including emergency and endemic animal disease management and control;
- IAI will increase opportunities to manage lambs and carcasses at farm and processor level to increase sale and processor efficiency as lambs can have highly variable specifications;
- Producers can manage lambs better when responding to drought, changed market conditions etc; and
- Producers and processors can benchmark their product across the whole of the industry.

Threats to using IAI

- Strong and variable opinions in industry and government on the value of IAI (from an EID perspective) are hampering a consensus on the value of IAI in its own right (electronic or otherwise);
- Software systems are complicated, making it difficult to merge data sets;
- The culture of most lamb producers is not favourable to IAI and in many cases even to mob feedback;
- Non-specialist and / or small lamb producers (less than 1,000 sheep) may receive little benefit from IAI and mob based feedback may be adequate for now;
- There will be farmer resistance if Government intervenes too strongly (e.g. regulation);
- Even if more information on lambs or carcasses is available there will be no impact unless benefits are well defined and communicated; and
- For some participants there will be negligible benefits.

3. Stakeholder perspectives and potential contributions

This section identifies the various stakeholders in sheepmeat RD&E and attempts to understand their perspectives and capacity to contribute to the national program. Summaries are presented below, with greater detail provided in Appendix 2.

3.1 Funding bodies

Meat & Livestock Australia

MLA is the key provider of RD&E funding through producer levies, matching Government R & D contributions, voluntary contributions and through funds provided through processors and livestock export industry bodies. Levies in 2010 were 2% of sale price with a maximum of \$1.50 for a lamb and \$0.20 for a sheep. In 2009-10 lamb and sheep levies totalled \$31m and the R&D component attracted matching Federal funds.

Australian Meat Processor Corporation

The Australian Meat Processor Corporation (AMPC) aims to maximise the long term efficiency, financial viability and sustainability of the Australian red meat processing industry. Policy for the industry is set by the Australian Meat Industry Council (AMIC).

AMPC spent \$4m on sheep and lamb research in 2009-10. Funds are raised by levies (sheep \$0.15 /head, lambs \$0.16 /head at processor) and R&D investments are matched by the Federal Government. AMPC has previously been involved in relevant projects such as with NLIS and national traceability. For further detail see 'Appendix 2: Further information on R&D funders and providers' and AMPC (2010).

AMPC sees benefits of IAI and some key individual processors have a commitment to adopting it in the abattoir and providing information back to producers. Nevertheless, views vary within AMPC and the processing industry on the value of individual- versus mob-based identification and certainly with respect to whether IAI should be mandatory.

LiveCorp

LiveCorp is a provider of R&D, marketing, training and communication services to the Australian livestock export industry. Levies are collected on each sheep sold (see MLA above).

LiveCorp, perhaps until recently, would have had little interest in investing in IAI. However the recent 'Independent Review of Australia's Livestock Export Trade' (Farmer 2011), the outcomes of which have been supported by the Government, includes a recommendation (No. 8): '...that the Australian Government should work with the states and territories and industry to implement individual identification of all sheep and goats as soon as practicable'. This situation may influence LiveCorp and the livestock export industry to view favourably investments into relevant IAI RD&E.

3.2 State agencies

State agencies all support the need for improved value chain efficiency and for mobs of sheep (at least) to be identified. DPI Victoria is committed to the implementation of EID for sheep and lambs and Qld DEEDI regards it as inevitable. The other states support research that improves value chain efficiency and the need for more information to flow seamlessly up and down the value chain. This has an influence on their commitment to the types of RD&E activities proposed and their willingness to contribute staff and

resources. Many state agencies, especially Victoria and NSW who are 'Major' providers to the sheep industry, have already been very active in relevant RD&E.

The National Sheepmeat RD&E Strategy (PISC 2010a) categorises state agencies as either 'Major', 'Support' or 'Link', as shown in Table 1. This table is adapted from Tables 3.1 and 3.2 in PISC (2010b).

Table 1 – Sheepmeat production RD&E priorities in state agencies

State agency	Intended role in sheepmeat RD&E	FTE capacity in sheepmeat (2009)	FTE capacity in areas related to value chain efficiency ¹	Comments on value chain efficiency (VCE) capability
Primary Industries Research South Australia	Support	21.7	21.1	Major capability is in productivity rather than VCE, but is doing VCE research
Department of Food and Agriculture Western Australia	Support	30.5	27.8	Major capability is in productivity rather than VCE, but is doing VCE research
Department of Primary Industries Victoria	Major	53.6	30.2	Includes staff working on IAI, production systems and with processors
Tasmanian Institute of Agricultural Research	Link	4.9	2.6	Relatively limited capability and resources. Focus is on traceability
Department of Employment, Economic Development and Innovation Queensland	Link	1.5	1.4	Relatively limited capability and resources. Focus is on traceability
Department of Primary Industries NSW	Major	50.5	33.3	Includes Meat Quality group, product development staff, extension officers and vets
Total		162.7	116.4	

¹ Staff nominally allocated to strategic imperatives 1, 3, 4, 5 and 6 (PISC 2010b), which still cover a range of very general areas.

It is noted that the FTE capacities presented above are likely to have changed since 2009, although the relativities between agencies are likely to be the same.

While all of the state agencies were contacted, the focus of consultation for this plan has been on the Major partners (NSW and Victoria). Support and Link partners have expressed a keen desire to continue to work in the field but have generally been either unable or unwilling to commit specific resources (FTEs, cash or in-kind), pending a clearer understanding of the industry's priorities and funding base.

DPI Victoria

With NSW DPI, DPI Victoria is one of two main agencies for the delivery of sheepmeat RD&E. DPI Vic makes a clear distinction between supply-chain and value-chain approaches and places a strong emphasis on the development of the latter by the lamb industry (see Appendix 2).

DPI Victoria is developing an integrated series of activities to serve lamb industry development, delivered by Farm Services Victoria (the delivery arm), Future Farming Systems Research and Biosciences Research. These programs span all aspects of the lamb value chain from genetics, nutrition and management to information systems and economics.

The DPI lamb program will span the whole of industry, from producers (using focus farms and the Bestwool / Bestlamb producer network), through collaborating processors to retailers. A strong State commitment to sheep EID underpins the program. DPI already has several focus farm pilot programs involving lamb and reproductive production systems implementing EID tags, infrastructure and software.

Infrastructure developments to the value of \$1.28m have been undertaken during 2010/11, with a further \$2.05m requested in 2011/12 for an animal house with imaging and other capability at Hamilton. Facilities have been consolidated to a Centre of Excellence in Hamilton with strategic research also being at Bundoora and Attwood. The staffing budget for has been increased by \$3.3m over three years then \$1.0m pa ongoing, with emphasis on accelerating adoption of new technology in farm systems (35%), improving the exchange of information through the value chain (10%), developing targeted technology to increase productivity and lamb supply (35%) and building a leading lamb RD&E capability to meet national obligations and attract investment (20%).

NSW DPI

The vision of NSW DPI is that producers should be paid a direct proportion of the retail / wholesale value of each lamb and that the benefits of a more efficient value chain need to be equitable. NSW DPI works with a range of processors to develop ways to measure carcase properties and provide better information to producers. See Appendix 2 for further information.

NSW DPI is prepared to include a number of staff, including research and development officers, in new value chain projects. New industry funding would allow project staff to work with a number of NSW processors, representative of both the domestic and export markets. NSW DPI maintains an extensive network of livestock officers (sheep), district agronomists and funds staff who work directly with processors. At least one large processor has offered to contribute to a new RD&E program.

With improved animal health feedback from processors, NSW DPI and the Livestock Health and Pest Authority (LHPA) veterinarians as well as animal health diagnostic laboratories such as EMAI, Camden, will be involved in new programs to reduce the incidence of downgrading and condemnation of carcasses. Key infrastructure is at the Centre for Red Meat and Sheep Development at Cowra. NSW DPI may have access to some cash to help leverage projects that are predominantly funded by MLA.

PIRSA / SARDI

PIRSA is a Support agency to the Sheepmeat RD&E plan. It has recently completed a major project analysing the meat value chain and consumer / market requirements (the National Lamb Value Chain Project – report pending). PIRSA seeks to continue its focus on understanding consumer / market needs and relating these back to industry.

PIRSA will play its role as a Support agency to the industry but does not have firm commitments (staff, cash) to IAI for sheep, pending clarification of industry priorities, projects and funding.

South Australia is in the unique position of having access to the Sheep Industry Fund (SIF), a 'voluntary' levy on sheep producers that raises approximately \$2m per annum and which can be used for the development of the SA sheep industry. While its application is currently the subject of review, some money for SA-specific activities relating to IAI may be available.

DAFWA

The 'Departmental Plan to Support Livestock Industry Development: 2009-12' (DAFWA 2009) does not specifically refer to individual animal measurement, nor to electronic identification of sheep, but it does list individual animal measurement as a priority. This Plan also refers to the fact that DAFWA will lead national planning for wool RD&E with AWI and 'Support' the National Sheepmeat RD&E plan.

DAFWA has not developed a strategic position on its investment in the area of individual animal ID to improve value chain efficiency. Once this is in place the agency will be seeking co-investment from MLA and its commercial partners with its current focus on biosecurity through its support for NLIS. DAFWA aspires to investigate new opportunities to use electronic tags and extend the return on the existing investment in tags and readers, plus develop management and analysis software to use the data collected.

WA's main issues are supply and the consistency of supply. The one major abattoir uses Viascan to assess estimated meat yield.

DPIPWE

As a very small lamb-producing state, Tasmania does not have firm commitments (staff, cash) to IAI for sheep, pending clarification of industry priorities, projects and funding. DPIPWE is also in a period of transition as it progressively moves its research capacity to the Tasmanian Institute of Agricultural Research (TIAR).

DPIPWE supports the concept of IAI / EID for the sheep industry, especially from a biosecurity / stock theft point of view but, like several other agencies, is wary of its imposition on industry. A national approach is favoured and one which has equivalence between sheep and cattle so as to remove duplication of infrastructure and direct costs.

DEEDI

DEEDI is listed for only 1.5 FTE for the Sheepmeat strategy but with vacancies across its sheep program has less than this capability available at present. DEEDI will 'Link' with the National Sheepmeat RD&E Strategy. It is unlikely to provide cash. In the future

it seeks to support any major lamb supply chain project, mainly in extension. It is anticipated DEEDI would link in with any NSW DPI Northern D&E programs.

DEEDI considers RFID to be inevitable with food safety / quality assurance / biosecurity the primary role followed by provision of feedback on carcass parameters. It accepts that mob-based identification has to be functional first before there are any moves to IAI.

3.3 Universities

Key universities operating in this field tend to be aligned with the Sheep CRC (Murdoch, University of New England (UNE)) and are considered under the CRC below.

The University of Melbourne

The University of Melbourne, through the Mackinnon Project at the Faculty of Veterinary Science, has expertise in farm production systems, including pastures, health, genetics and in particular the use of data to drive decision making. There are four senior staff and three Masters / PhD students in the unit. The Mackinnon Project is available to deliver RD&E if funding is made available.

Charles Sturt University

CSU, in particular the School of Animal and Veterinary Sciences and especially the Morley Unit, has expertise in animal production and health. CSU has current research on live sheep exports and with local sheep abattoirs. It would participate projects in the sheep value chain including the development regional animal health programs based on data fed back from abattoirs. PhD students would be available depending on funding.

3.4 Sheep CRC

Participants in the Cooperative Research Centre for Sheep Industry Innovation (Sheep CRC) include a range of RD&E providers such as Murdoch University, UNE, NSW DPI, DPI Victoria, SARDI and DAFWA plus commercial providers. The CRC receives Commonwealth and industry contributions.

The aim of the CRC is to turn Australia's sheep innovations into successful new products, services and technologies, and make the Australian sheep industry more efficient, productive and competitive. The Sheep CRC has conducted much of the research on precision sheep management which is where IAI may have a significant role (Rowe 2010).

For the purposes of this RD&E plan, we assume that the Sheep CRC will not be extended past 2014 and thus will not be available to undertake key programs from this proposed RD&E plan after this time.

With respect to the lamb and sheep value chain and IAI, CRC priorities are:

- Fully integrated feedback systems for improved management of the supply chain and lamb quality. This would include automatic weighing systems to aid inventory management;

- Better use of genetics to improve product quality which would include known genetics and genomics of individuals. This requires IAI. This information could then be incorporated into MSA grading;
- Animal and product tracking and 'online' bidding for the (predicted) supply. The animals could have predicted tenderness, fat levels, lean meat yield and growth rate at sale point; and
- Demonstrations of supply chains that are fully integrated.

Specific current programs relevant to supply chain efficiency and IAI are the meat quality program (3) including sub-program 3.3 on Lean Meat Yield & Supply Chains.

Present projects include:

- Assessment of technologies for measuring lean meat yield including the Hennessy probe, the Carometec fat-o-meter probe and further assessment of ultrasound;
- Using data from benchmarking activities with early adopter processors to develop industry-relevant descriptive statistics on lean meat yield;
- Developing a skin scoring system that will consider carcass hygiene and skin value in relation to soiling. This project will develop an objective language for industry to use in communication and value based trading systems along the supply chain;
- Training in the use of EID for sheep management and breeding; and
- The Lamb Supply Chain Group. This group works with supply chains, processors, supermarkets and software and hardware providers to increase the accuracy of fat measurement and explore other carcass measurement such as lean meat yield and feedback systems that will enhance supply chain efficiency.

3.5 Commercial operators

Identification system suppliers

The commercial sector developing and providing software and hardware (e.g. Allflex and Shearwell) for EID in livestock is very active. Market failure cannot be said to exist.

Software providers have tended to commence operations by targeting a specific segment of the industry and then working their way up or down the value chain. For example, Practical Systems was initially farm-oriented, Sapien supply-oriented, Livestock Exchange saleyard-oriented and Cedar Creek processor-oriented. Over time these companies have sought to provide whole-of-industry solutions so competition is strong.

Discussions indicate that all providers are very keen to cooperate to progress the implementation of EID for the sheep industry and to develop their businesses. In fact a common comment was the view that the sheep industry is potentially a more important market and would reap greater benefits from EID than cattle. However, any such investment by software or hardware suppliers would understandably be towards assisting in the evaluation of systems and processes, rather than the provision of research for whole-of-industry benefits.

A further consistent comment was that software development costs are small compared to those for infrastructure / hardware and that the industry would benefit by having a consistent system of how data should be handled (format, length etc).

Saleyards operators

In a press release of 5 September 2011, the Australian Livestock and Property Agents Association (ALPA) indicated that NLIS for sheep must be rolled out in a nationally-coordinated manner for it to be effective. It indicated that the costs to saleyards of installing electronic sheep tracking systems in saleyards would be substantial and that the cost would need to be recouped 'from somewhere'. The release also points out that 'the current visual tag system (is) failing because producers (are) not tagging their sheep or filling out the National Vendor Declaration form correctly', and that an electronic system would not fix this problem.

The Livestock Saleyards Association of Victoria is currently involved with 12 saleyard complexes piloting the potential introduction of sheep RFID tags to create a whole-of-chain traceability system.

Processors

As noted in Section 3.1, the commitment of lamb and sheep processors to IAI varies enormously. Some are very publicly vocal in their support, while others want to be directly involved in R&D but wish to do so under commercial-in-confidence arrangements (which we are unable to document for obvious reasons). Others are quite content with the status quo and only see costs to producers from IAI without any substantial benefit to producers or themselves.

In general, there is a lack of commitment and investment by many in the processing industry in new tools and technology such as hook tracking and carcass scanning.

The review team has been in touch with abattoirs in NSW, WA and Victoria. It is evident that the strong relationships between state agencies and some processors will be important in the roll-out of any RD&E plan. Many processors are keen to continue to be involved and contribute to further value chain efficiency R&D. Some benefits of IAI at the processor level have been documented in Section 2.3.

4. Vision

The vision for this plan is a streamlined lamb value chain along which information on animal management, genetics, health status, carcass yield and product quality flows freely in both directions, increasing the overall productivity and efficiency of lamb production, as well as delivering other potential benefits such as improved market access, increased biosecurity, reduced costs and increased consumer satisfaction and loyalty.

Adding more substance to the vision...

The sheep meat industry of the 1980s/90s could have been described as supplying a mob-based *commodity*. Following the transformations of the last 20 years, it is probably best characterised today as supplying a mob-based *product*. Within the next 10 years it is quite plausible that the Australian sheep industry will have moved to an individual animal-based product that is even more driven by customer and consumer needs. Essentially, producers and processors will be paid for what consumers prefer.

So what might this look like in practice? Appendix 3 gives an example scenario of a segment of the industry in 2020. The scenario shows that by 2020 the lamb and sheepmeat industry could be characterised by the following:

- All sheep and lambs carry individual electronic tags.
- The range of measurements taken on animals far exceeds that of today.
- Specifications for sheep meat products, especially lamb, are more precise and are based on consumer (e.g. eating quality) and processor (e.g. saleable meat yield) requirements. Producers and processors are paid on these factors, not just weight. Systems are in place to measure and to pay on lean meat yield.
- Such requirements are selected for in on-farm breeding programs, using molecular-enhanced breeding values, and managed on individual animals not mobs.
- There will be far greater sharing of data up and down the pipeline due to:
 - rapid changes in information technology capability;
 - a recognition that the competition is not within the Australian lamb value chain but external, that is from other meat products within Australia and overseas;
 - the availability of improved genetic selection;
 - the ability to measure (or predict) key processor / consumer traits on live animals;
 - the need for greater transparency and traceability to meet government and consumer requirements in relation to biosecurity and origin of product;
 - standardisation of trait definitions and formats for data transfer; and
 - the existence of an industry-owned central database that holds animal production data, animal health data, carcass data including predicted processing and eating quality data, specific processing data such as saleable meat yield and consumer feedback. This database could be used for industry benchmarking, to enhance or maintain market access and to respond to emergency disease incursions.

5. Gap analysis

5.1 What is needed to reach the vision?

Some producers and processors collect large amounts of data on individual animals (or on a mob basis), while others collect very little. Much of this data is not analysed or interpreted rigorously to enhance decision making for productivity, efficiency or product improvement and it is rarely transferred freely along the value chain in either direction.

The variety of data becoming available (e.g. breeding values, carcass traits, product quality) is changing quite quickly and is expected to continue to do so in coming years. Hardware and software to capture and analyse such data are commercially available.

However, there are a number of challenges facing improved flows of information along the lamb value chain, including increased use of IAI, such as:

- There is no agreed vision or strategy as to how this may be done;
- There is no clear understanding of how value is added at various stages of the chain – who pays and who benefits;
- The value proposition of capturing and analysing animal information, either on the mob or on individual animals, is not evident for a significant proportion of the industry;
- There is no standardised / agreed system for transferring data up and down the value chain. Data tends to become protected information within one sector or organisation or business unit of the chain;
- There is industry experience that it is difficult to get various pieces of individual measuring equipment to ‘talk’ to each other;
- There is fear that a substantial investment in technology will be wasted because the technology is superseded or is made redundant if industry introduces some form of standardisation;
- There is no mechanism by which the results from the significant body of RD&E work already done (and continuing to be done) can be readily shared and utilised by all participants; and
- There are limited short-term incentives to share information along the chain – often there is a fear of doing such and trust between stakeholders is an issue.

Table 2 provides an overview of current information, potential new information, gaps in the provision or application of that information and commentary on who could fill those gaps, including via this plan.

Note that some of the potential new information will be more valuable if on an individual basis (e.g. animal health status, hot carcass weight (HCW) or lean meat yield (LMY)), while other data will still be very valuable if on a mob or group basis (e.g. pedigree, NVD, consumer feedback on a branded product).

Table 2 – Gap analysis

Sector	Information available now or easy to obtain	Information potentially available in the future	What value could this new information have?	Where are the gaps? (*see RD&E plan below)
Seedstock	<ul style="list-style-type: none"> • Live weight • ASBVs for carcase, maternal traits, reproduction, fibre • Breed, pedigree, age etc • Growth rates, nutritional data, health status • (Can be on mob or individual basis) 	<ul style="list-style-type: none"> • ASBVs for new traits such as Omega-3 fatty acids, tenderness, IM fat, LMY etc • Better feedback from processors • Enhanced electronic data capture and interpretation • Estimated LMY on live animals 	<ul style="list-style-type: none"> • Seedstock producers breed for consumer traits • Studs potentially get paid for what they produce • Commercial producers get preferred rams • Feedback on commercial lambs slaughtered to seedstock increases values all round 	<ol style="list-style-type: none"> 1. ASBVs for new traits (in part covered by other programs) 2. Enhanced electronic data capture (covered by NLIS and commercial operators) 3. Standardised formats for data - national dBase and sector dBase* 4. National genetic benchmarking database*
Commercial producer	<ul style="list-style-type: none"> • Live weight • Fat score • Breed, sometimes pedigree • Numbers and expected sale date • PIC registration and number • MSA accreditation 	<ul style="list-style-type: none"> • Full pedigree • Lamb growth rate – lifetime and pre-slaughter • Environmental and animal welfare • Better feedback from processors • Estimated LMY 	<ul style="list-style-type: none"> • Producers get paid for what they produce • Processors can buy preferred lambs • Improved genetic selection/cullin g 	<ol style="list-style-type: none"> 5. Understanding the benefits* 6. Understanding how the system works commercially* 7. Efficient mob-based feedback from processor* 8. Efficient individual animal feedback from processor*
Farm to sale (saleyard or direct)	<ul style="list-style-type: none"> • NVD on paper • Financial – fax and mail 	<ul style="list-style-type: none"> • Electronic NVD • Direct and electronic transfer of animal movement 	<ul style="list-style-type: none"> • Reduced transaction costs for buyer and seller • Enhanced traceability and market access • Direct-to-farm financial management programs 	<ol style="list-style-type: none"> 9. More robust and accurate NLIS (covered by NLIS)

Sector	Information available now or easy to obtain	Information potentially available in the future	What value could this new information have?	Where are the gaps? (*see RD&E plan below)
Processor	<ul style="list-style-type: none"> • Supplier • Carcase weight (HCW + chilled carcase weight (CCW), sometimes fat) • If condemned or retained and trimmed • Vendor • MSA 	<ul style="list-style-type: none"> • Estimated lean meat yield, eye muscle depth (EMD), meat eating quality predictors, pedigree / breed, animal health status • National supply inventory • All electronically transferred 	<ul style="list-style-type: none"> • Can pay producer on LMY / meat eating quality • Can have preferred suppliers • Processor can buy on LMY, eating quality, breed, other traits etc • Better opportunity for branding and selling on specifics (breed, welfare etc) • Inventory management aids plant efficiencies e.g. chiller space, yard space, labour, robotics • Producer and regional improvements in animal health 	<ul style="list-style-type: none"> 10. Measurement or predictors of LMY* 11. Predictors of meat eating quality* 12. Feedback systems to producers on animal performance and health status* 13. Systems to manage regional animal health information* 14. Systems to convert data to information for producers to inform decisions (largely covered by commercial operators) 15. Systems to provide processors with information for decisions (covered by commercial operators)
Wholesaler / retailer / exporter (including processors that export)	<ul style="list-style-type: none"> • May get some ad hoc feedback from next sector. No industry capture of feedback • MSA 	<ul style="list-style-type: none"> • Consumer to producer feedback captured 	<ul style="list-style-type: none"> • Greater brand loyalty • Allows improvement • Provenance • Point of difference in product 	<ul style="list-style-type: none"> 16. Ability to trace specific carcasses / cuts*
Consumer	<ul style="list-style-type: none"> • Maybe MSA • Lamb or sheep • Product or supplier brand 	<ul style="list-style-type: none"> • Feedback provided • Can source lamb with specific attributes • Additional provenance information 	<ul style="list-style-type: none"> • Greater brand loyalty • Consumer gets consistent lamb experience • Provenance 	<ul style="list-style-type: none"> 17. Mechanisms to obtain supplier information* 18. Mechanisms to provide feedback to supplier*

Sector	Information available now or easy to obtain	Information potentially available in the future	What value could this new information have?	Where are the gaps? (*see RD&E plan below)
Whole of industry	<ul style="list-style-type: none"> • Many 'isolated' reviews, demonstrations and economic analyses 	<ul style="list-style-type: none"> • Clear benefits identified for each sector • Identification of value added along pipeline and areas for intervention. • Segmentation of the market depending on benefits 	<ul style="list-style-type: none"> • Integrated value chain with enhanced information flows • Co-operative value chain • Collaboration and partnerships across the value chain • Degrees of specialisation creates production efficiencies 	<p>19. Integrated demonstrations of value*</p> <p>20. National extension plan*</p> <p>21. Lack of an IAI forum to share latest information and results between industry sectors and service providers (including hardware & software)*</p>

5.2 Links and associated activities

The plan presented below is inextricably linked into, and in part dependent upon, other RD&E activities within the lamb value chain such as:

- Enhancements to current animal identification systems (NLIS (Sheep & Goats) working groups at national and state level);
- The work of MLA and others on Livestock Data Link;
- Collective work (MLA, Sheep Genetics, Sheep CRC etc) on improvements to ASBVs and a better understanding of (and prediction for) meat eating quality etc;
- Work being undertaken by private and public organisations to improve and demonstrate the role of RFID in the sheep industry; and
- Policy positions taken by Government in conjunction with the lamb and sheep meat industry and associated working groups. For example, PIMC has formed a working group to explore the feasibility of electronic identification devices for sheep and goats, including looking at technical and commercial barriers to its uptake. The details of the working group will be determined by PISC.

6. Lamb supply chain RD&E Plan

6.1 Outcome areas

Three key outcome areas form the basis of this RD&E plan. They are:

1. Collect and transform data into information of value to participants;
2. Improve sharing of information along the value chain; and
3. Demonstrate, communicate and extend the benefits of improved information flow.

Each of these contributes to the overarching objectives of producing the right product for the market, increasing market access and food security and managing compliance.

For each of the key outcomes, the plan provides a rationale for the investment, outputs sought, linkages to other RD&E programs, early thoughts on the level of funding that may be required, specific projects to achieve the outcome, KPIs, timeframes, likelihood of success (risks) and potential partners or means to attract partners.

An important note on funding

The indicative funding requirements provided below are based upon consultation with the Major state agencies (NSW and Victoria) about the expected cost of projects in the respective project areas. However, budget figures must be regarded as approximate at this stage. Budgets cannot be finalised until specific project proposals are received and decisions made on, for example, whether projects are conducted in just one state or across several.

In any case, decisions on funding will naturally be based on more detailed, project-specific benefit/costs analyses than are possible here. The actual investments made and the split of funding between partners will depend on the BCA and who gains the benefits. If the overall plan is supported by the RMCiC then, during implementation, budget totals and allocations between partners will need to be flexible.

Outcome 1: Collect and transform data into information of value to participants

Rationale:

Data is of no value unless it becomes collated **information** which can be interpreted to improve knowledge and understanding to drive decisions. Much of the data currently collected on farm, in abattoirs and by retailers is not used and therefore has no value. Collated / aggregated information has a value and should be demanded by chain participants.

There are commercial providers offering hardware and software systems for the collection, interpretation and use of data by producers, in abattoirs and by retailers. Thus, there is no apparent market failure in these outcome areas and no argument for industry RD&E funding. However, there is a limit in linking of systems even within an abattoir. There is also a failure to use the information in the market as it resides in individual databases.

The development of expert systems to enhance the use of individual animal information for producers is a less clear-cut commercial proposition, especially in respect to the use of animal health data for regional animal health surveillance and intervention programs.

Outputs:

- System(s) to allow interpretation and use of data by producers and processors
- System(s) to collect and communicate animal health and performance to specifications data from abattoirs (AW)

Linkages:

- Sheep CRC³, animal genetics and genomics strategies – RD&E on measurement of new parameters on live animals (e.g. ASBVs for eating quality, LMY etc)

³As noted in section 3.4 it is assumed that the Sheep CRC will not be extended past 2014 and thus will not be available to undertake key programs from this proposed RD&E plan after this time.

- Sheep CRC – RD&E on better tools to measure carcass parameters such as LMY, eating quality etc
- NLIS / Livestock Data Link (LDL) – reporting of traceability, performance to specifications, carcass value and animal health data
- National Animal Health Information System (NAHIS, through Animal Health Australia) – collection and reporting of national animal health data
- Commercial parties – providing hardware and software systems for the collection, interpretation and use of data by producers, abattoirs and retailers

Funding:

- Indicative \$5.8-7.3m over 4 years

Funding sources:

- MLA, AMPC, State agencies, processors, commercial sector

Projects	KPIs	Comments	RD&E providers	Indicative \$
1.1 Develop technology for real-time assessment of meat quality attributes and meat yield in the live animal (leverage off beef work if successful e.g. high intensity scanning / cameras for scoring etc)	Accurate and cost effective systems being used	<ul style="list-style-type: none"> • 2012-15 • High priority • Links to similar project in beef, but may be more technically difficult because of wool – start with feasibility study 	<ul style="list-style-type: none"> • Vic, NSW DPI interest • Private companies 	<ul style="list-style-type: none"> • MLA \$500k • Agencies and others \$1m
1.2 Develop and/or demonstrate better technologies for in-abattoir measurement of sheep meat and carcasses based on specification, meat yield and meat quality attributes, especially the linkages between NLIS and carcass tags	Accurate and cost-effective systems being used	<ul style="list-style-type: none"> • 2012-15 • High priority • Already work in the demonstration area • Links to similar project in beef 	<ul style="list-style-type: none"> • Vic, NSW DPI interest • AMPC • Processors 	<ul style="list-style-type: none"> • MLA \$1-2m • AMPC • Agencies and others \$1-1.5m
1.3 Develop expert systems that integrate information to assist producers to interpret and utilise data collected on farm and via processors as a result of projects 1.1 and 1.2	Availability of interpretive models for producer use	<ul style="list-style-type: none"> • 2012-15 • High priority • Will incorporate new tools emerging from research work (ASBVs for eating quality, improved carcass measures/ predictors) • Merging of data still a problem; need simple applications • LDL is moving this way 	<ul style="list-style-type: none"> • Vic, NSW DPI interest • Other state agencies • Software providers 	<ul style="list-style-type: none"> • MLA \$600k • Agencies and others \$300k

Projects	KPIs	Comments	RD&E providers	Indicative \$
<p>1.4 Develop systems to collect animal health data and interpret and transfer this data to producers and animal health / biosecurity agencies</p>	<p>Systems in place to collect, tabulate and transfer and interpret data for producers and processors (e.g. 'HealthBoss' SG and skins information)</p>	<ul style="list-style-type: none"> • 2012-15 • High priority • Systems to collect animal health information in abattoirs exist and this information can be transferred back to producers and animal health authorities, but often it is not • Systems to enhance the ease of capture on a mob basis, transfer information to producers and then provide guidance as to what producers should do are required • LDL is moving this way and private software providers are also engaged • Legal issues will need to be addressed (e.g. by Sheep / Goat NLIS Working Group) • Linked to Victorian bobby calf process 	<ul style="list-style-type: none"> • Vic, NSW DPI interest • Other state agencies • Software providers 	<ul style="list-style-type: none"> • MLA \$1m • Agencies and others \$500k

Outcome 2: Improve sharing of information along the value chain

Rationale:

Information has value not only at the point of collection but at other points upstream and downstream in the value chain. Information-sharing systems are not yet fully integrated. There are opportunities to reduce value chain costs and improve performance in meeting consumer demand, although the critical points along the chain need to be identified first and the benefit/cost of interventions estimated as such information is not currently available.

Healthy competition between commercial hardware and software providers is highly desirable but value will be lost if there is a lack of standardisation and therefore the capacity for data to be exchanged.

Outputs:

- Understanding of the 'what's-in-it-for-me' for individual participants of interventions to improve information exchange, incorporating both economic and cultural/social factors
- Standardised definitions and rules to facilitate information exchange along the chain
- Technology(ies) to allow retailers/consumers to establish the provenance (source, environmental and welfare credentials) of a lamb product

Linkages:

- NLIS / Livestock Data Link and other providers
- Sheep Genetics (LAMBPLAN and MERINOSELECT)
- NLRS
- Commercial parties – providing hardware and software systems for the collection, interpretation and use of data by producers, abattoirs and retailers

Funding:

- Indicative \$3.1m over 4 years

Funding sources:

- MLA, AMPC, State agencies, hardware and software providers, processors

Projects	KPIs	Comments	RD&E providers	Indicative \$
2.1 Analyse the lamb value chain and points for value-add and intervention; quantify benefits of tracking animals from farm to processing to retail at each point in the chain	Situation analysis of case studies in 1.2 to benchmark current, then compare to situation analysis in 5 years when system is in place	<ul style="list-style-type: none"> • 2012-14 • High priority • Several studies on specific examples of this conducted. Need to draw conclusions together • Should include market access / growth / maintenance opportunities • Some being done by the CIS group in MLA • There should hopefully be a number of critical intervention points identified at farm and processor levels 	<ul style="list-style-type: none"> • Vic DPI • Other agencies • Private providers 	<ul style="list-style-type: none"> • MLA \$200k • AMPC • Agencies \$400k
2.2 Investigate social, commercial and financial opportunities and barriers to information collection, sharing and use throughout the value chain	Shared understanding of drivers and barriers to allow greater uptake	<ul style="list-style-type: none"> • 2012-15 • Medium priority • Some information on this already e.g. MSA study on EID in Vic • Vic DPI and MLA have two PhD EOs on offer in this area 	<ul style="list-style-type: none"> • Vic DPI • Other agencies • Private providers 	<ul style="list-style-type: none"> • MLA \$100k • Agencies \$150k (one PhD)
2.3 Develop and extend national standards for information exchange along the pipeline – language, formats	Incorporation of standards into software applications and specification databases (eg standardisation of tag font)	<ul style="list-style-type: none"> • 2012-14 • High priority • Previous work in this area by CSIRO in AWI / CRC project has not been taken up. Initially undertake modest review of why first project failed (barriers) and build on that (Software? Language? Complexity?) • Must aim to reduce rather than increase complexity/admin time • Recent project completed to link SG and NLIS databases • There is a Standards Committee • Needs policy support 	<ul style="list-style-type: none"> • State agencies • Private providers 	<ul style="list-style-type: none"> • MLA \$400k • Agencies \$60k

Projects	KPIs	Comments	RD&E providers	Indicative \$
2.4 Develop technology(ies) to allow processors / consumers to establish the 'provenance' (origin, at property or individual animal level) and credence of sheepmeat products	Accurate and timely traceback system available	<ul style="list-style-type: none"> • 2012-15 – but could leave until later once abattoir tracking systems are in place to the boning room, to determine if there is a market driver • Low/medium priority • Will enhance or maintain market access to have systems in place, but critical to do BCA before implementation – may only need to be mob-based provenance • Addresses key biosecurity needs • AMPC needs to be involved • Private benefit, not industry benefit – maybe outside public funded research 	<ul style="list-style-type: none"> • Vic and NSW DPI • Other agencies • Private providers 	<ul style="list-style-type: none"> • MLA \$1m • AMPC • Agencies \$750k

Outcome 3: Demonstrate, communicate and extend the benefits of improved information flow

Rationale:

There is good evidence that a value chain approach will benefit the entire lamb industry but more some than others. It will be imperative to segment the market and identify benefits that can accrue to each and demonstrate these in convincing ways. A key element of any change program is to 'model the way'; that is, to show what can be achieved. In the case of the lamb value chain, this means demonstrating how the parts fit together in a technically and commercially feasible way.

There is a sound 'market failure' justification for RD&E activity in this area, because single players have limited incentives to link all parts of the value chain. Where they do have an incentive, it is driven by increasing profit at that point in the chain and not along the chain as a whole. Producers (as individuals) have the least market power of all the players and should seek to manage the development of an information-sharing system so that they gain a share of the benefit from it.

Outputs:

- Establishment of a vehicle (a forum) by which value chain participants can exchange information and ideas – acknowledging that there will be commercial constraints to the information that is shared
- Demonstration and validation of integrated value chain(s) systems
- Delivery of extension and training programs
- Establishment of baseline data that can be used to monitor progress

Linkages:

- Numerous participants including AWI, CRC and State DPI advisory and training providers and private Registered Training Organisations (RTOs) including those that CRC has licensed
- MLA's proposed demonstration sites for ASBVs
- Making More From Sheep and Producer Demonstration Sites

Funding:

- Indicative \$4.6m over 4 years

Funding sources:

- MLA, State agencies, commercial operators

Projects	KPIs	Comments	RD&E providers	Indicative \$
3.1 Establish a forum for the exchange of information and improved communication between participants in the value chain	<ul style="list-style-type: none"> • Technical forum established across sectors with industry involvement 	<ul style="list-style-type: none"> • 2012-15 • Medium/high priority • While several forums on NLIS etc already exist there is no avenue to address industry wide issues, exchange of ideas and results of research across sectors. • Difficulty of achieving desired outcomes understood – but should be offer open to all • Need to cover expected outputs and reporting mechanism • NSW DPI is organising smaller rep group, as is Vic DPI • Link to 2.3 	<ul style="list-style-type: none"> • All agencies • Private providers 	<ul style="list-style-type: none"> • Component of program management budget • \$20k per agency
3.2 Design, implement, demonstrate and evaluate a number of integrated information systems; quantify costs and benefits of these	<ul style="list-style-type: none"> • Five systems in place 	<ul style="list-style-type: none"> • 2013-15 • High priority • Some within-sector systems in place, but none fully integrated • Can be linked to SG's ASBV demonstration sites and LDL • NSW and Vic are establishing, WA and SA may wish to contribute • Engaging of processors the key and should be first focus • Will utilise more sophisticated linking of data (follows 2.3 to some extent) 	<ul style="list-style-type: none"> • Vic, NSW DPI interest • Other agencies 	<ul style="list-style-type: none"> • MLA \$3.2m • Agencies \$800k

Projects	KPIs	Comments	RD&E providers	Indicative \$
3.3 Develop and implement a national extension / education program on lamb value chain, linked to 3.2 but also including stand-alone modules (e.g. through Making More from Sheep)	<ul style="list-style-type: none"> Producers understand the genetics and management to improve conformance to specifications Producers and processors understand where IAI can benefit them Market segmentation available 	<ul style="list-style-type: none"> 2012-14 Medium priority The Sheep CRC has an active program in this area, but the CRC is not a long term provider Vic DPI has an 8-module business development model for value chains PIRSA has a value chains group NSW DPI through Sheep Connect / Making More from Sheep Engage service providers and agents Link to 3.1 and 3.2 	<ul style="list-style-type: none"> Vic, NSW DPI interest Other agencies RTOs 	<ul style="list-style-type: none"> MLA \$400k Agencies \$160k
3.4 Examine role of IAI in enhancing industry logistics	<ul style="list-style-type: none"> Reduction of the administrative burden on the pipeline 	<ul style="list-style-type: none"> Timing TBC Medium priority Need to involve NLIS and LDL (examining electronic weigh bill and NVD) LPA has already endorsed this and the PIMC RFID Working Group is examining this Link to 3.2 	<ul style="list-style-type: none"> State agencies Saleyard operators 	<ul style="list-style-type: none"> TBC

6.2 Portfolio characteristics

The RD&E plan recommended by this report has a primary focus on development and extension / education. As noted throughout this report, much of the pure research has already been undertaken either by research agencies or by the private sector. The focus of attention should now largely be on further developing the technology and the infrastructure which supports it and demonstrating the technology to a broader range of industry participants.

Notwithstanding the above point, the likelihood of a far greater utilisation of the technology should not be over-estimated – due to the complexity of the issue and polarised views across industry.

Summary of timeframes for delivery

Figure 6 provides an indication of the likely distribution of investment in project areas over the life of this plan.

There are few if any specific dependencies between projects – any could be progressed prior to completion of any other project. The timeframes are deliberately shaded to indicate the most likely emphasis between projects in given years where decisions must be made to prioritise investments. Thus, for example, 3.2 is likely to precede 3.3 because the outcomes of demonstration chains will form part of the content of extension packages.

Figure 6 – Summary of timeframes for delivery of RD&E Plan

Outcome / Project	2012	2013	2014	2015
Outcome 1: Collect and transform data into information of value to participants				
1.1 Real-time assessment of meat quality attributes and yield in the live animal				
1.2 Carcase tracking and measurement systems to determine value in abattoirs				
1.3 Expert systems to assist producers' interpretation and utilisation of data				
1.4 Systems to collect, transfer and interpret animal health data				
Outcome 2: Improve sharing of information along the value chain				
2.1 Analyse value chain and points for value-add and intervention and quantify benefits				
2.2 Investigate opportunities and barriers to information collection, sharing and use				
2.3 National standards for information exchange along the pipeline – language, formats				
2.4 Technology to establish provenance of products				
Outcome 3: Demonstrate and extend the benefits of improved information flow				
3.1 Forum for the exchange of information and ideas between participants in the value chain				
3.2 Integrated information systems				
3.3 National extension / education program on lamb value chain				
3.4 Role of IAI in enhancing industry logistics				

Summary of indicative budget

The indicative budget for the program described in this plan is shown in Table 3.

As described above, this is very much a preliminary budget based primarily on the input of NSW and Victoria Departments of Primary Industries. It requires much greater development following tighter definition of projects including geographic coverage.

Table 3 – Summary of indicative budget for RD&E Plan

Outcome/project	Indicative \$
Outcome 1: Data into information	\$5.8m
Outcome 2: Improve sharing of information	\$3.1m
Outcome 3: Demonstrate, communicate and extend the benefits	\$4.6m
Program management (see Governance)	\$0.4m
Total	\$13.9m

6.3 Links to other programs

The RD&E program described here has overlaps with and links to other programs developed under the RMCiC and through other arrangements as described in Section 5 for each of the Outcome areas. No doubt there will be linkages into other strategic plans either developed (e.g. Feedbase) or under development (e.g. Genetics / Genomics).

Communication between the governance body for this plan and other plans / activities described in this report will need to be comprehensive so as to:

- Minimise duplication of work;
- Take advantages of opportunities for joint projects where the resources needed may be similar (for example, where carcass traits are measured as part of a grazing systems evaluation); and
- Minimise the opening of gaps in the overall sheepmeat portfolio (in which programs assume that other programs are covering a specific investment area).

It is for these reasons that this Plan suggests an overarching governance group to manage and monitor progress in this area (see Section 10).

6.4 Portfolio risks and risk management

Table 4 lists risks, and associated mitigation strategies, associated with this plan.

Table 4 – Plan risks and mitigation

Risk	Likelihood without mitigation	Mitigation strategy / Comments
1. State agencies may not be supportive of work that is solely IAI	Medium	Clarify that this Plan does not seek to provide industry policy in relation to sheep ID
2. Agencies may not be prepared to invest in identified projects	Low / Medium	Ensure agencies (via the PDT and RMCiC) are supportive of the Plan prior to release (note: much liaison has already been undertaken with agencies in the development of this plan)
3. AMPC may not support because of confidentiality issues with some processors	Medium / High	At the initial stages at least, this plan should provide improved options for those who wish to participate rather than imposing a national system for all
4. Mandatory electronic IAI may be imposed	Medium	Outside of the control of this Plan. While such a policy decision will have implications for this Plan (particularly in relation to timing) it should still be able to operate effectively as it has been developed with this possibility in mind
5. Electronic tag costs and cost of obtaining data may outweigh benefits	Low / Medium	This plan does not suggest mandatory use of electronic IAI
6. Only large enterprises will realise benefits and rest of industry will not support	Medium	This plan does not suggest mandatory use of electronic IAI. In the early stages at least, targeting of specific market segments will be important
7. Other issues (e.g. drought, animal welfare, regulations, major decline in lamb prices) may become a priority for industry and improved IAI will get lower priority	Low	While other issues will regulate speed of adoption, it is unlikely that enhanced IAI will removed as a priority for the reasons listed in this report

7. Economics

Economic evaluation, plan outcomes and analysis approach

Ex ante economic evaluation provides insight into the likely performance of Plan investments and guides data collection to facilitate monitoring and *ex post* evaluation. Economic evaluation was completed in a standard benefit cost framework (see CRRDC Guidelines 2007) and a real discount rate of 7% was applied. Sensitivity analysis was

completed on the percentage of the flock adopting research outcomes and receiving a price premium – a major assumption driving the analysis.

The Lamb Supply Chain and Animal Information RD&E Plan will deliver three major groups of industry outcome, i.e.:

1. Transformation of data into information valued by industry;
2. Improved sharing of information along the value chain; and
3. Demonstration, communication and extension of the benefits of improved information flow.

To illustrate the benefits that might be generated from the Plan a case study approach was adopted. Plan outcome number one⁴ was analysed and is expected to deliver a real time assessment tool for processors. The assessment tool will measure meat quality attributes and meat yield in the live animal and leverage off beef work already completed (e.g. high intensity scanning / cameras for scoring etc.).

Costs incurred to realise economic benefits

To achieve this lamb industry outcome investment will be required by MLA, other co-investors and industry. MLA and other co-investor costs are budgeted at \$5.15 million over four years and are shown in Table 5 below.

Table 5 – MLA and co-investor budget to deliver Outcome 1

		2012-13	2013-14	2014-15	2015-16
1.1 Develop real-time assessment tool	MLA	125,000	125,000	125,000	125,000
	Other co-investors	250,000	250,000	250,000	250,000
1.2 Demonstrate tool in abattoir	MLA	375,000	375,000	375,000	375,000
	Other co-investors	312,500	312,500	312,500	312,500
1.3 Develop expert systems for producers	MLA	150,000	150,000	150,000	150,000
	Other co-investors	75,000	75,000	75,000	75,000
Total		1,287,500	1,287,500	1,287,500	1,287,500

In addition to these direct Plan investment costs, cost will be incurred by lamb producers to capture additional data and turn the resulting information into industry benefit. These include costs of sire selection, labour and weighing costs to grade lambs and ensure they meet processor specifications. A cost per lamb assessed of \$1.50/head was deemed reasonable following discussions with MLA (personal communication April 2012).

⁴ Note that only projects 1.1-1.3 were included in the analysis. The expected of outcome 1.4 (animal health information) provides a benefit that is more difficult to quantify and stands apart from the other three.

Benefit identification and estimation

Benefit types and industry impact associated with the Plan are summarised in Table 6. All potential benefits are economic in nature. No social or environmental benefits have been identified.

Table 6 – Plan benefits for industry

Benefit type	Industry impact
Improved information delivering increased productivity and efficiency	Additional sales at premium prices Production cost savings
Improved market access	Additional sales at premium prices
Increased biosecurity – endemic and exotic disease management	Avoided losses associated with exotic disease events (additional sales) Production cost savings
Consumer satisfaction	Additional sales at premium prices

Additional lamb sales at premium prices dominate expected industry impacts and this benefit is quantified in the economic analysis. The benefit is estimated using data gleaned from published industry statistics (e.g. ABARES) and experience in Western Australia with improved processor feedback on the performance of slaughter lambs (i.e. WAMMCO). Data used to quantify industry benefit is summarised in Table 7.

Table 7 – Summary of assumptions

Variable	Assumption	Source and comment
Price premium paid to lamb producers as a result of better information and meeting processor specifications	\$0.22/kg	WAMMCO Western Australia data provided by MLA. The premium is the actual payment made to lamb producers for complying stock. It is therefore a proxy for processor profit and is net of any capital or operating costs incurred by the abattoir
Average slaughter weight of Australian lambs	21.8 kg per head	ABARES 2011 – average carcass weight 2005 to 2010
Per head gross benefit of adopting Plan outcomes	\$4.80/head	Premium per kg (\$0.22/kg) X average slaughter weight (21.8 kg)
Cost per lamb assessed	\$1.50/head	Consultant estimate – including both capital and labour and an estimate for those stock that do not receive a premium
Net benefit to producer of lambs that better meet processor specifications	\$3.30/head	Gross benefit of \$4.80 less grading cost of \$1.50. This estimate is broadly consistent with the literature e.g. McLeod 2007 found a benefit of \$3.32/head while Anon. 2010 identified a benefit of \$3.50/head
Australian lamb kill	19.6 million head	ABARES 2011 – average of turnoff for slaughter 2005 to 2010
Percentage of the Australian lamb kill adopting Plan outcomes and receiving the price premium	15%	Consultant assumption – tested with sensitivity analysis
Year in which improved information flows and some adoption of plan outcomes first occurs	2018	Consultant assumption based on review of the RD&E Plan
Year in which maximum adoption occurs	2023	Consultant assumption based on review of the RD&E Plan
Year when premium begins to decay	2031	Consultant assumption based on review of the RD&E Plan
Probability of research success delivering price premium to producers.	80%	Consultant estimate based on plan quality and low risk profile of MLA investments

Summary of benefit/cost analysis results

Benefit/cost analysis results associated with delivery of outcome one for both a 'core' and 'pessimistic' scenario are summarised in Table 8.

Table 8 – Benefit/cost analysis results (discount rate 7%, 30 years)

Criterion	Pessimistic scenario (10% of flock receive premium)	Core scenario (15% of flock receive premium)
Present value of benefits (\$' million)	26.55	35.56
Present value of costs (\$' million)	4.08	4.08
Net present value (\$' million)	22.48	31.49
Benefit/cost ratio	6.52	8.73
Internal rate of return (%)	30.4	33.2

Breakeven analysis reveals that the percentage of the flock receiving a price premium would need to fall to 2% before investment costs would equal investment benefits.

Economic evaluation conclusion

Investment in outcome one of the Lamb Supply Chain & Animal Information RD&E Plan has been assumed to produce a number of benefits, one of which has been valued (i.e. a price premium for lamb carcasses that comply with processor requirements). A total investment in outcome one of \$4.08 million (in present value terms) has been estimated to produce gross benefits of \$35.56 million (present value terms) providing a net present value of \$31.49 million and a benefit/cost ratio of almost 9:1 (over 30 years, using a 7% discount rate).

8. Alignment with industry / Government priorities

The planning context for this document is described in Section 1.1. Further detail on relevant plans, namely the National Sheepmeat Production RD&E Strategy, Sheepmeat Industry Strategic Plan (SISP) and MLA Strategic Plan 2010-15, is presented in Appendix 1.

In summary, these plans envisage the development of a low-cost individual animal identification (IAI) system and associated hardware, software and data flows between producers and processors, with benefits from the improvement of:

- Supply chain efficiency;
- Product integrity and quality;
- Disease tracing and surveillance; and
- Remote monitoring and management of sheep on-farm.

This plan largely addresses the strategic priorities of these three plans. We note however in respect to the National Sheepmeat RD&E Strategy that:

- Some of the target dates identified in the National Strategy are unlikely to be met – in particular, for several deliverables in imperative 1 with a target date of 2011 (although some have arguably already been met, for example ‘software and systems that provide tracking capability for individual carcasses to final inspection’).

- This current plan has not included the deliverable: 'By 2019, commercialise a low cost animal ID system with the required management and traceability features'. This is considered to be a matter for the private sector.

Table 9 shows the Commonwealth Government's Rural Research and Development Priorities and the degree to which the RD&E recommended in this plan aligns with those priorities.

Table 9 – Alignment with Rural R&D Priorities

Priority	Outcome	Alignment of this plan
Productivity and Adding Value	Improve the productivity and profitability of existing industries and support the development of viable new industries	High – potential productivity benefits as highlighted
Supply Chain and Markets	Better understand and respond to domestic and international market and consumer requirements and improve the flow of such information through the whole supply chain, including to consumers.	High
Natural Resource Management	Support effective management of Australia's natural resources to ensure primary industries are both economically and environmentally sustainable.	Low
Climate Variability and Climate Change	Build resilience to climate variability and adapt to and mitigate the effects of climate change.	Low
Biosecurity	Protect Australia's community, primary industries and environment from biosecurity threats.	Medium – opportunity to increase traceability and animal health surveillance
Supporting the Rural Research and Development Priorities: Innovation skills Technology	Improve the skills to undertake research and apply its findings. Promote the development of new and existing technologies.	High

9. Management structure and reporting

9.1 Steering Committee

Overview and role

Primary oversight of this plan should be the responsibility of a Lamb Value Chain Efficiency Steering Group or Committee. It is envisaged that this group would report to either the RMCiC because of its national focus or, potentially, the Southern Australia Meat Research Council (SAMRC), which brings together representatives of peak industry bodies, funding bodies, research providers and other stakeholders.

A committee of SAMRC – similar to those already in place for programs such as Feedbase – is likely to be the most suitable ‘home’ for Lamb Value Chain Efficiency, because the focus of work is clearly in southern Australia.

The role of the Committee will be to take a strategic role, ensuring monitoring and evaluation of current activities, identifying gaps / future work and allocating resources appropriately.

Because the three outcome areas proposed for this plan are closely interlinked, there will not be a second-tier governance structure at outcome level. Project steering teams would be justified for larger projects.

Membership

The starting point for the Committee is the Sheep CRC and MLA-convened Lamb Supply Chain Group, which comprises managers from various sections of MLA, the Sheep CRC, NSW DPI, Vic DPI and DAFWA (that is, the principal investing partners). This Group will cease at the conclusion of the sheep CRC. A new steering committee should be established and the membership adjusted with the following considerations in mind:

- While some representation of investors is inevitably required, the membership should provide a range of core skills. The skills needed at the table include:
 - Sheepmeat production;
 - Sheepmeat processing;
 - Livestock exchange;
 - Information systems;
 - Animal health surveillance;
 - R&D management; and
 - Extension/capacity building.
- The membership should reflect the emphasis on ‘D’ and ‘E’ rather than ‘R’ in this plan.
- The level of competition between private providers of hardware and software systems would seem to argue against their inclusion in the Committee. Instead, this plan (see Project 3.1) suggests a forum for exchange of information and ideas between participants across the value chain.

9.2 Program and project management

Program and project management – coordinating calls for proposals, contracting, milestone monitoring, variations, IP management and so on – will be the responsibility of MLA. MLA has established contractual relationships with each of the agencies and the required processes and systems are already in place. The \$3m+ annual investment justifies a part-time equivalent staff member or external contractor to manage the program and provide executive support to the Steering Group. As noted in the proposed budget, \$100,000 per annum (5%) has been allowed for to cover professional fees and expenses associated with program management.

Appendix 1: Relevant excerpts from related industry plans

National Sheepmeat Production RD&E Strategy

Outcome	SMART deliverable
Imperative 1: Enhancing food safety, product integrity and biosecurity	
<p>2. Develop a low cost individual animal identification system that provides for;</p> <ul style="list-style-type: none"> - individual animal tracking in the yards and remotely in the paddock - improved productivity through collection and analysis of lifetime production data to aid selection and breeding decisions - traceability through the supply chain for producer feedback and to meet biosecurity requirements - the development of automated animal handling systems that reduce labour and handling costs 	<ul style="list-style-type: none"> • By 2014, enhance animal ID systems that provide lifetime identification for management purposes and traceability through the supply chain. • By 2019, commercialise a low cost animal ID system with the required management and traceability features. • By 2011, in collaboration with the private sector, develop software and systems that provide tracking capability for individual carcasses to final inspection. • By 2011, in collaboration with the private sector develop the relationships and culture that will improve the feedback of carcass/ disease information to producers. • By 2011, integrate individual ID with automated animal handling systems to reduce labour and handling costs.
<ul style="list-style-type: none"> • Imperative 4: Enhancing integration and value-adding in supply chains (including cost efficiency) 	
<p>1. Develop a tool for real time live animal assessment of meat yield and other meat quality attributes.</p>	<ul style="list-style-type: none"> • By 2012, quantify the marginal value of real time technology to predict yield compared to using weight and fat score measures. • By 2015, complete technical and commercial feasibility studies for portable real time live animal yield assessment. • By 2015 assist sheep processors develop abattoir systems to measure and pay suppliers on saleable meat value.
<p>2. Develop best practice systems for effective, individual animal, carcass and disease feedback from abattoirs to producers.</p>	<ul style="list-style-type: none"> • By 2011, undertake market research to understand grower requirements from processor feedback systems. • By 2012, develop a framework and protocol for best practice feedback to sheepmeat producers from the processing sector.
Imperative 7: Aligning animal welfare practices with consumer and community expectations	
<p>2. Use individual animal ID technology to remotely monitor animal health and welfare through automated systems that reduce labour and management time.</p>	<ul style="list-style-type: none"> • By 2015, provide proof of concept for technology to remotely monitor individual animal health and welfare. • By 2020, commercial systems for remote monitoring individual animal health and welfare available to producers.

Sheepmeat Industry Strategic Plan (SISP)

Strategic theme	Action
1. Meeting demand	<p>3. Improve supply chain efficiency</p> <p>Examine and work with five supply chains representing at least 50% of the industry capacity to develop a framework to improve measured efficiency in those chains by 2012 (MLA/Sheep CRC).</p> <p>Trial the framework in five chains and extend results to industry by 2015 (MLA/Sheep CRC).</p>
2. Quality	<p>4. Increase the relevance and availability of feedback along the supply chain to facilitate quality improvement in lamb and sheepmeat.</p> <p>Implement five systems that accurately measure carcass fat and yield by 2012 (Sheep CRC/MLA).</p> <p>Implement carcass data feedback in three sheep supply chains by 2014 (MLA).</p> <p>Investigate the viability and implementation of a practical national value based trading system for lamb by 2015.</p>
4. Consumers, product integrity and market	<p>3. Improve nationally integrated product integrity systems</p> <p>Implement an integrated traceability system that meets the National Traceability Performance Standards by 2013.</p> <p>Evaluate and quantify the on-farm value of traceability systems by 2011.</p> <p>Increase the uptake of on-farm integrity systems.</p> <p>Residue risk is proactively managed through a program of property audits and both targeted and random residue monitoring programs to maintain current excellent risk profile (NRS).</p> <p>Residue monitoring programs meet overseas market requirements to underpin all trade (NRS).</p>
6. Health	<p>1. Improve traceability and surveillance (tracking for disease)</p> <p>Maintain and where appropriate enhance the national disease/surveillance system which captures information from farm, abattoirs and diagnostic laboratories by 2014 (AHA/MLA/SCA/AMIC).</p> <p>Integrate the national system with the planned traceability system (see 4.3) to enhance information flow through the supply chain (AHA/MLA/AMIC/SCA).</p>

MLA Strategic Plan 2010-15

Imperative	Strategy
Imperative 1: Improving market access	
1.1 Enhancing product integrity	2. Develop and promote appropriate meat and livestock traceability systems
1.3 Maximising market options for producers and exporters in the livestock export trade	2. Improve industry capabilities and livestock performance through the supply chain.
Imperative 2: Growing demand	
2.1. Achieving consistent eating quality	2. Develop and maintain standards and measurement tools to underpin guarantees of eating quality 3. Partner with supply chains to support brands and adopt eating quality systems
2.6 Aggressive promotion in export markets - sheepmeat	4. Under co-operative programs support the growth of branded lamb supply chains to develop trade and consumer loyalty
Imperative 3: Increasing productivity across the supply chain	
3.1 Increasing productivity – on farm	3. Optimise business performance in supply chains
3.2 Increasing productivity – off farm	3. Develop new systems to improve processing decision-making
3.3 Improving supply chain and market information	4. Facilitate improved information flows and risk management within supply chains
Imperative 5: Increasing industry and people capability	
5.3 Building industry innovation capability	2. Provide a range of tools, methodologies and enabling support structures at enterprise and supply chain levels

Appendix 2: Further information on R&D funders and providers

AMPC

The Australian Meat Processor Corporation invests in 3 programs:

1. The Joint program, which operates in accordance with an agreed Memorandum of Understanding across the red meat industry organisations, focuses on marketing activities and some R&D, directed at supply chain, market access and developing and marketing products in international and domestic markets.
2. The Core R&D program, which is the main program directed at research in the meat processing industry, is administered by AMPC and delivered by MLA and is supported by industry-wide consultation processes. This program addresses issues facing the red meat industry such as climate change research, environment, sustainability, technology and innovation, livestock management and capability. The program is directed to address R&D issues that impact industry, Government and the community.

3. The Plant Initiated Program (PIP) is a program directed at enhancing uptake of Core R&D through plant-initiated projects, allowing for company-specific innovations and facilitated adoption through applied R&D.

DPI Victoria

DPI distinguishes between a 'supply chain' and a 'value chain' approach to the lamb industry. The distinction between the two – that is, what DPI believes needs to change – is shown in Table 10.

Table 10 – Distinction between 'supply chain' and 'value chain' approaches (Vic DPI)

'Supply chain'	'Value chain'
Producer-led and production driven	Consumer-led and market-driven, innovative RD&E
'Long' with more interventions	'Short' with fewer interventions
Uncoordinated, disjointed communications with poor feedback	Database and software integrates communications from end to end with effective feedback loop
Minimal inventory management and mob-based with a disconnect in scheduling and ability to meet product specification	Uses inventory management and EID to schedule production and inform breeding objectives to meet product specification
Random contracts, wide-ranging specifications and speculative pricing impedes production / profit	Specific contracts and value-based marketing used to drive on-farm production and profit
Ad hoc market compliance and undefined food security standards	Excellent market compliance and food security advantages

DPI is developing an integrated series of programs to serve lamb industry development, delivered by Farm Services Victoria (the delivery arm), Future Farming Systems Research and Biosciences Research. These programs include:

- 'Lamb Directions', managed by DPI's Future Farming Systems Research division. Lamb Directions seeks to conceptualise and model – both virtually and on real farms – cutting-edge lamb production systems which are then used to inform RD&E and policy.
- Flexible Feedbase Systems, such as Evergraze, in which flexible pasture systems are matched to production systems such as lamb finishing.
- Innovative Animal Systems, examining issues such as ewe management, lamb survival and early reproductive success.
- 'Lamb Foundations', a major 6-year research project to establish a genotypic and phenotypic resource for all of the above.

The DPI lamb program will span the whole of industry, from producers (using focus farms and the Bestwool / Bestlamb producer network), through collaborating processors to retailers. A strong state commitment to sheep EID underpins the program.

Infrastructure developments to the value of \$1.28m have been undertaken during 2010/11, with a further \$2.05m requested in 2011/12 for an animal house with imaging and other capability at Hamilton. Facilities have been consolidated to a Centre of Excellence in Hamilton with strategic research also being at Bundoora and Attwood.

The staffing budget for the lamb program has been increased by \$3.3m over three years then \$1.0m pa ongoing. The indicative allocation of this funding is as follows:

- Accelerate adoption of new technology in farm systems: 35%
- Improve exchange of information through the value chain: 10%
- Develop targeted technology to increase productivity and lamb supply: 35%
- Build a leading lamb RD&E capability to meet national obligations and attract investment: 20%

The new positions created under this budget are a Principal Scientist; 8 Senior Research and Research Scientists (from field to genomics); one Lamb Specialist (Extension); one Lamb Value Chain Project Officer; and several PhD students.

NSW DPI

NSW DPI works with willing processors to measure and capture a defined value and yield of lamb and distribute this value to their suppliers. Systems need to be in place to follow individual carcasses / animals and/or lots through to the boning room with a mechanism for the estimation of yield and value. Systems need to be automated and allow easy communication up and down the chain. NSW DPI seeks stronger ties between the processor and producers and through to the seedstock producer with genetics. There are at least 5 current lamb and sheep supply chains that have developed due to previous co-operative work by NSW DPI.

Improving the value chain is a priority for NSW. NSW DPI is committed to continue to work strategically with individual processors as each has different needs. Some processors may want to develop systems with preferred suppliers and others may want to use components of a system that improves their efficiency or improves product quality such as reducing number of lambs outside their preferred specifications or through specific technology like electrical stimulation to achieve MSA compliance. NSW DPI believes that a blanket approach to value chains will not work. NSW DPI has done most of the RFID and precision sheep management work for the Sheep CRC and worked with Victorian DPI.

New industry funding would allow project staff to work with a number of NSW processors, representative of both the domestic and export markets. These abattoirs process a high proportion of the NSW kill. NSW DPI has an excellent working relationship with these and other processors and appropriate policies to ensure commercial and in-confidence issues are appropriately addressed. At least one large processor has offered to contribute to a new RD&E program.

With industry support NSW DPI's intentions are to:

- Develop systems for information transfer including development of improved market intelligence;
- Oversee further development of web-based feedback systems for weight, fat, yield, eye muscle depth (EMD), PIC, animal health and commercial value. This work will continue the development of mob-based systems for NLIS which was funded by the Sheep CRC to investigate the use of RFID technology on-farm through to the abattoir;
- Assist development of processing efficiency including further automation on the killing floor and in the boning room and for the tracking of carcasses;
- Develop measurement technologies for carcass traits and economic meat quality traits for application at the processing level;
- Better understand factors that influence yield and eating quality and the relative value of these factors;
- Develop with industry new lamb and sheep meat cuts to improve total carcass return;
- Improve lamb supply channels and timing of sale;
- Improve skills of lamb producers and buyers in livestock assessment, market specifications, value of improved genetics and strategic relationships within value chains;
- Continue to oversee and manage demonstration sites including use of mob and individual animal identification for finishing systems and for improved genetics by simple progeny evaluations for commercial traits of significance such as weight, leanness and EMD;
- Continue to liaise with and advise industry participants of the appropriate strategies to improve efficiency within each specified value chain;
- Demonstrate to value chains and industry that RFID is one of a number of tools that can be used on-farm for capturing and transferring information;
- Work with producers and processors to ensure efficient and sustainable supply chains occur through communication and trust; and
- Create understanding within supply chains that management tools can improve efficiency, but that these don't ensure either efficiency or sustainability. The key for success is based on trust, good communication and flexibility.

Sheep CRC

The Sheep CRC and its predecessor have developed systems that could improve value chain efficiency and these usually need IAI, specifically electronic ID.

These systems include precision sheep management (www.sheepcrc.org.au/industry-tools-and-information/precision-sheep-management.php) (PSM) which focuses on managing individual or selected groups of animals to take advantage of the large variation between animals within a flock with many extension and training programs and material being developed, for example the PSMGlovebox Guide and a new training course 'Using eID for Sheep Breeding'.

Walk Over Weighing (WOW) utilises the concept of remote individual animal management (RIAM) to monitor sheep without human intervention by electronically capturing and recording an individual sheep's tag and weight as it passes over weighing scales on its way to feed or water. Sheep require electronic (RFID) tags for the collection of individual animal weights but untagged animals can be monitored as a mob. Equipment required includes an RF tag reader, electronic weigh scales and an indicator (data logger) to record the tags and weights. The system is powered from 12 volt solar panels and batteries. A drafting unit can be added. With the Tru-Test indicator and telemetry systems, remote access and data transfer from the indicator to a home computer using mobile phone and modem technology is now available. Associated software has been developed

Pedigree MatchMaker offers a method of collecting dam pedigree of the lamb. It is a walk-by system with associated software that uses animal RFID data to estimate associations between dams and their lambs, and ultimately provides an accurate pedigree match. When added to sire pedigree, it adds substantially to the value of the information.

Various software programs to aid management have also been developed, predominantly by NSW DPI:

- Lamb Growth Predictor uses repeated live weights to calculate individual growth rates and predicts weights and number over a target weight at future dates.
- Simultaneous Assortment selects animals most appropriate for wool or meat production from an existing flock. It depends on individual information on the animals.
- Selection Assist predicts genetic progress that can be made using different selection strategies over a 5- or 10-year horizon.
- Ram Value Calculator estimates and compare value of rams in a commercial flock.

Appendix 3: Scenarios for 2020

A producer perspective

This scenario suggests that individual animal information (IAI), efficiently handled, could:

- Lead to significant productivity increases on farm through better genetics and animal management;
- Reduce on-farm cost of production;
- Improve individual animal health and welfare;
- Provide tight carcass specifications built on consumer and processor needs;
- Build certainty about supply / demand via co-operative pipeline arrangements - partially removing barriers between buyers and sellers;
- Allow a continuous improvement philosophy to permeate the value chain;
- Differentiate the market and enhance consumer satisfaction;
- Meet future Government and industry requirements in relation to biosecurity issues;
- Improve and demonstrate improvement in industry's management of animal welfare; and

■ Make farming 'easier'.

Sylvia's story

Sylvia Cash hit the send button. It wasn't the old email approach that was used last decade, she recalled with some amusement, but a cyber-file that went straight to her buyer's database. At the same time, it immediately linked into and updated their own inventory data-base; adjusted MyAcct, their accounting program; and sent the information (as required) to ASTORMICloud, the sheep industry's national database managed by Extensive Livestock Australia Pty Ltd (ELA). ASTORMI stood for Australian Sheep Terminal Of Registered Measurement Information and, back in 2014 when the name was coined, stormi seemed a good name given the kafuffle over RFID and a central sheep database over the preceding few years.

What's the enabling technology?

A central database to house all pipeline information from farm genetics to consumer feedback
Direct data transfer to pipeline participants

Sylvia knew that things were now so much easier on the farm since they had invested in soft systems to support their business. The productivity gains they made on the farm and their ability to meet customer requirements was something they could only dream of 10 years ago in 2010.

What's the enabling technology?

Electronic ear tags in lambs and sheep with reader, automatic drafting and wireless transfer of data

Sylvia had just 'sent' a consignment to High Country Meats (HCM), the processor and wholesaler to whom they sold most of their animals. This consignment was of 75 culled ewes, identified by her husband Jack who finished pregnancy testing their ewes not 30 minutes ago. It was so simple. Jack would electronically read each eartag, scan the ewe, type in 0, 1, 2 or 3 to signify the number of fetuses identified and the information would be zapped back to Sylvia in the office. In Sylvia's office, the data would be automatically checked and any ewes that were dry or were found to have low EBVs for key production traits would be shot straight back to the yards where these sheep would be drafted off automatically. All that was left to do now was for the HCM truck to come and pick them up.

Out of 1600 ewes, 75 being dry or having low EBVs was unusually high given how stringently their sheep were culled, but it had been a much tougher season this year. For a variety of reasons, the Cashes took a pretty unforgiving approach to their business. Not pregnant – out you go; low EBV's – out you go; health issues – out you go. But the resultant productivity gains warranted it.

Being culled ewes and thus destined for manufactured meat, the information required by HCM was quite a bit less than for the prime lambs they bought. All HCM wanted to know was sex, age, live weight (taken the standard 4 hours off feed and water), their calculated Lean Meat Yield (LMY) and of course electronic ID number. Obviously the Cashes' database held a lot of production information on these ewes (EBVs, fleece weight and fibre diameter, FECs, number of progeny per annum, ease of lambing etc) but that was of little interest for these old girls now. The

Cashes were always only ever paid on LMY – they would have preferred to be paid on Saleable Meat Yield but knew that this was a more difficult metric given the differences in the degree of fat trimming required for processors to meet specifications for various markets. For these cull ewes, LMY was calculated by a constantly updated algorithm based on real results compiled by HCM over the last 10 years on the Cashes' animals. The processing data on these 75 animals would actually be added to the Cashes' database and then a new algorithm produced and zapped back to Sylvia. Also returned, once these sheep were processed, was information on any animal health issues picked up during processing so that the Cashes could take remedial action if necessary.

Sylvia and Jack really ran a family farm, but it was different to that of a decade ago where they had to employ 2 or 3 men part time – and that was costly. Now with the use of EID, remote sensing, automatic drafting and regular animal measurement across a whole range of traits, the two of them could easily manage the 12,000 ewes they ran – although a good dog was still needed!

Sylvia went back to her database to save all the files when an email alert hit Sylvia's screen. HCM advised that a client had to supply a special order for the Legends Dinner at the Cricket World Cup in two weeks' time at Turnbull Stadium in Canberra. They needed 100 lambs with specified eye muscle depth, eating quality grade A and estimated LMY of 60%. Sylvia reckoned they could supply that but the best part was that the order was 25% above yesterday's price grid. If they couldn't get 100 lambs to meet that spec out of the flock of Bart the 3rds (Jack's best ram) then she'd eat her hat. She hit 'accept' and hoped that her bid got back to HCM first so that they won the contract.

'Good old Bart the 3rd', she thought. He was a ripper. His genetics were superb, and several years of progeny testing and feedback from processors showed that Bart's offspring regularly topped the ASTORMICloud Meat Eating Quality Awards. As a result,

What's the enabling technology?

Prediction of processor / consumer traits on live animals - LMY, eating quality, EMD etc

Development of and constant updating of specific algorithms to enhance accuracy of key processing / consumer traits

What's the enabling technology?

Development of and constant updating of specific algorithms predicting key processing characteristics

What's the enabling technology?

Highly specified grid pricing schedules clearly understood by producers

Direct tenders for product

Genetic markers for eating quality

companies like HCM chased his lambs because they easily met the MSA premium grade that was required to get lamb into any restaurants of two stars and above. Bart's progeny always received a 5% premium over other sires' lambs because, not only was his eye muscle size huge and LMY high, but his marbling for such lean animals was quite remarkable – making meat from his progeny highly sought-after. The best part, Sylvia thought, was that Bart the 17th showed even better potential. But HCM didn't know about him – yet!

Jack's story

Gee that's a good beer, thought Jack, as he took another sip and watched Snowy and Rusty keep the sheep up to the automatic drafting race to take the culls off before he took the bulk of the mob back to the paddock. Suddenly his phone beeped. Damn, he thought! Jack had received a text from ROVER5 that indicated he might have a struck sheep in the one-year-old maidens. I had better go and have a look – these girls are worth \$350 each – and that's enough to pay school bus fees for a month.

What's the enabling technology?

Remote sensing of individual animals by mobile mechanical means (the example here portrays a vehicle, but the concept could be stationary or undertaken by other means)

So while Snowy and Rusty did their stuff, Jack jumped on the 6-wheeler to see what was wrong. ROVER wasn't another of his prize Border Collies but a strange looking contraption, an electronic 'shepherd' that wandered around the paddocks day and night. ROVER was a Remote Observation Vehicle with Extended Range. ROVER was a mobile ration dispenser and weighing device that could also detect a range of visual, olfactory and temperature symptoms in sheep. The sheep would step up onto a low platform on ROVER, their ear tag would be read and if they hadn't had their holistic supplement for 24 hours, a small (100 gram) ration would be dispensed to the feed bin (if they had, no feed would be sent down and the sheep would eventually back out). While feeding, ROVER would weigh the sheep and its sensors would smell for any tell-tale fly strike odours, take body temperatures etc. On this occasion, it picked up the risk of fly strike so the gates behind the sheep closed and it sent a message to Jack.

"Good old ROVER gets it wrong sometimes," Jack thought as he drove down the paddock. But ROVER had been invaluable. Not only did he constantly monitor the animals, but he and his cousins had also been a key driver in the Australian sheep industry getting the RSPCA and OIE "tick" of approval for animal welfare practices,

What's the enabling technology?

Saleyards with automated electronic readers and databases linked to the national database

now so important for domestic and export markets. This time ROVER was right so Jack treated the animal, let it go back to the mob and headed home to let the sheep out. Jack knew that their data-base would be automatically updated with this info and that the ewe

⁵ ROVER was a product of the LWA / AWI scenario planning project FutureWoolscapes

just treated may soon be culled as a result. On the way home Jack thought to himself that he must look at buying ROVER 2 as the newer model actually has the capacity to treat the animal itself. Jack parked the trike and headed inside. Tonight old Fred was coming to dinner.

Fred was a great old bloke. Been farming for 50 years but to be honest struggled to make ends meet. His wife left him a few years back and with all the kids now off his hands Fred was pretty lonely. Jack and Sylvia did the neighbourly thing and invited Fred over for dinner every few weeks.

"How could you afford to buy the missus a new stove?," said Fred as he walked into the kitchen, where the piquant aroma of rosemary-infused rack of lamb wafted. "I dunno how you do it, I got 110 bucks for my best lambs at Hamilton last week and that will hardly cover my electricity bill," Fred said. Sylvia tried to change the subject as she knew that if she got the World Cup dinner contract, those fellas were going to bring \$270 each. "I must remember to tell Jack about that," she thought, "but not in front of Fred".

Fred was one of a small but disappearing group of sheep producers. He used EID only because it was Government-mandated after the worrisome FMD scare of 2013 (which turned out to be an absolute furphy but was enough to push all state Governments to make EID compulsory from a biosecurity perspective). Fred shoved an EID tag in his sheep and lambs just before they got on the truck but he kept no measurements of individual animals and received no feedback from processors; information that helped the Cashes continuously deliver a better product to their customers. Jack had tried many times to encourage Fred down the path he had taken. "You can still sell through saleyards, Fred," Jack had said on numerous occasions. Indeed many producers who sold through saleyards with individual animal ID did very well, but they did so not because of an ear tag but because of the information that sat behind it. Information that processors and consumers increasingly wanted.

Jack lamented the fact that his friend was still a price taker, when the investment in software and hardware that Jack and Sylvia had made had paid for itself in a couple of years.

A consumer perspective

Jenny's story

Jenny had guests for dinner last week where she had served Moroccan spiced barbecued lamb using lamb rounds. Her guests commented later how delicious the lamb was. Jenny had bought the lamb from a major supermarket chain and had

recorded the barcode on the package. She had checked the industry database with her smartphone. The lamb had been grown in western Victoria and parentage had included a NSW Dorset bred ram and a SA Merino ewe that both had identified genetic characteristics for meat tenderness and higher-than-average omega-3 fatty acids. The lamb and its dam had been grown using lamqa1, the farm industry assurance scheme for

What's the enabling technology?

Web-based, publicly-available information on quality assurance schemes and branded product

sustainable environment, animal welfare and food safety. It had also been slaughtered and the meat processed using lamqa2, the processing and retail industries' meat quality and food safety module. Ninety-three percent of customers who provided feedback on this product over the last 3 months had rated the product as excellent.

Based on the genetic profile of the sire, it was also likely the lamb would have zinc and iron levels that would meet product official dietetic guidelines. The omega-3 fatty acids were also 40% above the meat industry average, meaning that Jenny would not have to buy highly priced fish to meet her personal health needs.

Jenny did a search and found a similar product was available at a number of local stores, but on special at an outlet in the next suburb. She purchased the same branded lamb rounds for her next dinner. She also provided feedback on her previous purchase and was rewarded with double customer loyalty points for her next similar product purchase.

Appendix 4: Listing of organisations consulted

- Allflex
- AMPC
- Australian Livestock Export Corporation (Livecorp)
- AWI
- DAFWA
- DEEDI Queensland
- DPI NSW
- DPI Victoria
- DPIWE Tasmania
- Hardwicks, Kyneton (processor)
- Hillside abattoirs
- Lamb Supply Chain Group
- Livestock Exchange
- MLA – Livestock Production Innovation, CIS, NLIS, NLRS
- Murdoch University
- PIRSA
- Practical Systems
- Livestock producers
- Sapien Technology
- SARDI
- Sheep CRC
- Sheepmeat Council of Australia
- T & R Tamworth
- WAMMCO

Appendix 5: Documents reviewed in the preparation of this plan

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