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Developing RD&E priorities and investment plan for sheep reproduction

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Executive Summary

National Reproduction Research, Development & Extension Investment Plan 2012-2017

The Sheep Reproduction RD&E Investment Plan was developed with oversight from the Reproduction Steering Group and involved broad industry consultation with many individuals, organisations and producer groups involved in the sheepmeat and wool industries. This consultation process identified current national priority and capability in sheep reproduction RD&E, the key challenges for improving sheep reproduction and the balance of investment across various aspects of sheep reproduction RD&E, and stakeholders' perceptions of the opportunities to build a collaborative national plan.

In addition to the stakeholder consultation, a key feature of the process undertaken in developing this plan is the robust economic analysis of the value of improving sheep reproduction and the aspects of sheep reproduction that would be most rewarding for the industry to invest in. Furthermore a detailed 'rapid appraisal benefit analysis' was undertaken on each of the RD&E concepts submitted by stakeholders and those concepts yielding a benefit cost ratio of more than two were consolidated to form the basis of the plan.

The proposed investment plan is defined by the four priority areas (or pillars):

- Conception and early embryo mortality,
- Ewe and lamb survival,
- Early reproductive success and weaner performance, and
- Genetics and biological mechanisms,

The recommended balance of investment in strategic and applied research and industry development and extension across each of these pillars, as outlined in the framework below, will combine to deliver a 10% increase in national sheep reproduction rates in the next 5 years (2012-2017).

Investment plan management and co-ordination

A key finding from the consultation process was that the implementation and management of the National Sheep Reproduction Plan should be undertaken by independent program management that is supported by MLA and AWI. In addition each investment pillar will be guided by a leadership team. The implementation of the overall plan will be overseen by a group consisting of the independent program management, pillar leaders and a representative from MLA and AWI. This group will perform the function of the Reproduction Steering Group that oversaw the development of this plan.

Reproduction investment plan linkages

The development of the Sheep Reproduction RD&E Investment Plan was originally commissioned by the RMCiC on behalf of the sheepmeat industry. A critical objective achieved in developing this plan was linkage with the Wool RD&E Plan and that AWI committed to developing their priorities for investment in sheep reproduction RD&E simultaneously, as part of this process. The resultant outcome is a truly national, collaborative Sheep Reproduction RD&E Plan. As the implementation phase of the reproduction plan commences further linkages with the Welfare RD&E Plan must also be sought. An additional recommendation of this plan is that the sheep, beef and dairy industries should combine resources and ingenuity to establish an across industry CRC on Reproduction, which would enable significant collaboration across the national RD&E platform of the order not previously achieved.

National reproduction investment plan framework

Pillar	Aim	Project Cost ($m)				Project Investment (%)
		Strategic Research	Applied Research	Development & Extension	**Total**	
Conception and Early Embryo Mortality	To improve conception rates by; (i) Researching, demonstrating and implementing nutritional strategies that improve ovulation rates, ewe condition at mating, and conception rates, and (ii) Quantifying the loss of embryos in early pregnancy (pre and post implantation), investigating and extending ways to minimize embryo loss.	0.1	0.8	0.4	1.3	5
Ewe and Lamb Survival	To improve ewe and lamb survival by; (i) Developing and extending recommended nutrition profiles for pregnancy and lactation for adult Merino, crossbred and Dorper ewes, (ii) Research, demonstrate and extend tactical management strategies that improve ewe and lamb survival, particularly twin lambs, and (iii) Researching and implementing innovative extension strategies that create widespread industry impact.	1.4	4.7	8.1	14.2	58
Early Reproductive Success and Weaner Performance	To improve early reproduction success in maiden ewes and weaner performance by; (i) Quantifying current industry performance of maiden ewes lambing at either one or two years in various breed types, (ii) Developing and extending best practice guidelines for the nutrition and management of maiden ewes, and (iii) Evaluating the impacts of lambing at 12-15 months on lifetime performance.	1.0	2.2	1.7	4.9	20
Genetics and Biological Mechanisms	To improve reproductive efficiency by; (i) Defining biological mechanisms that drive reproduction and interactions with the production environment, (ii) Increasing the potential for genetic gain in reproduction by improving the genetic parameters, accuracy of data collection and genetic analysis, and (iii) Developing and extending nutrition and genetic strategies that increase reproduction rates.	2.5	0.9	0.9	4.3	17
Investment split by RD&E (%)		20%	35%	45%		

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Investment split by RD&E (%)		20%	35%	45%		

Abbreviations used in this document

AGBU	Animal Genetics and Breeding Unit
AWI	Australian Wool Innovation
BCR	Benefit/cost Ratio
BWBL	Best Wool Best Lamb
CEEM	Conception and Early Embryo Mortality
CSU	Charles Stuart University
DEEDI	Department of Employment, Economic Development and Innovation (Qld)
DAFWA	Department of Agriculture and Food Western Australia
ERS	Early Reproductive Success
FTE	Full Time Equivalent
JBS	JBS Australia
La Trobe	La Trobe University
LTEM	Lifetime Ewe Management
MIDAS	MIDAS Whole Farm Optimisation Model
MLA	Meat and Livestock Australia
Murdoch	Murdoch University
NPV	Net Present Value
NSW DPI	New South Wales Department of Primary Industries
PIRSA	Department of Primary Industries and Regions South Australia
PV	Present Value
RD&E	Research, Development and Extension
R&D	Research and Development
RR	Reproduction Rate
RMCIC	Red Meat Co-investment Committee
SARDI	South Australia Research & Development Institute
SILC	Sheep Industry Leadership Council
SISP	Sheep Industry Strategic Plan
Syd Uni	Sydney University
TIAR	Tasmanian Institute of Agricultural Research
Uni Adel	University of Adelaide
Uni Melb	University of Melbourne
UNE	University of New England
UTAS	University of Tasmania
UWA	University of Western Australia
Vic DPI	Victorian Department of Primary Industries
WAMMCO	Western Australian Meat Marketing Cooperative

MIDAS Glossary

Discounting

Discounting is done to account for the flow of funds over time. Money earned or spent now is more valuable than money earned or spent in the future. Discounting is a similar concept to earning interest on money you have now or paying interest on money that you borrow to spend now.

Present Value of Costs or Benefits

The Present value of the total costs or benefits discounted to today's dollars. This provides a method to compare in one number the receipt or expenditure of money over time.

Net Present Value

The present value of the benefits of a project minus the costs of the project.

Benefit Cost Ratio

The ratio of the present value of the (net on farm) benefits divided by the present value of the research costs. A value of 1 means the on farm benefits are equal to the research cost (ie the project breaks even and there is 0% return on investment), a value of 2 means that the benefits are twice as large and there is a 100% return on the research dollars invested.

1 Introduction

1.1 Context

The Red Meat Co-investment Committee (RMCIC) has overseen the development of the National Sheep meat Research Development and Extension (RD&E) strategy. Within both this strategy and the Sheep Industry Strategic Plan (SISP) increasing the size of the ewe flock and improving reproductive efficiency were seen as major areas that require industry investment. The Working Group for the National Wool RDE Strategy (Wool Working Group) has also overseen the inclusion of reproductive efficiency in its program of work.

The aim of this consultancy was to provide the RMCIC and the Wool Working Group with a review of all RD&E aspects of lamb and weaner survival that can improve the productivity of lamb and sheepmeat and wool production and to develop a comprehensive plan for this RD&E program that covers both the sheepmeat and wool sectors. In addition, the plan includes all aspects of maternal efficiency including reproductive wastage, the capacity for early reproductive success and ewe mortality.

The methodology included a systematic, consultative and rigorous approach to identify the RD&E Priorities and development of an Investment Plan that included the following major aspects for improving reproduction rates:

- Conception and embryo mortality,
- Lamb survival- birth to weaning (including the affects of the ewe, sire and lamb),
- Ewe mortality- particularly during late pregnancy, lambing and lactation
- Early reproductive success- for maidens lambing at either 12 to 15 months of age or 2 years of age,
- Weaner performance and survival- from weaning to 12 months of age.

Each of these aspects for increasing reproduction rates were examined in detail during all stages of the project.

1.2 Project objectives

The objectives of this project include;

- Develop a national investment plan for at least the period from 2012 to 2017, for consideration by the RMCiC and the working group of the National Wool RDE Strategy with a particular focus on strategic & applied research and the identification of delivery priorities and opportunities for extension.
- Document the priorities and industry deliverables that will generate an increase in net reproduction rate of 10%.
- Provide recommendations for the management and coordination of the investment plan across the national RD&E framework.
  Suggest appropriate mechanisms for linkage to the Animal Welfare RD&E Strategy.

2 Investment Plan Contribution and Consultation

The Sheep Reproduction RD&E Investment Plan was developed with the oversight and contribution from the Reproduction Steering Group. Members of the Steering Committee included representatives from many stakeholder organisations.

The Reproduction Steering Committee Members are:

Chris Shands (Chair)	NSW DPI
Dr Alex Ball	MLA
Dr Ralph Behrendt	Vic DPI
Dr Forbes Brien	SARDI
Dr Bronwyn Clarke	Kurraian Consulting
Mark Murphy	Industry Representative
Dr Jason Trompf	JT Agri-Source
Assoc Prof Andrew Thompson	DAFWA/Murdoch University

Other members of funding bodies and the project team who have contributed to the Investment Plan include:

John Young	Farming Systems
Dr Mark Ferguson	DAFWA/Murdoch University
Dr Simon Walker	Embryo Technologies
Andrew Alford	MLA
Prof Graeme Martin	UWA
Mandy Curnow	DAFWA
Penny Hawken	UWA

2.1 Industry Consultation

Broad industry consultation played a major role in the development of this Investment Plan. A complete list of individuals and organisations consulted and the questions asked can be found in Appendices A and B respectively. The key questions were canvassed using a range of consultative approaches, including in-depth interviews, focus groups and surveys.

A clear message from industry was that the present market scenario and flock dynamics are such that if reproductive rates are not able to be improved now – they never will be. Hence, the time is right to make an impact on the industry by investing in R, D and particularly E that develops and enables widespread adoption of best practice that improves sheep reproduction rates.

"We have never had an opportunity like this before" [Bruce Hancock]

Information provided by all agencies, universities, groups and individuals are summarised in this section. Useful information about the balance of investment, human resources, project priorities and ideas to enhance collaboration are included and provide the basis of the Sheep Reproduction Plan and recommendations about its management. Information provided by consultation regarding technical issues and challenges to adoption are summarized in Section 3: Reproduction Situation Analysis.

2.2 Current Reproduction RD&E Investment and Capability

State agencies, universities and other significant stakeholders were consulted about their current FTE commitments to sheep reproduction, as well as the future priority they intend to give to sheep reproduction RD&E within their organisation.

2.2.1State Agency & University Capability

Consultation as part of this project has provided an estimate of human resource capability in sheep reproduction RD&E (Table 1).

Table 1: 2011 FTE Survey and Interview data.

State Agency/ University	**Reproduction FTE in RD&E**		
	R & D	Extension	**Total reproduction FTE**
AGBU	0.5	0	**0.5**
CSU	1.8	0	**1.8**
DAFWA	5.9	2.6	**8.5**
Holmes and Sackett	0	0.4	**0.4**
McKinnon	0	0.3	**0.3**
Mike Stephens & Assoc	0.2	0.7	**0.9**
NSW DPI	2.5	3.9	**6.4**
Private Vet	0	0.2	**0.2**
Rural Solutions SA	0	0.4	**0.4**
SA Livestock Consultants	0	0.8	**0.8**
SARDI	0.9	0	**0.9**
TIAR	0.1	0.3	**0.4**
UNE	4.5	0.3	**4.8**
UWA	5.2	0	**5.2**
Vic DPI	2.8	1.3	**4.1**
Murdoch	1	0	**1**
Total FTE	**25.4**	**11.2**	**36.6**

Given the current poor reproduction rates in sheep flocks across the nation and the severe lack of human resources and capability in sheep reproduction extension (totaling 11.2 FTE, (Table 1), this means it is highly

unlikely that the circumstance with the national flock will improve in the foreseeable future. Although, it should be noted in recent years a significant national delivery team has been established for Lifetime Ewe Management funded through the Sheep CRC. This includes many of the organisations in Table 1 plus other individuals. Furthermore, there are two national networks that provide resources and guidance for improving sheep reproduction, in Making More from Sheep and Lifetime Wool.

Opportunity: Investigate who influences reproduction decision making on-farm, and define strategies for how these influencers can be utilized to extend best practice messages (similar to the Sheep CRC with pregnancy scanners).

2.2.2Stakeholder Priorities

Stakeholder priorities are in line with FTE devoted to reproduction. When asked about the priority placed on sheep reproduction the results below were given (Table 2). This table shows the discrepancy between state agencies and universities compared to consultants and extension agencies. There is a perception by many consultants and extension agencies that it is not economical to improve sheep reproduction (especially in Merinos). This is a serious gap in belief and understanding that is hindering broad uptake of research and development in Sheep Reproduction.

Opportunity: Carry out economic analysis showing benefit of improving sheep reproduction and identify differences to benchmarking analysis that may influence priority given to reproduction by those directly advising farmers, along with case studies on properties that have improved reproduction rates and whole-farm profitability simultaneously.

Table 2: State Agency, University and Industry Priority given to Sheep Reproduction

	Priority	Priority number (1 = low, 5 = high)
ABGU	high priority/significant concern	5
CSU	continuing high priority	5
DAFWA	highest	5
Holmes and Sackett	low	1
McKinnon	low	1
Mike Stephens & Assoc	medium	3
NSW DPI	in top 5	4
Private Vet	high	5
Rural Solutions SA	medium	3
SA Livestock Consultants	low – medium	2
SARDI	Medium	3
TIAR	Low	1
UNE	medium	3
UWA	Equal top	5
Vic DPI	equal second behind feedbase	4
Murdoch	Top	5
Average		**3.4**

2.3 Balance of investment in sheep reproduction

The Sheep Reproduction Steering Committee and the Wool RD&E National Research Forum members were asked to indicate preferred balance of investment in the various aspects of sheep reproduction. These results (Table 3) highlight that a larger emphasis should be placed on improving lamb survival, as a priority, than other aspects of sheep reproduction.

Table 3: Suggested balance of investment for sheep reproduction by sheepmeat and wool representatives.

Aspect of Sheep Reproduction	Suggested balance of investment for sheep reproduction		
	Sheepmeat Steering Committee	Wool RD&E National Research Forum	**Average**
Conception & early embryo mortality	5 %	5 %	**5 %**
Lamb survival	65 %	49 %	**57 %**
Early reproductive success	20 %	10 %	**15 %**
Weaner performance/survival	0 %	22 %	**11 %**
Overall reproductive efficiency	10%	14 %	**12 %**

Opportunity: Lamb survival is seen as the most important area of investment in sheep reproduction RD&E investment planning, being rated more than three times higher than any other aspect of sheep reproduction. In addition lamb survival will be a priority in the Welfare RD&E Plan.

2.4 Commissioned versus open call for projects

All interviewees were asked what they thought the appropriate split should be between commissioned work versus a call for projects. The majority were in favour of commissioned work rather than open for call projects (Table 4), with the exception of Rural Solutions SA, University of Western Australia and Murdoch University. It should be noted that universities will generally favour a competitive process due to higher funding levels being linked to competitive grants.

Table 4: Commission versus Open Call of projects

	Commissioned	Open Call
ABGU	70	30
CSU	80	20
DAFWA	70	30
Holmes and Sackett	90	10
McKinnon	90	10
Mike Stephens & Assoc	90	10
NSW DPI	80	20
Private Vet	80	20
Rural Solutions SA	30	70
SA Livestock Consultants	80	20
SARDI	70	30
TIAR	70	30
UNE	60	40
UWA	25	75
Vic DPI	85	15
Murdoch	30	70
Average	**69**	**31**

The advantages given for **Commissioned Projects** were that they:

- facilitate well co-ordinated R&D when partnerships are formed from inception,
- assist with collaboration,
- allow you to develop a targeted team to address industry needs,
- ensure at a high level agreement is made on the work to be done for the industry which sends a clear message and gives direction,
- avoid wasting time with multiple applications,
- increase efficiencies in R&D,
- give ongoing funding to core capability,
- capitalise on having a co-ordinated plan with national partnerships, and
- are the best use of everyone's efforts.

In contrast, it was thought that an **Open Call** for projects:

- allows for innovation and gaps to be addressed,
- caters for proposals that add value or are novel,
- caters for more localised issues, and
- gives greater project ownership,

However, an **Open Call** can also:

- undo good will by wasting a lot of peoples time and effort,
- make it very difficult to retain capability within organisations,
- hinder collaboration, and
- cause individual consultants to be disinterested because they put in a lot of work for little reward.

Opportunity: A co-ordinated and collaborative national investment plan would be best built with an approximate 70:30 split between commissioned projects and open call for project proposals. Open calls should be directed at strategic gaps in RD&E or to elicit innovation in specific areas, whereas commissioned projects should be utilized for mainstream RD&E where national collaboration is sought.

2.5 Enhancing collaboration

Ideas to enhance national collaboration on the Sheep Reproduction Investment Plan were given by interviewed stakeholders (Table 5). Consistent messages include commissioning projects and having strategies in place for collaboration and communication. An opportunity identified that would assist with those areas is the idea of an independent program manager who could provide leadership and who has the support of both MLA and AWI.

Opportunity: An independent program manager who could provide leadership and has the support of both MLA and AWI. The scope of this role in conjunction with internal program managers in MLA and AWI would need to be clearly defined.

Table 5: Opportunities to enhance national collaboration in the Sheep Reproduction Investment Plan

Agency	Opportunities identified
CSU	• National projects with regional activities. • Build in activities to encourage communication and collaboration • Without CRC's it is up to agencies and RDCs to foster this collaboration.
Vic DPI	• Have a plan within which there are defined pieces of work and you can engage the appropriate organisation to do the work. • Proper commissioning is based on capability and level of co-investment.
Murdoch University	• Ensure the plan is inclusive rather than exclusive.
AGBU	• A national meeting for presenting preliminary ideas might assist in the development of a wider variety of preliminary applications and collaboration. Rules to protect the IP for organisations would need to be in place.
NSW DPI	• For collaboration a plan needs to run over a few years. • An industry built and shared plan that is stuck to – will encourage and facilitate collaboration. • Including scholarships for students in the plan will encourage long term collaboration. • Transparency around the ranking and funding of projects.
SARDI	• Commissioning projects aid collaboration and avoids loss of capability.
PIRSA	• Collaboration will only occur if it starts day one of the project.
SA Livestock Consultants	• More engagement/communication is required for collaboration. • A good stocktake of opportunities. • Plan for succession of expertise from one generation to the next
DAFWA	• Strong national leadership is required. • Need strategy and leadership. • Both AWI and MLA co-funding the development of the plan and resultant projects is the key to collaboration. • Need long term programs (greater than 3 years). • Give people freedom of resources. • Have an independent program manager to oversee the plan, supported by MLA and AWI.
UNE	• Regular national workshop/discussion • Shared post-doctoral positions

Opportunity: The Sheep Reproduction Plan must establish a robust and transparent approach to ranking and funding project initiatives and a defined strategy for engaging partners in collaborative RD&E.

Opportunity: Offering two student scholarships annually, with the prerequisite of multiple agency supervision, is an effective approach way of enhancing national collaboration of sheep reproduction and will further this culture in the next generation.

3 Reproduction Situation Analysis

Analysis of the current situation has involved desktop reviews of reproduction focused research and extension along with broad industry consultation. As a result, the emerging RD&E opportunities have been identified. These opportunities must be interpreted in the light of the current flock dynamics and evaluated accordingly. A thorough examination of the national flock composition, turn off rates and current reproductive performance is required to compliment these reviews and should be undertaken at the commencement of the Sheep Reproduction Plan.

The urgency of this has been highlighted by a study commissioned by the Sheep Industry Leadership Council (SILC) of Western Australia. This study examined the minimum number of sheep that are required to allow existing processing and live export industries to continue in Western Australia through to 2020 (SILC, 2011). They also examined the flock size, composition and performance that are required to support that level of turn off. What was found, was that at current and predicted flock sizes the industry is quickly become unsustainable. Sheep numbers in WA need to increase to avoid losses of infrastructure and market. The key pathway identified to address this circumstance is to improve sheep reproduction rates by in excess of 10%.

Opportunity: To utilise 2011 census data to accurately examine the national flock composition, turn off rates and current reproductive performance, which would assess the sustainability of the sheep industry and its constituents.

3.1 Research review

An important step in the development of an industry investment plan was to clarify historic R&D reproduction outputs and evaluate their uptake. A major sheep reproduction review was carried out in 2002 (Walker, 2002). This review has been updated with research output that has been generated since 2002 and has included the identification of some emerging opportunities from this literature review. The review (Walker, 2011) was used as a basis for stakeholder and project team discussion of the emerging opportunities identified. The emerging opportunities listed provide suggested solutions to the gaps that were identified in the discussion of literature.

A table of emerging opportunities arising from this review is provided in Appendix C.

3.2 Stakeholder situation review

The stakeholder consultation included a question about what they see as the biggest issues and challenges for improving sheep reproduction (Table 6). The results were not dissimilar to issues identified by the research and extension reviews. Lamb survival was certainly the most common theme, along with understanding the barriers to adoption of strategies to increase reproduction rates.

Table 6: Stakeholder comment about the biggest issues/challenges to improving sheep reproduction

Stakeholder	Identified issue/challenge
TIAR	• Stopping the slippage from mating to birth, particularly between scanning and lambing • Lamb survival first 48 hours of life • Increasing reproduction rates in Merino ewes
CSU	• Twin lamb survival, particularly in Merinos • Lamb survival is a major welfare issue • Promoting twin ovulation and embryo survival through targeted feeding • Optimising maternal behaviour • Demonstration of best practice • Increasing producer adoption of best practice • Creating ideal lambing environments
Vic DPI	• Lamb survival, particularly understanding the contributors to dystocia • Ewe mortality – opportunity cost high at present • Lamb survival and ewe mortality as significant welfare issues • Ability to achieve consistently high scanning rates, particularly in maiden ewes • Condition score management profiles for maternals • Improving maternal efficiency • Managing community expectations for lamb survival • Understanding producer barriers to adoption • Need social research around why we are still getting such low lambing percentages • Lack of adoption of best practice • Lack of investment in extension relative to investment in R&D • Lack of adoption of best practice – need to break through 100% barrier to make enable genetic gain to be expressed • Lack of adoption of MERINO SELECT • Lack of attention to detail in ewe management, health, nutrition and time of lambing • Merinos are not fed to express their potential
LTEM Producers	• Practices haven't changed on farm • Stocking rate push and push to increase wool/ha – both of which have decreased ewe condition score and decreased reproduction rate • Farm consultants have not seen any economic benefit in increasing reproduction rate – therefore haven't advocated increasing reproduction rate • Complexity of the message and management practices required • Role of trace elements in improving reproduction is not understood • Individual animal management practices, huge potential but not adopted • Need a management plan or guide for maidens and ewe lambs that delivers repeatable results tailored for different breeds and different production systems • Foot health on good pastures
UWA	• Lamb survival- the first 2 days of life • Early embryo mortality
AGBU	• Lack of accurate reproductive data and inadequate recording software; limited examinat trait definitions for maximising genetic progress • Variable predictability of existing reproductive EBVs for some flocks and the uncertainty this generates amongst breeders regarding the utility of reproductive and potentially other trait EBVs • Lack of breeder understanding regarding data recording, and the limited accuracy arising from lowly heritable traits • Adequate understanding to consider opportunities with respect to breeding program design issues. • Previous two points imply breeders need to access more education and support

NSW DPI	• Lack of adoption by commercial producers of things driving RR • Improving lamb survival • Variability between flocks response to nutrition (genotype difference) • Weaner survival • Getting producers to identify where their problem with RR lies
SARDI	• Improve lamb survival in a cost effective manner • Lamb survival is the rate limiting step – no point improving other aspects (ie conception rate) until lamb survival is improved • Use of genetic selection to improve lamb survival
PIRSA	• Producers attitudes and aspirations – we have the technology – but not getting the adoption • How to optimise stocking rate, reproduction rates and turn off simultaneously
SA Livestock Consultants	• On-farm management of neonatal period – uptake of existing knowledge in nutrition and management – primarily an extension issue • Lamb survival • Changing producers attitudes to ewe management to give ewes the best opportunities at time of lambing • Lack of recognition of losses that are occurring • Convincing Merino breeders to better manage their ewes to reach higher reproduction potential • Mixed farmers lack of attention to ewe management for long periods • Ram health – Brucellosis
Mackinnon	• Natural cap on any idea to increase ovulation or conception due to poor lamb survival in Merinos • Difficulty to overcome poor lamb survival in Merinos cost effectively • Weaner survival – the true extent of this is not appreciated by producers, and could make rapid gains (lack of adoption and improved weaner management). This is also a welfare issue • Impact of wild dogs
Holmes and Sackett	• Weaner survival • Ill thrift in Merinos – eg monitoring worm burden • Influencing lamb survival cost effectively • Achieving high reproduction rates at high stocking rates • Cost effective reproduction rates in ewe lambs (crossbreds) and repeatable outcomes • Labour requirements for monitoring ewes (needs technical solution like walk-over-weighing)
Agrarian Consulting	• Question why reproduction rates are not improving • Seasonal variably and management capability • Time of lambing • Small margins in reproduction
Mike Stephens & Associates	• Majority of wool growers are happy with what they are achieving • Lack of demonstrated benefits from using best practice (witness factor) • Mixed farmers not primarily focussed on sheep production • Many producers, advisors, agents unaware of what can be achieved • Power of the pull of agents, advisors, wool reps – and they become your greatest opponents through naivety
DAFWA	• The sustainability of the national flock • Poor reproduction rates and poor lamb survival • Adoption – next 2-3 years important for whole of industry

UNE	• Lamb survival and lamb vigor • Improved ewe nutrition for optimizing flock performance • Ewe lamb mating (particularly Merinos) and lifetime productivity
Murdoch	• Having cost-effective, proven strategies for increasing lamb and weaner survival. This is the area where nearly 50% of reproductive wastage is occurring. The other main area of reproductive wastage is in the early embryonic period. • Twin lamb survival from Merino ewes • Reliably mating ewe lambs – both crossbred and Merino • On-farm adoption of better ewe nutrition • Lack of a visible problem • Merino flock selection strategies – going against reproduction • Not managing for reproduction • Lack of awareness of impacts of nutrition based on todays dollars • Mixed farms – sheep only small proportion of income – so lack of attention • NLW for genetic selection only measured by 6% of SG users • Less than 15% of producers nationally are pregnancy scanning for multiples
WAMMCO	• Lack of knowledge of how to improve reproduction • Need a well-funded national extension strategy • Mixed farmers– limited income from sheep– how to communicate (eg text messages) • Lack of demonstration of best practice
JBS	• Nutrition pre-mating and pre-lambing – lack of adoption of nutrition principles • Whole of industry is not concentrating on fertility • Poor pasture productivity
David Rendell & Associates	• Popular culture that stocking rate is more important than reproduction rates – the value of fertility is discouraged by industry advisors • Lack of adoption of pregnancy scanning • Poor scrotal circumference in rams at young age • Lamb survival – the impact of various abortion agents (eg campylobacter)
Best Wool Best Lamb Co-ordinators	• Lamb survival – especially in twins and triplets • Very poor understanding of genetics • Time of lambing • Too much focus on $/hd instead of $/ha • Agents perpetuating inaccurate information • Complacency amongst producers • The trend towards earlier lambing • Low participation in extension activities • Lack of motivation to improve lamb survival • Low ram percentage due to price of rams and ram health management • Shelter • Fox disturbance • Dystocia • Continual industry belief that 70% lambing percentage was appropriate. This is coupled with high SR's and high wool cut/ha without recognition of the impact on reproduction • Lack of understanding of why lambs die due to various forms of dystocia • It is perceived to be expensive to improve lamb survival • Poor pasture productivity • Maiden ewe performance • Ewe nutrition and ewe management – poor lamb survival outcome • Merino breeders pushing the wool envelope too far– at the detriment of reproduction • Understanding barriers to adoption

The widespread concern about national lamb survival rates and the regular comments regarding lack of improvements over a long term means this is a key challenge that this plan must address in order to achieve the aim of a 10% increase in reproduction rates in the next five years.

Opportunity: A nationally directed communication and extension program for improving lamb survival that achieves high levels of engagement across the industry resulting in at least 50% of sheep producers adopting key elements of improved reproductive management.

4 Investment Plan Development

The sheep reproduction RD&E priority areas identified as a result of the process outlined above are;

1. Conception and Early Embryo Mortality
2. Ewe and Lamb Survival
3. Early Reproductive Success and Weaner Performance
4. Genetics and Biological Mechanisms

These priority areas define the framework of the Sheep Reproduction Investment Plan and referred to, in the remainder of this document, as the "pillars" of sheep reproduction. Interested organisations submitted RD&E opportunities that align with these pillars in accordance with the Project Proforma as outlined below.

4.1 Project Proforma

In conjunction with industry economists (Andrew Alford, MLA, and John Young, Farming Systems) a Project Proforma and evaluation process was developed. This process was based on the Rapid Evaluation Tool that was developed by MLA to evaluate Feedbase project proposals, but includes economic aspects of sheep reproduction that have been valued by MIDAS modeling (Young *pers comm*, 2011).

The Project Proforma (Appendix D) was developed and sent to all stakeholders in Sheep Reproduction. The aim of this proforma was to canvas all areas of interest in RD&E in sheep reproduction aligned with each of the four pillars that will enable the Australian sheep industry to achieve the goal of a 10% increase in sheep reproduction in five years.

4.2 Evaluation of project concepts

The RD&E concepts proposed were evaluated according to the process outlined below. The concepts that yielded a Benefit Cost Analysis of two or more form the basis for the RD&E to be commissioned on behalf of the Sheep Reproduction Investment Plan.

4.2.1 Background

To value the contribution of the 56 projects submitted to the Sheep Reproduction Plan it was decided that a Benefit Cost Analysis would be useful. In order to be able to evaluate the number of projects submitted in a

realistic timeframe it was necessary to develop a rapid appraisal system. The following outlines the system that was developed and the economic analysis of the on-farm benefits that underpins the analysis.

The Sheep Reproduction Plan has been divided into four pillars and the proposals have been analysed within these pillars:

1. Conception and Early Embryo Mortality (CEEM)
2. Ewe and Lamb Survival
3. Early Reproductive Success and Weaner Performance
4. Genetics and Biological Mechanisms.

The Benefit Cost Analysis was based on an economic analysis of the on-farm benefits calculated using the MIDAS model, the Project Proforma completed by each project proponent and a committee decision to ensure consistency between projects.

4.2.2The MIDAS Analysis

Model Description

The analysis was carried out using the South West Victoria version of the MIDAS model (Young et al 2011). MIDAS is an appropriate analysis technique because it is able to quickly and efficiently value the impact of improving each component of reproduction while accounting for the other related production and management changes that result or are necessary to maximise the value of increasing reproductive rate. The design and production assumptions included in MIDAS that are relevant to an analysis of changing reproductive rate are:

1. Inclusion of a full self replacing flock with breeding ewes, lambs, replacement ewes and a wether component if relevant. This ensures that the implications of reproductive rate on flock structure are fully accounted which includes the proportion of ewes to dry sheep, the change in age structure and the number of young sale animals and older sale animals.
2. Inclusion of a detailed feed budget that accounts for the change in energy requirement and intake capacity of dry, single and twin bearing ewes through gestation and lactation. It also accounts for the extra liveweight gain of reproducing ewes after weaning.
3. Wool production (CFW & FD) varies with the age of ewe (assumptions based on measurements from the Base Flock in Katanning)
4. Ewes bearing twins have a higher energy requirement during late gestation and during lactation than single bearing ewes
5. Ewes bearing twin lambs produce less wool that is finer than ewes bearing singles and ewes bearing singles produce less wool that is finer than dry ewes.
6. Survival of twin lambs is lower than survival of single born lambs
7. Twin born lambs produce less wool that is broader than single born lambs
8. Lambs from young dams produce less wool than lambs from older dams. The assumption is that lambs from 2yo dams produce 100g less CFW than lambs from older dams and that the penalty is double for lambs from 1yo dams.
9. To reduce % dry usually results in increase in % twin

The components of increasing reproductive rate were valued in line with the 4 pillars of the Reproduction Strategy. A total of seven components were identified and these are the basis of the production increases that were included in the proforma sent to the research groups.

1. Conception & Early Embryo Mortality (CEEM)
2. Single lamb survival (LS – Single)
3. Twin lamb survival (LS – Twin)
4. Ewe mortality (Ewe Mort)
5. Reproductive rate of animals mated to lamb at 12 months of age (ERS 12 m)
6. Reproductive rate of animals mated to lamb at 24 months of age (ERS 24m)
7. Survival of weaners (WS)

For each component the increase in profit was calculated and then expressed as the increase in profit per ewe per unit increase in that component of reproduction. For example, for improved conception the increase is per 1% increase in scanning rate, for lamb survival the increase is per 1% increase in single or twin lamb survival. This method of expressing the results leads to the simple calculation that:

Total Benefits = Unit benefit from MIDAS x Number of Units x Numberof ewes

The above 7 components of reproduction were valued for each of 3 different flock types

1. Merino: A self-replacing flock with a focus on wool production in which merino ewes mated to merino rams. The wether component of the flock was sold at 17 months of age.
2. Terminal: A self-replacing flock, with a dual focus on wool and lamb production. There is merino-merino self-replacing flock and surplus ewes are mated to a terminal sire for production of finished first cross lambs.
3. Maternal: A self-replacing flock based on a composite genotype selling finished lambs.

Results

A result that is important in order for these results to be used in the BCA is that the increase in profit is linearly related to reproduction rate (Figure 1). This means it is possible to multiply the expected increase in production by the slope of the line to get the expected total increase in on farm benefits.

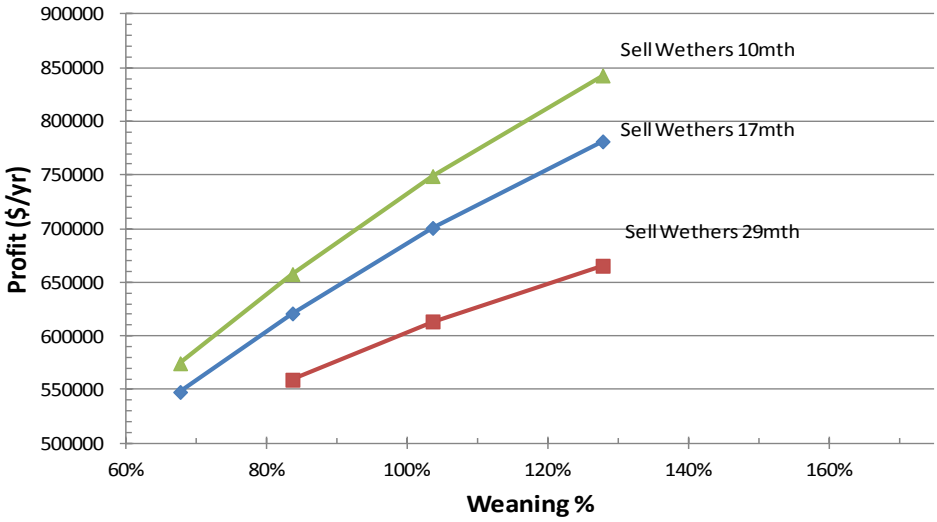

Figure 1: The increase in profit is linearly related to reproductive rate.

The value of increasing reproductive rate is higher for the Terminal & Maternal flock than the pure Merino (Table 7). This is predominantly due to the higher sale value of the lambs and for the maternal flock the higher sale value of surplus young ewes.

Table 7: MIDAS values calculated for the increase in profit from an incremental increase in different components of the reproductive process.

Component	Units	Merino – Merino	Merino-Terminal	Maternal
CEEM	$ / ewe / % scanned	0.05	0.12	0.22
LS-Single	$ / ewe / %	0.43	0.48	0.34
LS – Twin	$ / ewe / %	0.29	0.42	0.61
WS	$ / weaner / %	0.84		0.96
ERS 12m	$ / 12mo ewe / %	0.55		0.70
ERS 24m	$ / 24mo ewe / %	0.45	0.56	0.51
Ewe Mort	$ / ewe / %	1.76	1.92	1.96

Increasing conception is less valuable than increasing survival because improving conception leads to a higher proportion of twins and twin lambs have a lower survival rate, so a 10% increase in scanning may only lead to as little as 2.5% increase in weaning rate. Also, the higher proportion of twins means an increase in the number of lower production twins in the adult flock.

The value of increasing twin lamb survival compared to single lamb survival is impacted on by the proportion of single and twin bearing ewes in the mob. In the maternal flock there are relatively more twin bearing ewes so increasing twin survival (per ewe) is more valuable than for the merino & terminal flock structure in which the twin proportion is lower.

4.2.3The Rapid Appraisal Benefit Cost Analysis

The components of the Benefit Cost analysis were:

1. Target Sheep population
2. On-farm Benefits (OFB)
3. On-farm Costs (OFC)
4. Probability of Technical Success (Success %)
5. Cost of the Research (RC)
6. Level of peak adoption (PA)
7. Time required to achieve peak adoption (TPA)
8. Lag to start of adoption (Lag)
9. Time to complete dis-adoption (TDA)
10. Discounting rate is 15%

Each of these components were defined by respondents in their completed Project Proforma.

Target Sheep Population

Research projects could target different segments of the National Flock. Statistics & estimates provided by Kimbal Curtis were used to quantify the number of sheep in each segment.

Table 8: Estimates of sheep numbers provided by Kimbal Curtis (pers comm).

Ewe Numbers		
Merino Ewes x Merino rams	23.12m	MLA Aust Sheep Ind Projections 2011
Merino Ewes x other rams	9.42m	MLA Aust Sheep Ind Projections 2011
Non-Merino ewes	10.27m	MLA Aust Sheep Ind Projections 2011
Dorper ewes (included above)	1.28m	MLA Aust Sheep Ind Projections 2011
Lambs Retained		
Merino Lambs retained	9.7m	
1st cross Lambs retained	1.2m	
Non-Merino Lambs retained	1.3m	
Ewe lambs available for mating		
Merino	7.0m	
Non-Merino	1.3m	

For the estimates used in the analysis an adjustment was made to the number of Merino-Terminal ewes. The value included (Table 9) is the total number of ewes on farms that mate a component of ewes to Terminal Sires. It was necessary to separate farms that only mate merino rams to merino ewes because the MIDAS analysis showed that for these flocks increasing reproductive rate is less valuable than for flocks that mate surplus ewes to a Terminal sire. This is because the proportion of ewes that are surplus increases as the Merino weaning rate increases. To make this adjustment it was estimated that 50% of farms with merinos also have a merino to terminal enterprise (based on Curtis & Croker 2005, p15).

The number of adult ewes and maiden ewes (24mo) was calculated from the total numbers provided above based on ewes being sold after their 6yo lambing (Curtis & Croker 2005, p10).

Table 9: Sheep numbers used in the BCA analysis (m hd)

Segment	Merino – Merino	Merino-Terminal	Maternal
Adult ewes	9.25	16.8	8.2
Maiden ewes (24mo)	2.3	4.2	2.1
Ewe Lambs	7.0	0	1.3
Weaners	9.7	1.2	1.3

On Farm Benefits

The MIDAS analysis calculated for a generic farm the benefit of an incremental change in different components of the reproductive process. This value per unit was multiplied by the expected increase from research for each component to achieve the total on farm benefit.

A detail not accounted for in this BCA is that any change in price received by the producer that would result from the shift in the supply curve has not been included in the calculation of the on-farm benefits.

On Farm Costs

This includes any costs that farmers would incur in order to implement the message or product on farm. The MIDAS analysis includes the cost of feeding the animals once they are pregnant or lactating or once they have survived, but it doesn't include the cost of improving the reproductive performance i.e. MIDAS values the consequences but not the intervention cost. The costs of intervention are entered in the BCA as a cost per animal.

Technical Success

This is an estimate of the probability that the project will deliver findings that leads to practice change amongst producers. In this manner it includes that the research is successful and an outcome similar to that which is expected is achieved, it also includes the probability that the finding can be converted into a message/product that producers will adopt.

Research Cost

This is the estimate of the research group of the total cost incurred in doing the RD & E associated with the project. This cost has been reported as both the total cost and the cost being requested from the funding body (reported as 'Industry Cost").

Peak Adoption

This is an estimate of the total number of producers that will implement the technology or knowledge. The estimate reflects the adoption strategy that is outlined in the proposal.

Lag

The lag to the start of adoption was in most cases set at half the length of the research phase of the project. In some cases this was altered to reflect projects that either;

1. Had to complete the research phase before any messages are likely to be available for farmers and the lag was increased, or
2. Included a lot of farmer participation in the research or development and hence farmers would be likely to adopt sooner.

Time to Peak Adoption

This reflects the time it will take to convince producers to adopt the technology/knowledge. As the complexity of a technology increases the time for the technology to peak adoption will increase.

Dis-adoption

The time to dis-adoption was assumed to be the same as the number of years to achieve full adoption. This assumption is an approximation but is based on projects that are quick to adopt will also be quickly superseded or farmers would have got the information from another source.

4.2.4Value of Potential Gains

Part of the process followed by the evaluation team evaluating the proposal to ensure consistency in evaluation between projects was developing a table of the potential production increases that could be achieved in each of the components of reproduction (Table 10).

Table 10: Current & potential levels of reproduction in each of the components of reproduction.

	Merino-Merino		Merino-Terminal		Maternal	
	Current	Potential	Current	Potential	Current	Potential
CEEM						
Scanning %	120	160	130	175	140	190
Lamb & Ewe Survival						
Singles	75	92	78	95	80	97
Twins	45	85	50	87	55	90
Ewes	6	2	6	2	4	1
ERS & Weaner Performance						
ERS 12mo	20	70			40	100
ERS 24mo	50	100	55	110	60	120
Weaner Survival	8	2			6	2

For each project evaluated the proportion of the production increases allocated was determined by the nature of the RD&E to be undertaken.

The change from current to potential multiplied by the on-farm benefit of a unit gain multiplied by the relevant number of animals in the national flock provides an estimate of the potential value of RD&E into the area of sheep reproduction. These results provide an idea of the overall benefit of research into each pillar of the strategy and can be used as one method of defining the split of funding between the research pillars.

Table 11: Potential value ($/yr) of research into the different pillars of the National Sheep Reproduction Research Strategy.

	Potential Value	
	$m	%
CEEM	263	9
Lamb & Ewe Survival	1305	47
ERS & Weaner Performance	482	24
Genetics & Biological mechanisms		20*
Total	2050	

*Note: The value for Genetics & Biological mechanisms pillar is based on an estimate of the evaluation team of the importance of this area of investment. The other pillars were scaled down proportionately to make the total 100%.

5 Sheep Reproduction RD&E Investment Plan

5.1 Aims of each pillar of the Reproduction Plan

The aims of each pillar of the Sheep Reproduction Plan are outlined below. The more detailed program logic in each pillar will be developed with input from each pillar leadership team, in conjunction with those managing the implementation of the Sheep Reproduction Plan.

Conception and Early Embryo Mortality

To improve conception rates by;

(v) Researching, demonstrating and implementing nutritional strategies that improve ovulation rates, ewe condition at mating, and conception rates, and

(vi) Quantifying the loss of embryos in early pregnancy (pre and post implantation), investigating and extending ways to minimize embryo loss.

Ewe and Lamb Survival

To improve ewe and lamb survival by;

(vii) Developing and extending recommended nutrition profiles for pregnancy and lactation for adult Merino, crossbred and Dorper ewes ,

(viii) Research, demonstrate and extend tactical management strategies that improve ewe and lamb survival, particularly twin lambs, and

(ix) Researching and implementing innovative extension strategies that create widespread industry impact.

Early Reproductive Success and Weaner Performance

To improve early reproduction success in maiden ewes and weaner performance by;

(vii) Quantifying current industry performance of maiden ewes lambing at either one or two years in various breed types,

(viii) Developing and extending best practice guidelines for the nutrition and management of maiden ewes, and

(ix) Evaluating the impacts of lambing at 12-15 months on lifetime performance.

Genetics and Biological Mechanisms

To improve reproductive efficiency by;

(vii) Defining biological mechanisms that drive reproduction and interactions with the production environment,

(viii) Increasing the potential for genetic gain in reproduction by improving the genetic parameters, accuracy of data collection and genetic analysis, and

(ix) Developing and extending nutrition and genetic strategies that increase reproduction rates.

These investment pillars, with the recommended balance of investment in strategic and applied research and industry development and extension, will combine to deliver a 10% increase in national sheep reproduction rates in the next 5 years.

5.2 Investment in each pillar and RD&E split

The project concepts that yielded a Benefit Cost Ratio (BCR) of 2 or more form the basis for the RD&E to be commissioned on behalf of the Sheep Reproduction Investment Plan. The cumulative 'Benefits', 'Costs' and 'Value' of these projects in each pillar are summarized in Table 12 below. The original 56 project concepts submitted had a total cost of $61.8m (including in-kind). In Table 12 the total cost of the projects with a BCR > 2 is $24.7m, with an industry and other investors cost of $17.6m, and they represent a NPV to the Australian sheep industry of $155.7m. These benefits are derived from both wool (42%) and meat (58%).

Table 12: Benefits, Costs and Value of Project Concepts with BCR > 2.

Pillar	**Benefits**			**Costs**				**Value**		
	Total On-Farm Benefit (PV) ($ m/yr)	% Wool (%)	% Meat (%)	Total On-Farm Costs (PV) ($ m)	Total Project Cost ($ m)	Industry and other investors ($ m)	In Kind ($ m)	Net On-farm Benefit (PV) ($ m)	Project NPV ($ m)	BCR
Conception & Early Embryo Mortality	12	38%	62%	9	1.3	0.9	0.4	3.7	2.6	3.4
Ewe & Lamb Survival	417	40%	60%	284	14.2	10.6	3.7	133.5	122.5	12.2
Early Reproductive Success & Weaner performance	86	50%	50%	59	4.9	3.3	1.6	26.9	23.2	7.3
Genetics & Biological mechanisms	22	47%	53%	12	4.3	2.9	1.4	10.8	7.3	3.1
Total	537	42%	58%	363	24.7	17.6	7.1	174.9	155.7	9.1

The investment in each pillar in the Sheep Reproduction Plan is presented in Table 13. The investment allocated to each pillar reflects the priority of each pillar defined in both the consultation and evaluation processes. The investment split between strategic research, applied research, development and extension is also outlined in Table 13. This investment allocation across pillar and RD&E represents a balance portfolio of investment that will deliver substantial dividends for the Australian sheep industry. It should be noted that 45% of the investment in this plan is in D&E, which is justifiable given the immediacy of the need to improve national reproduction rates and the high BCR (18.0) of projects in this area (Table 13).

Table 13: Pillar investment as a percentage of total investment and RD&E split (for concepts with BCR >2)

			Project Cost ($m)				
Pillar	Project NPV ($ m)	BCR	Strategic Research (SR)	Applied research (AR)	Development & Extension	**Total**	Pillar Investment (%)
Conception & Early Embryo Mortality	2.6	3.4	0.1	0.8	0.4	**1.3**	5%
Ewe & Lamb Survival	122.5	12.2	1.4	4.8	8.1	**14.2**	58%
Early Reproductive Success & Weaner performance	23.2	7.3	1.0	2.2	1.7	**4.9**	20%
Genetics & Biological mechanisms	7.3	3.1	2.5	0.9	0.9	**4.3**	17%
Total	155.7	9.1	5.0	8.6	11.1	**24.7**	
Investment Split SR, AR, D&E (%)			20%	35%	45%		
BCR by SR, AR, D&E Investment			3.1	6.4	9.9		

This cost summary doesn't include the management of the Sheep Reproduction Plan (outlined below) or the cost of bringing pillar leadership teams together annually.

5.3 Investment in the management of the Sheep Reproduction Plan

As highlighted in the industry consultation, independent program management, supported by MLA and AWI, is essential to the success of the National Sheep Reproduction Plan. The Project Management Role will include:

- Overseeing the implementation of the Sheep Reproduction Plan and the commencement of RD&E,
- Establishment of leadership teams to drive collaborative RD&E in each pillar,
- Leading the development of evaluation processes from the inception of the plan, including a thorough analysis of changes in national flock dynamics,
- Furthering the analysis undertaken in the development of this plan that values various interventions for increasing sheep reproduction and communicating this understanding to industry,
- Utilising the Rapid Evaluation Tool developed to value future RD&E proposals and ensure linkage to the Sheep Reproduction Plan,
- Fostering a collaborative and unified approach to reproduction RD&E that facilitates industry change,
- Disciplined project co-ordination to ensure milestones and industry targets are met within time and budget, and
- Communicate progress achieved to all stakeholders.

It is envisaged that the program will be overseen by a management group comprising representatives from:

- Project management
- Project leaders from each RD&E pillar
- MLA
- AWI
- An industry representative

To deliver all the elements of the Project Management role given above, including subcontracting expertise as required, a standard 5% of total industry contribution should be allocated within the investment plan. This approximately equates to $200,000 per annum. MLA and AWI will have the joint responsibility of the overall investment, particularly contracting service providers, variations and IP management. In addition to the management costs, this component of the Reproduction Plan must also include the costs of bringing pillar leadership teams together annually and gatherings to establish collaborative RD&E for inception of the plan. Another additional cost is the two student scholarships to be awarded annually for the first three years of the plan, which is estimated to be $80,000 per annum and is cumulative. Therefore overall this component of the Sheep Reproduction Plan is estimated to cost $400,000 per annum.

5.4 Indicative industry investment 2012-2017

The budget below (Table 14) outlines the annual industry and other investors contribution required to deliver the Sheep Reproduction Plan to both the sheep meat and wool industries. The total investment is $19.63m over five years.

Table 14: Indicative industry and other investors funding required for delivery of the Sheep Reproduction Pan.

	Total	Year 1	Year 2	Year 3	Year 4	Year 5
Industry and other Investors Funding Cash Flow	17.63	3.84	3.84	3.22	3.38	3.35
Management	2.00	0.40	0.40	0.40	0.40	0.40
Total cash Flow	**19.63**	**4.24**	**4.24**	**3.62**	**3.78**	**3.75**

Given that 58% of the benefits derived from the Sheep Reproduction Plan are accumulated in meat and 42% in wool, it is suggested that this would also reflect an appropriate funding split. Hence for sheepmeat this would equate to 11.4m (58% of 19.6m) over 5 years, thus averaging approximately 2.3m per annum. Whereas for wool this would equate to 8.2m (42% of 19.6m) over 5 years, this averaging approximately 1.65m per annum.

5.5 Recommendation for across industry CRC on Reproduction

The immediacy of the challenge to improve sheep reproduction rate means the majority of investment in this Sheep Reproduction Plan is in applied research, development and extension, with only 20% of the budget being devoted to strategic research in sheep reproduction. It is recommended that the sheep industry, along with the beef and dairy industries, all of which in independent studies have identified 'reproduction' as the number one issue confronting them, should combine resources and develop a cross industry CRC on reproduction. This will consolidate national investment and expertise on reproduction, and enable true collaboration across each of the industries RD&E plans recently established.

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Industry National Research Development and Extension Strategy (June, 2011)

Walker, S. (2011) Sheep Reproduction in Australia. 2011 Update on current status and emerging R & D opportunities

Appendix A

5.6 Industry Consultation List

Name	Organisation	Grouping
Dr Sue Hatcher	NSWDPI	RD&E
Ashley White	NSWDPI	RD&E
Gordon Rafsague	NSWDPI	RD&E
Chris Shands	NSWDPI	RD&E
Alex Russell	NSWDPI	RD&E
Dr Ralph Behrendt	Vic DPI	RD&E
Ron Harris	Vic DPI	RD&E
Lyndon Kubeil	Vic DPI	RD&E
Dr Michael Friend	CSU	RD&E
Dr Belinda King	CSU	RD&E
Dr Forbes Brien	SARDI	RD&E
Bruce Hancock	Rural Solutions SA	RD&E
Colin Trengrove	SA livestock consultants	Consultant
Ken Solly	SA livestock consultants	Consultant
Simon Ellis	SA livestock consultants	Consultant
Kevin Chennel	DAFWA	RD&E
Bruce Mullin	DAFWA	RD&E
Dr Mark Ferguson	DAFWA/Murdoch	RD&E
Assoc Prof Andrew Thompson	DAFWA/Murdoch	RD&E
Dr David Miller	Murdoch	RD&E
Prof Graeme Martin	UWA	RD&E
Dr Penny Hawkins	UWA	RD&E
Dr Jo Sneddon	UWA	RD&E
Jo Elliott	UWA	RD&E
Rob Egerton-Warburton	WA - SILC	Industry Influencer
Mark Murphy	QLD SMCA	Industry Influencer
Andrew Bailey	TIAG	RD&E
Rob Davidson	WAMMCO	Processor
Mark Inglis	JBS	Processor
Peter Bailey	Vic DPI	Supply chain
Sandy McEacrhern	HSA	Consultant
Prof Andrew Vizard	Mackinnon Project	Consultant
Ashley Herbert	Agrarian	Consultant
Dr Kim Bunter	AGBU	RD&E
Dr David Rendell	Private Vet	Consultant
John Keillor	Cashmore Park	Industry Influencer
Lifetime Ewe Management Producers	LTEM	Producers
Best Lamb Best Wool Co-ordinators	Best Wool Best Lamb	RD&E and Consultant
Stud Merino Breeders	Blue Chip Livestock Group	Industry Influencers
Wool RD&E National Research Forum	Wool Industry Partner Organisations	RD&E
Dr Geoff Hinch	UNE	RD&E

Appendix B

5.7 Questions for State Agencies and Universities

Questions to develop RD&E Priorities and Investment Plan- Sheep Reproduction

The scope of sheep reproduction includes- conception and early embryo mortality, lamb survival, weaner survival, early reproductive success and ewe mortality.

Q1. What do you regard as the big challenges/issues for improving sheep reproduction?

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Q2. Please outline the current RD&E activities of UNE in sheep reproduction?

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Q3. Please list the staff and FTE's devoted to these RD&E activities, and is this likely to increase or decrease?

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Q4. Within UNE what level of priority is sheep reproduction RD&E?

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Q5. Please outline the future RD&E priorities of UNE in sheep reproduction, and are these likely to change with the direction of the national plan?

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Q6. How does UNE intend to fund these RD&E priorities, and what level of support will be required?

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Q7. What is UNE's intended balance of investment/split between R, D, and E in sheep reproduction?

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Q8. In the final RD&E Investment Plan for Sheep Reproduction what do you think the balance should be between commissioned RD&E projects and 'calls for projects'?

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Q9. How can national collaboration in the RD&E Plan for Sheep Reproduction and resultant projects be enhanced?

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5.8 Questions for producers and consultants

Background data from Livestock Farm Monitor Project- South West:

Wool Sheep- 40 year marking average is 77%, average last 10 years 76%.

Prime Lamb- 40 year marking average is 99%, average last 10 years 101%.

Q1. Why are sheep reproduction rates in Victoria, in both Wool and Prime Lambs, not improving?

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Q2. What extension is required to improve Victorian sheep reproduction?

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Q3. What research is required to improve Victorian sheep reproduction?

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Appendix C - Walker Review Opportunities

Balance of investment	**10% increase in reproductive rates in 5 years**	RD&E split	Program Areas			
			Management (M)	Genetics (G)	Biological Mechanisms (BM)	Creating industry impact (CII)
A%	Conception and early embryo mortality (CEEM) • Objective	R – x%	**Nutrition effects on OR** • Effects of strategic feeding during development of antral & preovulatory follicles on OR, oocyte/embryo quality, PFMO & overall reproductive performance. • Id factors that influence egg & embryo quality. • Effects of diet on oviductal fluid & peripheral concentrations of AAs (particularly branch chain AAs), growth factors & ammonia/urea. **Peri-conception nutrition & health/welfare of offspring** • Effects of nutrition in peri-conception period (-60 to + 30 days of ovulation) on reproductive efficiency & lifetime productivity of resultant fetuses/offspring. • Impact of short term under-nutrition in peri-ovular period (compared with peri-conception period) on embryo quality, placental development and fetal survival. • Id determinants of fetal size & function, particularly if trophectoderm cell allocation is involved. **Nutrition from mid-preg to**	• Id indirect selection criteria and use in the Australian sheep industry. • Use of crossbreeding to improve reproductive efficiency - given availability of exotic breeds suited to Aust environments (e.g. Dorper, SAMM) &/or of high inherent fertility (e.g. East Friesian). • Compilation of suitable breeds & their potential use to be made available to the sheep industry. • Long term genetic selection programs consider goal of nematode resistance. Selection would benefit from the identification of cheap indirect selection criteria.	• Biological effectiveness & economic feasibility of using "ram effect" to mate flocks out-of-season as a means of better aligning reproductive demands & pasture supply. • Effects of breed & time of season on response. • Physiological & endocrinological mechanisms of "ram effect" so that its full usefulness in flock reproduction can be determined including its use in AI programs. **Other** • Heat-induced infertility – cross-breeding is likely to be more productive than genetic selection *per se*. • Consumption of phyto-oestrogens – no longer produces acute infertility but a sub-clinical problem is likely to remain in higher rainfall areas	

			lactation • Nutritional management of the twin-bearing ewe so that fetal growth can be optimised, to enable adequate milk supply during lactation & to recover body condition for the following breeding season. • Effects of nutrition during lactation on development of pre-antral follicle & consequences for reproductive performance during next breeding season.			
		D – y%	**Nutrition effects on OR** • Extend research to randomly cycling flocks & to flocks in which a degree of synchrony is obtained using "ram effect". • Use info to develop recommendations for nutritional management of sheep during pre-mating period. **Peri-conception nutrition & health/welfare of offspring** • Recommendations for nutritional management in peri-conception period that take into account recommendations outlined above for 30–day period before mating. **Nutrition from mid-preg to lactation** • Strategies to min effects of drought on reprod performance of offspring born to ewes during drought. **Other**			

			• Shearing ewes during mid-pregnancy - increases birth weight but has inconsistent effects on lamb survival.			
		E – z%	**Nutrition from mid-preg to lactation** • Promote nutritional requirements of ewes during mid–late pregnancy & lactation, maybe a "ready reckoner", taking into account variables such as breed, twin/single status & quality of feed. • Promote use of ultrasonography to identify twin bearing from single bearing ewes as well as barren ewes.			• Establish flocks at appropriate locations to demo biological & economic feasibility of improving reproductive performance by strategic feeding throughout the year. • Increase interaction between basic & applied research as well as consultants, particularly in understanding complexities of genomic imprinting & the way this understanding might be used to improve flock performance.
B%	Lamb Survival (LS) • Objective	R – x%	• Id parameters of ewe behaviour & physiology in peri-parturient period that may be associated with improvements in lamb survival.	• Indirect selection of associated traits • Development of new measures for temperament traits		
		D – y%	• Develop clearer guidelines & better promote benefits of supplementary feeding late in pregnancy on ewe & lamb behaviour & on lamb survival. • Define relationship between stocking density, frequency of ewes lambing, litter size &	• Sheep Genetics development of alternative reproduction ASBVs (ie Scan Repro)		

			paddock size (studies suggest a flock size of 400) - for single & twin-bearing ewes & for various combinations of each. **Other** • Availability of shelter – uptake of this strategy is unlikely to improve given relevant information has been available for decades			
		E – z%				
C%	Reproductive Efficiency • Objective	R – x%				
		D – y%				
		E – z%				
D%	Early Reproductive Success (ERS) • Objective	R – x%	• Improving reproductive output of older sheep either through improved lifetime management &/or through cross-breeding. Breeding from adolescent ewes if (a) key live-weight and pasture availability standards are realistic & (b) appropriate levels of management are available during pregnancy & lambing. Further research, under Australian conditions, is warranted including the infusion of genes of highly fertile sheep			
		D – y%				
		E – z%				
E%	Weaner Survival (WS) • Objective	R – x%				
		D – y%				
		E – z%				

Appendix D – Project Proforma

National RD&E REPRODUCTION Plan

PROJECT PROFORMA

PROJECT PROFORMA SHOULD NOT EXCEED 2 PAGES

Process

Completing this proforma will enable your project to be ranked as part of developing the National RD&E Reproduction Investment Plan. Completing this proforma will ensure that your project will be considered as part of the National Investment Plan.

Timing of Application

Project Proforma should be submitted by the 8th of December 2011.

Instructions to Complete Project Proforma

This Project Proforma should be completed in a maximum of **two (2)** pages. Applications must be submitted in electronic format, and sent to Bronwyn Clarke at the following email address – br@azurecapital.com.au

Project Title

Organisation(s) Conducting the R, D or E (include collaborating organisations)

Contact Details

Title/First Name/Last Name	
Mailing Address	
Phone Number	
Facsimile Number	
Email Address	

Project Objectives

Brief Description of Proposed Work (Brief methodology)

Target number and class of sheep proposed work is relevant to in the national flock:

Target number of sheep: _____ head

Class of sheep (tick):

☐ Ewe lambs ☐ Adult ewes

☐ Maiden ewes ☐ Weaners

Sheep Type (tick):

☐ Merino ☐ Meat

☐ Both

Highlight the area(s) of reproduction that your project relates to, what are the current rates and likely rates as a result of the project?

Area	Unit	Approx current rate	Approx rate after project
Conception and Early Embryo mortality	☐ scanning rate		
Lamb survival	☐ % single survival		
	☐ % twin survival		
Weaner survival	☐ % weaner deaths/yr (from weaning to 12 mths)		
Early reproductive success	☐ weaning rate (12mth old lambing)		
	☐ weaning rate (24 mth old lambing)		
Ewe mortality	☐ % ewe deaths/yr		
Overall Reproductive efficiency	☐ weaning rate		
	☐ kg lamb weaned/kg ewe joined		

Justification of the impacts outlined above:

Likely on-farm cost ($/target animal) _____

Explanation of above costing

Probability of technical success (0 = not achievable, 100% = definitely achievable). _____**%**

Justification of technical success

Expected level of peak adoption (% of target sheep numbers) _____ **%**

Expected years to reach peak adoption _____ **years**

Justification for given adoption outcomes:

Approximate total project cost: $ _____ (excluding in-kind contribution)

Estimated in-kind contribution: $ _____

Expected length of project: _____ years