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Cost-Benefit Analysis of eBale - Radio-Frequency Identification (RFID)

Final Report

Poimena Analysis

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Poimena ANALYSIS

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Executive summary

A cost-benefit analysis was undertaken for the introduction of Radio Frequency Identification (RFID) technology in wool packs in the Australian wool industry. Drawing and building on the previous study done in 2005-06 (the Schmitt report), the new analysis adopted a Net Present Value approach to estimating the net benefits to the industry. This assessed the benefits to the Australian industry over a 10 year period, brought back to current dollar terms. The study also assessed the incidence of the costs and benefits between seven sectors: growers; AWH (which handles around 60% of Australia's wool); medium wool brokers (brokers who handle around 30,000 bales or more per year that do not use AWH); small wool brokers and private treaty merchants (brokers and merchants who handle less than 30,000 bales a year), dumps/shippers and early stage processors in Australia.

Overseas processors have not been included in the detailed assessment due to uncertainty as to how to estimate the infrastructure cost for these overseas processors, what proportion of processors that would take advantage of the RFID technology, how they would handle wool from other countries that didn't use RFIDs in their bales if Australian wool bales had RFIDs and so on. A guide to the possible net benefits to overseas wool processors based on scaling up the net benefits accruing to Australian early stage processors is provided. This would overstate the actual net benefit as not all overseas mills would make use of the RFIDs and labour costs are also vastly different in some of the major processing countries.

The benefits to AWTA are also not included as the potential gains appear to be very small.

The cost-benefit analysis shows that there is a significant net benefit to the industry flowing from the introduction of RFID technology, with the Net Present Value of between **$12.2 million and $15.9 million** in the Base Case (depending on the interest rate used to discount future benefits and costs). Even at the higher interest rate used for discounting future benefits, the $12.2 million saving seems to justify introduction of RFID technology. The detail of the costs and benefits and the split by sector is provided in the Table on the following page. The table includes the guide on the net benefit accruing to overseas early stage processors, which is between **$5 and $6 million**.

These results are very stable, with only moderate changes arising from a 10% variation in some of the key parameters such as the cost of the RFIDs, the cost of scanners, or the pre- and post-sale per bale savings. The largest change is the result of a 10% change in the pre-sale savings and the cost of the RFID.

However, these Base Case results do change significantly under some different scenarios around the key assumptions. One of these is the proportion of the annual wool production for which the advantage of the available RFID technology is actually taken. If the smaller brokers/private treaty merchants (which account for around 19% of all bales) do not implement the technology (even though it is available in the wool packs), this reduces the NPV of the industry benefits by **$4.3 million** over 10 years.

As well, the purchase of scanners for use by growers or shearing contractors would also **reduce** the net benefits by between **$4.8 and $6 million**, entirely because these are a cost for which there is no benefit attributable. This is one area that may warrant further investigation.

On the other hand, a scenario where the need for countermarking is removed sees a **$6 million increase** in the net benefits to the industry. The key issue here is whether overseas mills would all accept the absence of countermarking, which would require those mills to adopt the new technology.

Finally, a scenario where the cost of the RFIDs were half the cost assumed in the Base Case shows a **$5.97 million increase** in the net benefits to industry, with all of the gains accruing to woolgrowers (who pay the cost of the RFIDs in the form of increased pack costs.

In addition to these benefits, there are other benefits which have not been quantified in this study, which could realise even greater gains than those from improvements in wool handling and logistics identified in this study. These include efficiency gains in wool handling and logistics that have not been considered in this report which may flow as the result of the availability of RFID, including wool store rationalisation and new storage and handling systems.

Other benefits also include the possibly significant benefits arising from better and more efficient trace-back systems which provide marketing advantages for Australian wool. Given concerns expressed by the Chinese industry at the Australia-China Joint Working Group about the need for traceability, these benefits could outweigh the logistic/wool handling benefits identified in this report. This trace-back benefit will also be important for biosecurity purposes, particularly in the event of an outbreak of an emergency animal disease, such as Foot-and-Mouth Disease.

In summary, there are significant industry benefits from introducing and implementing RFID technology and it should be pursued. Leaving aside any technical impediments, however, a significant issue for the industry to address is securing agreement from woolgrowers.

Woolgrowers would bear a significant cost through the cost of RFIDs in wool packs but not secure any direct benefits. Other sectors (notably wool handling/broking) secure the greatest share of the benefits.

While the competitive market will ultimately ensure that benefits will flow back to growers, these will not be obvious in the general ebbs and flows of business transactions. Consideration should be given at an industry level as to a commercial arrangement from the start which could provide these obvious benefits to growers to secure their support. Such an agreement could, for example, be a cash rebate from brokers, private treaty merchants and wool handlers back to growers, for an initial period.

Table: Net Present Value of net benefits to the industry from implementing RFIDs and the start-up investment ($million)

Sector	Base Case NPV		Start-up Investment
	5.5%[1]	10%[2]	
Wool growers	-$11.9	-$9.6	$0.0
Label printer	-$0.35	-$0.30	-$0.15
Wool handling	*$21.0*	*$16.4*	*-$0.7*
AWH	$13.6	$10.7	-$0.1
Medium brokers	$4.5	$3.5	-$0.2
Small brokers/private treaty	$2.9	$2.2	-$0.4
Dumps/shipping	$6.6	$5.2	-$0.1
Australian early stage processing	$0.5	$0.4	-$0.04
Total Australian wool industry	**$15.9**	**$12.2**	**-$1.0**
Guidance estimate of benefits to overseas early stage processing	$6.2	$4.8	-$0.5

[1] The Australian Government 10 year bond rate [2] A 10 year real return with increased risk.

1. Overview

AWEX, through its e-Bale Technical Working Group, requested the preparation of a Cost-Benefit Analysis of Radio Frequency Identification (RFID) technology across the Australian wool clip. The Technical Working Group is assessing appropriate and alternative RFID technologies, which is outside the scope of this current study and report.

A previous study by Leigh Schmitt in 2005-2006 (Schmitt, 2006) conducted a technology assessment and cost-benefit analysis for AWEX and AWI and concluded that there was a net benefit of $1.16 per bale across the Australian wool clip in logistics and handling savings from store to early stage processing. This equated to a net benefit of around $3.1 million per year at the production level at that time (which was 467 mkg or 2.62 million bales).

The Australian wool industry has shrunk since 2006, with production at 352 mkg in 2012/13 (a total of 2.102 million bales were tested by AWTA in 2012/13) and the forecast for 2013/14 to be 345 mkg (1.96 million bales at an average weight of 175.8 kg/bale to end January 2014). As well, labour and other costs have increased since 2006. Furthermore, some key assumptions, such as the proportion of wool going to dumps before shipment, have changed. Finally, the cost of technology (notably scanners) has fallen.

This report provides the updated cost-benefit analysis of the introduction of RFID technology into the Australian wool industry, given the current size of the industry, current labour costs and current practices. In particular, the report presents:

- A review of 2006 study and assessment of whether the stage-by-stage process maps used as the basis of the 2006 report, the steps in the processes that are eliminated by introduction of RFID assumed in the 2006 report and the cost savings arising from the steps that are eliminated as a result of the introduction of RFID determined in the 2006 report are still valid or require adjustment.
- Identification of the costs of introducing RFID technology, including the unit and industry cost of the RFIDs, the unit and industry-wide cost of scanners (hand-held and fixed), and other costs (such as software development costs for systems used by wool handlers, wool dumps etc.)
- Identification of the benefits from eliminating steps in the receivals, handling, testing, dumping and shipping of wool arising from the use of RFID technology.
- Identification of the benefits from automating and/or removing the need for counter-marking, and the associated costs.
- Investigation of the benefits to AWTA.
- The results of an industry-wide cost-benefit analysis from the introduction of RFID technology in wool bales, based on the information obtained in the previous steps.
- The incidence by sector of these costs and benefits. The sectors considered are: growers; sellers (broken down by sub-sets: large wool handling; medium sized wool brokers; small wool brokers/private treaty merchants); exporters/dumps; and Australian early stage processing.
- Sensitivity analyses of these results around some of the key assumptions, notably the cost of the RFIDs and different scenarios.

2. Approach

The approach used in this project was to review and draw on the 2006 study, so as to not re-invent the wheel. In particular, the process maps, the cost model and the steps that are eliminated with the introduction of the RFIDs that were prepared by Leigh Schmitt (with assistance from Max Dugmore) for the 2006 study were used as a starting point. This was reviewed and updated together with Craig Finlay of AWH based on current cost levels and used as a basis for discussion with other broker representatives to confirm and adjust the processes, the steps and the cost savings.

Information was obtained from AWEX (Kerry Hansford and Mark Grave) on the costs of the RFIDs and the scanners. Talman provided the broad, indicative cost of software changes. Information from AWTA on sampling/coring locations was obtained for the cost-benefit model, together with AWTA test data information and the number of wool pack imports.

As with the 2006 study, this report focuses on the logistics and wool handling benefits arising from RFID technology, rather than any marketing benefits. These marketing benefits (such as traceability from mill to farm) may be significant, but it is not possible within this study to quantify these. These and other benefits are considered in section 3.6.

2.1. Review of the 2006 Schmitt report

An Australian Wool Exchange project, co-funded by Australian Wool Innovation, in 2005-06 by Leigh Schmitt investigated the introduction of RFID technology into the Australian wool industry. This study (the Schmitt report) conducted a review of the available technology and provided recommendations, and prepared a cost-benefit analysis arising from the introduction of RFID. The report estimated the net benefit per bale to the wool handling, wool dumping and early stage processing sectors. This was based on a set of detailed logistic process maps for each stage (pre-sale handling; re-handle and lot building; weight-adjusting; post-sale handling; and dumping) and on an associated detailed cost model based on AWH Ltd processes, developed by Max Dugmore of AWH for the project.

Note that the process maps from the 2005-2006 project are included as an appendix with the 2006 report, but the cost model was not due to commercial sensitivity. However, it was made available by AWH to this current project on a confidential basis. Both the process maps and the cost model were used as the basis of the analysis in the current project.

Some of the key assumptions in the 2006 cost-benefit analysis were:

- Electronic Classer's Specification is available for all wool.
- 22 process steps could be automated or eliminated in pre-sale wool handling activities.
- 41 process steps could be automated or eliminated in rehandle activities.
- 4 process steps could be automated or eliminated in post-sale wool handling activities.
- 11 process steps could be automated or eliminated in dumping.
- The report says that automated countermarking was excluded from the cost saving, although it recognises that there is potential to either remove or automate this process.
- Detailed cost modelling for early stage processing was not undertaken and the report made an estimate of the per bale savings for processors.
- RFID tags were assumed to be $1 each and no recycling.

- Industry production levels at 2.62 million bales.
- 95% of bales are dumped.
- Handheld scanners in the field were assumed to be $2,000, with 800 scanners in the field for shearing contractors.
- Handheld scanners in the plant were costed at $4,000 and fixed scanners were assumed to be $6,000 each. AWH estimated the number of handheld scanners for their operation and converted to a cost per bale. This was inflated by 20% for smaller wool handlers.
- Scanners and software assumed to have a 5 year lifespan.
- Costs for early stage processors was assumed to be 33% of the cost per bale for wool handlers.
- Installation and software development costs were estimated at $600,000.

Based on the above, the estimates of the costs and benefits per bale in the 2006 report are shown in Table 1.

Table 1: Savings and costs per bale by stage/sector – estimated in 2006

Stage	Savings ($/bale)	Cost ($/bale)
Pre-Sale (AWH)	+$1.52	
Post-Sale (AWH)	+$0.38	
Total wool handling (AWH)	**+$1.90**	
Total wool handling (other wool handlers)	**+$1.54**	
Average all wool handlers	+$1.73	
Dumping	+$0.52	
Early stage processing	+$0.28	
Total saving	**+$2.50**	
RFID Tag		-$1.00
Infrastructure		-$0.34
Total cost		**-$1.34**
Net return	**+$1.16**	

Based on the annual production in bales at the time, this net return equated to **$3.1 million per year** to the industry. The report noted that this was only for the savings in logistics and that *"the figure could easily double when the potential impact on working capital, countermarking and less tangible benefits from improved marketing and information flow"* are taken into account.

Estimates for each of these benefits were then given, resulting in the following:

- $0.94/bale or $2.5 million saving per year from reducing the cost of working capital for every 7 day reduction in the time for the wool pipeline.
- $1.00/bale or $1.3 million per year by automating or removing the countermarking process.
- $0.75/bale or $2 million per year for every 0.1% improvement in value of wool that may arise from improved information flow and improvement in the reputation of Australian wool.

However, a detailed assessment of the cost model used for the Schmitt report found that the benefits of counter-marking to wool handlers actually was included in the cost model and therefore included in the $1.90 per bale benefits for the AWH operations. The cost of the R&D and the capital required for automatic countermarking was not included in the report. Analysis of the cost model suggests that the oversight inflated the post-sale benefits by $0.28/bale for AWH. This therefore reduces the total wool handling savings for AWH to $1.68/bale. Using the same proportions as used in the Schmitt report, this reduces the wool handling savings of the smaller wool handlers to $1.31/bale; reduces the average saving for wool handling in total to $1.48/bale; reduces the total saving to $2.25/bale; and reduces the net return for all sectors to $0.91/bale or $2.4 million/year. The report also notes that the net benefit it estimated excluded the potential benefits to AWTA.

The Schmitt report notes that the cost of the RFID tags will be borne by woolgrowers, while the benefits accrue to downstream sectors. It comments that '*the appropriate commercial model needs to be developed to ensure that the woolgrowers share in the returns generated from this initiative*." As noted later, the issue remains a key issue and concern.

2.2. Adjustments to process maps, start-up costs and cost savings

The current study used the Schmitt report's process maps, the process steps that are eliminated with RFID technology and the cost model as the starting point. The steps were:

1. Review the process maps and eliminated steps with Craig Finlay, CEO of AWH, adjusting and/or confirming the detail of the process maps and eliminated steps.
2. Adjust the % change in saving of various costs for each process step where necessary.
3. Adjust the start-up costs to 2014 levels. For example, the cost of the fixed and handheld scanners in 2014 are assumed to be $2,600 (fixed) and $1,800 (handheld), compared with the 2006 prices of $6,000 and $4,000.
4. Obtain updated costs for each step which have reduced costs due to the RFID (e.g. receiving, marshalling, coring and grab sample, delivery) from AWH.
5. Adjust the 2006 cost savings to equate to the 2014 cost levels.

6. Using steps 2, 3 and 4 above, derive the new cost savings by process step in 2014, with the following assumptions:
    a. The proportions of bales between pre-sale, post-sale, dumped & shipped are the same now compared with 2006.
    b. Within the pre-sale process, the proportions of bales that are weight adjusted, bulk-classed, rehandle transfers relative to the bales handled pre-sale are the same now as in 2006.
    c. The buyer storage component proportion to post-sale bales is the same as in 2006 and there is no additional or lower number of days stored.
    d. Only small savings in countermarking, not the significant savings included in the 2006 model.
7. Derive the new cost savings for pre-sale, post-sale and dumping for AWH.

Once this was done, interviews with Michael de Kleuver (Rodwells/WISS) and Marty Moses (Moses & Sons) permitted adjustments to the process steps, steps that are eliminated or automated and the costs for each process step for medium sized wool handlers (around 30,000 bales a year or more). For example, these medium wool handlers do not have sortation machines which AWH does. A further adjustment was made for smaller wool handlers to reflect lower throughput and efficiencies of scale.

With regard to Australian early stage processors, an interview with David Ritchie of Victorian Wool Processors helped determine the possible savings for processors. Based on this interview, the savings for early stage processors would be the same as for dumps given that the activities in handling wool are essentially the same.

2.3. Cost-benefit analysis model

A cost-benefit model was developed as an Excel spreadsheet for the project. Note that as there would be a transition period from the existing system to the new system with RFIDs, the timing of when the costs are incurred and when the benefits are realised will be different. For this reason, a Net Present Value approach is the preferred measure of the net industry benefits and was used in this study. However, annual net savings and costs per sector were also determined and are provided.

The features of the cost-benefit model are:

- A 10 year model of all costs and benefits across the period.
- Seven sectors identified for which costs and benefits are established:
    - Growers.
    - AWH (which handles around 60% of Australia's wool).
    - Medium wool brokers (brokers who handle around 30,000 bales or more per year that do not use AWH).
    - Small wool brokers and private treaty merchants (brokers and merchants who handle less than 30,000 bales a year).
    - Dumps/shippers (AWH, AWH/IWD (WA), Packtainers, Winnipeg). and
    - Early stage processors in Australia (VWP, E R Robinson, Michells).
- Spreadsheet inputs of:
    - The $ savings per bale for each sector (where appropriate) from the 2014 cost model.
    - The number of wool packs used each year.

- The cost of the RFID in each pack.
- The number of wool bales handled, dumped/shipped and processed:
  - number of bales handled by the three woolhandler/broker segments;
  - number of bales dumped/shipped;
  - number of bales used by domestic wool processors; and
  - number of bales used by overseas processors.
- The cost of upgrading wool handler/broker, dump and processor software.
- The cost and number of handheld scanners for each sector (including growers and shearing contractors/classers).
- The cost and number of fixed scanners (including set-up cost) for each wool handler/broker, dump and processor.
- The frequency of replacing handheld and fixed scanners (i.e. the life-span).
- The frequency of upgrading software (i.e. the life-span).
- The discount (interest) rate to be applied to determine the Net Present Value estimates of benefits and costs. Two interest rates were used:
  - 5.5% which is the Australian Government 10 year bond rate (i.e. very low risk); and
  - 10% which represents the real return with greater risk.
- The cost of automatic counter-marking machine and annual operating cost per bale for the machine.

- Spreadsheet outputs of:
  - The Net Present Value of the total net benefit to the industry, discounted over a 10 year period.
  - The Net Present Value of the cost or benefit for each sector, discounted over a 10 year period.
  - The year-by-year net cost or benefit for each year over the 10 year period for the industry.
  - The year-by-year net cost or benefit for each year over the 10 year period for each sector. and
  - The start-up cost for each sector.

The Excel spreadsheet file for the cost-benefit model is provided as Appendix A to this report, and as a separate file.

With regard to the benefits to the Australian Wool Testing Authority of introducing RFID, discussions with Ian Ashman (General Manager, Raw Wool) and Tim Steere (Sampling Operations Manager – Eastern Australia) indicate that there would be only minimal benefits for AWTA. The initial thinking was that the benefits would only come in terms of increased productivity for AWTA sampling officers at the coreline. However, Tim Steere's opinion is that there would be little impact on the speed of the coreline as *"The 'choke point' on most corelines is the grab. Even between lots AWTA staff are waiting for the computer to print the weight note and there's enough time to queue the next lot in the computer. It may have some impact on accuracy and reduce rework by avoiding incorrect folio numbers or bale numbers."* Given this, there was no benefit (or cost) to AWTA included in the cost-benefit model.

2.4. Key assumptions

The following are the key assumptions for the Base Case of the cost-benefit analysis. The full list of assumptions is provided in Appendix B.

Packs/bales

- Assume that all new packs will have RFIDs.
- Assume that number of packs imported per year and number of bales sold are the same on average. Set this at 1.8 million packs/bales.
- Initially take 1.5 years to bring in and replace existing stocks of packs; lifting to 90% by year 3, then progressively to 100% in year 7. Assume all new packs have an RFID.
- Assume no recycling of RFIDs.
- Assume RFID adds $1 per pack, paid by the grower.
- Assume that all brokers/wool handlers implement for all bales.

Start-up costs

- Assume 201 new handheld scanners needed for the industry in Australia (if none provided to growers or shearing contractors) at $2,600 each
  - A further 90 are currently owned by AWH that require upgrading at $300 each.
  - 20% of these need to be replaced every year, starting year 2.
- Assume that 105 fixed scanners are required for the Australian industry. Cost is $1,800 each including antennas and LAN connections.
- Software
  - AWH does not require software upgrade
  - $2,000 cost for each Talman user (indicative cost advice from Gibson (2014)
  - $3,000 cost for each non-Talman user (including dumps and processors)
- Assume that a capital cost of $150,000 is required for the label printer to purchase the machine to print the new labels with the RFID adhered to the label.
- Other infrastructure and issues
  - Assume that electronic classer's specifications are not available for all wool. The Schmitt report assumed that it was available.
  - Assume no new automatic countermarking available.

2.5. Sensitivity analysis and different scenarios from Base Case

Sensitivity analyses were conducted on a variety of input parameters, including the cost of the RFIDs, the cost of handheld and fixed scanners, the cost of software, the pre- and post-sale savings for wool handlers/brokers and the savings for dumps/shipping. As well, the cost of the machine to print the new labels with the RFID adhered to the label was included at a cost of $200,000, rather than $150,000 as in the base case.

In addition, different scenarios were run to investigate the impact of these changes to the Base Case. These scenarios were:

Packs/bales

- Assume that small brokers/private treaty merchants do not implement the use of RFID technology, reducing the % of bales from which savings are achieved by 19%.
- Assume electronic classer's specifications are available for the all wool delivered to wool handlers.
- Halve the cost of RFIDs.

Start-up costs

- Assume 800 scanners are required for shearing contractors/classers at $2,600 each.
- Assume additional scanners required for growers are provided through brokers. Assume 1,000 at $2,600 each.
- Only AWH automates countermarking. Capital cost of $400,000 and annual operating cost of 10 cents/bale.
- Remove the need for counter-marking across the industry. The efficiency gain to each wool handler/broker is assumed to be the same as that included in the 2006 cost model.

3. Industry and sector costs and benefits from introducing RFID technology

The industry and sector costs and benefits arising from introducing RFID technology were estimated using the updated and revised process maps and updated cost model, the cost-benefit analysis spreadsheet model and the assumptions.

3.1. Per bale cost savings

The first elements of the costs and benefits that were estimated were the per bale cost savings for each sector based on the assumptions and advice from brokers and processors interviewed.

The pre- and post-sale savings for wool handlers/brokers were estimated using the updated version of the 2006 cost model, and then adjusted according to advice from wool handlers/brokers. Similarly, the savings for dumping were estimated using the updated cost model. As noted above, it is assumed that the per bale cost savings for early stage processors are the same as for dumps.

The updated per bale savings for each sector are shown in the Table 2 and compared with the 2006 savings. As can be seen, the savings per bale have increased where comparisons are possible. For example, pre-sale savings for wool handlers have increased by 51 c/bale, while post-sale savings (with automated countermarking included) have lifted by 13 c/bale. These increases reflect the increased costs over the eight years since the 2006 study, as well as some improvements in the efficiency savings in marshalling compared with the savings assumed in 2006.

There has also been an increase in the savings per bale estimated for dumping/shipping. This increase reflects the increased operational costs for dumps since 2006.

The comparison for early stage processing is less relevant as the detailed cost model approach used for wool handling and dumping was not undertaken either in the 2006 or the current study.

Table 2: Updated savings per bale by stage/sector – 2014 compared with 2006

Stage	2014 Savings ($/bale)	2006 Savings ($/bale)
Pre-Sale		
AWH	$2.03	$1.52
Medium brokers	$1.95	
Small brokers/private treaty	$1.83	
Post-Sale[1]		
AWH	$0.12	
Medium brokers	$0.12	
Small brokers/private treaty	$0.09	
Post-sale with automated countermarking (AWH)	$0.51	$0.38
Total wool handling		$1.73[2]
AWH	$2.15	
Medium brokers	$2.07	$1.54[2]
Small brokers/private treaty	$1.92	
Total with automated countermarking (AWH only)	$2.53	$1.90[2]
Dumping/shipping	$0.67	$0.52
Australian early stage processing	$0.67	$0.28

[1] No savings in automated counter-marking included
[2] Savings from countermarking included

3.2. Net benefits to the industry for the Base Case

The net benefits and costs for the industry were calculated both each year for 10 years and on a Net Present Value (NPV) basis, drawing on the savings per bale for each sector (as presented in Table 2),

together with the number of packs and bales each year, the assumed uptake of packs with RFIDs, and the implementation cost (for scanners and software development). The estimated Net Present Value of the net benefit to industry from implementing RFIDs (with Base Case assumptions) is shown in Table 3 under two different interest rate assumptions.

Table 3: Net Present Value of net benefits to the industry from implementing RFIDs and the start-up investment ($million)

Sector	Base Case NPV		Start-up Investment
	5.5%[1]	10%[2]	
Wool growers	-$11.9	-$9.6	$0.0
Label printer	-$0.4	-$0.3	-$0.15
Wool handling	*$21.0*	*$16.4*	*-$0.7*
AWH	$13.6	$10.7	-$0.1
Medium brokers	$4.5	$3.5	-$0.2
Small brokers/private treaty	$2.9	$2.2	-$0.4
Dumps/shipping	$6.6	$5.2	-$0.1
Australian early stage processing	$0.5	$0.4	-$0.04
Total Australian wool industry	**$15.9**	**$12.2**	**-$1.0**
Guidance estimate of benefits to overseas early stage processing	$6.2	$4.8	-$0.5

[1] The Australian Government 10 year bond rate [2] A 10 year real return with increased risk.

The table shows that there is a significant net benefit to the industry flowing from the introduction of RFID technology. Even at the higher interest rate used for discounting future benefits, the $12.5 million saving seems to justify introduction of RFID technology. This is a substantial benefit to industry.

It is also probably a conservative estimate of the benefits as additional efficiencies that have not been considered are very likely to be implemented once RFID technology is available. It is possible, for example, that it could encourage some rationalisation of existing wool stores with some wool handlers and brokers. As well, it may encourage new methods of and technologies in stacking/storing wool at

wool stores. These will bring additional benefits from logistics and wool handling which are not included in the efficiency gain estimates.

Furthermore, the NPV estimates for the Australian wool industry do not include benefits in logistics and handling for overseas processors due to uncertainty as to how to estimate the infrastructure cost for these overseas processors, what proportion of processors that would take advantage of the RFID technology, how they would handle wool from other countries that didn't use RFIDs in their bales if Australian wool bales had RFIDs, and so on. A simplistic approach to provide a guide to the possible net benefits to overseas wool processors is to scale up the net benefits accruing to Australian early stage processors based on the number of bales used in Australia's early stage processing industry and the number of bales used overseas. This is shown in the final row of Table 3. This benefit of between $5 and $6 million would overstate the actual net benefit as not all overseas mills would make use of the RFIDs and labour costs are also vastly different in some of the major processing countries. Nevertheless, it provides an indication of the potential substantial benefits would could flow for overseas mills.

Benefits to AWTA are not included as the potential gains appear to be very small, as noted earlier. Finally, no efficiencies or benefits have been assessed for wool growers, in line with the approach taken in the Schmitt report.

The start-up investment is also shown in Table 3. For the industry as a whole, it is estimated that an initial investment of $990,000 is required for scanners, software development, label printer and other infrastructure. This does not include the cost of the packs with the RFIDs themselves, although it does include the cost of the label printing machine that would adhere the RFIDs to the pack label.

The annual flow of the costs and benefits to the Australian wool industry over the ten year period is shown in Table 4.

Table 4: Annual flow of costs and net benefits to the Australian wool industry ($million)

	Start	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
$m	-$0.99	$0.36	$1.32	$2.27	$2.45	$2.38	$2.83	$3.03	$3.03	$3.03	$2.78

As can be seen, the flow of benefits starts quite low due to the gradual take-up of wool packs with RFIDs as existing stocks of old wool packs are run-down. The benefits then build to around $3.03 million per year in later years, although year 10 is a little lower than that as the cost of assumed software replacement reduces the net benefits.

3.2.1. Comparison with 2006 results

The net benefit over the ten year period for the total Australian wool industry shown in Table 3 and the annual flow of benefits compares with the annual net benefits estimate in the Schmitt report (2006) of $3.1 million. If the $3.1 million net benefit is taken over 10 years at the two discount rates, this results in an NPV of **$23.4 million** and **$19.1 million** respectively.

The 2006 estimate is higher due to a combination of four things:

- The number of bales produced in 2006 was 2.62 million bales, compared with the 1.8 million bales assumed in the current study. So the benefit per bale accrues on a greater number of bales.

- The Schmitt report assumes immediate net benefits of $3.1 million from year 1.
- Benefits from the use of electronic classer specifications were included in 2006, but were excluded in the Base Case in the current study.
- Although the Schmitt report said that savings from automatic countermarking were excluded, the 2006 cost model actually included these savings, but the capital and operating cost was not included. The Base Case in the current study does not include any benefits from automating or removing the need for counter-marking.

3.2.2. Incidence of the costs and benefits by sector

The split of the costs and benefits for each sector of the industry will be an important consideration, in particular to secure industry-wide agreement to the implementation. As Table 3 shows, the woolgrowers bear a significant total NPV cost of between $9.6 million and $11.9 million over the ten years.

On the other hand, the wool handling/broking segment gains the greatest benefit of between $16.4 million and $21 million NPV over the 10 years. Of this, AWH and its broker clients secures the most significant share of around 65% of the net benefits for the wool handling/broking segment. There is no real surprise in this, given that AWH handles around 60% of the Australian clip, has lower start-up costs as it already uses handhelds and has a greater amount of automation (such as sortation machines). Medium and small brokers/private treaty merchants gain a smaller total NPV of between $3.5 million and $4.5 million (medium brokers) and, for small brokers/private treaty, between $2.2 million and $2.9 million.

Dumps/shipping gains between $5.2 million and $6.6 million over the 10 years, while Australian early stage processors gain around $0.4 million to $0.5 million. This latter figure is not very surprising given the small size now of the Australian early stage processing industry.

As wool handling/broking, dumping/shipping and processing are very competitive industries, the savings and benefits will be passed back to growers (and up to overseas processors). However, it will be important that consideration be given at an industry level about suitable commercial arrangements that can be put into place to secure wool grower support. Such an agreement could, for example, be a cash rebate from brokers, private treaty merchants and wool handlers back to growers for an initial period.

3.3. Sensitivity analyses of the costs and benefits in the Base Case

Selected sensitivity analyses were conducted using the Base Case model to investigate the impact of some of the key assumptions of the major parameters. These assumptions tested were:

- Vary the cost of the RFIDs by 10%.
- Vary the cost of handheld and fixed scanners by 10%.
- Vary the cost of software development by 10%.
- Vary the pre-sale savings for all wool handlers/brokers by 10%.
- Vary the post-sale savings for all wool handlers/brokers by 10%.
- Vary dump savings by 10%.

All variations were both an increase and a decrease from the Base Case levels, using a discount rate of 5.5% (the 10 year Government bond rate).

Table 5: Sensitivity Analysis Results ($million)

Parameter Base Case = $15.86m	Total Industry NPV		Change from Base Case	
	+10%	-10%	+10%	-10%
RFID Cost	$14.66	$17.05	-$1.20	+$1.19
Scanner cost	$15.69	$16.03	-$0.17	+$0.17
Software cost	$15.83	$15.89	-$0.03	+$0.03
Pre-sale savings	$18.02	$13.70	+$2.16	-$2.16
Post-sale savings	$15.98	$15.74	+$0.12	-$0.12
Dump savings	$16.60	$15.12	+$0.74	-$0.74

There are no surprises in the results from the sensitivity analysis. Firstly, the estimates of the net benefits are pretty stable to changes in the parameters. Secondly, the changes in NPV arising from a 10% change in the parameters are symmetrical. The increase or decrease in NPV is the same for a 10% rise or a 10% drop in the parameter (allowing for rounding). Thirdly, the largest change comes from a change in the pre-sale savings. This is to be expected as it was the most significant parameter contributing to the total industry NPV. Finally, the smallest change occurs with a 10% change in the software cost, which is also not surprising given that it is a small component of the cost of implementation.

3.4. Scenario variations to the Base Case

A number of variations to the Base Case were investigated to assess the impact of some of the possible key determinants. The different scenarios were:

Scenario 1
Small brokers/private treaty merchants do not implement the use of RFID technology, reducing the proportion of bales from which savings are achieved by 19%.

Scenario 2
Electronic classer's specifications are available for the all wool delivered to wool handlers

Scenario 3
Handheld scanners are provided to shearing contractors/classers: 800 at $2,600 each.

Scenario 4
Scanners for use by woolgrowers are provided through brokers. Assume 1,000 at $2,600 each.

Scenario 5
Only AWH automates countermarking. Capital cost of $400,000 and annual operating cost of 10 cents/bale.

Scenario 6

Remove the need for counter-marking across the industry. The efficiency gain to each wool handler/broker is assumed to be the same as that included in the 2006 cost model.

Scenario 7
Halve the cost of RFIDs to 50 cents. There is considerable uncertainty about the cost of RFIDs, with latest quotes suggesting a price much lower than the $1/unit cost assumed in the Base Case.

Table 6 provides the results from the scenarios, based on the Base Case and using the 10 year Government bond rate.

Table 6: Changing Scenario Results ($million)

Scenario Base Case = $15.86m	Total Industry NPV	Change from Base Case
1. Not all brokers implement	$11.52	-$4.34
2. Electronic classer spec	$16.73	+$0.83
3. Scanners for shearing contractors	$11.04	-$4.82
4. Scanners for growers	$9.83	-$6.03
5. AWH automatic countermarking	$16.74	+$0.88
6. No countermarking	$21.87	+$6.01
7. Halve RFID cost	$21.83	+$5.97

Some of the six scenarios result in significant changes to the NPV of industry benefits.

The **use of scanners by shearing contractors and by growers** reduces the net benefit by between **$4.8 and $6 million**. This is not surprising as there are no on-farm benefits attributable to the use of scanners on-farm by either shearing contractors or growers. This is one aspect that could be investigated further.

If **small brokers/private treaty merchants** (which are estimated to account for around 19% of the bales handled in Australia) **did not make use of and implement the RFID technology**, there would be a drop in the net benefits to the industry of around **$4.3 million**. This arises due to a loss of the net benefits to this sector and lower benefits being realised by dumps/shipping and Australian early stage processors. These lower benefits for dumps and processors are due to 19% of bales sold not having the relevant information and identifiers that dumps and processors can use to improve their efficiency.

On the positive side, some of the biggest gains come from **removing the need for countermarking** by all firms in the industry. This realises an increase in the net benefits of around **$6 million**. The key issue here is whether overseas mills would all accept the absence of countermarking, which would mean that these mills would need to adopt the new technology.

Halving the cost of RFIDs from $1 to 50 cents also provides an increase in net benefits of slightly under $6 million. All of these gains would accrue to woolgrowers who pay for the RFID in the first place.

The other two scenarios realise only small improvements in the net benefits to the industry. It is perhaps surprising that the availability of **electronic classer's specifications** realise such small gains. This is because it is assumed that the availability of electronic classers' specifications remove the need for office staff to enter classer specification data at receiving. The use of automatic countermarking will only be a benefit to AWH as the automatic countermarking machine is expensive and it is deemed that other wool handlers are not large enough to justify the investment.

3.5. Benefits not addressed in this study

There are additional benefits that have not been addressed in this study, which was restricted to wool handling and logistic benefits for the Australian wool industry. These include:

- Greater efficiencies in wool handling and storage that could be realised through adoption of other new, related technologies and/or rationalisation of existing wool stores.
- Detailed assessment of the logistic and wool handling benefits accruing to overseas processors, as well as costs of infrastructure for these processors.
- Freeing up of working capital arising from reducing the elapsed time between shearing and scouring. The Schmitt report estimated these benefits to be around $2.5 million per year for 2006.
- The possibly significant benefits arising from better and more efficient trace-back systems and marketing advantages for Australian wool. Given concerns expressed by the Chinese industry at the Australia-China Joint Working Group about the need for traceability, these benefits could outweigh the logistic/wool handling benefit identified in this report.
- This improved trace-back will also be important for biosecurity purposes, particularly in the event of an outbreak of an emergency animal disease, such as Foot-and-Mouth Disease.

4. Conclusions

The cost-benefit analysis presented in this report provides a clear case for implementing RFID technology in wool packs in Australia, subject to resolving any outstanding technical issues. There are significant positive benefits to the industry of around $16 million, regardless of assumptions, with the exception of providing scanners to either shearing contractor or wool growers.

Furthermore, the benefits estimated in this study can be viewed as being conservative, excluding greater efficiencies in wool handling and storage that could be realised through adoption of other new, related technologies and/or rationalisation of existing wool stores. As well, the benefits exclude logistic benefits accruing to overseas processors. It also excludes possibly significant benefits arising from better and more efficient trace-back systems and marketing advantages for Australian wool.

As shown in the scenario assessment, if the need for countermarking can be eliminated, this would increase the net benefits to the Australian wool industry by a further $6 million. Halving of the RFID cost would also realise a significant improvement in net benefits of a little under $6 million, all of which would accrue to woolgrowers (as they pay the cost of the RFID).

Leaving aside any technical impediments, however, a significant issue for the industry to address is securing agreement from woolgrowers. Woolgrowers would bear a significant cost through the cost of RFIDs in wool packs but not secure any direct benefits. While the market will ultimately ensure that

benefits will flow back to growers, these will not be obvious in the general ebbs and flows of business transaction. Consideration should be given at an industry level as to a commercial arrangement from the start could provide these obvious benefits to growers to secure their support.

5. References

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Appendix A: Cost Benefit Analysis Model

Excel spreadsheet (file name: eBale Cost Benefit Analysis – Poimena Analysis June 2014 final.xlsx) provided as part of the report.

Appendix B: List of Assumptions for the Cost Benefit Analysis Model

- Assume that electronic classer's spec is not available, unlike the 2006 assumptions.
  - This was included as a sensitivity analysis item. Note that including 100% staff savings due to electronic classers' cert only adds about 9 c/bale to cost savings.
- Assume that all wool handlers adopt RFID technology in the Base Case.
  - As a sensitivity analysis, assume that the smaller wool handlers do not adopt (i.e. about 80% of bales).
- Counter-marking savings were not included in the Base Case because cost of counter-marking machine is too high for all bar AWH. In the 2006 spreadsheet the savings were 73.39% of labour cost.
  - Add in Craig Finlay's estimate of 10% ($0.09) saving in countermarking from some efficiencies to be gained in the C/M process and also reductions to C/M errors (which are frequent).
  - Include the saving, the capital and operating cost for AWH only as a sensitivity analysis.
- For non-AWH brokers, take out saving associated with a sorting machine as they don't have sorting machines.
- Assume that number of packs imported per year and number of bales sold are the same on average. Set this at 1.8 million.
  - AWEX budgets for 1.8 million packs imported each year, but only imported 1.7 million packs in 2012/13 (Grave, 2014).
  - AWTA reports that the number of bales tested in 2012/13 was 2.1 million bales.
  - Allow 100,000 bales for second hand and 200,000 bales for re-test (around 10%). As per discussion with Ian Ashman.
  - Initially take 1.5 years to bring in and replace; lifting to 90% by year 3, then progressively to 100% in year 7. Assume all new packs have RFID.
  - Assume no recycling of RFIDs.
- Scanners - handheld
  - Assume that 20% of handheld scanners are replaced every year after first year (Craig Finlay personal correspondence)
  - Cost $3,650 each for a 2-watt reader less discount making it $2,600 each (Justin Anderson email, 12 March)
  - Assume AWH needs to upgrade 90 that they already have (80 for pre- and post-sale and 10 for dumps) – assume $300 to upgrade
  - Assume medium brokers need 54 (18 locations, 3 each)
  - Assume small brokers/private treaty need 120 (40 locations, 3 each)
  - Dumps need:
    - AWH already has 10 in the three locations; just a $300 upgrade (as above)
    - That leaves 2 locations in Melbourne (Packtainers and Winnipeg), 1 in Sydney (Packtainers), 1 in Port Adelaide and 1 in Brisbane. So a total of 15 handhelds (3 in each location)
  - Assume Australian processors need 12 (3 locations, 4 each)

- As a sensitivity analysis, assume that brokers have handhelds to loan to their clients. BUT that would mean around 1,000 handhelds around Australia (one or so for each office location)?
- As a sensitivity analysis, assume that classers/shearing contractors have one to use while shearing – another 800?
- 20% of all handheld scanners need to be replaced every year, starting year 2.
-

- Fixed scanners
  - Cost $1,400 (2 watt with 4 ports) plus $800 for antennas (4 antennas) less discount plus wiring to Ethernet making it $1,800 each (Justin Anderson email, 12 March)
  - Assume AWH needs 33 (Craig Finlay, 2014):
    - one for each of the 29 corelines
    - one for each of the 4 sortation machines
  - Assume medium brokers need 18 (18 locations, 1 each)
  - Assume small brokers/private treaty need 40 (40 locations, 1 each)
  - Assume dumps need 14. AWH has 9 dump presses. Packtainers and Winnepeg have 5
  - Assume no fixed scanners are required for Australian or overseas processors (based on advice from David Ritchie (2014)
  - 20% of all fixed scanners need to be replaced every year, starting year 2.
  -

- Assume software needs to be updated every five years
  - Talman provided an indicative costing of $150,000 for the software upgrade (Gibson, 21st March 2014). Note that this is not firm and can only be determined with any certainty once more detail is known about the technology.
    - But only 40% (i.e. $60,000) to be charged as other 60% would be covered by existing annual contracts.
      - They have around 50 selling companies as clients, some are only small.
      - Say 30 for the $60,000 to be covered?
      - Therefore cost for Talman-using companies is assumed to be $2,000 each.
    - If no discount, then cost is $5,000 each
      - Apply this to each non-Talman company
        - Broking
        - Dumps
        - Processors
      - $10,000 for AWH given a bigger company and can spread the cost

- Total no of bales tested by AWTA in 2012/13 was 2.1 million Assume static wool production. Adjust for second hand bales (100k) and re-test (200k). This leaves 1.8 million bales of wool per year.
- Assume no change in bale numbers over the 10 year period.
- Assume 59% of first hand wool receivals (AWEX data, Mark Grave, 2014) is handled by AWH. Craig Finlay says 63% (Finlay, 2014)
- Assume medium wool brokers who do not use AWH account for 22% of annual wool handled

- Assume small brokers/private treaty handle remaining 19%.
- Assume 93% of wool bales is dumped/shipped/exported - based on Australian wool export data for 2012/13 (ACWEP,2013)
- Assume remaining 7% is processed in Australia.


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