Australian Wool Exchange
E – Bale Project

Technology and cost/benefit assessment of electronic bale ID

In conjunction with

Australian Wool Innovation

Project TD043

Final Report

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Terms and Acronyms

AWI	**Australian Wool Innovations Ltd**
AWEX	**Australian Wool Exchange Ltd**
AWH	**Australian Wool Handlers**
AWTA	**Australian Wool Testing Authority**
EBID	**Electronic Bale Identification**
ECR	**Electronic Classers Report**
EPC	**Electronic Product Code**
ESP	**Early Stage Processor**
DF	**Dual Frequency**
FDX	**Full Duplex**
HDX	**Half Duplex**
HF	**High Frequency**
ISAC	**Industry Services Advisory Committee**
LF	**Low Frequency**
MEMS	**Micro Electro-Mechanical Systems**
NLIS	**National Livestock Identification System**
RFID	**Radio Frequency Identification**
UHF	**Ultra high Frequency**
SAW	**Surface Acoustic Wave**
WDO	**Wool Delivery Order**

Project Objectives

The AWEX E-bale/AWI Project TD043 – Technology and cost/benefit assessment of electronic bale ID

Key wool pipeline stakeholders, as represented by AWEX's ISAC committee, made an 'in principle' decision undertake a review of electronic bale ID. The key objectives of this project were identified as:

- Identify available and preferred electronic ID technologies that meet performance standards required by the wool pipeline.
- Develop a cost and benefit analysis of the additional costs and qualitative/quantitative benefits at all stages of the pipeline that may use bale ID.
- It was envisaged that the recommendations of this project may be followed by additional bale ID implementation projects, including at least one large scale trial. The commercialisation of the outcomes of the project will be subject to further project proposals.

This project identified the key drivers of adoption of electronic bale ID as:

- Wool and bale traceability and quality control.
- Potential logistical savings through the pipeline. The cost/benefit analysis will assess where these accrue.
- Improved information flow from farm to processor.

- The emphasis of this project was on keeping the solution:
- Simple, reliable and scalable;
- Tailored to the financial justification which is based on improving logistics efficiencies rather than creating a new marketing system;
- Whilst not sacrificing reliability, focus on building off existing infrastructure where appropriate such as the introduced sheep and cattle ID system (NLIS) and not necessarily adopting the latest technology;
- Uniform technology across the industry where appropriate.

Project Methodology

This project was designed to build on previous AWI projects in relation to EBID and, as such, relied heavily on research, trials and reports already undertaken and published. The primary focus of work was the impact that EBID would have on logistics rather than marketing systems. Any previous recommendations made were tested against advances in technology and, where the technologies within the probable operating environment were not adequately addressed, further technology trials were undertaken. The finding cannot be considered conclusive as the project funding did not incorporate allowance for adequately sized trials however this is the intention of any trials that will flow from the recommendations in this report.

Review of previous research and trials

The core reports reviewed and relied upon in this project are:

- Intrawool (Feb 2000) – Wool Bale Identification – Evolution From Hand Stencil to Transponder
- AWI Project EC452 (November 2003) – Pilot Industrial Trial of Electronic Bale Identification

A detailed report detailing the strengths and weaknesses of observations and recommendations made in these reports was produced during 2005 and is provided in Appendix A.

A higher level review was undertaken on the Sheep ID trials (EC453) and Sheep ID Standards (EC551A) reports where appropriate. The National Livestock Identification System (NLIS) and National Flock Identification System (NFIS) were also examined during this project.

Industry consultation

Industry consultation focussed on brokers, wool handlers and early stage processors to identify potential efficiencies in logistics related to wool movement and handling. Operational requirements provided the core criteria for technology selection.

Previous research provided adequate coverage of on-farm costs and benefits likely to accrue from EBID and this work was not duplicated.

Technology review and assessment

Given the rate of change in RFID and other emerging technologies in the logistics area, all previously reviewed technologies were revisited and several new candidates assessed. All technology options were benchmarked against both operational and commercial criteria (refer later section on technology review). Small scale trials of new technologies were undertaken.

Cost benefit analysis

The majority of work to develop the cost benefit analysis was undertaken with Australian Wool Handlers, an entity responsible for handling approximately 60% of Australia's wool clip. This work identified and quantified all handling activities within the wool store and estimated the potential financial benefits from the introduction of EBID. Several medium to small wool handling and dumping companies were also included to test these estimates. Several domestic and overseas ESPs were contacted requesting their feedback on potential logistics benefits from the introduction of EBID.

Executive Summary

The wool industry has been investigating machine readable systems for the past fifteen years. This technology has delivered significant improvements to other material handling businesses around the world.

However, the requirements of the wool industry differ from most other industries, especially in the dumping area and technology simply cannot be transferred from other industries with an expectation of achieving similar results.

The frustration has been that whilst the cost of tags and readers have dropped significantly over the past few years the environmental issues within the wool industry, particularly in the dumping process, remain. These issues have in the past prevented a “one solution fits all” approach for most technologies.

During this study only one technology was demonstrated to work successfully in all areas of the supply chain. This was the dual frequency tag from iPico. However this product can only be described as an emerging technology as only 12 million tags are being produced world wide annually. The company supplying the product is small and is currently in the process of being listed on the Canadian Stock Exchange.

The company’s ability to support the introduction of the technology into the wool industry can be better assessed during the proposed trial period.

Other technologies such as low frequency and ultra high frequency work well in most applications but fall short in the dumping process necessitating a potentially costly procedural change to “work around” these deficiencies. This fact should exclude them from further trials unless the recommended technology fails in the full-scale trial and a fallback option is required.

RFID technology is being rapidly developed by a number of global industries far larger than the wool industry and ultimately a viable solution which is more reliable and cheaper than is currently available will present itself to the industry in the future.

However this fact should not stop the industry from moving to a RFID solution in the short term. The operational and financial benefits are clear from such a strategy. A workable system can be developed from one of the technologies being recommended for further trials.

Industry need for and response to EBID

The response to the prospect of introducing EBID is highly positive across the industry players interviewed and generally consistent with one respondent’s comment “Anything which can reduce costs and improve efficiency would be welcome.” The following points identify the key issues and observations that arose during the consultation process:

Support for the introduction of EBID was conditional upon industry wide adoption of the new technology.

The general view was that EBID should be focussed on driving logistics efficiency and not be seen to impact on existing marketing arrangements or to cut across any commercial relationships. This is consistent with the project design and objectives.

There are numerous examples of where the need can be established based on potential cost savings however an issue to be addressed prior to implementation of EBID is the willingness of downstream

participants to share the benefits that EBID will generate with wool growers who will bear the largest proportion of the cost through tagged woolpack acquisitions.

A key innovation required to drive the benefits of EBID is the introduction of Electronic Classers Reports. The savings from this initiative generate approximately 25% of the savings from EBID in the wool handling sector (refer table below).

An objective of any further large-scale trial will be to verify the potential savings and develop a commercial model to equitably apply these savings.

Technology options

As with previous research there is a required balance between selecting established and robust technologies against emerging technologies that may better suit the operational environment. The major limitations for most technologies tested are similar to those of 10 years ago; read distance and interference from moisture and metal in the operating environment.

There is still no technology developed to the point of meeting all required criteria for full scale implementation[1]. The research and trial work has identified two technology options which are approaching industry requirements and are considered appropriate candidates to participate in an industry trial (refer technology section for selection criteria). These are:

Dual Frequency RFID: This emerging technology was tested successfully during this project[2] and appears to meet the required read range as well as solving the LF RFID[3] shortcomings.

Semi-active UHF: This technology best meets the operational requirements from results demonstrated in the small scale trial work undertaken but the price point may still remain a barrier at the end of the trial. Given the rapid reduction in RFID costs this technology should be retained as an option at this point.

> *These two technologies have increased in reliability and reduced in cost since the last review in EC 452. In particular the dual frequency technology has advanced but must still be considered in its infancy in the commercialisation phase with only 1 million tags being produced per month*.

In relation to the potential risk of backing proprietary IP of a small company our initial enquiries indicate that tags using iPico's chips are being manufactured by the major tag manufacturers such as Sokymat, IER, and KSW Microtec and importantly, their protocols have been made available and are supported by major reader manufacturers including AWID, Psion, Samsys and SmartID.

In relation to LF RFID, Sokymat have advised that they are in the process of testing a tag and reader that that will allow a 2 metre read range and incorporates anti-collision but it is still in the test stage. This report recommends incorporating this technology in the recommended future trials if, as indicated by Sokymat, a working prototype is available by March this year.

Cost benefit analysis

A conservative estimate has been made of the benefits accruing to the wool handling and ESP sectors. Potential benefits to AWTA have been identified but not valued in this calculation. Additionally, there is the longer term potential to remove or automate countermarking which is not only a high cost to the industry (up to $1.00/bale) but also creates downstream quality and production issues due to the generally poor quality and inconsistency of this practice.

[1] Refer selection criteria in technology section; one criteria being vendor support which requires more testing with smaller and emerging companies.
[2] This project was not financed for large scale trials of technology however the smaller scale trials and evaluation of reports on various available technologies support this recommendation.
[3] LF RFID was recommended in AWI Project EC452 but fell well short of the required read ranges in wool handling and processing environments – 0.5 metres versus requirement of approx. 2.0 metres.

The high level numbers indicate a direct net benefit of up to $1.16 per bale of wool is achievable across the industry to the point of scouring. At current production levels this indicates an **annual net benefit of approximately $3.1M to the wool industry** at forecast production levels. This is summarised in the table below:

Sector	**$/Bale**
Benefits	
Wool handling	$1.73
Wool Dumping	$0.52
Early Stage Processors	$0.28
Total Benefit (weighted average)[4]	**$2.50**
Costs	
Tag	($1.00)
Infrastructure (readers/software etc)	($0.34)
Total Costs	**($1.34)**
Net Benefit	**$1.16**

This estimate covers improvements in logistics only and excludes the expected ongoing reduction in tag costs. Other less tangible or measurable benefits such as enhancing the reputation of the Australian wool industry for quality and innovation have been excluded in the above numbers. However, the potential value to the Australian wool industry through improving downstream efficiency and quality management to maintain the price and position of wool in the increasingly competitive textile market should not be totally overlooked.

As improving efficiency in the supply chain continues as an imperative, a further benefit from EBID will be in its potential to shorten the wool pipeline – the days it takes from shearing to scour. While not factored into the above numbers, every week taken out of this pipeline equates to a reduction in working capital costs of $0.94/bale or $2.5M across the Australian wool industry.

Implementation

The cost benefit analysis has been based on a "whole of industry" implementation and this approach for Australian wool should remain the objective.

A staged implementation is required along the following framework:

- Undertake a large scale trial to confirm the preferred technology and firm up the cost benefit analysis
- AWI (on behalf of the wool industry) to call for expressions of interest to provide a total industry solution
- Develop the appropriate business model for implementation and secure industry support for widespread introduction
- Phase implementation starting with the larger players (AWH)
- Ensure industry wide roll-out proceeds within 12 months of initial phase

[4] The adjusts for approx 5% of bales not going through the dumping process

Recommendations

The Australian wool industry has demonstrated throughout its history the ability to introduce innovation to improve the quality and efficiency of the wool supply chain. EBID is the next logical step and the financial benefits assumed in this paper are considered conservative but are still compelling to recommend proceeding towards implementation. This is particularly the case if EBID can be used to facilitate a reduction in supply chain working capital and enhance information flows. The following steps are recommended:

Proceed with trials of the two technology options which offer the potential for a complete solution from farm scour. It is proposed that two small scale trials of approx 500 bales be undertaken on each of the technologies during March to coincide with the introduction of the new AWEX bale label. This should then proceed to a major trial of the preferred technology in the new wool selling season.

- Prepare specification and documentation in preparation for calling an industry wide tender
- Implement a full scale trial of approximately 100,000 bale for the preferred technology
- Engage broader industry on adoption of EBID and ECR
- Prepare detailed proposal to AWI in relation to industry wide adoption of EBID including a detailed implementation plan
- AWEX to develop a prototype ECR which is acceptable to all sectors of the industry and investigate opportunities for education for growers and wool classers for implementation of ECR

Review of previous studies and trials

Project EC 452 – Pilot Trial of EBID

A detailed evaluation of this research is provided in Appendix A. The major points in relation to EC 452 relevant to this report are:

The EC 452 recommendation to adopt LF RFID tags did not adequately consider:

- Required read distances in the operational environment. At the time, LF RFID technology provided a read range of less than 1 metre compared to a requirement of up to 2.0 metres.
- Anti-collision requirement.
- Technology in relation to LF RFID tags and readers has advanced since EC 452 was completed and these aspects will be tested in the recommended trials.
- The recommendation for a read only capability is supported.
- The recommended packaging and positioning of the tag is supported by this report.
- The recommendation to remove the existing label to realise cost savings is not supported. Retention of the label and addition of a 2-dimensional barcode is recommended in this report.

IntraWOOL

A detailed evaluation of this research is provided in Appendix A. The major points in relation to IntraWOOL relevant to this report are:

- The recommendation to establish a central industry database is not supported.
- The recommendation for a read/write capability in RFID is not supported.

National Livestock Identification System (NLIS)

The National Livestock Identification Scheme (NLIS) is a system of permanent identification of individual cattle enabling reliable traceability from birth to slaughter. The scheme is implemented on a state-by-state basis and underpinned by state legislation. State legislation will determine the compliance requirements in terms of specific requirements for identification of cattle with approved NLIS devices and whether these devices will need to be read and movement details recorded on the NLIS database.

Meat and Livestock Australia (MLA) introduced compulsory tagging for Cattle being sold in 2005 (there are exemptions for certain conditions). The main drivers behind the NLIS are traceability of animals in case of a serious disease outbreak and as a measure against animal theft. The technology chosen is based on using half duplex, low frequency RFID. The decision in relation to the sheep industry is still outstanding as at the time of writing this report.

From a technology perspective it is clear that the animal ID issue is a global one and will drive the cost of this technology downwards while at the same time increase read ranges – a key requirement for the wool industry. It may even see new technologies introduced which may flow in to the EBID requirement.

The advantage of aligning the EBID technology with that of NLIS is recognised as having the potential benefit to reduce tag costs, on-farm reader costs and lock into a more mature technology. This consideration should be deferred to the final selection process when it will be clearer whether any compromise in technology performance is properly compensated by these benefits.

A factor that should not be overlooked in review if NLIS is that tagging/tracking is a legislated requirement. This will not be the case with wool and, as such, the proving of the benefits and the model to apportion these benefits will be a critical part of the trial and implementation. There will be little comfort to growers from a “feel good” factor should wool pack prices increase and there is no compensation in wool price or handling fees.

Industry developments and applications in RFID

Since the completion of EC 452 significant developments in RFID and other technologies have given cause to reconsider the technology options for EBID. The growing emphasis on animal tracking technology in particular has driven the cost of LF RFID downwards and further development of reader technology which may ultimately improve the read range to the level required for the wool industry application. Developments related to dual frequency and semi-active UHF tags have also introduced these technologies as potential candidates. A complete summary is provided in the relevant section below.

Summary of key findings

The review of previous studies and trials reflects the current project where, as yet, there is no perfect solution which provides the simplicity, reliability and cost point to identify a clear solution. There are technologies that are quickly converging on meeting these requirements and it is clearly a case of “when not if” the requirements will be met particularly as the R&D is being driven by significantly larger global opportunities than wool.

As such, it is reasonable to expect the benefits to increase as the cost of tags and related infrastructure (readers) decreases, as has been the pattern over the past 10 years.

Maintaining the focus on logistics efficiency rather than marketing is a key issue to ensure broad industry support as is the need to consider the commercial model to drive widespread adoption of EBID to ensure equitable spreading of the costs and benefits. This model should be developed and agreed prior to introducing the technology to avoid pricing/charging issues encountered with NLIS (“Who pays?” etc).

The opportunity to utilise the same technology as adopted for NLIS in order to reduce overall industry costs has been recognised however the decision criteria should remain focused on the optimal solution for the wool industry which has significantly different downstream requirements compared with the livestock industry.

Industry need for and response to EBID

Background

Extensive consultation was undertaken with the Australian based operators handling or processing the majority of Australian wool clip[5]. The general response was highly supportive of introducing EBID and provided direction as to what the technology should provide and several key implementation issues to address. The following selection of extracts from discussions is provided:

- *A system which will reduce costs & improve efficiency would be welcomed by the industry.*
- *Must not cut across existing commercial relationships.*
- *Must be implemented throughout industry. All bales must be tagged & minimum standards introduced to allow for the "linking" of information at various points of the supply chain.*
- *Industry database not required.*
- *RFID will deliver better quality & accuracy thus improving customer service & enhancing our reputation as a quality supplier.*
- *The introduction of a standard Electronic Classer Report (ECR) must be pursued. The provision of bale details prior to the wool arriving at stores will provide significant savings in terms of double handling & less space used. Accuracy will also be improved.*

More accurate & precise identification of bales through all stages of processing will allow for better feedback to growers.

This feedback is consistent with previous research undertaken on related projects.

Of the four overseas processors contacted only two provided positive feedback in regard to the potential for automating some processes and benefiting from reduced errors from Australia. One of these provided indicative financial benefits for their operations.

Potential benefits

Given the project's focus on logistics savings the primary activity in identifying benefits focused on the wool handling sector which has the highest direct benefit from EBID[6]. This report must acknowledge the excellent cooperation of Australian Wool Handlers (AWH) in assisting with the highly detailed process mapping in order to identify process improvements and cost savings possible with the introduction of EBID. This has provided a high degree of confidence not only in the estimated cost savings but importantly in the process required to implement EBID effectively through the process. A detailed costing model has been developed behind the process maps provided in Appendix D however, for commercial reasons, only the summary level savings can be produced for this report.

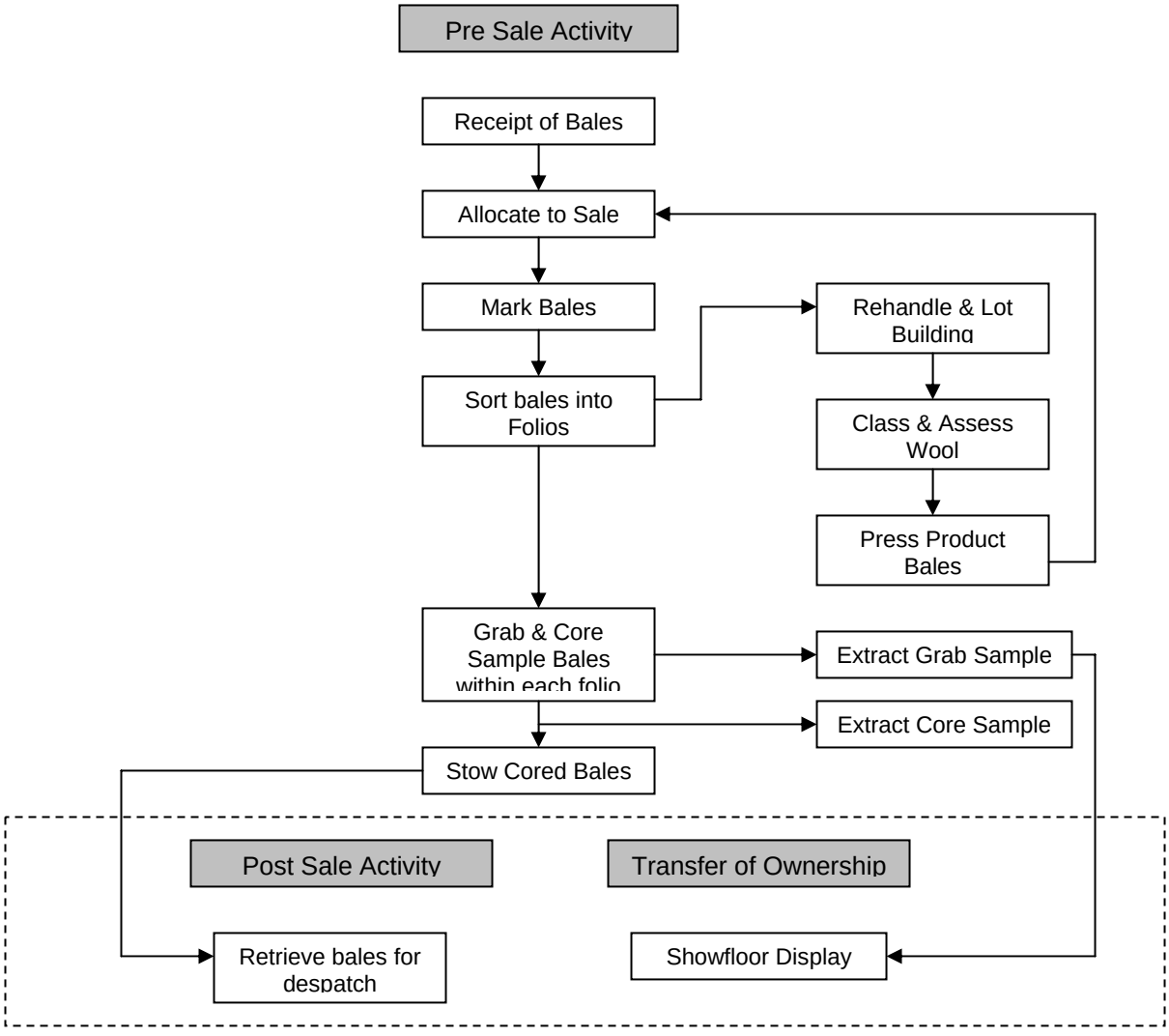
[5] Refer Appendix B: Industry Consultation
[6] excluding potential working capital and flow-on marketing benefits

Wool Handling

The processes involved in wool handling are numerous and complex. The input from AWH to develop detailed process flowcharts from receival to despatch to dump has provided a tool not only to estimate the potential cost savings but also to plan any trials or EBID implementation that may follow from this report.

The following schematic describes the high level processes within AWH. Each of the steps shown has an accompanying detailed process map in Appendix D.

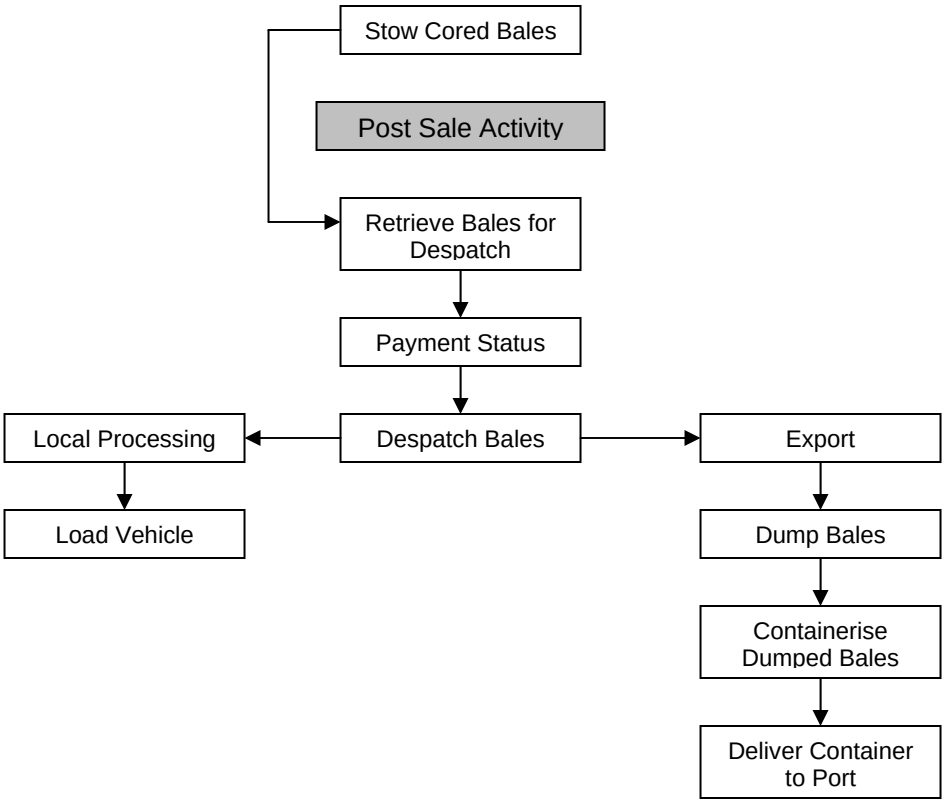
Pre Sale Activities



The following table summarises the steps that can be either automated and/or eliminated and the potential flow-on savings (refer detail in Appendix D):

Pre Sale Handling	*Total Steps*	*Automate*
Receival	13	7
Classers Report	5	5
Marking	8	5
Sorting	9	2
Coring & Grab Sample	10	3
Total	45	22
Savings per Bale		$1.52

Post Sale Activities



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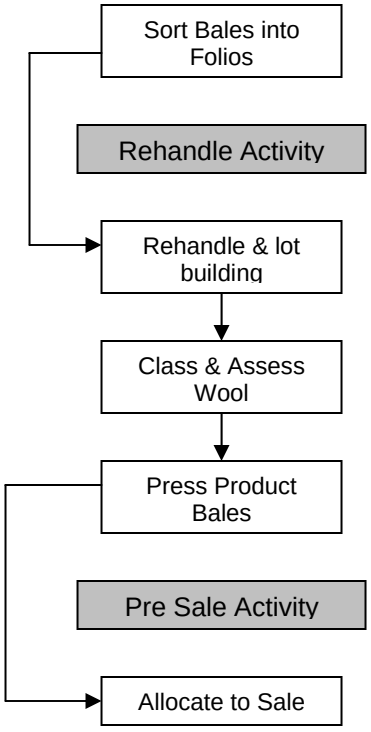
The following table summarises the steps that can be either automated and/or eliminated and the potential flow-on savings (refer detail in Appendix D):

Post Sale Handling	*Total Steps*	*Automate*
Inventory Management	5	2
Transfer of Ownership	3	0
Delivery	12	3
Total	20	5
Savings per Bale		$0.38

These savings are predicated on all agents including the RFID tag number on the invoice transmission file and all shippers ensuring it is included in the WDO transmission file.

Rehandle Activities

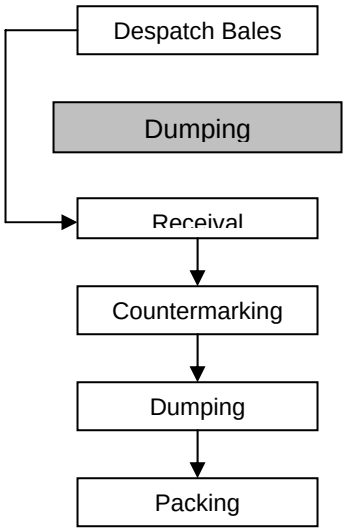


The following table summarises the steps that can be either automated and/or eliminated and the potential flow-on savings (refer detail in Appendix D):

Rehandle & Lot Building	***Total Steps***	***Automate***
Assemble bales for transfer	10	5
Receipt of rehandle bales	5	0
Bulk Classing	15	11
Bulk Class Pressing	5	0
Laser matched Interlots - measurement	12	1
Laser matched Interlots - assessment	11	1
Build & Marshall Bales	14	6
Weight Adjusting - Determine course of action	5	2
Weight Adjusting - Remove O/Weight bales	16	6
Weight Adjusting - Handle U/Weight bales	17	9
Total	110	41

These savings are included in the average pre-sale savings detailed previously.

Dumping



The following table summarises the steps that can be either automated and/or eliminated and the potential flow-on savings (refer detail in Appendix C):

Dumping	***Total Steps***	***Automate***
Receival	15	6
Dumping	7	1
Packing	11	4
Total	33	11
Savings per Bale		$0.52

Countermarking has been excluded from this cost saving at this point although there is the recognised potential to either remove or automate this process.

Other Wool Handlers

Having developed detailed process maps for AWH the other Australian wool handlers were approached for their estimation of potential savings. As AWH handles the majority of the Australian wool clip it was not considered viable (within the project's budget constraints) to undertake as detailed an analysis of their work flow processes. Compared with the $1.90/bale savings estimated by AWH for pre and post sale activities the estimate for other wool handlers was $1.54/bale. The lower number reflects AWH's ability to lower average costs through automation due to greater bale numbers.

Overall, the potential savings in the wool handling sector was estimated at $1.73/bale after taking into account the bales handled by the various wool handlers.

Early Stage Processors

The potential savings for early stage processors (ESPs) to the point of scouring has become difficult to estimate due to the closure of 90% of Australia's processing capacity making detailed estimates along the lines of the AWH exercise impractical within the budget limitations of this project. A further dynamic is the global shift in production to low-cost countries reducing the potential for cost savings due to the lack of sophistication of many of the remaining players, uncertainty with RFID standards across several regions and the fact that lower labour costs have diluted a portion of the potential downstream savings. This difficulty was compounded by a lack of response from ESPs contacted and/or those respondents being less comfortable in the provision of numbers.

A more conservative approach was taken in light of this situation. One ESP estimated the potential benefits that the Australian wool EBID initiative would have on their operation. The increased automation of their processes and the upstream reduction in bale identification errors was estimated to have a positive financial impact of $0.67 per bale. A review of their assumptions showed this to be a reasonable basis to apply for other ESPs who incorporate RFID into their operations.

This potential saving was discounted to reflect the possibility of sub-optimal adoption of RFID across the ESP sector and the variability of cost savings due to differing labour rates across processing countries. Overall, an average benefit of $0.28/bale is estimated for this sector of the industry.

Industry cost/benefit modelling

A high level cost benefit model was developed to estimate the net industry benefits. As the appropriate technology has not yet been finalised estimates have been required and the costs assumed below represent either actual costs quoted or price points required to adopt EBID[7]. The following high level assumptions were used:

Industry production level of 467Mkg or 2.62 million bales[8]

95% of bales will be dumped.

Cost of tags will be $1.00 each and there will be no recycling

Cost of readers:

Handheld in field: $2,000 each

Handheld in Plant: $4,000 each

Fixed Readers: $6,000 each

Installation and software development costs of approximately $600k was estimated for the wool handling sector

Life of the reader and software asset was assumed to be 5 years

AWH estimated the number of fixed and handheld readers required across their operations. This was converted to a cost per bale and this figure was inflated by 20% to apply to smaller wool handlers.

[7] The estimated cost estimates were confirmed verbally by suppliers as likely price points in the near future for the volumes required by the wool industry.

[8] As per December 2005 forecast for 2005/06 developed by the Australian Wool Innovation Production Forecasting Committee

The cost for ESPs was estimated to be 33% of the cost for wool handlers given the lesser number of processes from receival to scour.

The number of hand held readers in the field was estimated at 800 (approximately 2 for every shearing contractor – estimate also covers those growers who may acquire their own readers).

Costs

Using the above assumptions the capital cost was amortised over 5 years to product the following annual equivalent cost per bale:

Tag: $1.00/bale

Infrastructure: $0.34/bale

Total: $1.34/bale

Savings

Based on the earlier analysis of AWH, other wool handlers and ESPs the following logistics savings have been identified:

Wool handling: $1.73/bale

Dumping: $0.52/bale (applied to 95% of bales)

ESPs: $0.28/bale

Total: $2.50/bale

Net returns to industry

The annual net return based on the above numbers is $1.16 per bale or $3.1M annually. It should be noted that this is a conservative benefit and relates only to logistics savings. This figure could easily double when the potential impact on working capital, countermarking and less tangible benefits that could accrue from improved marketing and information flow initiatives that are expected to flow from this initiative. These are covered in the following section.

Other potential benefits

Working capital

There are no freely available numbers on the working capital invested in the wool supply chain however the following analysis indicates how the working capital benefits could easily outweigh the logistics benefits if EBID can reduce the average elapsed time between shearing and scouring. The following estimates were used:

- Wool Production: 467Mkg greasy
- Average bale weight 178 kg (greasy)
- Clean from Greasy 65%
- Average clean price 650 AU cents/kg
- Cost of funds 6.5%

Using these assumptions, every 7 days on average reduction in the wool pipeline is worth $0.94 per bale. If this was achieved across the industry the return is $2.5M.

Countermarking

Errors with countermarking (transcription or illegibility) can cause significant errors in the dumping process with one estimate being that there is up to a 10% error rate in bales being received by some ESPs. Wide scale introduction of EBID will provide the means of automating this process and possibly removing it over time. The potential cost saving of automating/removing the countermarking process up to $1.00 per bale or $1.3M across the industry (excluding the quality impact downstream due to reduced error rates).

The impact of this is clearly demonstrated by recent examples of good versus poor countermarking:

Examples of good countermarking:

Examples of poor countermarking

Intangible benefits

The potential to improve information flows across the supply chain and the impact this has on production quality and resultant margin should not be overlooked. Even at current low prices, every 0.1% improvement in value of wool is worth $0.75 per bale or $2M annually.

The reputation of the Australian Wool Industry for ongoing quality and process improvement may enhance its position in the market place to deliver on time to specification better than alternative sources. As with the previous paragraph, it requires only micro improvements in margin to generate significant returns.

Key issues and recommendations

The issue remains that it is the **wool grower** who will bear the majority of the cost of implementation while the benefits accrue to downstream sectors. As wide scale implementation will not be legislated but voluntary the appropriate commercial model needs to be developed to ensure that the woolgrowers share in the returns generated from this initiative either through sharing of the downstream returns or the downstream operators bearing a higher proportion of the cost (most likely a mix of the two).

The logistics benefits resulting from EBID justifies the wide scale implementation of the technology.

A major hurdle may remain the price point of the selected tags and the ability to operate in the wool handling environment. To raise the profile of this challenge it is proposed that, rather than shop around and experiment in a piecemeal approach, the collective wool industry, through AWI/AWEX, calls for expressions of interest to implement an industry wide EBID solution in Australia (including some international connectivity where appropriate). This will present the size of opportunity required to generate the required vendor interest to develop the required reader improvements and drive the tag cost to acceptable levels.

Technology Review

Summary of previous trial data

The EC 452 report recommended LF RFID as the industry solution however this does not currently meet the desired read range within the wool handling and ESP sectors nor does it have the anti-collision capability necessary to identify al bales within the dumped TriPak form. We are however recommending maintaining a watch on this technology given Sokymat's recent indications of improvements in both of these areas.

The major issue with the wool industry requirements are:

- *Read range*: The need to read bales on both the forklift and within the dumped TriPak. A range of 2+ metres is required to meet all requirements in the wool supply chain.
- *Dumping*: The ability to survive the dumping process and be read despite the interference from moisture content and metal interference. Anti-collision capability is also a requirement within this process.
- *Cost*: The reduction in both the size of the industry and wool prices has reduced the cost tolerance of the industry. As it will be a voluntary system the cost of tags should be at a price point around or below $1 per tag to ensure an economic case can be argued.

The EBID solution's desired versus minimum characteristics are summarised in the table below:

Attribute	**Desired capability/range**	**Minimum requirement**
Read Range	2+ metres	2.0 metres
Ability to read through butt to head of bale	1.2 metres	1.2 metres
Tag durable to survive dumping	100%	100%
Price of tags	$0.50	$1.00
ISO standard	Yes	Yes
Vendor support	Multiple vendors and local manufacture	Local technical support
Multiple tag read ability (anti collision)	Yes	Operational "work around" available

A number of trials were undertaken to test concerns highlighted in previous research and to better align the industry requirements with each technology's capabilities.

Current technology options

The technologies assessed for this program and their strengths and weaknesses in relation to meeting the wool industry's requirements are described below:

Technology	Low Frequency	High Frequency	Ultra High Frequency	Dual Frequency	Semi Active UHF
Carrier	125 - 134 kHz	13.56 MHz	850 - 950 MHz	125 kHz /6.8 MHz	850 - 950 MHz
Reading Range	< 1m	30cm - 70cm	0.5 - 5m	60cm - 2m	5m+
Data Rate	Low (< 8 kbit/s)	Medium (64 kbit/s	High (256 kbit/s)	High (256 kbit/s)	High (256 kbit/s)
Propagation	Through conducting bodies	Through conducting bodies	Line of sight	Through conducting bodies	Line of sight / less affected by metal & water[9]
Anti-collision	Limited	Good	Good	Good	Good
Reliability	High	High	High	High	High
Tag Cost	$1.50-$2.00	$1.10	$0.70	$1.00	TBA
Vendor Support	Excellent	Good	Good	Limited	Limited

Excluded from this table are Surface Acoustic Wave (SAW) and Micro Electro-Mechanical Systems (MEMS) technologies as they are too immature and unproven at this point.

Overview of dual frequency tags

The dual frequency approach has been around for 12 years but it has only been in the last 2 years that the technology has been successfully been combined into one chip by iPico.

This project reviewed the output from tests undertaken with Amcor[10] which showed that iPico's Dual-Frequency RFID technology should meet the stringent requirements of the wool industry. The technology works as follows:

It uses a 125 kHz carrier to power the tag, using a loop antenna to set up the oscillating magnetic field. The tag has a receive loop antenna tuned to 125 kHz, through which it receives power to supply its chip.

The tag transmits its code back by pulsing its own (separate) transmitting loop antenna, which then resonates at 7MHz giving a series of short, decaying, RF bursts containing the ID information, using the proven iP-X anti-collision protocol. More than 120 tags can be read simultaneously if they can all be powered in the active field, but in the wool industry application only a few bale are likely to be read at the same time.

The iP-X protocol appears to be overtaking EPC as the preferred standard in China and we understand that it has recently been submitted for ISO certification which is expected to be completed within 6 – 12 months[11].

[9] i.e. when compared with passive UHF
[10] An application within the paper industry reading tags embedded within a 2.5m diameter paper reel.

In a small scale trial within the wool stores and dumps there was a 2 metre read range achieved and the tags tested under dumping condition had 100% success rate although this was limited to 9 tags given the limitations of this project to fund any extensive trialling.

Overview of semi-active UHF

Active RFID labels or tags have a battery inbuilt to power the circuitry and transmit information. These tags, whilst highly reliable with long range capability are too expensive ($50+) for the wool industry application. Semi-active tags have an inbuilt to power the circuitry reducing the requirement to gather energy from the reader's signal before reflecting back to the reader using the power drawn from the reader's signal[12]. The design feature allows the tag's antenna to be optimised for reflecting over longer distances rather than being optimised for collecting energy which is the design requirement of passive tags.

The read ranges achieved when using these tags at AWH were up to 5 metres as well as 2+ metres in dumped bales. Again, this was only on a very small sample and requires a larger scale trial as proposed in this report. The supplier, iPico, was confident of the technology reaching the required price point however this will be verified before committing to a trial of this technology along with the DF trial.

Vendor support

The major area of concern with iPico is vendor support as they have only one representative in Australia. As stated earlier in the report it is envisaged that iPico technology will be produced under licence and be subsequently packaged into appropriately robust tags by the current major suppliers to this industry. Importantly, the protocols are already being incorporated into the readers being manufactured by the major suppliers. These factors will be fully explored and proven during the proposed trial and the tender process, if it follows as expected from the trial, will engage the major suppliers referred to earlier.

Recommendations

From the research and trials undertaken it is only the DF and semi-active UHF tags that will provide a technology solution for EBID across the supply chain from farm to scour. The alternative technologies are either too immature at this point or require operational "work arounds" to overcome the deficiencies at the point of dumping. The remaining issue for the recommended technologies is vendor support which will be tested during the trial. If the trial proves successful there are viable commercial options to reduce the reliance on iPico such as ensuring the technology is produced under licence by providers better geared to provide the support required in the Australian Wool Industry.

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[11] According to independent industry sources iPico have offered the dual frequency technology to China for free but the rest of the world will have to pay licence fees. China wants independence and does not want to pay for the technology. iPico need ISO support and this requires at least 5 countries to back them which at this stage is not happening. There is an ISO meeting in Tokyo in March 2006 which will involve iPico and their push for ISO support.

[12] All power drawn is utilized in the reflective phase rather than powering the chip's circuitry therefore requiring less power to be drawn in order to be effective.

This paper recommends trialling the two technologies through 500 bales during March with the more suitable technology proceeding to a large scale trial of 100,000 bales to commence in time for the next wool selling season.

Appendix A: Review of previous research and literature on electronic bale ID

The AWEX E-Bale/AWI Project TD043 – Technology and cost/benefit assessment of electronic bale ID

Key wool pipeline stakeholders, as represented by AWEX's ISAC committee, have made an 'in principle' decision to proceed with a review of electronic bale ID. In order to do this, an assessment is required of:

Available and preferred electronic ID technologies that meet performance standards required by the wool pipeline.

A cost and benefit analysis of the additional costs and qualitative/quantitative benefits at all stages of the pipeline that may use bale ID.

AWEX and AWI to co-fund the project with appropriate sub contracted consultants to carry out the above assessment.

The recommendations of this project may be followed by additional bale ID implementation projects, including large scale trials. The commercialisation of the outcomes of the project will be subject to further project proposals.

The key drivers of adoption of electronic bale ID have been identified as:

- Wool and bale traceability and quality control.
- Potential logistical savings through the pipeline. The cost/benefit analysis will assess where these accrue and if they are passed back to the wool grower.
- Improved information flow from farm to processor.

The emphasis should be on keeping the solution:

- simple, reliable and scalable;
- tailored to the financial justification which is based on improving logistics efficiencies rather than creating a new marketing system;
- whilst not sacrificing reliability, focus on building off existing infrastructure where appropriate such as the introduced sheep and cattle ID system (NLIS) and not necessarily adopting the latest technology;
- uniform technology across the industry where appropriate.

A deliverable within this project is to review previous reports into electronic bale ID, summarise their findings and assess the strengths and weaknesses of their recommendations. The two key reports are

Intrawool (Feb 2000) – Wool Bale Identification – Evolution From Hand Stencil to Transponder; and

AWI Project EC452 (November 2003) – Pilot Industrial Trial of Electronic Bale Identification

Within the commentary on these reports reference will also be made to the Sheep ID trials (EC453) and Sheep ID Standards (EC551A) where appropriate. A review of the National Livestock Identification System (NLIS) and National Flock Identification System (NFIS) will be undertaken as a separate component of this project.

The weaknesses highlighted in these report are for the purpose of identifying areas requiring further research or verification and are not intended as criticism as, in many cases, they often reflect issues outside the scope of the reports reviewed.

Review of AWI Project EC452 (November 2003) – Pilot Industrial Trial of Electronic Bale Identification

The key observations and recommendations from this report are summarised in the following table:

Observation / Recommendation	Strength	Weakness
Recommended transponder is the low frequency 125 kHz	- Workable read range - Integrate with on farm readers and wool production systems - Many of the ISO 11784/5 compliant readers already read both tags - Low interference levels - Packaging suited to logistics and warehouse environments - Relatively inexpensive - The report indicates a broad evaluation of alternative technologies, ultimately focusing on a proven, cost-effective and widely available solution.	- Read range not comprehensively tested under all conditions - Standards other than FDX-B should be more widely explored to ensure it is as "future proof" as any other alternative - The preferred solution has not been adequately benchmarked against alternative technologies with regard to read range, anti-collision avoidance and possibly cost - The need or otherwise for anti-collision capability requires review - Whilst alternatives were dismissed due to cost or limited availability they should be reviewed again given the rapid advances in this technology space. - Fails to take advantage of HDX which is already widely distributed through NLIS
A read-only tag with a 10 digit number is all that is required for the solution.	- Eliminates complexity, - reduces cost, - increases reliability, - removes the sensitivity related to the transfer of marketing related information	- A unique numbering system within Australia does not take into account similar initiatives which may be undertaken in wool overseas. A brief review of any overseas bale ID technologies and a review of the IntraWOOL recommendation for EAN Serial Shipping Container Code (SSCC) should be undertaken.

		Review whether the proposed numbering system will provide a similar outcome
A PVC credit card style is recommended as the optimal packaging	- Tag enabled sufficient flexibility, strength and protection to withstand downstream handling stress (e.g. at core test and dumping) - 100% read success rate was achieved	- The application/incorporation of this tag into the woolpack was not adequately addressed nor the resultant read risk: e.g. applying at point of manufacture introduces upstream risk such as high compression prior to containerisation. - Proper analysis to determine application cost and potential risks not undertaken (although similar risks apply with alternative technologies)
The most appropriate point to attach transponders on to bales is the top flap of the pack, centred as per the current label, set back 10 – 150mm from the edge of the flap.	- Maximises read capability and reduces risk of damage.	-
The transponder procurement process be centralised to a controlling industry body that controls the supply of tags and tag design and packaging for wool packs. This industry body be made up of representatives of AWEX, AWI, three brokers and dumpers and the RFID industry (for technical advice)	- If this works effectively it would ensure uniformity, lowest price and proper maintenance of standards	- Inadequate detail in the report as to how the distribution of tags will work operationally. - The RFID industry representatives will competing to promote their respective technologies – cooperation may not be likely nor effective. An alternative may be an independent technology consultant. - Tag design would appear outside the appropriate role of the industry body – refer earlier comment as to setting the standard.
A typical ISO reader is adequate for on-farm reading while longer range readers are recommended into and out of the wool dump.	- Low cost option and may piggyback off existing reader technology already in the field	- The type of readers currently in the field is variable. Some read HDX only, some HDX & FDX.

		- Inadequate stress testing within the downstream processing environment (eg in wool stores, dumps, ESPs) as well as assessing potential impact of the variety of downstream facilities. - Reference made to "specifically designed reading hardware" for wool stores but no costing provided. - Requirements within downstream handling and processing operations was not adequately addressed or costed (generally outside the scope of the report)
As part of a controlled implementation program, development costs be channelled into a long range portable reader that can be used at various stages of handling.	- Addresses read range challenges at points of the supply chain – particularly in downstream handling	- This would appear more appropriate to be developed by a potential vendor – part of a tender for supply to the Australian market. Alternative may be to channel funds into an existing vendor to develop and support appropriate reader technology.
Industry Standards: - That the 125 kHz tags are tested and certified as reading 100% at point of dispatch by the transponder manufacturer - Where transponders are delivered from supplier direct to pack manufacturers, the pack manufacturers read and certify tags at the latest possible point prior to dispatch to assure readability of packs - That reader hardware equipment uses a standard communications interfaces of RS232 Serial connection, 9600 and/or 19200 bps, 8 data bits, No parity, 1 stop bit - That software developed within the industry	- Whilst the industry cannot impose international standards on other parties, a consistent use of the technology using commercially viable protocols will ensure hardware and software conforms to reasonable protocols.	-

conforms to a standard platform for communication. Reader output files should be in the standard CSV format External files that are transferred are coded into the standard XML format		
There are several aspects of integrating RFID and this should be in a controlled and orderly manner to progressively integrate the technology. Recommendations: a) The existing wool pack label with the barcode on it should be abolished immediately b) Transponders to be attached on existing packs in Australia (i.e. old style in stock at time of introduction of Bale ID), using a central contract packer. Tags can be delivered direct to the packer in pockets prepared prior to delivery and that transponders are delivered direct to pack manufacturers, for delivery to Australia c) Second hand pack repairers be accredited to remove old RF tags from packs, and replaced with a new tag sewn in to the repaired pack d) Tags should not be recycled e) That a RFID Implementation Program be set up and controlled to commence and manage the progressive implementation of RFID tagging to wool bales throughout the supply chain. Program to tag and manage a minimum of 100,000 bales throughout the country, from producer to processor, using pre-tagged bales f) Program to be managed by AWI and AWEX g) Program to include at least two brokers of wool handlers from each state, plus a selection of major national brokers such as AWH, Elders	a) Significant cost saving b) Facilitates earlier and initially broader implementation if feasible c) As per (b) d) Removes risk of duplication e) A large scale project with the level of buy-in proposed would be an excellent launching program. f) Ensures industry priorities are properly addressed g) Ensure industry buy-in h) Properly derived costings will provide a basis for equitable apportionment to ensure a win:win with participants	a) May not be feasible. Further research is required as to whether some form of label is still required. b) Several issues here: o It is unclear what process is proposed for “registration and approval” of these parties. o It is unclear as to substantiation of cost estimates provided o Discussions with wool pack manufacturers and importers on this matter do not appear to be included in this report o The cost night be avoided if old packs are allowed to “wash out” through the system c) As per (b) d) The recycling of packs and tags is not fully explored and warrants a brief review as to whether the manufacturers can recycle/renumber the tags (possibly a more expensive tag required) or whether agreed processes can facilitate recycling of numbers within the wool chain. e) There is no attempt to quantify such a program (cost or timeframe) or how and when benefits will be achieved / realised. (In fairness, possibly outside

and Wesfarmers Landmark. Program to also include all major dumps, plus overseas processors in Europe and Asia. Local processors such as Chargeurs and Michell to be included h) Program to provide accurate costing of benefits to the industry. These cost improvements to be shared with producers and post farm parties through lower costs i) A number of forums and demonstrations to producers and Classers be constructed and carried out to demonstrate the electronic forms of existing documentation, and to advance the general advantages of RFID to on farm management		the scope of the project but unfortunately referred to in the report) f) N/A g) N/A h) With all savings being realised downstream from the farm gate the concept of such a cooperative approach is idealistic but possibly not commercial. This must be tested with downstream participants. A detailed cost:benefit analysis does not necessarily require a trial i) Standardisation of software and procedures across all classers is a major implementation issue hardly addressed – critical area to assess prior to commitment to a full scale trial. Also, other parties in the shearing process (e.g. contractors) should be consulted.
Based on the earlier recommendations, the Sokymat World Tag ISO Card at a cost of A$1.40 to A$1.50 provides the likely landed cost for Australia	- This is a small cost in relation to the value of a bale of wool and, in particular, to the total handling costs which should reduce due to the introduction of this technology	- There is insufficient information in the report in regard to the up front and ongoing costs of developing the bale ID reading infrastructure and the subsequent “cost per read”. - The problems with NLIS with buyers refusing to pay the $0.40/hd to cover the reading of tags with the cost subsequently being passed onto the vendor (and now pushing for government subsidy) - Issue of “who pays” requires resolution prior to implementation and will be addressed in the CBA.

The estimated net savings per bale of wool is estimated at $3.65 per bale or $10.2m for the Australian wool industry	- Substantial saving - 50% estimated to accrue to growers	- Lack of rigour and substantiation in the economic case - $0.70 attributed to removal of need for a bale label – this is apparently not the case but should be properly evaluated / canvassed. - No assurance (or supporting research) that adequate benefits will accrue to wool growers - No analysis of degree of uptake required to generate returns and whether they are realisable across all participants
On farm trials successful in translating information into electronic versions of existing forms and emailing through to the wool store	- A major area of savings once the wool store knows in advance the details of the bales in transit to the store (i.e. receipt of electronic classers report).	- No analysis of potential uptake, cost of developing programs for electronic classers report and integration costs with wool stores
Surface Acoustic Wave (SAW) tags should be assessed as an alternative technology	- This has the possibility of halving the cost and increasing the read distances - SAW technology has the ability to be used within the same reader network as the current low frequency readers	-

IntraWOOL (Feb 2000) – Wool Bale Identification – Evolution From Hand Stencil to Transponder

The introduction to the report provided the following insight which was the precursor to the first three recommendations of the report:

“It was announced in October 1999 that "The Wool Exchange Board has agreed to implement new pack labeling requirements, which should be in place by the start of the 2000/01 selling season, and to work with industry to determine what further development of bale ID technologies was required". This announcement signaled the Board's acceptance of two recommendations made to it by the Steering Committee of IntraWOOL Australia shortly beforehand.”

The key observations and recommendations from this report are summarised in the following table:

Observation / Recommendation	Strength	Weakness
The numbering format known as the EAN Serial Shipping Container Code (SSCC) to be adopted or the numbering of wool bales.	- This is an internationally recognised system of numbering and will provide each bale with a unique ID to which all data related to the bale and its contents can be linked. - Such data will then be available for access by all accredited parties along the supply chain.	- The proposal for a central database cuts across current commercial arrangements without adequately addressing IP and commercially sensitive data.
A label of material consistent with wool pack material (Nylon 6 or 66) to be attached to all wool packs and that requirement to be incorporated into the wool pack specification. A bar code representation of the EAN number format was to be included on the label.	- A key objective of the IntraWOOL Project was to provide electronically readable bale identification along the whole supply chain. At the time it was acknowledged that bar code technology is not sufficiently robust for that purpose. - The IntraWOOL Project was about to complete its bale ID trial program and endeavoured to evaluate and recommend the use of radio frequency identification systems as a solution to the whole of supply chain bale ID objective.	- Bar code not an ideal working solution but cost effective whereas the EAN is recognised internationally
An RFID solution cannot be implemented with the stroke of a pen. The Project has identified a technical solution and parties that have been closely involved with the work done have an	- Such a program would provide further opportunities to pursue a lower cost RFID system commensurate with the rapid development of this technology.	-

appreciation of the benefits available. However for the technology to be adopted comprehensively across the industry further demonstrations need to be provided to a wider range of commercial industry participants. **3.1** The industry should continue its progress towards adopting RFID technology as the primary means of providing electronically readable wool bale identification along the international wool supply chain. **3.2** The RFID device is to be located in the seam of the wool pack and to be attached at time of pack manufacture. **3.3** The device and its interrogation equipment is to be initially ISO compliant, until it can be demonstrated that abandoning ISO compliance will enhance the cost effectiveness and availability of equipment (tag - scanner - antenna configuration) to the producers, material handlers and customers in the international wool industry. The Steering Committee of the IntraWOOL Australia Project strongly urges the Australian Wool Exchange to ensure that the introduction of a Standard for a whole of supply chain RFID solution is vigorously pursued.	- Pragmatic approach to the economics of widespread introduction and initial requirements for strict standards.	
4.1 Businesses in the industry, such as individual Brokers and early stage Processors, to become members of EAN. **4.2** Taking advantage of 4.1, it is suggested that the Broker representative bodies introduce a common EAN system for identifying farm lots. **4.3** Similarly, it is suggested that early stage	- 4.1 supported industry buy-in and involvement up to ESP level - 4.2 supported consistentcy throughout the system in relation to numbering - 4.3 is consistent with 4.2 for downstream processors	- The cost of an industry database and its ongoing management are not adequately addressed nor are the benefits of the database

Processors adopt an EAN system for identifying their products.		
5.1 It is recommended that the tag specified for the industry is a read / write model. **5.2** The tag should be formatted such that the bale ID, once programmed in, cannot be changed. **5.3** Tag available memory should be sufficient to have two further fields of data programmed in: Lot number to be added at Broker's store; Countermark to be added at dump.	- Addressed early aspirations for the ability to carry data through the supply chain to drive information and handling efficiencies - 5.2 provides an element of tracking security in relation to ID. - 5.3 Pragmatic approach to what further data would be written without creating commercial sensitivity	- 5.1 introduces security issues and sensitivities which could undermine widespread support and adoption despite the proposed limited data to be written - Read/write introduces elements of cost and reliability - Moves from a simpler solution when the added complexity has not demonstrated acceptability on commercial or political bases
6.1 An industry standard message to be developed that defines the data fields that are to be used when collecting data during the harvesting of the wool clip. By having available a message of standardised content and structure, all businesses at the beginning of the wool supply chain will be able to exploit the potential for electronic data capture and transmission technology to reduce errors and streamline materials handling operations. It is suggested that the responsibility for the development and administration of this new standard message should be passed to the Wool Industry EDP Users' Group (WIEDPUG). This industry committee routinely manages the existing set of electronic industry messages	- Strict standards promoted to support downstream information availability and efficiency	- There are simpler ways of transferring information other than on the bale ID device - Must understand what the expectations of the standard message is: is it number only or other data
The report recommends that AWEX should administer and issue numbers for identification of greasy wool bales and of bales of ESPs	- Central control of the standards and numbering - Logical that this is centralised for good governance sake.	
The report supported the recycling of woolpacks	- A cost effective approach but reliant upon a central database to record the	- Becoming less of an issue as 2nd hand packs becoming harder to get

	bale trail (although a central database is not necessarily required to achieve this)	
The report recognises the need to retain a bale label for visual ID when reliance on electronic ID is either not possible or impractical. The report also supported the use of barcodes	- Recognises the need for a visual fallback (not recognised by EC452)	- Barcodes now seen as impractical relative to alternative technologies. At the time limited read ranges for RFID was a greater constraining factor than at present.

The IntraWOOL project had objectives which no longer appear to be an imperative of the broader wool industry and it was European focussed whereas the bulk of Australia's wool is now sold into China. Those original objectives were:

To **set up a system (INTRAWOOL electronic marketplace**) based on Information Technology, which provides access to all relevant information the European partners require for their decision making, producing and processing wool at any time from all places in Europe.

To **adopt EDI-standards for the wool industry** and to demonstrate the benefits of its application.

To **set up a barcode / transponder based identification system**, that is suited for the bale handling processes in the wool industry.

The report relevant to this current project addressed item 3 but may have carried through the influence of aspiring to developing a system to allow access to critical information across the processing chain, hence the recommendation of having write capability.

Appendix B. Industry Consultation – list of interviewees/respondents

Date	Company	Person / forum	Location	Purpose / subject
27-May-05	AWI	ISAC meeting	Sydney	Presentation Electronic Bale ID project
30-Jun-05	AWI	G Waldthausen	Sydney	General discussion re project approach
4 & 5-Jul-05	AWH		Geelong	Work on costing model
7-Jul-05	G.S World	Brian Barrett	Sydney	Discussion on issues that wool pack manufactures may face
12-Jul-05	Landmark	R Bawden	Melbourne	General discussion on EBID. Options for introduction of ECS
12-Jul-05	AWTA	M Jackson & I Ashman	Melbourne	Industry issues plus specific issues for AWTA.(I Ashman to produce paper)
21-Jul-05	Southern Wool Services	D.Frazier & M Dekluver	Melbourne	Costs and benefits for a small broker. Paper produced.
22-Jul-05	EP Robinson	J Robinson	Melbourne	Costs and benefits for a small ESP
25-Jul-05	Independent Wool Dumpers	S Johnson	WA	Costs and benefits for medium sized dumper. Paper produced
26-Jul-05	Jandakot Wool		WA	Cost saving identified for medium sized wool scourer
26-Jul-06	AWH	J Ward	Geelong	General discussion cost benefit paper produced
26-Jul-05	Wool Agency	S Shenton	Perth	Costs and benefits for small broker
1-Aug-05	New England Wool	A Blanch	Sydney	Meeting re what benefit a wool exporter with ESP interests could get. AB to get additional information from mill
1-Aug-05	ADF	D.Nancarrow	Sydney	As above
2-Aug-05	AWN	K Ipson	Sydney	Meeting re costs and benefits for medium sized broker
2-Aug-05	AWH		Geelong	Continuation of work on costing model
4-Aug-05	AWEX	M Grave	Sydney	AWEX project up-date
5-Aug-05	Elders	S Read	Melbourne	General discussion on introduction of bale ID
11-Aug-05	AWI	G Waldthausen	Sydney	Project up-date
18-Aug-05	NCWSB	Brokers		Presentation to national council of wool selling brokers
26-Aug-05	ISAC		Melbourne	ISAC meeting project update
1 & 2-Sep-05	AWH		Geelong	Continuation of work on costing model
5-Sep-05	GH Michell	D Michell	Adelaide	Costs and benefits for ESP in Australia
6-Sep-05	Quality Wool.		Adelaide	Small broker-general discussion
6-Sep-05	Adelaide Wool		Adelaide	General discussion re effect on private wool buyers
8-Sep-05	AWI	G Waldthausen	Sydney	Project up-date
12-Sep-05	Manu-Tech	S Harvey		Discussion on technology options and Industry contacts
13-Sep-05	Infinion	M Walsh	Melb	Outlineof project & general discussion on RFID & possible options

14-Sep--05	Ipico	P Almond	Phone	General RFID discussion. Trial to be set up in Brisbane at a later date
14-Sepl-05	Sokymat	L Brickland	Phone	Discussion on results of trail using their tags in P March study
15-Sepl-05	Sokymat	G Cromm	Melbourne	Meeting arranged to set up trial
26-Sepl-05	Sunshine Technologies	G Wind	Phone	Technical discussion. Arranged to meet in Brisbane to trial various equipment
29-Sep-05	Sokymat	G Cromm	Geelong/ Brooklyn	Inspection of wool store & dump. Proposal for trial
4-Oct-05	Electro-Com/ Texas Instruments	C Lennard	Melbourne	General discussion on option. Arranged to do trial in their workshop using bales from AWH
11-Oct-05	AWN	K Ipson	Brisbane	Continuation of work on costing model for medium sized broker
12-Oct-05	Allplex	P Gunston	Brisbane	Discussion on technical issues of various tags
13-Octl-05	Sunshine Technologies	G Wind	Brisbane	Demonstration of UHF tags on dumped & undumped bales
14-Oct-05	AWH	M Dugmore	Brisbane	Continuation of work on costing model
21-Octl-05	Wickham Plastics	I Gallop	Melbourne	Discussion of packaging options for RFID tags. They will develop some options for trials early Dec
24-Oct-05	AWEX	M Grave	Melbourne	Project update
26-Oct-05	CSIRO	G Swiegers	Phone	Discussion on SAW technology
8-Nov-05	Key performanc Logistics	M Saunders	Melbourne	Discussion re costs or benefits for ESWP
10-Nov-05	Texas Instruments	C Lennard	Melbourne	Trial of UHF tags on dumped bales
15-Nov-05	G S World	B Barrett	Melbourne	Meeting re attaching tags to new labels & possible trials
17-Nov-05	Texas Instruments	C Lennard	Melbourne	Further trials
24-Nov-05	Unique Micro Design	G Ramadan R Fisher	Melbourne	Project outline & discussion of possible options
29-Nov-05	Unique Micro Design	R Fisher	Lara/ Brooklyn	Inspection of wool store & dump
5-Dec-05	Manu-Tech	S Harvey	Melbourne	Discussion and evaluation of process to date
7-Dec-05	Electro-Com	C Lennard	Melbourne	Demonstration of UHF tags
12-Dec-05	Invetech	S Baxter	Melbourne	Discussion of 2D barcodes as a potential tracking solution
13-Dec-05	Unique Micro Design	G Ramadan	Melbourne	Follow up of their visit to woolstores and wool dump
13-Dec-05	MEMS-ID	Dr Z Moop	Melbourne	Discussion on MEMS technology
14-Dec-05	Margellan	K Lang	Sydney	Discussion on use of high frequency tags
15-Dec-05	Ipico	P Almond	Brisbane	Demonstration of dual frequency tags
7 Feb-06	ISAC	AWEX	Melbourne	Submission of Draft report and feedback for next stage of RFID project

Three overseas ESPs - BWK AK AG, Modiano and ADF – were sent letters requesting feedback on the EBID initiative and indicative savings that might accrue to their operations. Only one response was received.