AN AUSTRALIAN SHEEP GENETICS SYSTEM

PART 1

FEASIBILITY
ISSUES
OPTIONS

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and
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An Australian Sheep Genetics System

Feasibility, Issues, Options

This report considers a range of the expectations, issues and concerns that characterise an active, competitive marketplace …

"The future belongs to companies that make the effort to know who their clients are and what they like."
Robert Gottliebsen
'Most valued customers'
W. Australian August 2000

"Any really good new science will automatically be commercialised."
Professor Barry Ninham
Institute of Advanced Studies, Australian National University,
The Australian 16 August 2000

"Industries cannot implement visions, strategic plans, blueprints … Only individual businesses and the people who run them can do so" … [but industry led organisations are expected to be] "innovation and implementation" drivers.
From the Wool Task Force Report 1999

"Protagonists of the application of the new technology point to indicators of the slow genetic progress in wool production of Australian sheep compared with that in other livestock industries. … genetic progress has accelerated spectacularly in these other industries as a result of the introduction of modern quantitative genetics in the last three decades."
Professor David Lindsay 2000

… with regard to:

– adoption of genetics technology in the Australian sheep industry,
– the market for genetics services and systems for service delivery, and
– improving returns for breeders and commercial wool and sheepmeat producers.

To identify issues and options, this analysis works from first principles at a number of points, especially on the marketplace for sheep genetics services. Every effort has been made to ensure material is accurate, but many aspects depend on input from others.

The report is written with a range of reading audiences in mind, some less familiar with genetics (or sheep) than others. It unfolds toward Chapter 3 where Options are considered, and section 3.6 which advances a framework for a pro-active Agency.

My aim is to provide new and frank and robust analysis to support future MLA and Woolmark decision-making for industry. My thanks to all persons contacted for making time to discuss elements of this complex area of investigation.

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Report Summary

Part 1
1. Context : Change, challenge and genetics.
2. Australia's sheep genetics marketplace.
3. One sheep genetics system? Options, issues.

Part 2
4. Genetics services and compatibility.

Chapter 1. Context: Change, challenges and genetics

- Implementation of genetics R&D into a marketplace of diverse experience, tradition and independence, presents a complex challenge. Issues prompting this Study and broad objectives are identified in 1.1.

- The changing circumstances for sheep businesses is essential context. Key directions include: competition, sheep sub-industries, mixed farm businesses including off-farm income, a growing role for private service providers in a wide-spread industry, and increased focus on successful R&D implementation [1.2].

- Genetic advance is important. There have been impressive results in intensive animal industries. These are a guide to potential for gain, and to areas for caution, but are not fully applicable to the Australian sheep industry [1.3].

- After four decades of investment, use of quantitative genetics (QG) across the sheep industry is less than hoped. Industry acceptance of QG is a vital question [1.3.1]. Understanding the dynamics of the current and future sheep genetics marketplace is a key to evaluation of current service arrangements, and for identification of approaches likely to be successful. This Study needs to :
  - Consider the commercial producer and sheep breeding marketplaces as separate though interacting.
  - Understand differences of opinion about genetic gain, important selection traits and about techniques.

- Extension programs, R&D application and new science are considered briefly in 1.3.2. The front-line of genetic and reproductive science is relevant. However, technologies useful in intensive animal breeding, or in high value animals such as cattle, will be less use with sheep until costs are lower. New selection tools could also be of low interest to breeders not convinced by quantitative genetics.

- During the 1990s, the meat and wool industries have aimed to implement genetics research and secure returns for industry members through extension and major service programs, including Rampower and Lambplan.

- Knowledge and large quantities of sheep genetics data have accumulated. For large advances from QG, a genetics system and database would need to support sizeable across-flock evaluations. A large, linked, database would also encourage new lines of science.

Chapter 2. Australia's sheep genetics marketplace

- The success of almost any venture in a market economy such as Australia will reflect its fit with marketplace needs, particularly into medium and longer terms.
- In active marketplaces buyers shape suppliers through custom, prices and feedback. Providers can explain, lead and educate. Success will relate to known or hidden needs and wants of buyers plus the skills of marketers and educators.
- Within the sheep genetics marketplace there are interactive sub-markets of breeders, ram buyers and commercial producers plus a range of service providers.

2.1 The markets – ram breeders and commercial producers

- The key markets for genetics services – Merino and meatsheep breeders – are explored to develop an understanding of the size of market and customer patterns.
- A promising target market of sheep breeders who could be interested in science-based genetic evaluation system is identified in 2.1.1, as:
  - 1,600 breeders/studs and some 500,000 new animals for analysis each year
  - being 800 Merino studs (320,000 animals), & 800 meatsheep/other (180,000).
- Under the current industry structure, if most of these 1,600 studs (of some 3,600 studs in all) were selecting for traits agreed as important, average industry genetic gain should accelerate (measured as return to commercial producers). However, opinion on important traits and methods is diverse, especially in the Merino arena.
- Factors influencing the interest, or non-interest, of the target market in a genetics system include: mixed custom and price signals from ram buyers, time and money costs of joining, need to develop a competitive edge and market niche, alternative genetics methods available, and approaches taken by genetics services providers.
- Some, not all, producers will rank genetic gain as a priority by paying more for superior animals [2.1.2]. Of meat-ram buyers, about half pay extra for Lambplan rams; about 30% look for EBVs. Proportions are lower for Merino ram buyers.
- A market for professional genetic evaluation services could be developed among specialised commercial sheep producers breeding rams for their flocks – say 1% of 44,000 producers, or about 400 potential users.

2.2 Issues at the interface of markets, science and technology

- About 710 studs now use some quantitative genetics services, 600 in Lambplan. This is 44% of the Target Market, 16% of Merino target, 73% of meatsheep [2.2.1].
- Identifying realistic targets markets sets a positive vision, but is a first step only in achieving the custom needed for a successful genetics service system.
- To secure the interest of a large part of the target market (1,600 studs, 400 producers), any new system will need to cater for diverse views on what breeding objectives should best suit their enterprise and their clients [2.2.1].

- Debate over the 1980s and 1990s about which traits and methods are important is considered in 2.2.2, both to learn from prior experience and to assist assessment of current arrangements and options for development.

- In a very competitive industry, individual breeders will and should decide what product mix they will develop for their customers.

- It is assumed QG offers more potential return to Merino breeders and producers, than approaches using fleece measurements and forms of sheep classing. How much more will appreciably influence adoption of QG selection. Over time, markets should pay for value-adding traits and conceivably give returns for investment in QG.

- For meat sheep, ram and product value characteristics are well defined. This is not so clear for Merino breeding, except that fibre diameter is the key trait for the three main selection systems (traditional, quantitative genetics, 'elite wool').

- It is a marketplace reality that 'style sells' – be it in wool, lambs, rams, stud-masters, advisers or geneticists. This needs recognition in any system.

- The question of goals for a new genetics system arises. Industry uptake of quantitative genetic techniques would be a better direct indicator of success than assessing 'genetic gain' based on any one set of parameters.

2.3 The range of genetics service providers

- Over the last decade, various groups have collected considerable quantities of sheep genetics data. These collections are identified and weighted in 2.3.1.

- Features of the following are outlined in PART 2 [4.1]: – Lambplan; Advanced Breeding Services (NSW Ag); Select (CSIRO); Central Test Sire Evaluation; Agriculture Departments in WA, SA, Victoria; Mackinnon Project; Independent consultants; Soft Rolling Skin and Elite Wool; Professional sheep classers; scanners and laboratories. Key points and assessments are summarised in 2.3.2.

- Considering the Australian sheep industry as a whole, its size and importance, the overall adoption of QG and the industry's QG service arrangements is not striking [2.3.2].

- In the meat sheep sector, substantial investment over decades has established a QG service. Lambplan has piloted significant genetic gain. It services some 600 studs, likely reaching 55-60% of meat-sheep rams, though less than half of registered meatsheep studs use Lambplan and membership growth has flattened. Lambplan members pay 60%-70% of costs [4.1.1].

- In Merino breeding, adoption of QG is still low and genetic gain is considered slow in key traits (diameter, fleece weight), notwithstanding investment in QG extension and development of several service providers. [4.1.2 to 4.1.5].

- Over 90% of Merino ram breeders do not use QG systems. A significant number follow 'elite wool' approaches [2.2.2, 4.1.6], but the majority are using objective measurements for diameter and fibre characteristics alongside traditional sheep classing for wool quality and sheep features [4.1.7].

- Wool industry QG services are provided by a small number of personalised consultancies. This reflects industry experience with Woolplan, an assessed need to provide one-to-one advice, plus limited market interest. Current services are modest in scale (ABS is the largest with up to 70 clients).

- There are no apparent far-seeing plans to lead, market and provide QG services on a wide scale to the Merino breeding industry. There is enthusiasm but the plans of current service units are limited compared to the industry's size.

- No government or industry service is charging prices that routinely cover full costs. Clients are partly or wholly subsidised. Lambplan recovers 60-70%; ABS covers its added costs. Low cost recovery reflects: departmental cost structures, what suppliers think breeders will pay, breeder views on the value of services, and breeder-producer expectations of low prices because of levies and taxes.

- Independent QG service providers, existing or new, have to compete on an uneven field (although single consultants tend to have lower costs). Notably, 'elite wool' consultants appear to charge business rates for their services and to secure clients.

- NSW Agriculture has developed much of the QG software, genetic parameters and reporting systems used by the Australian sheep industry. Lambplan has expanded on these as it has grown. NSW Agriculture distributes software without intellectual property restrictions.

- Even so, almost all the other service groups (as well as Lambplan) choose to use a slightly different approach to parameters and reporting because of assessed client preferences and, it seems, to add-value and for competitive differentiation [4.2].

- Sheep data is accumulating rapidly but on different bases and into different systems, through the Central Test Sire Evaluation, Merino Benchmark, SA Demonstration flocks, wether trials, various consultancies, plus Lambplan.

- There is apparent scientific agreement on the potential genetic power of a large, national, linked database providing across-flock analysis.

- The marketplace for quantitative genetics and 'elite wool' systems appears to be merging at some points. There is a lot of common ground and cross-interest, indicating market opportunities for a stronger, flexible genetics services entity.

- Any new system should aim to engage and offer services to the 'elite wool' sector for both industry genetics and commercial reasons. It now appears that scientists rather than the marketplace are keeping the approaches apart.

2.4 Opinions on genetics services and leadership

- Sheep breeding in Australia is a competitive arena with many different views on what the market wants and will pay for, as is to be expected. Forthright comments in 2.4 add depth to the review of the Australian genetics marketplace in 2.1 to 2.3.

- Considered together, this material should indicate whether there is a need for changed arrangements, whether there is likely to be market support in terms of use and payments, as well as probable change issues.

Analysis of comments from sheep breeders and industry leaders [2.4.1]

- Sheep and wool type-style are important in selection and selling, and how this is approached could be pivotal to a successful genetics system.
- The immediate issues for breeders using QG are:
  - the confusion created by different genetics analysis and reporting, and
  - that strong across-flock analysis is not accessible for much Merino data.
- Inconsistencies among Merino trials and services, and between Merino and Lambplan systems are concerns. Most feel neutral on which calculating and reporting system should be used.
- Vision, leadership and progress are sought, but not instruction. There is support for a higher level genetics system bringing together data and providing services more consistently and powerfully, and, some insist, under true commercial conditions.
- If a new system is to be judged as a success it needs to be used, and recognised through its use and results. Industry organisations should lead considered change, achieving patronage by addressing both the big picture and the detail.
- The indication is that any new system should start in a way that welcomes as many groups as possible, offering products and services to suit different needs alongside any leadership and guidance role it might be given or develop.

Analysis of views from, and about, genetics service providers [2.4.2]

- There are few sheep genetics scientists in Australia. A number of senior scientists have contributed very substantially over many years and this is acknowledged.
- There is also a stand-off among individuals at senior level, coupled with significant personality differences and project arrangements which let researchers set much of the delivery framework (even where there are consultative committees).
- Of concern is the frustration felt by the next level of younger scientists and agricultural technology advisers with the 'goings on' among their seniors, and how this influences the vision and interest of the younger practitioners.
- These strained interfaces also influence the public positions taken by genetics service providers, contributing to the complexity of QG systems both in reality and as seen by breeders (whether clients or not – most are not).
- Competition in the absence of marketplace dynamics is not always productive. It can be an inefficient use of industry levy resources, and not conducive to 'taking a helicopter view'. Proprietorial interests seem to prompt some stances on not changing.
- These people issues will come to the fore, and should not be avoided by the wool and meat industries when considering options for any new sheep genetics system. Overall, it does seem that many professionals in the sheep genetics arena see that the time has come for key decisions on future service arrangements.
- ***Industry reviews***: Some points arising from the McLachlan Report, McKinsey in NZ, Lindsay on Rampower, are considered in section 2.4.3.

Chapter 3. One sheep genetics system? options, issues

3.1 Moving ahead and defining a vision

- It is assessed, from Parts 1 and 2, that the time is about right for sheep industry leadership to work toward a single Australian Sheep Genetics System based on quantitative genetics principles.

- An Australian Sheep Genetics System can be envisaged which :
  - is marketplace oriented, noting a range of market segments
  - offers return on monies invested to many in the industry – so it is used
  - is genetically powerful, but flexible to service needs
  - obtains strength by urging current systems together, then building, and by supporting a diversity of genetics advice providers
  - includes a broadly and neutrally available service centre
  - promulgates a common language for industry wide products through informative and professional communications
  - builds a broad and varied, indirect and direct, client base, including breeders, producers, a range of advisers, businesses, researchers
  - is able to aim for commercialised operation by spreading costs
  - leads in a considered way, building broader market interest in Q genetics
  - learns from the past in terms of market needs, science and management.

- Such a System should be assessed on usage and usefulness. This Vision does not set out to secure genetic gain in itself. Gain should be achieved, with prompts from market price signals and wider industry activities, but methods may be diverse

- Many factors need to be reviewed in assessing the likely optimum form for such a system. To start, further understanding is needed of 'compatibility issues', if any, among the current performance recording, BLUP and reporting schemes.

3.2. Current services – methods and compatibility

- Compatibility, or lack there-of, among Lambplan, ABS, and other schemes, can look like a significant obstacle to change (or equally, a major reason for moving fast to bring processes and information together).

- As this Study's investigations advanced, the scale of compatibility issues contracted.

- The more detailed workings of main QG services, their associated data collections and evaluation approaches, including questions of compatibility are considered in PART 2, section 4.2, including: Enterprises, pedigree, accuracy and links; Traits recorded, measurement and data integrity; Data collection, delivery, processing; Preparing BVs, indexes, comparisons, reports. Assessments are recorded in 3.2.

- Overall, it is assessed that, with investment, energy and good faith, a single, national database for sheep genetics information could be constructed [3.2]. Should the owners be convinced, several of the current data collections together would provide a strong start to the database, which should then extend.

- There would be issues to be addressed in forming up a national database. The most important of these appear to be: Pedigree and accuracy [4.2.2]; Some entrenched positions [2.4, 4.2], and level of investment needed and priorities [3.6].

3.3. Key elements of a potentially successful system are identified as

- An overall system, oriented toward markets and targets
- A strong genetics base sufficiently powerful in capability and capacity, and responsive, and cost effective
- Management to achieve stakeholder objectives.

3.4 Four options are examined – degrees of change and leadership

1. Continue current arrangements
2. Develop a common language for the current arrangements
3. A consolidated service database
4. A pro-active sheep genetics agency and system.

3.5 Apparent best option – look to the marketplace

- It is assessed that introducing a common language and ID alone would not be worth the costs in terms of expenditure and disruption to current arrangements and communications, although Option 2 could lessen confusion to some extent.

- Options 3 or 4 should bring advances. Under Option 3, Merino breeders seriously using QG services would obtain stronger selection information in a common language, with probable higher rates of gain (as for meatsheep now). Option 3 would rely on current advisers and consultants and any newcomers, to promote use of QG services. Marketplace expansion would be moderate or slow.

- Option 4, additionally offers industry leadership in developing and promoting market-oriented, flexible, quantitative genetics services. It is assessed that only Option 4 could reach the targets of 1,600 studs and 400 producers as users of QG.

- Option 4 could also reduce scientific and organisational barriers to wider industry access of genetics tools arising from ongoing R&D investment.

- **On balance, from the analysis in this Study, it is recommended that Woolmark and MLA give in-principle support to development of a joint-industry Australian Sheep Genetics Agency to be a pro-active focal point for an integrated genetics service system.**

- Preparatory and planning work would be needed before decisions to proceed, including discussions on harnessing existing schemes. Option 3 – a Consolidated Database – should remain under consideration during the further assessment stages.

3.6 Towards an Australian Sheep Genetics Agency (ASGA)

Development steps and a timetable are provided, plus an Agency Framework – a picture of ASGA in five years – with notes for preparatory and planning stages [3.6.1].

Contents

PART 2

1 Context: change, challenges and genetics

Sheep breeding has formed part of the Australian ethos for two centuries. Through selection and crossbreeding, and with attention to environmental suitability, the strains of modern Australian Merino were developed from early South African and Spanish imports. Over 20 other sheep breeds have been introduced and improved to produce food and fibre products sold to Australians and world markets.

Near thirty years ago, CSIRO scientists Helen Newton Turner and SSY Young, after a decade of research on Merinos, published *Quantitative Genetics in Sheep Breeding.* About that time, RB Dun and R Eastoe also published articles summarising extensive Merino research sponsored by the NSW Department of Agriculture at Trangie. ***These were quantitative genetics 'turning points'.*** [1]

Then, in 1977, the Best Linear Unbiased Prediction (BLUP) procedure to estimate Breeding Values (BVs) was introduced to dairy cattle breeding. BLUP had been developed by CR Henderson in the 1950s but was made accessible by the surge in computing power in the 1970s. Breeding Values (BV), which adjust an animal's looks for environmental, heritability and other factors could then be realistically calculated for large numbers of animals and a range of traits.

Over the last forty years, many tens of millions of industry and public dollars have been directed to sheep quantitative genetics (QG) research and development. These funds originate from meat and wool industry levies and from Commonwealth (CSIRO, research levy matching, other grants) and State governments (usually via Departments of Agriculture).

However, implementation of genetics R&D into a marketplace of diverse experience, tradition and independence, presents a complex challenge.

- In 1998-99, of the 150,000-160,000 Merino rams sold to Merino breeders and to commercial woolgrowers, it is estimated from research for this Study, that:
  - Perhaps 25% of rams were selected using Quantitative Genetics, though a QG system used by less than 10% of registered Merino studs and other ram sellers.
  - Of these rams, a portion may have been sold using Breeding Values or Indexes.
- And in 1998-99, for meatsheep breeds :
  - About 70 % of terminal sires (Dorset, Texel, Suffolk) were selected on BVs by about 50% of registered studs. Some 30% of Border Leicesters were BV selected.
  - About 40% of these selected animals were sold on the basis of BVs or Indexes.

[1] Dr JW James, Animal Breeding as an Applied Science, Oration, *Proc. Assoc. Advmt. Anim. Breed. Genet. Vol 12* 1999

1.1 This study: particular issues and broad objectives

Meat and Livestock Australia (MLA) and Woolmark Company Pty Ltd (WM), and their predecessors, have supported substantial genetics research and implementation programs directly, and in collaboration with CSIRO and State Departments.

A number of sheep genetics data collections and services have developed, including :

- ***Lambplan*** – started in 1988 by the Meat and Livestock industry, focussing on meatsheep breeds, and recently, Merinos. A division of Meat & Livestock Australia.
- ***Advanced Breeding Services*** (ABS) a NSW Agriculture unit from 1990 concentrating on Merino breeders, including services to ***Merino Benchmark.***
- ***Select Breeding Services*** (Select) – an advisory unit based at CSIRO Chiswick concentrating on Merino breeders.
- ***Central Test Sire Evaluation, wether trials and breeding trials*** producing quantities of sheep data, for Merinos and meatsheep, some held in separate files.

STUDY FRAMEWORK: ***Meat and Livestock Australia and Woolmark have agreed that it is timely to review current database arrangements and to consider the feasibility of a national sheep genetics service facility.***

The issues prompting this study at this time are various, and include:

- the relatively low level of sheep industry use of quantitative genetics techniques, in Merino breeding and in breeding prime lamb maternal sires
- the existence of a number of different genetics database activities operating on different technical and costing bases, and with differing reporting languages
- whether current arrangements are the most efficient and effective or whether a more standardised or co-ordinated approach is warranted.

Broad objectives: It is understood that:

- ***Woolmark and MLA are concerned to achieve a viable and successful Australian sheep genetics system***, as marked by its usefulness to sheep industry sectors in achieving genetic gain of commercial value to sheep producers.
- ***Success would be measured, to a significant degree, by patronage of the system*** by the sheep industry marketplace and by adoption of QG techniques to achieve commercial gain – there would be no compulsion to use.
- ***The potential for any Australian genetics service entity to operate in a commercial manner*** is to be considered.

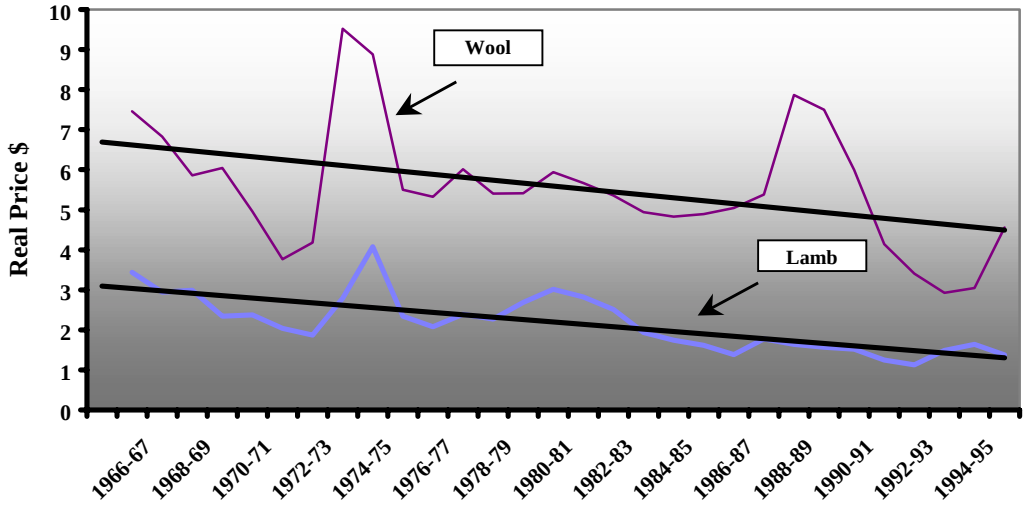
These market-oriented parameters set a challenge for this study and for decision makers, especially in review of options. A study of bringing together technical methods *without* considering the marketplace, would be easier, but not realistic.

1.2 Changing circumstances for sheep businesses

Over three decades, and within the experience span of many sheep producers, the export and domestic markets for Australian Merino wool and for Australian lamb have changed from traditionally secure to variable. Many factors have influenced this, including competition from alternative products priced to capture consumer markets.

Real prices for sheep enterprise products, wool and lamb, have been declining steadily since the 1960s. Periods of highs and lows, particularly for wool, have reflected changing demand and supply trends plus fluctuating competition.[2]

Real Prices for Wool and Lamb



Sheep industry structural adjustment was triggered by low wool prices during the 1990s, plus better prices for alternatives such as grains and cattle.

- Sheep numbers fell from190 million in 1990 to 120 million in 1997-1998.
- Wool production reduced some 30% from peaks in the late 1980s. Export volumes were maintained through stockpile sales.
- Over 1990 to 1997 the number of sheep farms fell – both specialist wool producers (minus 50%) and mixed-enterprise producers (minus 21% even with shift of specialists to mixed wool-lamb-beef-grain enterprises).
- At 1996-97, 75 per cent of larger wool producers (over 1,000 sheep) were mixed enterprises; 95 per cent of those smaller were mixed enterprises.
- Average size of sheep flocks has remained about the same, with about 75 per cent of wool produced by 30-40 per cent of sheep running properties.
- The latter 1990s saw a shift toward prime lamb production. Merino wool animals provide the basis for 45 to 50 per cent of lamb and mutton products. Domestic consumption of sheepmeat has declined but exports have increased.

[2] These data and trends are sourced from ABARE reports including: *Farmstats*, *Farm Surveys, Profile of Australian Wool Producers* 1998, Australian wool production-Its changing structure in the 1990s, *Australian Commodities* 1998.

The 1999 *Wool Industry Taskforce (McLachlan) Report* stressed that "the world does not need wool", so active change is imperative – to be more efficient, increase productivity, improve quality and get closer to customers. "Wool growing businesses must present a consistent, quality fibre to the wool textile chain at a competitive price."

To the national economy, the sheep and wool industry continues to be very important. Wool exports last year earned over $3 billion, with a further $800 million from export of sheepmeat and live sheep. In addition, near 50 per cent of lamb produced is sold to Australian consumers. Some 200,000 people are employed in sheep production and associated processing industries, most in regional Australia.

Looking forward five to ten years

The changing situation facing sheep producers, and ram breeders, is critical context to the need for and feasibility of a national sheep genetics system.

Large animal genetics are an essentially long term investment. Early selection results can be identified within a few years, but achieving confidence in and industry use of any new approach requires a longer term perspective.

For this Study – Key directions in Australian sheep industry evolution [3]

- ***Competition:*** Commercial sheep products (wool, meat) need to improve their quality-for-price to compete against alternatives, with production being viable and sustainable

- ***Sheep sub-industries*****:** *Export wool and lamb marketplaces will drive development of three or so sub-industries with distinct market and production characteristics –*
  - Fine clean Merino wool, especially under 18 microns, from high-medium rainfall zones attracting high and increasing prices but with associated production issues.
  - Broader wools from pastoral areas with limited alternatives (dual purpose sheep, goats)
  - Prime meat producers, often supplying through alliances, along with broader wools.

- ***Farm business as product mix*****:** A smaller number of producers will be wool or lamb specialists by choice or land-use limits. Wool, sheepmeat, and off-farm work income will be part of the possible product mix of increasingly professional agricultural businesses in most regions. *Hard-headed business decision-making will lead producers to place priority on genetic improvement in some circumstances, but not in others.*

- ***Regulation expansion*****:** Chemical use will develop as a meat and wool quality issue. More animal welfare and environmental considerations will influence production.

- ***Sheep production will still be a large, widespread industry,*** with challenges for delivery of innovative services. Governments will focus more on public issues eg. disease or land-use. Private sector advice will be increasingly emphasised at enterprise level.

- ***For industry organisations, successful implementation of R&D*** will become progressively more important as a measure of the organisation's performance.

[3] This outlook scenario has been developed for this Study with reference to a range of sources including ABARE projections and reports, MLA, and Woolmark reports, the Wool Task Force report, the Sheep CRC Business Plan 2000. and media.

1.3 Genetic advance

> "Genetic improvement is permanent, cumulative, and usually both sustainable and highly cost effective. It is permanent, since it influences the performance of animals for life. Improvements made in one generation get passed on to the next. So, when selection is continuous, the benefits are cumulative across generations. ... *Providing that selection is for an appropriate breeding goal, and steps are taken to limit loss of genetic variation, selection leads to sustainable improvements in animal performance*." [4]

Commercial sheep producers face many problems that limit or erode enterprise returns. Dramatic productivity gains could be made through new ways to attack blowfly strike, or by development of a new worm remedy, and/or through pasture systems that enable much higher stocking rates. Both MLA and WM support a range of such R&D projects, plus genetics research and implementation.

Genetic gains offer slower but enduring productivity benefits which accumulate within a flock and an industry. These include disease and parasite resistance, plus the potential to modify output products to meet changing marketplace requirements.

Among other investments, Woolmark and MLA are supporting the formation of a new Co-operative Research Centre (CRC) for the Australian Sheep Industry that will aim to co-ordinate and enhance much of Australia's sheep R&D.

Genetic improvement using QG technology is a major part the planned CRC research, development and implementation activity. The CRC's goals include reducing fibre diameter of wool for the apparel industry, improving meat and wool quality for long-term profitability (including investigation and management of genetic relationships between meat and wool quality traits); and breeding worm resistant sheep.

However, a bemusing question to geneticists and R&D managers is why adoption of longstanding quantitative techniques has been so variable among Australian industries. Dairy and pig breeders have embraced the methods. Use in beef cattle is fair.

In Australia, usage of QG for meatsheep through Lambplan is relatively high for the terminal sire breeding sector, but not among maternal sire breeders.[5] MLA sees uptake as sub-optimal among these breeders and commercial producers.[6] Adoption of QG in Merino breeding has been limited, and this is of concern to Woolmark.[7]

For this exercise, the sheep industry's acceptance of quantitative genetics is a baseline question. Understanding the main dynamics of the current and future sheep genetics marketplace is important to –

- ***evaluation of current database and service arrangements, and***
- ***identification of changed approaches that are likely to be successful.***

[4] *Returns from genetic improvement of sheep and beef cattle in Britain*, G Simm, P R Amer, J E Pryce ~ 1998
[5] Australian Sheep Industry CRC – Business Plan 2000 p7
[6] MLA report to Lambplan Advisory Committee, April 2000
[7] Woolmark Co. *Rampower Business Plan 1998.* Current wool industry wide genetic gain is estimated at 0.3% per year.

1.3.1 Quantitative genetics and its commercial adoption

The two key questions in animal breeding have been summarised as:[8]

- *Where do we go?* – What is the breeding objective? What traits need to be improved and how important are the different traits in relation to each other?
- *How do we get there?* – What traits are to be measured? Which animals are to be measured? What reproductive technologies and processes are to be used?

In many animal industries, economic assessment of which traits influence product value (through analysis of market demand and prices paid for various product combinations) now steers genetic selection (*where do we go?*).

Science-based (objective) measurement of these key traits, or graded assessment of non-measurable traits, plus Breeding Value calculations, can replace or guide traditional visual (subjective) assessment of animal features and associated breeding decisions (*how do we get there?*). These are the techniques of Quantitative Genetics.[9]

Quantitative genetics – steps in application to animal breeding

Deciding key traits and breeding objectives: Which animal traits (characteristics) are to be given priority in breeding? It is generally said that traits related to the market prices received for the commercial products, the amount produced and costs should be stressed (eg. fibre diameter, leanness, weights, fertility). *But views on key traits and their importance do vary*.

Measurement or grading of key traits: The preference is to develop and use a reasonably accurate measurement (such as a test for fibre diameter) rather than less accurate subjective (visual) inspection of a characteristic that might be only part correlated (related to) the economically important trait (such as crimp frequency for fibre diameter). For some traits, correlated measurements must be used (such as fat thickness for leanness) or standardised, graded visual inspection is the most practical method (animal structure, some wool traits).

Calculation of estimated breeding values (EBVs) ***or expected progeny values*** (EPVs) for the animal and each trait. In powerful systems, a particular animal's EBV can be compared to other EBVs (across groups, flocks, or breeds). These calculations will take into account the actual measurements, research on trait heritability, animal pedigree, correlation of measurements/scores with the key trait, plus factors such as single or twin, or born early/ late in a group. These affect physical appearance (phenotype) and can camouflage the real genetic value of the animal (genotype).

– EBVs can be calculated for any characteristic sought by a breeder, if it varies across a population of animals, is heritable, and can be assessed on a scale.

Development of Selection Indexes (SI) to combine and weight the EBV or EPV results for a set of higher value traits – a like basis for comparing animals within groups and across breeds.

Selecting which animals to mate, from where. Breeders generally look to select the 'best' animals from within their flock/s of sheep, from a number of different stud flocks, or from many studs across Australia, or a worldwide selection, within breed, and/or across a number of breeds. Quantitative genetics tools, with varying levels of information and computer effort, can enable this to occur using comparable EBVs or EPVs.

[8] Dr Julius van der Werf, An overview of animal breeding programs in *Animal Breeding - Use of new technologies*, 2000, eds. B Kinghorn, J van der Werf, M Ryan, Chp 1.

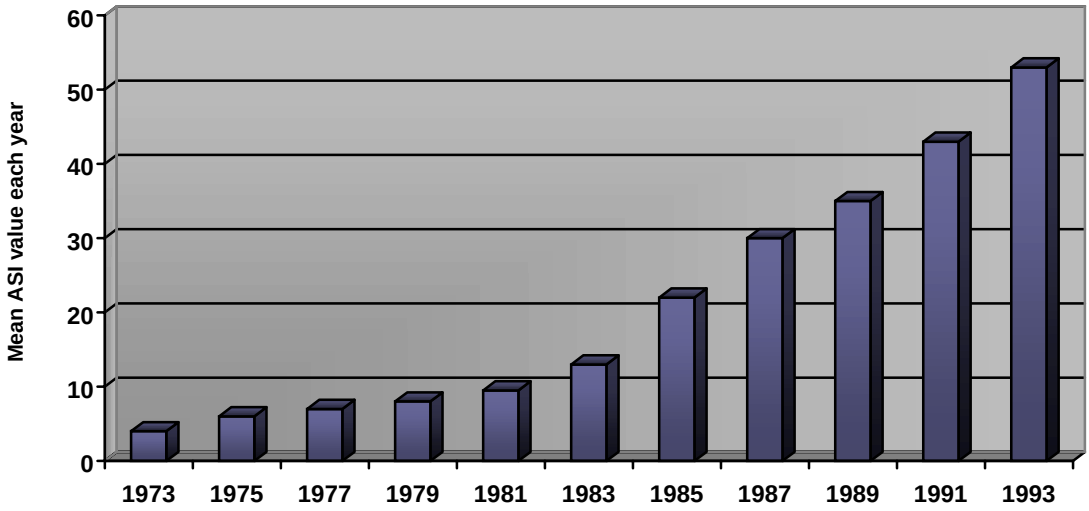
[9] For some key technical term refer Abbreviations and Glossary.

> "Throughout the 20th century the dairy, swine and poultry industries evolved into highly efficient and powerful breeding machines and production systems which now operate extremely efficiently in many respects." *Taylor et al, Texas A&M University1997* [10]

In Australia, over twenty or so years, dairy cattle improvement has developed from a set of State bull-testing programs with focus on milk volume, to a single national evaluation system, which has ties to world-wide Interbull.

Australian dairy industry genetic gain has increased dramatically since 1981 when the Australian National Dairy Herd Improvement Scheme (ADHIS) introduced BLUP calculation of Australian Breeding Values (ABVs). Genetic improvement, at many percent points a year, can be observed in increases in the mean Australian Selection Index value averaged across Australian Holstein cows evaluated annually.[11]

Genetic trend in Dairy ASI for Holstein cows



Where ASI = (3 X Protein ABV) + Fat ABV – (0.03 X Milk ABV)[12]

However, the achievements in these intensive industries have not been without costs. Taylor, Sanders and Rocha noted reproductive and metabolic disorders and mastitis in dairy cattle, leg disorders and sudden death in poultry, plus dairy inbreeding issues where rapid genetic gain was achieved at the expense of genetic variability. These problems are being addressed by maturing QG breeding systems, including ADHIS in its research and development role.

In these industries, genetic progress has been assisted by technologies such as effective artificial insemination (AI) and intensive production facilities. Take-up of quantitative genetics has also been associated with, if not a prime contributor to, forms of industry rationalisation as well as productivity advance.

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[10] Taylor, Sanders and Rocha, 'Twenty-first century challenges for genetic improvement in the livestock industries, *Proc. Assoc. Advmt. Anim. Breed. Genet* V12 1997. The authors deal with a range of industries, with focus on beef cattle.

[11] RG Banks and BP Kinghorn, Effectiveness of National Genetic Improvement Programs – A comparison of challenges across industries, *Proc. Assoc. Advmt. Anim. Breed. Genet* V12 1997. Trends (graph) are similar for Jersey cows.

[12] In ADHIS ABVs Protein = kg of protein, Fat = kg of fat, Milk = litres of milk

Adoption in the Australian sheep industry

Intensive animal production systems are important indicators of what can be achieved, and of points of caution, but are not fully comparable with Australian sheep production systems. These will continue to be widespread and field extensive especially for wool. Grazing is cost-effective usage of expansive Australian regions.

Further, while AI is increasingly utilised, sheep breeding enterprises (particularly Merino) generally also depend on paddock mating with large mobs.

In the sheep industry, a sizeable section of, but not all, breeders of prime lamb sires have adopted quantitative methods through the Lambplan system. Results have been spectacular for some, less so for others, and this has sparked controversy at times. A lower proportion of maternal sire breeders use Lambplan.

Quantitative genetics tools are not widely used in wool Merino breeding, and there are fervent differences of opinion about sheep selection techniques. As discussed in 2.2.2 below, many Merino and various other sheep breeders appear to consider that science does not cover all important considerations nor add-value to their individual skills or breeding aims (which relate to their ram-buyer customer needs).

Merino breeders have long taken a methodical approach to selection using skills honed over decades. A first culling removes animals with faults, then, noting family history, rams and ewes are classed for wool production, quality, structural points and reproduction in relation to regional environment. Objective measurement of some traits (average fibre diameter and associated tests) is now used by most stud breeders.

There are also differing views about which sheep and wool traits are most important, both technically and commercially. The Merino ram-buying marketplace appears, through sales, to place value on some features that differ from an ideal of intensive selection for those traits that are calculated to increase commercial profit.

On the other hand, research shows that visual appearance can conceal both positive and negative factors in an animal's breeding value. Quantitative techniques enable mathematical correction for twinning, order of birth in a flock, and pedigree history. Poor or unknown correlations between some assessed traits and those that add value for commercial producers can be addressed by direct measurement technology.

In a 1998 comparative analysis of the rates of genetic gain in Australian livestock industries, Professor David Lindsay expressed concern about 'highly conservative resistance of change' in the wool industry, and also about the emergence of new non-measured methods for assessing genetic merit of animals. Lindsay explained:

> "Those industries that have not improved measurably in [40 years], particularly the wool industry, have effectively not applied quantitative techniques to their breeding programs. … The reasons for this are historical, economic and social. All are very powerful and have little to do with the quality of genetic theory or its potential to accelerate development." [13]

[13] DR Lindsay, University of Western Australia, The Australian Livestock Industries: A case study in non-genetic factors that control genetic improvement, *Proc 6th World Congress on Genetics Applied to Livestock Production,* Armidale 1998.

The questions are not new – what is genetic improvement? How might it be measured? Who is to benefit from genetic gain?

> "Livestock production constitutes a rather complex system of many interacting components …as we expand the system of reference [beyond a given operation, and] consider the many sources of variability that are non-genetic, then the definition of what constitutes genetic improvement is probably beyond consensus … agree[ing] on the meaning of genetic improvement … is the *key* challenge." *Taylor, Sanders, Rocha 1997*

Lindsay's "historical, economic and social" influences on the decision-making by a buyer (of genetics, of a technique, of a product or service) can be more generally described as *factors influencing the marketplace*.

Markets, in the main, determine the rate of reward for, and so adoption of, any new approach such as quantitative genetics, or a new index, or a changed database system. 'Marketing', explanation and extension can influence markets, but actual 'reward', in terms of money and other less defined values such as status, confidence, involvement, is the sustaining driver. The apparent disconnect between market signals and the logic of fibre diameter-fleece weight selection power has been a longstanding puzzle to advocates of QG, and has prompted research in itself.[14]

However, as Lindsay identified in 1998, the wool industry stands out from other Australian livestock industries in the premiums paid for elite animals selected by stud breeders. The top 10 stud rams in a year can sell a ram for 2,500 to 3,000 times the price of young commercial ewe.[15] In 2000, 88 selected mostly two-tooth rams at Walcha NSW sold for an average of $2,892 each. Rams sell for $5,000+ regularly. The top ram sold for $20,000 at the Bendigo Australian Merino Classic Ram Sale.[16]

Multiple markets? Different value-traits? Different breeding objectives? It appears that a number of product marketplaces operate in the Australian sheep industry. The largest markets are the numerous commercial producers selling meat and wool to Australian and international buyers. Australian breeders sell rams to other breeders and to commercial producers – this is a smaller, different, market arena.

Analysis from 1.3.1 – Issues for this Study

- ***Need to consider the dynamics of both the commercial producer and sheep breeding marketplaces*** as separate though interacting. Each presents a different market for genetics services and for breeding outputs [Section 2.1].
- ***Need to understand differences of opinion about genetic gain, important selection traits and about techniques***, as a possible key to adoption issues and what marketplaces are looking for in data and advice services [2.2].
- ***Need to allow for genetics research underway and future directions.*** A changed sheep genetics system should have a 5 to 10 year or longer horizon and should need to be able to apply and assist technological advances [1.3.2].

[14] KD Atkins, Benefits of genetic Improvement to the Merino Wool Industry, *Wool Tech Sheep Breed*, 1993. Using a Fibre diameter-weight genetic gain model, Atkins calculated large industry returns if ram buyers were to patronise QG breeders.

[15] Lindsay 1998, above. In beef cattle the premium may be 350 times, in meat-sheep 50 times, and in the dairy and pig industries where use of quantitative genetics is very high, say 35 times.

[16] 'Rams gross $339,800 at Yalgoo sale', *The Land* 17 February 2000. 'Merryville tops sale', *The Land* 27 July 2000.

1.3.2 Extension, application and new science

Woolmark's genetics activity

After decades of support for core research into wool traits, heritability, correlations and other parameters, in recent years the Woolmark Company has concentrated on projects to boost producer returns by implementation and extension of research.

The Rampower program – Increasing profits from wool production using existing genetic improvement technologies – commenced in 1998. The Rampower Business *Plan* combines new projects and work underway in an integrated program with eight strategies [appendix 1].[17] Economic return and genetic gain goals are clearly stated.

The Woolmark Rampower program

Mission: To provide woolgrowers with the capability of *increasing the value of wool per hectare* by up to 20% over a 10 year period through continuous and cumulative genetic improvements in fleece weight, wool quality (fibre diameter, staple strength, style and other factors affecting processing performance) and disease resistance.

Objectives:
1. To increase the overall profitability of the wool industry by increasing the average realised rate of genetic gain in fleece weight and wool quality from 0.3% to 0.45% per annum over five years.

2. To better meet wool processor and wool fabric consumer needs through wool quality improvements achieved through better targeted and more efficient breeding programs

In early 2000, Woolmark commissioned a two-year appraisal of the projects within the *Rampower* program by Professor David Lindsay. In reviewing the original objectives of the *Rampower* program, and assessing progress, Lindsay observed:[18]

> "***Most breeders (and many advisers) are usually well out of their comfort zone when trying to decipher the mathematical basis of quantitative genetics*** … They realise that they must rely on others for support … as quantitative methods have become more effective but more complex through the development of more powerful computers and new techniques to make use of them, the concepts of quantitative genetics have become even more remote from the direct control of the average breeder.
>
> ***The job of convincing breeders under these circumstances to adopt quantitative techniques is therefore difficult***. It is made more so by the fact that the evidence for the effectiveness of quantitative genetics is most readily demonstrated in tables and graphs which are less convincing to many breeders than the visible differences in live animals."

[17] Woolmark Company, *Rampower Business Plan*, May 1998. WM anticipated investing $1.4 million over three years for the set of Rampower program projects (to June 2000). Other organisations involved would contribute $2.5 million, primarily as personnel and facilities, with some income from charges to trial participants.

[18] DR Lindsay, *Review of the Woolmark Company's Rampower project*, April 2000

In reviewing the *Rampower* project, Lindsay advocated, as general principles, that:

- Providing genetic and breeding services including one-on-one advice directly to sheep breeders, consultants and data gatherers should become a commercial fee-for-service arrangement not funded by R&D grants.
- Training, retraining and resourcing of such advisers and service providers is merited, with the aim to these people and groups funding their own refresher training within five years.
- R&D funding should continue to support focussed research projects in fundamental and applied genetics and the development of resources and packages "to ensure their adoption if appropriate by both breeders and their providers of advice on genetics".

Professor Lindsay endorsed progress in the South Australian Better Breeding trials (A2, E2), data computation, publication of *Merino Superior Sires* combining Central Test Sire Evaluation (CTSE) site results and inclusion of link sires (C1, C2), the Merino bloodline wether trials (D1), Victorian progeny test (E1) and the selection-classing demonstration flocks at Trangie (E3), plus the various associated field days.

Breeder and producer training via workshops with new materials was assessed as successfully completed. There had been good attendance. Lindsay was concerned about lack of progress and client response to a new Merino breeding advisory service (B1), and about limited response to and need for focus in training for private advisers (B2). Suggestions were made to improve fleece testing laboratory accreditation (F1).

MLA's genetics programs

MLA has instigated and supports a range of animal selection and genetics projects across both beef cattle and sheep, with some projects applicable to animal species generally. MLA's major programs, technology transfer and genetics advancement vehicles are LAMBPLAN and BREEDPLAN.[19]

Lambplan is an operational division of MLA with about 600 breeder clients over a wide range of meatsheep breeds plus Merinos. Lambplan goals, services, activities and custom are summarised in Part 2, section 4.1.1. Innovation in genetic concepts and services is both initiated by and implemented through Lambplan.

The Lambplan team provides explanation of QG and use of breeding values, selection indexes and other tools, through newsletters, attendance at field days, accreditation of operators and directly to breeder clients. Specialised products include the Young Sires Program and Total Genetic Resource Management (TGRM).

BREEDPLAN provides cattle evaluation and performance recording in Australia and overseas. The recent BREEDPLAN Version 4.1 allows calculation of EBVs across a wide range of carcase traits, including intramuscular fat, retail beef yield and eye muscle area. BREED-OBJECT is a software tool that uses EBVs plus user-described economic production and costs to guide animal selection for profitable animals.

[19] MLA *Research Results*, October 1999. MLA funds the development of BREEDPLAN through the Animal Breeding and Genetics Unit (AGBU). BREEDPLAN is delivered by ABRI (Agricultural Business Research Institute) under MLA licence.

New science and genetics services

Research and development currently sponsored by MLA and by Woolmark aims to explain, refine and establish existing quantitative genetics knowledge, and to look forward to 'new-generation' genetics services for these major Australian industries.

MLA's current genetics developmental programs include: –

- ***Development and validation of Genetic Evaluation Software for Lambplan*** (OVIS) – contracted developmental work carried out by University of New England and NSW Agriculture's AGBU (Animal Breeding and Genetics Unit) [refer 4.2.4].
- ***Superior Prime Lamb Dams (Maternal Sire Genotype Evaluation)*** – funding NSW Agriculture, Victorian Department of Natural Resources & Environment, and Primary Industries and Resources SA, to conduct progeny test trials of maternal meat-wool sheep breeds – Border Leicester, Coopworth, Finnsheep and East Friesian. . Lambplan involved. Results (annual EBVs) are published in *Dynamic Dams* newsletters and explained through field days, the website and media reports.[20]
- ***Genetic Parameters for Merinos*** – NSW Agriculture, Dr N Fogarty, with MLA support. To provide Lambplan with genetic parameters relating to carcass and meat quality traits in Merinos by June 2001, and correlations between meat traits and reproduction and wool traits. Recognises lamb producer concerns about genetic merit of flocks used to produce lamb dams, plus interest from many Merino breeders in improving the genetic merit of their flocks for meat production and quality.
- ***Development and implementation of Total Genetic Resource Management (TGRM) for beef and sheepmeat industries*** – a joint project between University of New England (65%) and MLA (35%), led by Professor Brian Kinghorn with Dr Robert Banks, to improve rate of genetic progress of beef and sheepmeat industries through development and adoption of TGRM. Mate selection software is to cover all functions required for successful application in beef and meatsheep breeding.

Total Genetic Resource Management (TGRM) uses pedigree and performance records (from Lambplan or another database) as raw material. The program is designed to provide guidance to individual clients assisted by a skilled operator/adviser. TGRM is a powerful genetic gain service. It can be applied before animals are mature, and at later stages as trait data is collected. TGRM can continuously guide a breeder's selection of animals. Breeding advice computes a wide range of possible criteria, weighted as the breeder considers appropriate.

In addition to trait EBVs and pedigree, a TGRM 'run' can take into account : *Technical issues*: rates of genetic improvement in selected traits, genetic connections to other animals and breeding groups, maternal effects and heterosis, inbreeding and genetic variation issues, genetic markers; *Costs issues*: Mating paddocks set-up, purchase or collection and use of semen/embryos, funds available; *Logistics*: semen/ram embryo availability, paddock and mating constraints, quarantine.

TGRM has been available to Lambplan members since 1998. MLA has set a Performance target of TGRM being adopted by at least 20% of Lambplan flocks by June 2002.[21]

[20] For example: *Dynamic Dams: make more from crossbred ewes*, NSW Agriculture Today, September 2000
[21] *Meat and Livestock Australia Work program* 2000-2001

- ***Progeny Testing for Eating Quality Traits in Meat Sheep*** – a MLA-SARDI project. About 100 progeny from each 15 industry sires identified by Lambplan will be performance measured for birthweight, carcase traits at different ages (fat, muscle) and meat yield. Blood samples to be analysed for possible genetic markers for eating quality parameters (such as meat pH, tenderness).

Woolmark R&D programs, in addition to Rampower

- ***Completion of the Fine Wool Project at CSIRO Livestock Industries, including technology transfer activities.*** The Fine Wool project, with the goal of encouraging finer Merino wool breeding and production, ran from 1993 to 1998 and contributed to the 'finer' shift in the woolclip (~ 1.5 microns in ten years).

- ***Precision Wool Production & Marketing*** – a Woolmark co-ordinated. producer driven project currently at Scoping Stage. The aim would be to increase profitability of producing wool, by evaluating and extending various combinations of existing technologies that assist growers to produce and present an accurately specified product for an identified market, including in-shed fleece testing and data collection, leading into animal selection, clip preparation and marketing decisions. WM would assist growers to develop combinations of technologies and systems associated with production, sheep selection, wool harvesting and marketing.[22]

Sheep genetics research and associated developmental work not funded by Woolmark or MLA has been, or is being, carried out across Australia, including State Departments of Agriculture, CSIRO, and in Universities. Some examples:

- UNE Dr van der Werf: *Evaluation of genetic markers for production traits in sheep.*
- NSW Agriculture: *Merino Genes to Suit,* customer focussed information on bloodlines
- NSW Ag: *Producing Merino Apparel Fibres and Genes to meet customer requirements*
- NSW Ag: Reducing chemical reliance for blowfly strike control by genetic means. [23]
- Agriculture WA, Dr J Greeff, *Staple strength and diameter co-efficient of variation,* also interest in meat traits in Merinos.
- Charles Sturt University, Dr M Friend, Gene Markers for fleece traits, ARC funding.

The Australian Sheep Industry Co-operative Research Centre (CRC)

Should this CRC be endorsed, it anticipates integrating R&D resources of industry partners, universities, and State, Federal and Industry organisations, aiming to enhance long-term profitability and competitiveness of sheep products via a number of pathways, including "faster rates of genetic improvement throughout the industry".[24]

Goal 2.1 Reduce fibre diameter of Australian wool for the apparel industry, including by breeding ultra-finewool sheep.

Goal 2.2 Genetic improvement of meat and wool quality for long-term profitability.
Strategies
2.2.1. Broaden and promote use of information from genetic evaluation schemes
2.2.2. Investigate and manage the genetic relationships between meat and wool quality traits
2.2.3. Use advanced genetics techniques to improve meat and wool quality (gene markers, gene mapping, DNA pedigree, mate allocation and selection)
2.2.4. Develop better sheep through transgenesis (introduction of specific genes).

[22] The Woolmark Company, *Precision Wool Production & Marketing, Scoping paper*, Distributed for comment August 2000
[23] NSW Agriculture, Division of Animal Industries, *Wool and Sheepmeat services program, Strategic Plan Priorities 1998/99*
[24] Australian Sheep Industry CRC, *Business Plan 2000*

At the science front-line, genetic and reproductive technologies merge and have potentially major influences on genetic gain. Artificial insemination (AI) and embryo transfer are well-established procedures, contributing to genetic revolution in industries such as dairy cattle.

DNA (gene) markers are now readily identifiable using advances in molecular genetics. Markers can be used in animal breeding to verify 'pedigree' (identifying the sire and dam of each lamb). These tests would be potentially very useful in extensive animal industries as correct pedigree information is often costly and difficult to obtain [4.2.2]. However, ***DNA fingerprinting*** costs $25-$30 a test, which is a barrier for lower value animals. The cost is not expected to reduce much.

Gene markers, once identified, can be used for selection of target animals on the presence of a key gene rather than measuring visual characteristics. This could be particularly useful for early selection (eg. lambs by blood test), for costly to measure traits (such as feed conversion efficiency), and for low heritability traits where additional information helps distinguish animals.[25]

Identifying specific gene markers is a complex exercise. One approach starts with analysis of large quantities of data from linked animals for performance patterns. Lambplan, for instance, has a new 'Gene detective' service using its large database.

Analysis from 1.3.2 – Issues for this Study

- ***In the 1990s, the meat and wool industries have stressed the implementation of genetics research and securing returns for industry members through extension and major service programs.*** Knowledge and large quantities of sheep data have accumulated through trials and client activity. Adoption of quantitative genetics remains variable and low in some key areas.
- ***Any Australian Sheep Genetics System should consider the front-line of genetic and reproductive science.*** However, technologies useful in intensive animal breeding, or in high value animals such as cattle, will be less use in the sheep industry until costs are lower. New scientific tools for selection may also be of low interest to breeders who are not convinced by quantitative genetics.
- ***For big advances from quantitative genetics, including capacity to address obstacles and to lead genetic improvement, the genetics system and database need to support sizeable across-flock evaluations*** [4.2.5]**.** Large, linked, databases also support new lines of science.

"The long-term impact of genetics will come from the development of comprehensive, across-flock genetic evaluation schemes that allow animals throughout the industry to be compared objectively for meat or wool traits, and traded on their genetic merit."
Australian Sheep CRC Business Plan 2000

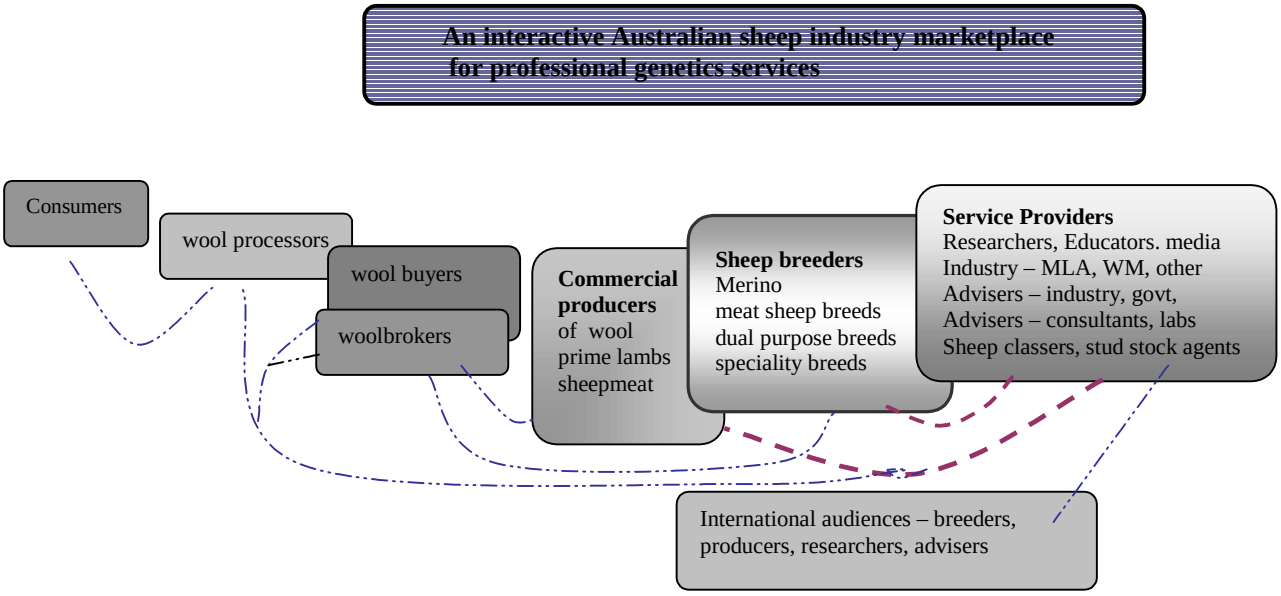
[25] Explained and discussed in Sillar Associates, Trurobe & JW James, *Review of Genetic Improvement Programs in the Beef and Sheepmeat Industries*, for MLA, March 2000.

2 Australia's sheep genetics marketplace

The success of almost any venture in a market economy such as Australia will reflect its fit with marketplace needs, particularly into medium and longer terms.

A 'marketplace' can be made up of an industry or segments of it, and/or specialised interest groups, commercial enterprises and individuals, community sub-groups as consumers and stakeholders, governments and voters. More often a broad market arena is a combination of these, and can contain active sub-markets.

Marketplaces send signals by way of relentless interactivity. Buyers clearly shape suppliers through custom, prices and feedback. Providers of goods and services can educate, lead and sway participants, aiming for commercial benefit (or for mass socio-economic benefit where government or industry entities are service providers). The extent to which marketing and education succeeds will be a sign of the known or hidden needs and wants of buyers, *plus* the skills of marketers and educators.



The Australian sheep genetics services marketplace and its directions of change are investigated in this Section.

An understanding of the marketplace is needed to assess the potential for any single Australian genetics system to be useful, and to operate in a commercial manner.

Key marketplace participants, and target markets, are identified in 2.1. Activity at the interface of markets and science is examined [2.2], including debate about which traits are important [2.2.2]. Australian sheep genetics service providers and roles in the marketplace(s) are reviewed in section 4.1, with assessments set out in 2.3. Opinions on the future marketplace, service needs and issues are considered in 2.4.

2.1 The markets – ram breeders, commercial producers

This study considers three main segments of Australia's sheep genetics market-place – sheep breeders (Merino, major meatsheep breeds) [2.1.1]; commercial producers [2.1.2], and the range of genetics service providers [4.1].

Woolbuyers, processors, and consumers provide critically important market signals through demand and prices paid. These and other factors are taken into account by industry participants in making breeding, genetics purchasing and production decisions, and in making decisions to supply and to use various types of genetics services.

2.1.1 Sheep Breeders and Associations

Pyramid breeding structures operate in most large-scale animal industries, some more strongly than others. Traditionally, closed nucleus studs have provided elite animals to daughter or multiplier studs. These sell larger numbers of genetically advanced breeding males and females to commercial enterprises, who concentrate on product output, although some breed their own flock rams. In recent decades, the emphasis on closed studs has declined as the advantage of bringing in genetics from time to time has become clear.

In theory, genetic improvement could be focussed on lead studs, with gains flowing down the pyramid to commercial industry and making considerable impact. In concentrated industries, with few lead breeding businesses, this can be very effective.

However, the Australian sheep industry is as diverse as the environments in which sheep are found. There are hundreds of Merino bloodlines, and numerous meatsheep breeds. ***Breeders, commercial producers and genetics service providers all exist within an active, free enterprise, and competitive marketplace.***

Lead studs have history behind them and many studs have solid reputations. Even so, in a competitive arena, breeders contacted are conscious that their position as a superior animal provider depends on market patronage and meeting customer needs.

Genetics technologies and breeding systems have widened the choice for ram buyers, whether buying for multiplier studs or commercial enterprises. Most ram sellers assess the marketplace and develop a reasonable-cost breeding and marketing program they consider will retain and build custom. Their points-of-distinction could emphasise technology, tradition, a speciality approach, or a mix of these.

> **"**The diversity in wool should be celebrated, not lamented. For too long, the focus has been on "the wool industry" and what "it" should do. This "one size fits all" attitude has worked against successful outcomes. It has led to consensus decision making, politically not commercially driven agendas, lowest common denominator outcomes, interminable delays in progressing reform, and generally an FAQ (fair average quality) culture and, much of the time, an FAQ product."
> *Wool Industry Taskforce (McLachlan) Report 1999*

.a. Merino breeding – estimating a target market

Of the four Merino strains, the *Peppin* accounts for about 70% of Australian Merinos including most slopes and plains sheep in mixed farming and pastoral areas. The others are *South Australian Merinos,* bred for arid climates, large animals, stronger wool, *Saxon Merino*, bred for high rainfall areas, and *Spanish Merino* (low numbers).[26]

Merinos are also categorised by 'bloodlines' that often trace back to nucleus studs. The Australian Association of Merino Stud Breeders (AAMSB) identifies three broad bloodlines: Superfine and Fine wool (fibre diameter less than 18 or 19 microns); Medium wool (20-23 microns, 70% of Australian clip); Strong wool (23-25 microns, and Poll (hornless) Merino types within each bloodline. However there are many more breeding bloodlines. ***Over 330 bloodlines have been involved to some degree in the Merino Bloodline comparison trials***.[27]

Reflecting the adaptability of the Merino, studs are spread across Australia.

AAMSB	**Registered Merino studs in *1999***	**Representative association**
Australia	**1659**	Australian Association of Stud Merino Breeders Limited AASMB
NSW	539	NSW Stud Merino Breeders' Association
Western Australia	446	The Stud Merino Breeders' Association of WA (Inc)
Victoria	295	The Victorian Stud Merino Breeders' Association (Inc)
South Australia	244	The South Australian Stud Merino Sheepbreeders' Association Inc.
Tasmania	69	The Stud Merino Breeders' Association of Tasmania
Queensland	66	The Queensland Merino Stud Sheepbreeders' Association (Inc)

An estimated 200 Merino ram sellers provided about 50% of the 150,000-160,000 rams sold in 1998. Of these, most sold 150-300 sires. 11 registered studs sold more than 1,000 rams (four sold over 2,000); 673 sold 50 or more rams.[28] A number of other breeders produce rams for members or sale. Discussions indicate perhaps 100-200 co-operative groups plus non-registered studs trading about 10% of Merino rams.

Some 900,000 Merino rams are mated in commercial flocks to around 100 million ewes (including 2 million ewes in Merino stud breeding flocks).[29]

The AASMB is made up of and represents the views of the six State Associations. It is "officially regarded as the body which speaks on behalf of all registered stud Merino breeders in Australia and it is regularly consulted on matters affecting the stud Merino industry by government, statutory authorities, scientific/research organisations and individuals, both in Australia and overseas".[30]

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[26] Australian Association of Stud Merino Breeders internet site 2000, history of the Merino, strains, bloodlines.
[27] Merino Bloodlines: *The comparisons 1987-98*, Coelli, Atkins, Casey, Semple, NSW Agriculture Agnote DAI/52
[28] From AASMB data. At *end 1998* there were 1,719 registered studs and 139,695 rams sold by them. To this should be added say 150 ram breeding groups and non-registered studs trading about 15,000 rams.
[29] Ian Rogan, *Notes on genetic evaluation services for Merino breeders*, 1999
[30] AAMSB internet site, August 2000.

A sampling of the Australian Stud Merino Flock Register (AASMB internet site) provides a better understanding of the activity of registered Merino studs.

The Register is listed alphabetically by State. To produce the following table, the first, then every 10th entry for NSW, West Australia and Tasmania were examined.

A cross-section of registered Merino studs and recent sales activity

Stud profiles 1999 flock register	**NSW Slopes and Plains**	**NSW Tablelands**	**Western Australia**	**Tasmania**	**Sample Totals**	**%**
	sample 54 studs		sample 45	sample 8	107	100%
Started before 1980	14 studs	12 studs	28	3	57	53%
Began 1980 or after	17	11	17	5	50	47
Micron range stated	6	2	2	0	10	9
Buying semen 96-98	6	3	10	0	19	18
Selling semen 96-98	3	4	5	1	13	12
Sheep per stud 1998						%
<500	7 studs	6 studs	5	3	21	20
501-1500	14	14	22	5	55	51
>1501	10	3	18		31	29
Rams sold 1998						%
0	5	7	8	3	23	21
1-50	10	6	14	4	34	32
51-250	14	9	14	1	38	37
>251	2	1	7		10	10
Sheep per stud 1996						%
<500	6	7	6	3	22	21
501-1500	15	13	24	5	57	53
>1501	10	3	15		28	26
Rams sold 1996						%
0	5	8	8	3	24	23
1-50	8	6	11	4	29	28
51-250	14	9	15	1	39	37
>251	4		9		13	12

Notably:

- Almost half of this sample have registered as studs since 1980 (when wool objective measurement was well established). Quite a few started in the 1990s.
- A surprising 21 to 22% of this sample of registered studs did not sell rams in 98 or 96.
- Half (including some large studs) are in the 'less than 50 rams sold' category. Sales of under 50 rams could be to one or two clients, perhaps neighbours.
- Less than 10% of studs mention their micron range in the space allocated by AAMSB. Mostly these appear to be slopes/plains studs with wool finer than might be expected.
- Near 20% of these studs bought semen in recent years. 12% were sellers.
- A proportion of studs have sister 'Poll' enterprises, run by the same principal.

Target Merino breeder market for genetics services

Q. Which breeders, in theory, should be interested in scientific genetics services in various forms to assist them achieve breeding objectives and developing their stud businesses?

Q. What part of the Merino breeding sector would wool industry leaders and geneticists like to see advancing genetic gain?

Taking into account these questions, of the estimated 1,800 studs and ram sellers, the following groups would realistically form a Target Merino Breeder market for quantitative genetics.

1. Merino studs selling over 50 rams a year (say 45% of total ram sellers), plus
2. Many of the ram sellers who commenced since 1980 (say 45% of sellers).
3. These segments overlap in part to add to say 50%. This needs to be reduced for a proportion of twin horned/ poll studs run by one breeder.
4. ***Hence, a realistic and desirable target market for quantitative genetics services would be about 800 Merino studs, producing an average say 800 assessable lambs a year, of which half are targeted, so about 320,000 new animals a year.***

** An 800 Merino breeder target market would be promising both in terms of facilitating industry genetic advance and as a solid client base for an Australian sheep genetics system.

** It would be realistic to expect a diversity of assessments on breeding aims and approaches among 800 Merino breeding businesses, many competing directly.

** Perhaps 130 Merino breeders (of varying sizes) are using quantitative genetics material through QG services. Most others receive advice from consultants and sheep classers [2.3].

Market intelligence

Developing an understanding of the dynamics of the Merino breeding market for genetics services, including the breeders' assessments of priorities, is important for considering options and foreseeing challenges for any new system.

Most ram breeders are also running business enterprises, and market feedback through custom and prices will influence many breeder decisions. New ways need to be seen as potentially contributing to enterprise success.

> "The overriding objective of most Merino breeders, regardless of their views about means, is to achieve genetic progress in a way that will improve the economic viability of their enterprise." *James Litchfield, Studbreeder, 1987* [31]

Real-life clues on marketplace activity and insights into priorities can be obtained from rural newspapers, industry newsletters and debates in the media.

A sampling of rural newspapers shows a range of market signals and active opinions about Merino breeding. These illustrate a highly competitive market arena.

[31] J Litchfield, 'Breeders' perceptions of industry needs', in *Proceedings of a National Symposium on Merino Improvement Programs in Australia*, Leura NSW, 1987.

Messages from the marketplace – as seen in the rural press of NSW for example

• ***Wether trials and field days are regularly covered.*** Wethers from different bloodlines and regions are run together at a property for some years, with results reported as commercial value of each wether's wool growth over years plus bodyweight. Many trials are now in Woolmark's Australia wide wether comparisons in Rampower program [1.3.2]. eg. Falkiner wether trial field day: *The Land* 24.2.00.

• ***Ewe Competitions organised by show societies, sheep classers and regional Merino breeder or grower groups also receive publicity.*** These trials assess visually the merit of groups of ewes at different properties in a locality. In the Parkes Merino Woolgrowers inaugural ewe competition, the winning flock "displayed good conformation featuring growthy, soft handling wools". *The Land* 4.2.00.

• ***Show results are widely covered. Reports describe how a stud animal looks and some measurements, but not breeding values.*** Demand for finer fibre diameter is clear. All Sydney show entries were side sampled and tested for fibre diameter and variation for the first time in 2000. "Objective measurements will not over-ride subjective decisions," said the NSW Stud Merino Breeders' Association president. "We want to take into consideration any means to improve our methods of determining better Merinos." *The Land* 20 April 2000.

Typical descriptions: "plenty of rich, soft handling wool", or for the medium wool section winner – "a strapping 20.2 micron" ram "that impressed the judge for its thickness, richness of fleece and sire qualities". The stud name is the main reference point for future ram buyers. *The Land* reported that the Uralla show grand champion ewe won for "her overall quality and balance, and superb soft fleece with elite wool on her foreleg and hindleg". Western Australian stud sheep winning the Australian Sheep and Wool Show at Bendigo were: "the most structurally correct sheep and the most even pair in both structure and wool quality… growing 20.5 micron wool": *The Land* 27 July 2000. Regular stud and flock sale reports concentrate on seller and buyer stud names, prices paid and fibre measurements.

• ***Stories on approaches to stud or commercial breeding are frequent, and diverse.***

From a Yass commercial flock manager with a full-time off-farm position: " 'I didn't know what SRS was but I know what good wool feel like and looks like. I …did an experiment with 70-80 wethers, testing by feel what I thought were the finest and best sheep.' This method is more cost effective than mid-side sampling, he said, as he has limited time to spend on his sheep. His maiden ewes were starting to show 'SRS traits' of soft lustrous wool: bold in the crimp with fibre diameter staying the same or reducing. *The Land*, 20 April 2000.

A Culcairn mixed farmer has decided to "concentrate more on our sheep and get serious about cropping". His flock rams must measure less than 19 micron, have a co-efficient of variation under 20 and have less than 4 % of fibres above 30 micron. *The Land* Dec.1999

XX superfine stud "aims to produce a robust, large, uncomplicated sheep that carries a high density of long evenly sized and evenly shaped cylindrical staples. These characteristics must be reproduced all over the sheep's entire surface". *Country Leader* 18 January 1999.

• ***Reports on genetics and technology do occur, and again are mixed.***

"Nerstane 142 is modern-day genetic wonder." Conceived through artificial insemination, Supreme Champion exhibit at the 1999 Royal Easter Show, "his career path at the [AI] laboratories is assured". *Sydney Morning Herald*, 7 April 1999

"A year AI program to produce a softer wool with top genetics at affordable prices is leading to a flock turnaround for Ungarie commercial woolgrowers … who won last month's West Wyalong ewe competition." These growers wool test all ewes up to five years old – they want 21 micron wool. They spent $5,000 a year on rams until by using AI and rams bred themselves costs were cut to about $2,000 but stopped as "the management required was too lengthy and intensive" *The Land* 30 March 2000

' DNA Dynamite' - DNA testing to isolate high performing sheep and better Australian flocks will soon become a mainstay of the industry: Georgie Klug, *The Land* 10 June 1999

'The Merino revolution in control of woolgrowers': Allan Casey, *NSW Agriculture Today*, June 1999

Ram seller advertisements also provide insights into marketplace priorities [2.2.1].

.b. Meat sheep – estimating a target market

'Second-cross' prime lambs (40-50% of lambs sold) are produced from flocks of first-cross ewes, often a Border Leicester X Merino ewe with broad wool of some value, and 'terminal sire' rams, mainly Poll Dorset or White Suffolk.

Poll Dorset studs provide the majority of terminal sires. Dorsets, Suffolk and Texels are also crossed with the Merino ewes in wool flocks to produce 'first-cross' lambs for lamb-meat markets. About 10% of lambs sold for meat are pure Merino.

From Breed Society Flock books 1999, by State, number registered flocks, average size[32]

1999	Poll Dorset registered stud flocks	Dorset studs average size (ewes -- rams sold)	White Suffolk registered stud flocks	WS studs average size (ewes in flocks)	Texel registered stud flocks	Texel studs ave size (ewes -- rams sold)
NSW	234	136 -- 50	57	159	63	35 -- 11
Victoria	229	113 -- 42	76	106	78	26 -- 10
S. Australia	101	143 -- 53	90	121	40	34 -- 12
W. Australia	140	137 -- 41	37	114	33	20 -- 5
Queensland	10	93 -- 35	6	87	4	37 -- 9
Tasmania	39	105 -- 40	10	114	19	19 -- 7
Northern T	1	26 -- 1				
Total studs (or animals)	754	(~100,000)	276	(~35,000)	237	(~11,000)

'First-cross' ewes are bred for use, or sale to other properties, with Border Leicesters as the most common sires to Merino ewes. There are some 330 Border Leicester studs Australia wide. Alternative maternal sires are the Coopworth (12 studs) and the Corriedale (110) with the East Friesian attracting increased interest.[33]

Breed Societies operate for each of these Breeds and many more exotic sheep types. The objectives of most sheep breed societies are similar. For instance, from the Australian Texel Stud Breeders Association Incorporated Flock Register:

The Purposes of the Association are:
(a) To encourage the breeding of Texel sheep and to develop, promote and maintain the purity and improvement of the breed in Australia.
(b) To collect, verify, record and publish information relating to Texel sheep in Australia.
(c) To investigate the histories, pedigrees, purity, and type of sheep registered or entered for registration.
(d) To consider and to grant or refuse any application for registration of any sheep or the transfer thereof or for the issue of a certificate for the export of sheep registered in accordance with the rules for the time being in force.
(e) To consider all questions affecting the interests of breeders of Texel sheep.
(f) To encourage, promote and carry out research into better methods of animal husbandry and genetics and thereby promote the development of the agricultural resources of Australia in general and the development of Texel sheep in particular. …

[32] Refer Flocks books 1999 for Australian Poll Dorset Association Inc, Australian Texel Stud Breeders Association Inc, Australian White Suffolk Association Inc.
[33] For more detailed numbers see to the *Australian Flock Register of British Breeds 1999*

Each breed Society provides descriptive and visual benchmarks against which the purity and type of a sheep submitted for registration can be assessed, and that assessment would demand a level of expertise developed over considerable time. For the Border Leicester breed, for instance, descriptions cover the appearance of the head, face, eyes, ears, neck, shoulders, chest, back, ribs, legs and feet, skin, carriage, plus:

> *Hind quarters*: Broad square and deep, leg of mutton well let down, tail well set on. *Fleece*: The fleece should be uniform. 44s-48s quality and even covered with a soft handling lustrous wool. good length of staple with a bold, broad lock, crimp well defined, carrying out well from skin to tip, dense on the skin and should fill the hand well having a weighty feel, free of wastiness or fribbyness on belly line or extremities, with no kemp or coarse fibres running through the fleece. …

The Poll Dorset Flock Book provides a breed type description and an 'LP' symbol. It is explained that LP shows "the Flock is recorded in the national genetic evaluation and improvement system for lamb production", which takes "measurements of growth rates and leanness for young rams and provides Estimated Breeding values (EBVs) for these traits" and that it is from these that "commercial lambs get their growth rate and muscling".

Target Meat-sheep breeder market for genetics services

As a start point, there are an estimated 1,800 studs breeding meatsheep and exotic types in Australia (ie. all non-Merino sheep breeding activity).

Of these, over 50% appear to be flocks with less than 100 ewes, and some specifically breed an unusual type of animal. Small breeding operations can produce high quality rams,[34] but also find flock genetic evaluation costly unless they can secure high prices for rams or semen or other income supports the breeding interest.

There is no basis for excluding any type of sheep from the scope of this Study. Some may build to important breed lines as rural industries change. eg. East Friesian dairy sheep for multiple lamb rearing, or the no-wool Dorper for arid and other areas.[35]

A realistic target market for genetics services among meatsheep breeds and non-Merinos, would appear to be 800 studs averaging 180 ewes and 270 new lambs a year, of which 80-85% or 180,000 new animals are evaluated each year.

- this leaves out 55% of current numbers as very small or specialised
- Poll Dorset, White Suffolk, Border Leicester, Texel and Corriedale breeds are assumed to dominate for the next decade but a number of other sheep breeders/cross-breeders could call on genetics services.

Currently, some 580 meat sheep studs are clients of Lambplan. Others use a personal selection system, some scanned measurements and/or advice of sheep classers [2.2.1].

While there appears to be a stronger accord among meatsheep breeders on commercial breeding objectives and important traits, there is still a mix of views among these breeders on both subjective and objective assessment. Debate arises about sheep type, primary breeding objectives, markets and selection criteria.

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[34] *Review of Genetic Improvement Programs in the Beef and Sheepmeat Industries* 1999, by Sillar Associates, Trurobe Pty Ltd and John James, for Meat & Livestock Australia.

[35] For example, *Meat Market Makeover, an introduction to the South African Dorper, Damara, Afrikaner, Meat Merino and Dohne Merino*, workshop by the sheep producer run Cicerone Project of New England NSW, 16 October 2000.

Market intelligence

> "Changes in terminal sire genetics have contributed to the production of larger, leaner lambs to better meet market requirements. However, maternal values also have a large effect on prime lamb profitability and improvement in lamb produced per ewe joined has lagged. In part, this is due to the industry structure that does not offer rewards to First Cross ewe breeders who deliver superior ewes to Second Cross breeders, who can benefit from those ewes." *Review of Genetic Improvement Programs for MLA 1999*

As in the Merino market, custom and price signals from the marketplace influence the interest of meatsheep breeders in genetic evaluation services, particularly when it costs time and money to achieve genetic results.

Again, media coverage of marketplace activity provides an indicator of what ram sellers consider will attract clients. Some Poll Dorset Association publicity points to target markets, breeding objectives, central progeny tests, sheep genetic evaluation and EBVs for growth, fat, eye muscle area, use of Lambplan and across-flock results.

Even so, the supreme Australian prime breeds exhibit of the 2000 Australian Sheep & Wool Show, was a young Poll Dorset ewe. "Her correctness, structure and stud quality is outstanding, while her commercial attributes of muscling, length and depth are also exceptional," explained the judge. In some contrast, the winning Corriedale ram was reported as "micron tested at 28.4 micron and scanned with an eye muscle area reading of four square centimetres and a 7 mm fat cover". [36]

Analysis from 2.1.1 – Issues for this Study

- ***A promising target market of sheep breeders who could be interested in science-based genetic evaluation system has been broadly identified as :***
  – 1,600 breeders/studs and some 500,000 new animals for analysis each year
  – being 800 Merino studs (320,000 animals), 800 meatsheep/others (180,000)
  – about 720 studs use some quantitative genetics services, 600 in Lambplan
- ***There will be segments within this target market. The Merino / meat sheep difference may not be the strongest.*** Commerciality and size may be distinctions. A study of target market segments could be needed.
- ***Under the current sheep industry structure of many studs, if most of these 1,600 studs (of some 3,600) were selecting for traits agreed as important, average industry genetic gain should accelerate*** (genetic gain measured as higher return to commercial producers).
- ***Opinion on important traits and methods is diverse, especially in the Merino arena. This is to be expected in a very competitive marketplace.***
- ***Factors influencing the interest or non-interest of the target market in a new genetics system*** likely include, the (mixed) market and price signals from ram and semen buyers, time and money costs of participating, the need to develop a competitive edge and market niche, alternative ways available, and approaches taken by genetics services providers.

[36] 'Armstrongs win supreme award, again', and 'Corriedale champion", *The Land*, 27 July 2000

2.1.2 Commercial wool and sheepmeat producers

The commercial sheep producer market for genetics products or services is not fixed or captive. Over time, many commercial farmers can switch among production businesses, influenced by prices and other market signals, costs, new venture ideas, plus environmental and other concerns. During the 1990s, the number of sheep farms and the number of specialist wool producers declined [1.2].

In 1998, ABARE reported:[37]

- 118 million sheep in Australia, with 43,960 farms carrying over 200 sheep
- In NSW 15,560 farms of over 200 sheep (average 2546); Victoria 10,130 (1,972); Queensland 2,720(4,225); South Australia 6,820(2,051); Western Australia 7,720 (3,732), Tasmania 940(1,117). One third of farms having less than 1,000 sheep.
- 75 per cent of larger wool producers running over 1,000 sheep were mixed enterprises; 95 per cent of those smaller were mixed enterprises.
- About 50% of wool producing farms made profits in the years 94/95 to 96/97.
- The proportion of 20 micron and finer greasy wool sold at auction was 33% in 1997-98, a significant increase from 22% in 1992-93.
- Farm income from lambs had increased, as had matings of meatsheep rams to Merino ewes. Few farms derive a large part of their income from lamb sales.

Sheep sub-industries have developed

Driven by wool and export lamb markets – there appear to be four sheep production sub-industries, with distinct market and production characteristics.

- Fine clean Merino wool, especially under 18 microns, from high-medium rainfall zones attracting high and increasing prices but with associated production issues.
- Broader wools from pastoral areas with limited production alternatives.
- Prime meat producers, often supplying through alliances, with broader wools, and
- A majority: Commercial farmers with sheep production among mixed activities.

In 1998, Peter Ralston, President of the Stud Merino Breeders Association of WA, observed that: "One of the most fortunate aspects of the diversity of the Stud industry is that whatever the requirement of the day – there are studs that have bred in that direction." He saw woolgrowers, so Merino ram breeders, moving into two groups:[38]

- *high input, high gross margin* – specialist woolgrowers growing to a tight specification, in higher rainfall, dust-free environments, top quality wools, lower than average micron.
- *lower input, lower gross margin* – not specialist woolgrowers, likely to be pastoralists, with an integrated cropping/cropping program, or running a prime lamb enterprises.

[37] ABARE, *Profile of Australian Wool Producers* 1998 and other reports. Mainly 1996-97 figures.
[38] P Ralston, Meeting processors requirements – Stud Merino breeders viewpoint, *Proc Assoc Advmt Anim Breed Genet.* v13

It is a marketplace reality that farm business decision makers place priority on their animals' genetic improvement in some circumstances, but not always.

Commercial producers are offered increased productivity and profitability by a range of income improvement possibilities. Changed grazing management is advocated across Australia.[39] Brochures on new pasture species suggest up to 60% increase in live lamb weight output. New worm treatments promise better Merino wool quality and quantity and heavy export market lambs with less dags and fly-strike.[40]

Flexible working and education have given producers more choices including off-farm career and income.[41] Some families will give priority to off-farm work. As business hard-headedness increasingly drives decision-making, more enterprises can be expected to develop a mix of sub-businesses, including profitable off-farm income.

To many, it appears, the big breeding decision will be whether to change from cattle to sheep, to Merino or Lamb sire or the reverse, and then where to source rams.

> "Lockyersleigh near Goulburn … turned off about 8,500 prime lambs this year. Future plans…will see a rise in the number of Merino ewes joined to Dorset rams, in a bid to cut costs. 'While we may not get a true second-cross lamb in terms of wool we will be able to double our money and can also get a fat lamb – we are probably looking at being $7 or $8 [a ewe] better off," said Manager, Mr Chamberlain. *The Land, 27 July 2000 p1*

Traditional allegiance to ram suppliers is reducing. A survey of 570 woolgrowers found "high and increasing mobility when sourcing flock rams".[42] However, where off-farm work and other businesses demand more time, convenience will still be a key factor.

Analysis from 2.1.2 – Issues for this Study

- ***Some commercial sheep producers will rank genetic gain as a priority by paying premiums for superior rams. Some will pay extra for high EBV rams.*** At this time, about half of prime lamb ram buyers pay more for Lambplan rams, about 30% look for EBVs [4.1.1]. Market indications are that these proportions are much lower for Merino ram buyers.

- ***Attitudes to genetic improvement could change with results (increased returns) and concerted marketing and extension, but a majority of commercial sheep producers appear likely to make straight-forward ram purchase decisions*** to meet broad aims (finer micron, Texel lambs). Animal budget, loyalty, regional suitability, and convenience will be factors.

- ***A market for professional genetic evaluation services could be developed among specialised commercial sheep producers steering their flocks – say 1% of 44,000 producers, or ~400 potential users.*** Clients would be spread widely – a delivery and cost challenge to genetics services providers.

[39] *Prograze, Profitable, sustainable grazing*, workshops. Also, some graziers invest significantly in cell grazing systems.
[40] *Increase yield and wool quality through capsule technology*, Ivomec Maximizer Capsules advert, *The Land* 27.4.2000
[41] The Tilbuster Common Resource Co-operative combines the land and people resources of five properties. It will carry 2000 sheep, 200 cattle, 500 goats. Members all have off-farm work. *The Sydney Morning Herald*, 5 August 2000
[42] NSW Agriculture survey, *Commercial wool grower bloodline selection survey*, Pope, Atkins, Casey, Semple, 1996. 62% had changed ram source in ten years, 25% felt they would have to change rams source to meet breeding objectives.

2.2 At the interface of markets, science and technology

> "The dichotomy that arose during the 1950s and 1960s between sheep breeder and scientist has in my view cost the wool industry dearly. … we can assume that the bulk of this muddy water has passed under the bridge. … the sheep breeder has a better appreciation of the potential value of the tools science provides. … the scientist is more aware of the complexities of the practical side and the degree of expertise required to use those tools effectively out there in the bush." *James Litchfield, Studbreeder, 1987* [43]

For rural production, a 'successful' research outcome might be characterised as an innovation that is progressively adopted in an open marketplace, over a reasonable time, with measurable advantage to the industry or key parts.

The Australian sheep industry is an open, little regulated, marketplace of many different breeders and producers making decisions about their businesses, often spurred by competition with each other and marketplace price pressures. ***Uptake of new ideas will vary, but it seems reasonable to expect that a useful innovation should receive solid marketplace attention in 5 to 10 years.***

Quantitative genetics services have been available since 1988 (Lambplan) and 1990 (Advanced Breeding Services). WOOLPLAN [2.2.2.b] began about 1987.

Estimated Adoption of Quantitative Genetics systems – Australian sheep industry

	Number of registered studs and ram sellers approx.	TARGET market as estimated in 2.1.1.a and 2.1.1.b.	Number studs using quantitative genetics services	Use of services by whole market, % of studs	Use of services by TARGET market (% of studs not animals)
Merino breeders	1,800	800	~ 130	7%	16%
Meatsheep/other	1,800	800	~ 580	32%	73 %
All sheep breeders	3,600	1,600	~ 710	20%	44%
Wool/meat producers	44,000	400			

In most industries, including sheep breeding and wool and meat production, adoption and use of a scientific innovation will depend on many factors, including:

- customer and price signals both short and longer term
- approaches taken by the scientific community in explaining, advising and 'selling'
- logic and evidence behind the innovation in practical as well as scientific terms
- fit of the innovation with improving competitive viability of varying businesses
- the often-avoided reality that there are usually 'winners' and 'losers' in change.

Use of measurement of key traits (eg. diameter and muscle) has increased, but 2000 sees most Merino breeders and numerous meat sheep breeders not using quantitative genetics tools.

[43] J Litchfield, 'Breeders' perceptions of industry needs', in *Proceedings of a National Symposium*1987.

2.2.1 Service providers and focus on the marketplace

> "Unfortunately, in the past there has been a view by some that geneticists and the stud Merino breeders had different 'bottles' of Merino genes. … This was a view from the 1970's and 80's when there was enough fat in the Merino industry to allow all of the participants to have their stand-offs on points of custom and ideology. Those days, of excess fat at least, have definitely gone. … I believe the various methods of breeding have come closer together because most successful breeding programs now depend as much on measurement as they may still do on visual classing."
> *Peter Ralston, President, Stud Merino Breeders Association of Western Australia, 1999* [44]

Professional genetics services providers are a crucial part of the Australian sheep genetics marketplace. Expert sheep classers have been offering skill and selection approaches to stud breeders since early Merino days.

The clients for genetics advice services are mainly breeding studs – most are registered, some are not. The clients of ram sellers are other breeders and commercial sheep farmers producing wool and sheep meat (lamb and mutton). As considered in 1.3.1.e, different marketplace signals and drivers can be expected for these segments.

Identifying realistic targets markets (1,600 studs, 400 producers) provides a promising vision, but is a first step only in securing the custom needed for a successful genetics service system.

Media advertisements can provide insights into real marketplace priorities. Advertisements reflect how stud breeders 'read' their clients needs, and these views are likely to flow through to dealings with service providers. The table below presents a NSW picture. NSW is the base of many current genetics services providers.

'How the sellers sell' – Market signals from 330 NSW stud sale advertisements [45]

Number of advertisements mentioning -	Merino studs NSW	Meat sheep studs NSW	Beef Cattle NSW
• Only stud name, bloodline, animal or wool features described	65	17	71
• Any measurements or testing	72		9
• Performance recording – generally	7		5
• Systems or services for ram selection	3		1
Lambplan		10	
Scanning method		4	
Merino Benchmark/ABS	3		
Select Breeding Services			
SRS/Elite/Watts/Swan	28		
Centrally Tested / EPVs	4		
Breedplan/Group BP/EBVs			31
Total advertisements	182	31	117

[44] P Ralston, Meeting processors requirements – Stud Merino breeders viewpoint, *Proc Assoc Advmt Anim Breed Genet.* v13
[45] Advertisements from: *The Land* 1999: 14.1, 28.1, 4.11, 16.12, 23.12, 2000: 6.1, 24.2, 9.3, 30.3, 20.4, 27.7,10.8, 24.8, 7.9, 14.9, 21.9, 28.9 wool stud sales, meat sheep, cattle. *CountryLeader* 18.1.99, 25.1.99, *Nornews Rural Beef Breeders' Annual* August 2000. *The Land* Millennium Merino Sales Supplement 17.8.00, *NSW Agriculture Today* 9.00.

The Advertisements tabulated are a reasonable sample. The indicators are that :

- In beef cattle, while the majority rely on stud name and basic description, Breedplan and EBVs are established as a selling basis and marketing tool.
- In meat sheep, Lambplan use and rankings are known and used, but some do identify scanning by others methods in their advertisements.
- For Merinos, that rams are measured (micron and other fibre tests) is now as important as stud name alone. The advertisements confirm that Traditional-with-measurements is the most used approach, then selection for 'elite wool' and 'advanced Merinos' (Soft Rolling Skins, Elite).

Marketplaces set the same challenges for service providers, be they public or private sector, as they do for all business enterprises. No matter how logical a technology or innovation is, buyer understanding, practicalities, full costs, real results vis-a-vis other approaches, marketing and fashion, will shape adoption and success.

The research for this Study confirms that the need to 'sell' good ideas into the marketplace is recognised and increasingly emphasised, but a number of those contacted have stressed the need to focus on service and persuade customers.

> "Western Australia seems to have a much closer relationship between agricultural researchers, farmers and consultants than elsewhere. … WA researchers appear to be working on practical problems all the time and constantly talking to groups of farmers, and often with farm consultants on how to turn research results into profitable profitability." *Graham Peart, Hassall and Associates, The Land, 23.12.99*

Tailored products, marketing, explanation, favourable prices, extra services and even regulation can influence uptake of new ways. These are all tools in the 'selling' armoury, but they can also be costly in time and money. It is easier to remark that 'more, personalised, advice' is needed, than it is to recover the true costs of such advice in a widespread industry. Some in the competitive marketplace argue that such costs should be fully recovered.

Analysis from 2.2.1 – Issues for this Study

- ***Need to understand more of issues at the interface of the markets for genetics services, and technology, including key points of debate*** [2.2.2].
- ***Need to consider services provided by a range of professionals and associates to segments of the sheep genetics marketplace***, including services with databases, different approaches on selection, sheep classing advisers, laboratories, government and industry extension officers [2.3].
- ***To secure the interest of a large part of the target market (1,600 studs), it appears any new system will need to cater for diverse views*** on what should best suit commercial clients and on developing a market niche [2.2.2].
- ***Issues of policy, principle and priority can arise for consideration, when industry leaders seek to achieve change in competitive marketplaces***.

2.2.2 Debate: Which traits are important? What methods?

> "Charles Massy [Severn Park, Cooma] says that the rewards of anticipating future requirements are exceeded only by the cost of ignoring them, and the real opportunity cost to the industry is the embedded FAQ mentality as regards genetics … the key to innovation, particularly the genetics of the skin. … 'Fine' can't be the only thing to select for – the other attributes involving major gene pathways must be included. There must be a multi-dimensional view of fibre quality…". [46]

It is generally agreed that defining a set of 'breeding objectives' or 'goals' serves to focus, and should advance, breeding results.

Objectives set a start point for collecting information on traits, then calculating breeding values (using research into the traits), and ranking animals on genetic merit. Breeding values can be calculated for any trait that varies among animals and can be reliably graded [4.2.5].

In quantitative genetics systems, breeding objectives are usually expected to be a weighted combination of 'economic traits':

> "… breeding objectives are generally expressed as economic weightings that describe the economic impact of a unit change in each trait of commercial importance. These economic weightings can be used directly to help evaluate different breeds and crosses, or more commonly, they can be used in conjunction with genetic parameters and knowledge of population structure to rank animals on an index of genetic gain in momentary units." *Professor Brian Kinghorn, 2000* [47]

Some QG advocates have been quite firm on which are the 'important economic traits' and expect EBVs or EPVs for these traits to be weighted into Selection Indexes. Nowadays, differing breeding objectives are allowed for in QG Systems. Breeders can customise selection indexes and methods to reflect their views of market needs, although significant divergence from the main traits is not encouraged.

In reality, somewhat different 'important economic traits' are likely for different markets and for sub-markets. Ram selling is a quite distinct market from wool or sheep meat selling [1.3.1]. Within the 'ram selling' industry, many Merino and some meatsheep breeders have developed their market position by providing animals with special combinations of features (such as to suit a regional environment).

Debate about breeding objectives and weighting, contributes to disagreement about whether 'genetic gain' is, or is not, being achieved.

In considering any new Australian sheep industry genetics system, it is important to understand the contention among industry participants about breeding objectives and different approaches to animal selection, and to learn from prior QG experience. This understanding should assist assessment of current arrangements and identification of options for development.

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[46] 'Microsoft wool: Charles Massy's suggestion for a new start, *Rural Post magazine*, February 2000

[47] B Kinghorn, Description and targeting of breeding objectives, in *Animal Breeding - Use of new technologies* 2000, Chp 20

.a. Meat sheep breeding

A majority of meat sheep terminal sire breeders use Lambplan, accounting for some 70% of Dorset, White Suffolk and Texel rams sold. Breeding objectives and selection indexes combining growth rate, fat and muscle factors are well adopted in this group.

Studies indicate that most lamb breeders and producers believe future genetic progress will be higher with Lambplan,[48] and various breeders are achieving high genetic gains with associated price premiums for rams and lambs [4.1.1].

Even so, there has been debate over the last 10 years about the 1996 decision to calculate all Lambplan EBVs on an across-flock basis. A proportion of larger meat sheep breeders do not use Lambplan. Concerns have been expressed about: [49]

- across-flock favouring some breeders and breeding directions, with others 'losing'
- not enough information being provided on what is happening in one's own flock
- difficulties with limited indexes at the start – the structure of indexes and fit with visual appearance, and about recognition of needs of different regions and markets
- lack of understanding of Lambplan among breeders and producer ram buyers.

.b. Merino wool sheep breeding

This is a complex arena. In 2000, a majority of breeders use visual classing of sheep within their flock aided by some measurements. Recent history provides some insight.

A 1987 forum, convened by the Australian Wool Corporation, brought together wool industry breeding expertise to consider Merino improvement programs. Geneticist Dr John James noted that quantitative genetics methods had developed during the 80s to a stage suitable for widespread use. Geneticists were turning to defining breeding objectives – specifying the combination of characters to improve.[50]

WOOLPLAN was introduced as the new Australian scheme designed to meet the performance recording needs of Merino ram breeding flocks. It would provide 'a ranking of animals within a flock on predicted BV for overall economic merit', using a 'breeding objective including all the traits influencing profit to the commercial sheep producer'.[51] Five traits were used, with stress on fleece weight and reproduction.

Trait in WOOLPLAN breeding objective	Economic value ($ per ewe lifetime)
Clean fleece weight (CFW)	14.5
Fibre diameter (FD)	-2.03
Reproductive rate (RR)	30.95
Sale weight of offspring (SW)	0.50
Weight of cull-for-age ewes (MW)	0.12

[48] *Review of Genetic Improvement Programs in the Beef and Sheepmeat Industries* 1999.
[49] From Lambplan customer surveys and studies 1999 and 2000, including debate in the rural press mid 1999.
[50] JW James, 'Breeding objectives for the Merino industry: an academic perspective', in *Proceedings of a National Symposium on Merino Improvement Programs in Australia*, Leura NSW, 1987.
[51] RW Ponzoni, 'WOOLPLAN – design and implications for the Merino industry, in *National Symposium Proceedings* 1987. WOOLPLAN was available through accredited wool testing laboratories. Reports would list the records of performance provided by the breeder, and for each animal, an EBV for each of the five traits and an overall index score.

Four WOOLPLAN selection indexes (criteria) were offered with combinations of the five traits. A fifth index enabled breeders to select economic values for the five traits.

In some contrast, Mr B Scott, a Queensland breeder, explained key steps taken by Merino breeders in selecting lead animals, with mention of breeding goals. [52]

Methodical sheep selection: with consideration of wool type suiting the breeders' environment

Visual culling – elimination of all obvious faults such as excessive skin wrinkle, black spots, fleece kempiness, excessive face wool, conformation faults, discoloured or low-yielding wool.
Wool cut per head – assessed by wool weight and body size to sustain wool growth
Yield – wool grease to maintain 70-75% clean wool (up from 50% in 100 years)
Staple length – assessed visually to increase wool cut in all strains of Merino
Crimp definition – gives bulk to the fleece, reduces moisture and dust penetration, subjective assessment over whole fleece as a guide to fibre diameter variation
Handle – degree of softness assessed subjectively through stud breeder experience
Wool whiteness – wools of high whiteness and brightness better able to stand up to excessive moisture
Suint – ideal fleece has high wool wax and low suint, less prone to discolouration and fleece rot
Tip – blocky wool better weather resistance, better processing performance, little attention by scientists
Skin wrinkle – visually thick skin and moderate wrinkle indicates productivity to an older age
Fibre diameter – priority depends on environment, aim to select for evenness of FD over a sheep and within a mob, increasing reliance on FD measurement
Reproductive efficiency – large body size, feminine/masculine appearance of rams and ewes linked to reproductive performance. Twinning advantage depends on region.

On scientific measurement, Mr Scott said:

> "Many characteristics can, and have been, measured for decades. But it is how these are used, in conjunction with subjectively appraised characteristics relying on skill and experience, that ultimately determines the degree of importance placed on measurements."

Other hands-on views about expectations were provided at the 1987 forum. Mr James Lichfield of 'Hazeldean' identified "strong demand throughout the sheep breeding industry for accurate comparative information about sources of genetic material and their suitability to specific environments". He considered that QG would work with Merinos to enable identification and exploitation of true genetic differences.[53]

Commercial producer, Mr AR Gooch of WA, identified that ram buyers seek, firstly, 'consistency of product – genetic repeatability or breeding true to type generation to generation', then fleece measurements and tools to make their own commercial selection judgements including selection for diameter, weight and environmental fit.[54]

> "I do not think the commercial breeder will be able to continue to accept the leisurely uptake of research and technology that has characterised the industry in the past. … I will be looking for more precise data defining the whole flock to provide background information to support individual results. Results of sire referencing and progeny testing in peer groups, to indicate the heritability of characteristics such as fertility, body and fleece weights, feed conversion efficiency, disease resistance, tensile strength and staple length, are the types of tools that would be of assistance in my selection decisions."

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[52] B Scott, 'Breeding objectives for the Merino industry: industry perspective', in *National Symposium Proceedings* 1987.
[53] J Litchfield, 'Breeders' perceptions of industry needs', in *National Symposium Proceedings* 1987.
[54] AR Gooch, 'A commercial breeder's expectations of the ram breeding industry', in *National Symposium Proceedings*

Other speakers in 1987 emphasised:

- *The importance of…trained advisory staff and [of scientists] familiarising breeders with basic aspects of breeding before advancing to more sophisticated procedures'.*
- That Victorian sheep producers tend to select their replacement rams with assistance from stock agents, sheep classers and the sheep breeder, and Merino breeders emphasise conformation and subjective wool characteristics when they buy rams, placing less importance on objective measures and none on reproductive pedigree.
- That availability of a low-cost, simple fleece measurement service in NSW backed by advisers had encouraged dramatic increase of ram measurement and of marketing rams with measurements – but in many cases the measurements created confusion due to variations in shearing dates, testing houses and ram ages.
- *"A major lesson from other industries is the importance of an across-herd, across-year genetic evaluation system in motivating genetic improvement.*" [55]

So, 13 years ago, there were various positions in the wool industry on breeding objectives, techniques and tools, plus levels of disagreement on approach, coupled with concern and enthusiasm about the future embodied in Woolplan.

WOOLPLAN operated until 1993 but did not achieve the hoped for custom and change. Elements flowed into the Woolmark *Rampower* software program [4.2.4].

> "*Woolplan* had the reputation of appearing paternalistic and prescriptive and was largely ineffectual for this reason. It was commonly believed that there was one Woolplan, and breeders were expected either to adopt it or not. Most did not."
> *Professor David Lindsay, 2000*

In 2000, except for consensus on finer diameter, opinion on which wool value-traits and Merino breeding goals are important is still many-sided.

A 1999 symposium, *Breeding for the 21st century customer*, was opened by German processor, Claus Gyrn, emphasising that "wool growers need to produce fibres which have desirable processing and comfort characteristics… contamination free… chemical residue levels which meet increasingly stringent environmental requirements".

Gyrn confirmed that measurements are used to predict processing performance, and saw diameter variation, crimp and length as traits to watch.[56]

> "I am not a geneticists or wool producer, but the challenge for sheep breeders is likely to be to breed sheep which produce sound wool with minimal mid-breaks, of good colour, low diameter variation, low crimp frequency and acceptable length. Fibre diameter will continue to be the most important price determinant."

WA stud breeder, Peter Ralston, outlined decades of market interaction. "If you went back 40 years investigating how the wool industry related to its processor customers, you would find the demand factors almost as clouded as they still are today." [57]

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[55] ME Goddard, L Jones, 'Relevance of experience in other industries, in *National Symposium Proceedings* 1987.
[56] CS Gyrn, BWK, 'Wool processors' requirements for the 21st century customer', *Proc Assoc Advmt Anim Breed Genet.* v13
[57] P Ralston, 'Meeting processors requirements – Stud Merino breeders viewpoint, 1999, *Proc AAABG* v13.

Merino breeding eras – Peter Ralston 1999

1970s-90s: "an era concentrated almost exclusively on fibre diameter and yield, the FAQ era … many wools were bred that became too high yielding (dry), lacking the correct balance of wax and suint to give protection against the elements, the fibre became flat with no crimp … great skills were lost.

1999-2000: once again we have processors in or industry calling for quality wools with plenty of performance and style (style can include good tip, evenness of crimp and deep well defined crimp, whiteness, low fibre curvature, low diameter variation, high strength and good position of break) …efforts are to lower average diameter …clients demanding bigger framed Merinos to gain income from the lamb or live sheep trade … under higher stocking rates.

Ian Rogan, Rampower National co-ordinator told the conference that modern genetic techniques should be able to increase Merino productivity 1.3% to 1.7% a year, ie. over 10 years a gain of 8% to 12% fleece weight with fall in fibre diameter of 0.8 to 1.5 microns. In 1997, Rogan surveyed Merino stud breeders on selection emphasis. 125 leading breeders said they placed weight on: fibre diameter (17.4%), fleece weight (16.9%), conformation (12.1%), colour/character/handle (10.2%), size/liveweight (12.1%).

> "[In] analyses of profitability from commercial merino flocks… fleece weight, average fibre diameter, liveweight … account for about 80% of the variation in income. With about 44% of selection emphasis placed on these characteristics by the surveyed Merino studs, it could be argued that these influential stud breeders were under-emphasising these commercially important characteristics in their selection programs." [58]

In this important survey group, difference is quite evident between marketplace-driven breeding practice and QG theory as it has been communicated over the years.

> "The breeding objective should include all those traits that influence income and expense in commercial flocks … based on the perceived future production and marketing environment [of] commercial flocks … Emphasis on characters that help with the marketing of stock but not with productivity at a commercial level may result in short term benefits for the ram breeders, but almost certainly, not in the long term." [59]

Impediments to adoption of QG technologies by Merino studs – Ian Rogan 1999

Lack of confidence in accuracy of fleece measurements particularly on young rams.

Lack of widespread formal breeding objective development by stud breeders which set targets for increasing wool cuts and/or improving wool quality, size, resistance to parasites, lambing rates.

Failure to clearly analyse and communicate the relative commercial importance of different potential selection characteristics.

The lack of pedigree and birth status information for most rams born in Merino studs (part due to the expense of obtaining this data at mating and lambing times, and of DNA fingerprint tests) so limiting genetic calculations within and across flock.

Absence of the great stimulus to genetic improvement in other domestic livestock species – across flock comparisons and ready access to superior sires through AI.

[58] I Rogan , 'Practical opportunities for Merino breeders to adopt modern genetics', 1999, *Proc AAABG* v13.
[59] R Ponzoni, Geneticist SARDI, 'Breeding objectives for the merino industry', 1999, *Proc AAABG* v13.

.c. Controversial Merino breeding criteria

Genetics researchers acknowledge that focussed breeding objectives will necessarily vary as Merino breeders target speciality wool markets (or parasite issues or carcase traits). However, some breeding directions appear to be seen more as fashion than serious, notwithstanding levels of industry adoption. For instance, the 'elite wool' (EW) and 'soft rolling skins' (SRS) systems [refer also 4.1.6].

> "Perhaps the most widely discussed focus in the Merino breeding industry for some years, is on SRS – or soft rolling skins. This concept has already been billed as the production answer to the problems of the wool processing industry. It also represents the first real challenge to traditional thinking amongst breeders, scientists and processors for many years. If the SRS system is proven and accepted, and a price premium develops, there will be quantum shifts in Merino breeding direction because processors will be prepared to pay for a product that performs." *Peter Galston 1999*

Merino ram and wool markets reward breeding and commercial decisions through custom and prices. Use of SRS and the similar Elite systems has grown during the 1990s. They are part of the genetics marketplace [2.2.1]. Some leading modern era studs, and studs of long history are clients of scientists Dr Paul Swan (Elite) and Dr Jim Watts (SRS).[60]

The South Australian Better Breeding selection demonstration trials supported by Woolmark [1.3.2], include a SRS selection line alongside traditional and QC selection. A March 2000 progress report described the points of emphasis:[61]

> "[The SRS] selection package is directed towards a highly productive, balanced animal with highly aligned, well nourished, soft handling, very stylish, lustrous pearly white wool. The fleece surface, which has a mop like structure is quite resistant to dust penetration, water damage and ultraviolet degradation. … our [selection] aim is to improve wool quality and handle, reduce mean fibre diameter and co-efficient of variation while maintaining fleece and body weight and reproductive performance."

The Elite system places considerable focus on measured wool characteristics and animal fit with the environment, and is expanding its client base. Measured results for diameter, CV, fibre curvature, fibres over 30 microns, plus fleece and animal weights and pedigree, are used to calculate selection ratios which relate to skin features. Outcomes, the features of progeny and products are generally reported in terms of fibre diameter, CV, fleece weight and style of wool [4.1.6].

GH Michells, Australian wool processor, on desirable wool characteristics [62]

1. Contamination is the single most problematic issue for the wool industry.
2. Fibre diameter is the most important parameter, accounting for most of price paid.
3. *Some types of wool will process better at the same micron. Wool of the future will have a clearly defined broad crimp, fibres are well aligned and strong, few fibres more than 30 microns.*
4. Test certificates stating mean staple length and strength (processors pay more for the test)
5. Colour of greasy wool not important so long as the colour washes out.

[60] Dr Watts commenced providing SRS consultations about 1991 with Dr Swan as a later associate. Dr Swan has been separately developing the Elite wool system since 1996. Discussions were held with Paul Swan for this Study.
[61] B Jefferies, Selection Demonstration Trial – Elite Wool group, *SA Selection Demonstration Flocks Newsletter* March.2000
[62] J Turk of Michells, Australia's largest wool processor, in *SA Demonstration Flocks Newsletter* No. 3 March 1999

.d. On value-adding and economic traits

In the 1970s, research effort was directed to statistical analysis of price determining wool characteristics or 'economic` traits'. Clean fleece weight and fibre diameter were identified as the primary factors.

Near three decades on, Rogan identifies "failure to clearly analyse and communicate the relative commercial importance of different potential selection characteristics" as an obstacle to genetic advance, noting that in commercial merino flocks, fleece weight, average diameter, and liveweight account for about 80% of the variation in income.

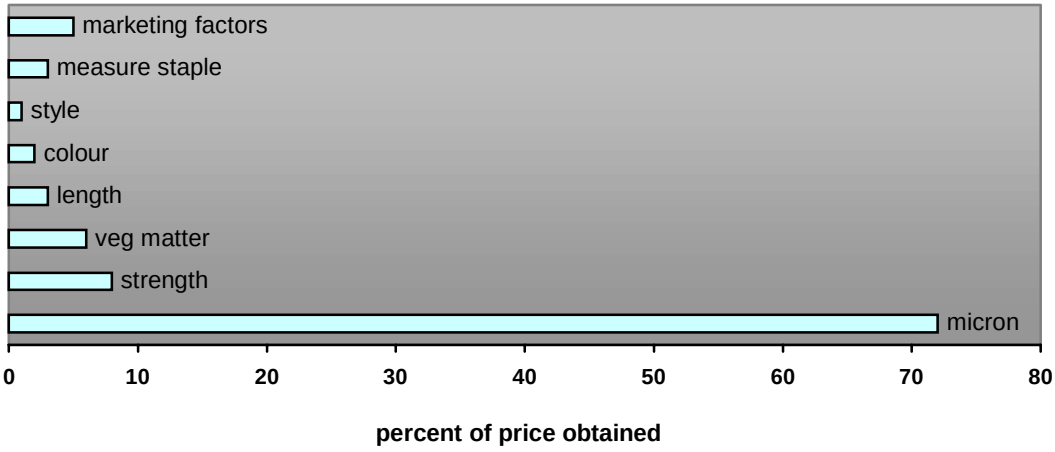
However, a number of breeders contacted for this Study emphasised a significant change in the nature of the Merino wool marketplace during the 1990s after the Reserve Price Scheme ended.[63] In recent years, they have observed a much greater market emphasis on wool style and follicle and fibre characteristics.

The CSIRO FineWool project examined impact of staple length, staple strength and style type on fine wool prices. Confirming the breeders' observations to some extent, non-measured fleece style type was found to explain a significant part of higher prices in fine wools, while accounting for little price difference in medium wools.[64]

Prices received at wool sales are continuously surveyed by Woolmark and these also show some basis to the feeling that wool type has been more important in the late 1990s, with style and colour in finer wools accounting for some 7-10% of price differences over the 1997/8 to 1999/00.

Overall, non-measured style traits have little price effect averaged across most wools, after accounting for a range of price determining factors [diagram].[65] However, it could be argued that wool 'style' or 'type' includes colour, length and strength, even VM, and that 'style' had been strongly selected for by breeders in advance of these comparisons.

Value determining traits 1999-2000 Merino fleece 18.6 - 24.5 micron



[63] Under the RPS, wool was acquired at sales by the Australian Wool Corporation, mainly on diameter and clean weight.
[64] Dr Ian Purvis, CSIRO Livestock Production milestone report.
[65] Diagram data Woolmark Company, www.woolinfo.com 'Pricemaker'. 'Measure staple' refers to the price effect of having or not having a test certificate for staple length and strength. Other marketing factors are region, sale by separation, re-handling and lot size.

Much too, depends on marketplace demand and supply.

> "With stronger competition for fine and superfine wool at Australian wool auctions last season, buyers had to be less particular about the quality of wool they purchased. As a result, discounts applied to fine and superfine wool for faults such as low tensile strength came back to more normal levels compared with those in 1998/99. … the relative importance of fibre diameter on the price paid for fine and superfine wool increased by 17 percentage points on 1998/99." [66]

Analysis from 2.2.2 – Issues for this Study

- ***In a very competitive industry, individual breeders will decide what product mix they will develop for their customers.***
- ***It is assumed for the purposes of this Study, that Quantitative Genetics offers more potential return to Merino breeders and producers***, than approaches using fleece measurements and forms of sheep classing. How much more does and will significantly influence adoption of QG selection.
- ***For meat sheep, ram and product value-determining characteristics are well defined. This is not so clear for Merino breeding, except that fibre diameter is the key trait.*** The three selection systems place top weight on reducing average fibre diameter. Measurements are used to confirm this.
- ***Patronage of any new sheep genetics system will depend in part on supplying genetics services to breeders and advisers with varying views and experiences.*** Over time, the market will pay for value-adding traits and perhaps return investment in QG to maximise these traits.
- ***It is a marketplace reality that 'style sells', be it in wool, lambs, rams, studmasters, advisers or geneticists.*** This needs recognition in any system.
- ***The question of goals for a new genetics system arises. Industry uptake of quantitative genetic techniques would be a better direct indicator of success*** than assessing 'genetic gain' based on one set of parameters.

[66] Woolmark Co, *Review and Outlook for Superfine wool* (in preparation).

2.3 A range of genetics service providers [from Part 2]

Australian sheep breeders are currently obtaining breeding and selection expertise from many sources, including (likely as a mix):

- considerable family experience plus reading and short courses/workshops
- university degrees with genetics, animal production, marketing/ business subjects
- feedback from ram and ewe customers, stock selling agents, wool and lamb buyers
- interaction with, and specifications set by, Breed Societies and at Shows
- advice and selection services from consultant sheep classers
- advice from agricultural consultants and local agricultural departmental officers
- a range of services from specialised breeding consultants using various systems
- involvement in industry-supported selection systems and trials using QG

Of the estimated 3,600 sheep breeders in Australia, a target market for science-based genetics services of some 800 Merino breeders plus 800 meatsheep breeders appears realistic and accords with aims to facilitate genetic gain [2.1.1]. To this could be added some 400 commercial producers breeding flock sires [2.1.2].

An array of professional genetics and advice services is on offer. Sheep classers and laboratories (for fleece tests) are widely used. Together the other services are patronised by a minority of Merino breeders; a larger number of meatsheep breeders.

Features of the following services are outlined in PART 2, section 4.1.

- Lambplan – Meat and Livestock Australia
- Advanced Breeding Services – NSW Agriculture
- Select Breeding Services – CSIRO
- Central Test Sire Evaluation
- Agriculture Western Australia
- Natural Resources & Environment, Victoria
- Mackinnon Project – University of Melbourne
- SARDI
- Independent consultants
- Soft Rolling Skins and Elite Wool systems
- Professional sheep classers and stud advisors
- Practical advisers and service providers (laboratories, scanners)

The key points and issues assessed from section 4.1, are presented in 2.3.2 below.

Data collections, compatibility and conflicts: The more detailed workings of these services, their associated data collections and analysis systems, including questions of compatibility are considered in PART 2, section 4.2, under the following headings.

4.2.1 Summary of sheep genetics data collections [also 2.3.1 below]
4.2.2 Enterprises, pedigree, accuracy and links
4.2.3 Traits recorded, measurement and data integrity
4.2.4 Data collection, delivery, processing
4.2.5 Preparing BVs, indexes, comparisons, reports

The assessments from Part 2 section 4.1, are recorded and discussed in Part 1, 3.2.

2.3.1 Summary of sheep genetics data collections

The following table summarises basic details about most sheep data accumulations in Australia,[67] and the relative worth of various aggregations (higher are shaded).[68] For understanding on how the value of a data collection assessed, refer PART 2, 4.2.2.

	BREEDER CLIENTS mid 2000 – Merino – other	**MERINO animal records** – in total (new 99-00)	**NON-MERINO records** – in total (new 99-00)	**DATABASE Full size** in animal records mid 2000	**Comments**
Lambplan	13 Mo 600 XB	87,000 (5,000)	830,000 (107,000)	917,000	structured database , many cross-links in meat sheep, some in Merinos, many full pedigrees
ABS client database	44 Mo (plus 26 Mo B'mk)	200,000 to 250,000 (~20,000)		200,000 to 250,000	data collection with EPVs, not structured as a database, within flock use, limited pedigrees
NSW Ag Bloodlines wether trials				large quantity of data over 10 years	usefulness limited. wethers with little pedigree. Many measurements and trait scores.
ABS Merino Benchmark	26 Mo	105,000 (~20,000)		~ 105,000	31% pedigree for sires, 15% for dams, good links to CTSE sires
Central Test Sire Evaluation		21,000 (~ 2,000)?		21,000 500+ sires	Across-flock evaluation by trials, part pedigrees, link sires
Meatsheep Maternal Sires Central tests			9,000	9,000 91 sires	sire and dam pedigree on most, limited links, assessed for unusual traits so not in LPlan
Select Breeding Services CSIRO	~20 Mo			~ 3,000	each breeder's data stored for within flock, not a database
CSIRO Fine wool project		10,000 (closed)		10,000	with pedigree and some ~ 7% links to CTSE rams
South Aust. breeding trials		2,400 Mo (600)		2400	full pedigree, links to CTSE and various studs
Trangie Q Plus trials					Closed selection flocks since 1992, full recording, few links
Mackinnon project	~10 Mo	~20,000 (10,000)		~ 20,000	mostly ewe data, limited links to sire databases
WA AgServices	~20-25 Mo	65,000		65,000	Merino data by flock, pedigree & links improve post 1998
Independents	~ 1-3				limited, within flock
Laboratories, breeders, sheep classers	large numbers				many measurement records for sheep most without sire/dam, AI records a stronger resource.
Elite/SRS clients	~ 100 Mo together				Pedigrees on most? Could be interesting. Limited links.

New Zealand's Sheep Improvement Limited (SIL) holds a large collection of genetics data for a range of sheep breeds, some with links to Australian sires. Lambplan and SIL are exploring co-operative analysis of some datasets, with permission. SIL is interested in Australian developments and the potential for across-Tasman evaluations.

[67] Figures are from the service managers where possible, but most would not confirm exact client numbers. The symbol ~ indicates a best estimate – likely to be high than low. There is also some overlap in Merino client counts. Perhaps a total of 130 clients, ranging in size from some large ram sellers (over 1,000pa) to medium size studs, to those starting up.

[68] For further information on the reasons for the data collections, and their features refer sub-sections in PART 2, 4.1.

2.3.2 Sheep genetics services – key points and issues

Analysis from Part 2, section 4.1

- ***Considering the Australian sheep industry as a whole, and its size and importance, and assuming that quantitative genetics systems have as much to offer sheep producers as other animal industries, the overall adoption of QG and the industry's QG service arrangements are not striking.***

- ***In the meat sheep sector, substantial investment over decades has achieved an established QG service in Lambplan, which has piloted significant genetic gain in key traits.*** Lambplan services some 600 studs and likely reaches 55-60% of meat-sheep rams sold, though less than half of registered meatsheep studs are using Lambplan and membership growth has flattened. Lambplan members pay near 60% of costs. [4.1.1]

- ***Marketplace messages and experience from Lambplan's development need to be considered in development*** of any new sheep genetics system. There are implications for products, marketing, and balancing of costs and pricing.

- ***In Merino breeding, adoption of QG is still low (less than 10% of registered studs and other ram sellers, perhaps 25% of rams sold annually) and genetic gain is considered slow in key traits*** (diameter, fleece weight per animal or hectare), notwithstanding investment in quantitative genetics research and extension and development of various service providers. [4.1.2 to 4.1.5].

- ***Positively, industry and scientific efforts during the 1990s to fine the flock have achieved results.*** Marketplace money signals, backed by industry research and extension have prompted extensive individual sheep testing for diameter (especially on studs) and buying of rams from finer bloodlines.

- ***Over 90% of Merino ram breeders do not use QG systems (over 80% of the target market). A significant number follow 'elite wool' approaches*** [2.2.2.c, 4.1.6], but the majority are using objective measurements for diameter and fibre characteristics on each ram alongside traditional sheep classing for wool quality and sheep features [4.1.7].

- ***Wool industry QG services are provided by a few personalised consultancies. This reflects both industry experience with Woolplan and an assessed need to provide one-to-one explanation and advice*** on QG and breeding programs. This, plus limited market interest [Chapter 2], means that current services are modest in scale (ABS the largest with up to 70 clients), mostly staffed by public sector officers involved in various other work.

- ***There are no apparent far-seeing plans to lead, market and provide QG services on a wide scale to the Merino breeding industry.*** There is enthusiasm but the plans of service units are limited compared to the industry's size. The Rampower software development and its supply to laboratories is a practical-level effort to take a basic EPV service closer to many breeders and growers. Interest has increased, but it has not achieved usage hoped for a range of reasons.

…. \

- ***Genetics is a 'high-tech' field and clients expect explanation and advice as part of services*** whether provided in Lambplan or ABS or other consultant form. Advisers are generally high cost employees, with substantial overheads, and advising takes time. Travel for property visits and workshops adds to these costs.

- ***No government or industry service is charging prices that routinely cover full costs. Clients are partly or wholly subsidised.*** Lambplan recovers above half. ABS feels it covers its added costs. Low cost recovery reflects: cost structures, what services think breeders will pay, breeder views on the value of services, breeder-grower expectations of low prices because of levies and taxes.

- ***Independent QG service providers, existing or new, have to compete on an uneven field*** (although they do tend to have lower costs). Notably, the 'elite wool' consultants appear to charge business rates for their services and they secure and retain breeder clients.

- ***NSW Agriculture has developed much of the key QG software, genetic parameters and reporting systems used by the Australian sheep industry.*** Lambplan has expanded and developed on these as it has grown. NSW Ag distributes software without Intellectual Property restrictions.

- ***Even so, almost all the other services groups (as well as Lambplan) choose to use a slightly different approach to parameters, system and reporting*** because of assessed client preferences and also, it seems, to add-value to and competitive differentiation from the base system [4.2.5]. The different systems are confusing to industry participants.

- ***Sheep data is accumulating rapidly but on different bases and into different systems*** [table above], through the important Central Test Sire Evaluation, Merino Benchmark, SA Demonstration flocks, wether trials, and the various consultancies, plus Lambplan.

- ***Differences and compatibility issues include*** : Enterprises, pedigree, accuracy, links; traits recorded, measurement and data integrity; data collection, delivery, processing, preparing BVs, indexes, comparisons and reports [Part 2, 4.2].

- ***There is apparent scientific agreement on the potential genetic power of a large, national, linked database providing across-flock analysis***.

- ***The marketplace for quantitative genetics and 'elite wool' systems appears to be merging at some points.*** There is a lot of common ground and cross-interests, indicating market opportunities for a stronger genetics services entity.

- ***Any new system should aim to engage and offer services to the 'elite wool' sector for both industry genetics and commercial reasons.*** It now appears that scientists rather than the marketplace are keeping the approaches apart.

2.4 Opinions on genetics services and leadership

Sheep breeding in Australia is a controversial, competitive arena, with 'big money' involved and many different assessments on what the market wants and will pay for. A diversity of views is to be expected on what sort of genetics services are needed in that active marketplace, and whether industry should lead changes.

Forthright comments obtained from discussions, documents and industry interchanges including Lambplan's email discussion line, add depth to the review of the Australian genetics marketplace [2.1, 2.2 2.3]. Considered together, this material should indicate whether there is a need for changed arrangements, whether there is likely to be market support in terms of use and payments, and probable change issues.

2.4.1 Sheep breeders, industry leaders – views and expectations

These insights have been collected mainly from breeding industry leaders. A majority but not all are supporters of QG systems. This is *not* a representative cross-section of breeders or of sheep industry participants [2.1, 2.2], however the comments below represent opinion at the industry change frontline.

On approach to selection

- ***There are three different breeding ways in wool – objective with QG, elite, and traditional on looks. We give priority to measurements and quantitative genetics, so long as style is good.***
- We use breeding values for diameter and weight and other traits, assessing for up to 50 traits for our use and clients requests (eg. crimp definition, pigment, structures). Select first on measurements, then 50-50 on numbers and appearance … both sheep and wool appearances are important economic factors. … discounts for poorer style.
- We have measured for decades. Clients now want family and measurements on rams. Micron and fleece weight provide some rankings but wool type is as important. At 18 microns, style, crimp, can add 300 cents, so micron is not straight micron. Genetic programs will not deliver for fine wools unless type is taken into account.
- Attracted to SRS approach in 1988. Started skin testing for a couple of years ($250 a test) then wool prices crashed. Many people got into real trouble selecting only on the numbers; rough wool. 1993 started looking at type of sheep. Now use measurements, EBVs and indexes, but I know if I pick SRS wool then going finer … got 15% more for SRS wool a bit finer, aligned fibres seem to be a processing advantage reflected in a premium. Also selecting for big sheep, some clients like to sell meat wethers.

➢ **Assessment: Sheep and wool type-style are important in selection and selling, and how this is approached could be pivotal to a successful genetics system.** Discussions confirmed that all in sheep breeding use many-sided selection approaches. In Merinos, breeding for wool and animal style is a critical issue, particularly for fine wools (and those heading finer) and for sheep to run in pastoral areas. Appearance and structure are important to meatsheep breeders.

On genetics services, use and usefulness

- What I can't understand is that so many people using Breedplan get a funny look in their eyes and say 'it doesn't work for sheep'. An art more than science in many ways. I am seeing the results to confirm the (QG) science. Have advocated a Breedplan for sheep. Get EPV calculation services from Select BS, practical discussions are harder. Plan to help some clients work out breeding objectives. A few customers come because the genetic data is available, most don't really care.

- ***If changes have to be made, the sooner the better. … I think the key here is to explain the changes before they happen, so breeders know why something has happened, and hopefully can understand why***. … If under the new pricing policy you are Lambplan Plus then you have access to elites and your animals data every month … anyone serious about Lambplan has to take up the Plus package, or at least a lot of the add-ons.[69]

- Using services mainly for BV and Index calculation and comparisons – not paying for advice. Probably make more decisions with Lambplan, use for wool and meat traits.

- ***We deal with all different geneticist groups for breeding values and reports*** … frustrated by the different flock ID systems, different reporting systems, that we cannot compare or get comparisons of linked rams across Merino Benchmark CTSE and Lambplan … getting full pedigree on 500 ewes, prefer Lambplan datasets.

- There is a mess of different numbers for the same animal or relatives, really confusing for the average ram buyer. Different animal IDs, EPVs, % reporting. No preference for EBVs or EPVs, most important thing is that numbers are consistent and reliable.

- ***Different science groups present their information in different ways, which is confusing and complex.*** Not so concerned about which is better but about achieving uniformity. End-users get confused by too much complex information without basics. Standardisation won't stop niche areas making changes for their marketing.

- Estimated Breeding Values (EBVs) - the value of the animal you are looking at rather than its progeny - are used in all other industries; no advantage in EPVs. EBVs should be in units of product (eg. kg) like every other industry in the world. Phase in change.

- I don't mind the language differences – can translate – same thing in different words. The big thing is the information needed to make for better decisions. Pedigree is do-able in Merinos, so then use a big Lambplan system to get the basic benefit of all that information, and TGRM. No point in putting records into other databases – because not across flock. Their information should be at least combined.

➢ **Assessment: The immediate issues for breeders are (i) the confusion created by different genetics analysis and reporting and, (ii) strong across-flock analysis is not accessible for much existing and new Merino data.** Inconsistencies among Merino trials and services, and between Merino and Lambplan systems are concerns. These breeders want to be able to compare widely through a structured system, and for a range of traits including meat in Merinos.

Most feel neutral on which calculating and reporting system should be used.

[69] On Lambplan, for a summary of marketplace feedback, positives and negatives, see Part 2, 4.1.1.

On further development of genetics services

- ***Industry should be taking the lead in getting a powerful set-up with across flock comparisons.*** Should be one database for sheep, industry to lead and manage, driving change to 'reasoned industry best practice', accessible to all not locked away, with some accreditation for handling business information. But still with competition at the service delivery level. Genetic trends for every trait graphed against the base.

- ***Any new arrangement has to be commercially focussed, on a user pays basis, not just a structure giving scientists jobs*** to do the same thing again, like Woolplan. Levy money should not be used favour some among commercial competitors. Questions raised about favouring some studs during Rampower trials.

- Can make staggering progress in measured economic traits rather than breeding more of the same. Departments of Agriculture try too much not to offend or rock the boat. Merino breeder moves using Lambplan prompted getting breeders together for Merino Benchmark. ABS is now advising on genetics with more courage.

- ***The industry wants standardised EBVs not necessarily indexes. Leave the selection up to the breeders. Need a simple system that works*** … should have EBVs for many different traits and let the breeders pick the traits they want to use. We are very responsive to our customers … so should they be.

- Current genetics set-up is holding the industry back. Some misgivings about different comparative benchmarks … same ram under three systems comes out with different EPVs. Merino Benchmark costs $700 a year at the moment … data is worth more … advantage is a better spread of leading edge genetics than Merino Lambplan and database getting bigger … some important studs are starting to go in … a minority are moving with the science – but still a large conservative group left.

- ***Genetics is the way to go … basically the only saviour for the wool industry. But not sure anyone takes the helicopter view needed to make real progress*** … there are some good people, but a real lack of knowledge about links between quality and price. Need to bring timeframes for breeding forward … in 5 years need to achieve *big* change. Lambplan is good - looking for 4-5 criteria with across flock linkages. Sheep industry generally is frustrating (compared to beef) unclear market performance measures, super-effort needed to know market you are selling into, not translated into price. Also sell wool through agents who give little true feedback.

➢ **Assessment: Vision, leadership and progress is sought, but not instruction**

There is general support for a higher level genetics system, which brings together data collections and provides a range of services more consistently and powerfully, and, some insist, under true commercial conditions .

However, wool industry members warn against the prescriptive, blunt approach said to have been taken in Woolplan. Some seek stronger direction, but the general feeling is that the technical services should help a breeder make selections, not dictate.

On implementing change

- There should always be changes being made to the LAMBPLAN software, as we all don't want LAMBPLAN to stop doing research into our industry. So any changes required need to be done has soon as possible. Then the quicker the meat sheep seed-stock industry can respond to the research findings and make necessary changes to breeding programs. Technology changes are easier to accept a little at a time.

- Overall, I think a centralised genetics data system is a good idea. Some of the hardest issues will be the minor ones – EBVs/EPVs. Need to try to not over-emphasise the Woolplan approach, but need to have reliable, consistent numbers crunched. No prescription on EBVs, breeders decide on use. Important to have protocols to indicate reliability of data before it is made public.

- If going to get anywhere with quantitative genetics in Merinos then need a DNA pedigree test at less than $20. Need a system which co-operates with and useful to major studs. Want to provide the best genetics they can. Have to sell rams at a young age, can pick them best by eye and hand (90%) with measurements as back-up but usually too young – selling rams at 14 months. CTSE local site reports are useful. Across sites not comparable or useful. Different shearing times, ages at tests

- It seems to be a sensible idea and the standardisation of genetic reports through Breedplan is a good example of what can be achieved. However, the parochialism of the wool industry is going to make any transition from the current situation to a more rational model very difficult eg. Woolplan largely failed because it was distrusted as an uncalled-for external interference. This opinion was from some of the most progressive breeders!

  Therefore any planned change will need to have a great deal of effort put into working out the process of change, not simply coming up with a new efficient system. The Better Breeding project in SA seems to be working well with breeders themselves acting as "champions" for the project. Maybe there is something useful to learn from this approach?

➢ **Assessment :** ***The warnings here are that if a new system is to be judged a success it needs to be used, and recognised through its use and results.*** Industry organisations should lead change but in a considered manner, achieving patronage by addressing both the big picture and the detail.

The indication is that any new system should start in a way that welcomes as many groups as possible, offering products and services to suit different needs alongside any leadership and guidance role it might be given or develop. Products, services and approach can evolve with time, with consultation and reflecting market responses.

2.4.2 Views from, and about, genetics service providers

These insights were collected from the different genetics service providers and associates contacted for this study, including principals of fleece testing laboratories, various independent participants and elite wool consultants. *Many of these comments are blunt. They represent realities in the genetic service providers' arena.*

On why develop a new system? The need for change?

- It was appropriate for alternative systems of providing genetic services to build up during the phase of research and development. These systems have now largely gone through that phase and are entering the stage of providing routine services. It is now time to pick the most acceptable of each of them and consolidate. Advisors and others often have to change hats (and vocabulary) in mid-consultation to talk about breeding sheep for meat and/or wool. *It is the Australian Railway system all over again. ….*

Even at the moment, there are a lot of producers out there on both the meat and the wool sides of the industry who are retreating behind tradition because they can't understand the complexities of modern genetics. *Prof. David Lindsay, Aug 2000*

- ***Need to challenge the concept that it is appropriate to develop services for an "Australian Sheep Industry"***. … we have several quite distinct industries and (largely) distinct production systems. Although there is undoubtedly a major role for Merino genetics in sheep meat production, the majority of merino breeders see themselves as primarily or specialty wool producers. They also have production and breeding systems that are very different to specialist meat sheep breeders … I don't think we should automatically assume that a single database or a single genetics service is the best thing for all sheep breeders who have a wide range of breeds, products, breeding objectives, customers, production environments, etc.

- ***There is a whole breeding network where the scientists have no entrée and no-one in science really admits that.*** … there is a 'belief' by state departments of agriculture that a 'consultancy' service will 'fix everything up'… little cooperation between research groups - everyone is chasing the Woolmark / MLA $'s …which is an important factor for those working for government organisations.

- The 'database' issue …sick of the politics, wastes too much time, at the end of the day keep coming down to the difficulties which exist between individual geneticists, the issues this presents and a certain degree of frustration at the futility of attempts to achieve cooperation.

- Bringing together developing databases into a national system … I hope that this is what will eventually happen. It is confusing for breeders to see 2 sets of EBVs (or EPVs and EBVs), and many of them do not realise that they are not comparable … Many breeders point to the fact that the results are different and use this as evidence that geneticists don't know what they are doing! Arguments about units (kgs or %), and EPVs or EBVs are a red herring. These should be easily inter-changeable, and should be made available in the units that clients want. The biggest issue is getting a decent across-flock analysis for merino industry, using all data available (eg. CTSE).

- ***We need one something (system), multiple approaches are frustrating and confusing to breeders. Then the biggest hurdle is progeny testing.***

On points to consider in achieving change

- ***The biggest problems will be … Inter-personal problems among some of the researchers who have been doing the work to date, and with that.... Ownership jealousies*** (My system is better than your system) … but none are so fixed that they wouldn't see what they needed to do if major decisions were made.

- Is this just a Lambplan takeover bid? Lambplan is currently too focussed on making the service commercial and have forgotten about the science and therefore credibility behind what they are doing.

- What has happened between those CSIRO scientist groups is disgraceful in what it has done to the wool industry [referring to the QG – SRS/elite wool split].

- CTSE is not going particularly well. 10 years ago I thought people would make money out of CTSE, but no real examples of this. Some QG users have not done so well (a few have). Probably not enough light (yet) between QG and using measurements with classing. For sheep run under extensive conditions; so many other things affect performance.

- We are pretty close to providing higher level genetics services – evaluation, advice and data, workshops, classing, for individual clients. We would be interested in using the information and analysis resources of an accessible database.

- We are advisers not data processors and could be interested in information services ... any recommendations which come out of your report must be subject to fully commercial survival of service providers.

- I feel quite strongly about the idea of a 'shop-front' in each State, located within each agriculture department.

- The kind of genetic databases that have been compiled are of limited value because they exclude information that is essential to achieve continued high increases in productivity and processing performance. The establishment of a single sheep genetic database modelled on existing databases would further institutionalise the present wastage of woolgrower research contributions.

- Firstly separate all ram breeders into 3 classes. The genetically educated who will use and absorb the EBV results and reports. They need no hand- holding so all they need is hard copy or on line results. The large breeders who sell 50% of all rams and who use consultants (private, public) to interpret and recommend say home sire evaluation procedures, and to interpret the data bank results where publicly available. The remainder are genetically unimportant !

- ***As a first step towards a common data base we could make our data available to each other on the basis that the CTSE central database is made available freely for analysis but with restrictions on reporting.*** That would mean that each service provider could do an analysis using the full data set, and so get the "best" results for the industry. But it would not allow one provider to publish the global report and in so doing put the others out of business… a step forward … create a situation where multiple operators were essentially performing identical analyses, and the obvious inefficiency may well lead to further progress… an impetus for co-operation.

Assessment: On views from and about genetics services providers

- ***There are few sheep genetics scientists in Australia. A number of senior scientists have contributed very substantially over many years in research and this is acknowledged. But there is also history behind the stand-off among individuals at the senior level***, coupled with significant personality differences and project arrangements which let researchers set much of the delivery framework (even where there are consultative committees).

- ***Of concern is the frustration felt by the next level of younger scientists*** and agricultural technology advisers, with the 'goings on' among their seniors and how this influences the vision and interest of the younger practitioners.

- ***These strained interfaces also influence the public positions taken by genetics service providers, contributing to the confusion and complexity*** of QG systems both in reality, and as seen by sheep breeders (whether clients or not; most are not).

- ***Competition in the absence of marketplace dynamics*** (reward or reckoning) is not always productive, can be an inefficient use of industry levy resources, and not conducive to 'taking a helicopter view'.

- ***The interactions of senior researchers and extension leaders has flavoured various comments received during this Study***, from breeders as well as from the geneticists and associates. Commercial, vested and proprietorial interests are apparent and seem to prompt some positions on not changing current arrangements.

- ***These people issues will come to the fore, and should not be avoided by the wool and meat industries when considering options*** for any new Australian sheep genetics system. For instance, the question of EPVs or EBVs is said by most to be a 'minor issue', but there are very firm positions and the decision will be seen by quite a few as symbolic of which group 'wins' – unless the people issue is openly grasped.

- ***Overall, it does seem that many professionals in the sheep genetics arena see that the time has come for key decisions on future service arrangements. They are looking to industry organisations to lead such decisions.***

2.4.3 From sheep industry reviews

Advancing productivity gain through 'genetics' gets strong mention in most reviews of agricultural industries. The concept is attractive and high-tech, and in intensive animal industries there have been dramatic results, alongside degrees of restructuring [1.3.1].

> We recommend that growers …
> Improve their flock performance with better breeding practices based on proven genetic techniques. A new genetic improvement company would work with breeders to improve the genetic stock of NZ sheep. *McKinsey and Company, June 2000* [70]

In the main, when reviews refer to proven genetics techniques' or 'superior genetics', they are advocating extension of Quantitative Genetics principles, and perhaps reflecting some of the frustration about slow adoption embodied in submissions received from scientists and some breeders and producers.

> *Wool Industry Taskforce (McLachlan) Report 1999,* Recommendation 6
> Woolgrowers should:
> - aim to achieve annual productivity improvements of 3-5 percent, even after they have reached "best 20 percent" cost levels;
> - assess their overall farming structure and the feasibility of improving land, labour and risk capital productivity via increased purchases or leasing;
> - improve pasture productivity and pasture management practices; align key sheep events (lambing, shearing) with annual pattern of pasture production; and
> - accelerate the rate of genetic improvement, utilising the results of comprehensive analysis now available (for example, Merino benchmark).

All is not as straightforward as perhaps thought by whole industry review teams, as demonstrated through Parts 1 and 2 of this Study.[71] However, this does not mean the aspirations are out of place. For instance, as many point out:

- ***The Australian sheep industry is and will continue to be widespread and grazing based.*** Large numbers of sires will continue to be needed for stud and commercial breeding flocks, offering different challenges to QG principles.
  - ***Yet, many of the these challenges can be met in practice*** as evidenced by Lambplan adoption in meatsheep breeding with genetic gain [4.1.1] and by Merino Benchmark progress [4.1.2].
- ***Wool in is an especially complex product***, with many dimensions to its value at wool sales, and (in a separate marketplace) to the value of Merino rams [2.1.1, 2.2.].
  - Even so, measured average fibre diameter, and amount of wool grown are key price determinants in wool and ram selling. Measured or assessed style or type are becoming more recognised in QG systems [2.2.2, 4.1.]

[70] McKinsey and Company, *Report to New Zealand Woolgrowers on Improving Profitability*, June 2000.
[71] Clues on industry contention are often in the subtext of inputs to broad reviews: eg. "There should non-biased research on merino genetics and breeding. Muller, R & H Avoca Vic Woolgrower in *Appendix 3. Submissions to Wool Task Force.*

- ***The 'sheep industry' is not a single entity, nor is the 'wool industry', or 'meatsheep industry'. Sheep business enterprises vary greatly, as do manager motivations and priorities*** [1.2]. The Wool Task Force stressed that "the diversity in wool should be celebrated" and censured consensus decision making. In some contrast, the McKinsey report for NZ Woolgrowers, recommended a number of centralised wool businesses including one for genetics services.

  - ***The potential to provide services to diverse business enterprises and specialised groups in the broad sheep industry would likely be increased*** by bringing together genetic data collections and establishing a powerful genetics services system. Operational and development costs could spread over a larger client and industry base.

In his recent review of Woolmark's Rampower projects, Prof. David Lindsay advocated a model that also provides valuable guidance for this Study and the consideration of Options in Chapter 3.

The challenge for *Rampower* or its successor now and in the future is to convince ram breeders that they can still control the breeding of their animals totally and that there are powerful tools and services available that can assist them in that breeding policy when and if they want them.
Secondarily, it should endeavour, within this constraint, to encourage relatively common goals in breeding to avoid dissipating the breeding effort.

A complete breeding system servicing the Australian wool industry can be envisaged as having a series of closely linked components. It must include:

1. Face-to-face servicing of sheep breeders and flock owners including • advice • measurements and storing of data • data processing and interpretation
2. A servicing package or product (eg *Rampower*)
3. Software for genetic evaluation, within and across flocks.
4. A national database
5. Supporting research and development at two levels • strategic or fundamental, • implementation
6. Supporting education, training, extension, demonstration and accreditation.

There are strong dependencies and interdependencies that make it vital that the whole system be coordinated. For example:

- Most breeders will need a reliable source of advice on genetics.
- Most advisers or agencies will need access to packages and software to process flock data
- Most advisers or agencies will need access to advanced processing software (BLUP) and to the national database for cross flock, sire evaluation and other data.
- The databases will depend on constant updating from breeders flocks.
- Training, demonstration and extension will be needed to keep all parties up-to-date and to expand services when and where necessary.
- Well designed and maintained, comprehensive databases are invaluable research resources.

3 One sheep genetics system? options, issues

3.1 Moving ahead and defining a vision

- **The time is right for sheep industry leadership to work toward a single Sheep Genetics System based on quantitative genetics principles, and which : -**

- ***is marketplace oriented, noting a range of market segments***
- ***offers return on monies invested to many in the industry – so it is used***

- ***is genetically powerful, but flexible to service needs***
- ***obtains strength by urging current systems together, then building, and by supporting a diversity of genetics advice providers***

- ***includes a broadly and neutrally available service centre***
- ***promulgates a common language for industry wide products through informative and professional communications***

- ***builds a broad and varied, indirect and direct, client base, including breeders, producers, a range of advisers, businesses, researchers***
- ***is able to aim for commercialised operation by spreading costs***

- ***leads in a considered way, building broader market interest in Q genetics***
- ***learns from the past in terms of market needs, science and management***

This assessment and 'vision' for a new system, is a conclusion drawn by balancing the many points identified in Parts 1 and 2 of this Study.

This is a Vision for a sheep genetics service system that would be used by clients in support of industry businesses, as part of their quest for profitable genetic advance.

The key targets for such a system are usage and usefulness. Notably, this Vision does not set out to secure genetic gain in itself. Genetic gain should be achieved, with prompts from market price signals and wider industry activities, but methods may be diverse, as noted during discussions among wool industry genetics interests in May 2000.

> "The Woolmark Company convened a meeting of 35 wool producers, ram breeders, consultants and researchers … to identify how best to achieve accelerated genetic gain in Merino sheep …
>
> While the meeting considered the various approaches currently undertaken by breeders, the meeting did not to seek to determine whether one approach was better than any other. That is a decision for individual producers to make based on the best information available."

Many factors need to be reviewed in assessing the likely optimum form for such a system – and, importantly, to avoid an industry 'white elephant'.

3.2 The assessments from PART 2, 4.2, on current arrangements and compatibility
3.3 Sets out probable key elements of a potentially successful system, as identified through Chapter 2, and cross-referenced to those sections.
3.4 Considers four options with regard to achieving the Vision and key elements.

3.2 Current services: methods and compatibility [from Part 2]

Having outlined a vision for servicing anticipated marketplace needs into the future, key elements of a potentially successful sheep genetics system can be identified [3.3] and options considered [3.4].

Before doing this, further understanding is needed of any 'compatibility issues' among the current performance recording, BLUP and reporting schemes.

Science based selection is more complex than sheep classing with measurements. QG requires consistent on-farm animal ID, sampling and data records, plus an integrated support structure for measurement, data collection, processing, calculations, expert adjustment of the genetics base through to indexes, reporting back, explanation and ongoing advice. There is potential for variation among service providers in all these areas. Some differences are more critical than others.

Compatibility, or lack there-of, among the Lambplan, ABS, and other schemes, can look like a significant obstacle to change (or equally, a major reason for moving fast to bring processes and information together).

> "There are already serious problems of incompatibility between different softwares for collection collation and storage of flock data on the one hand and between these and the packages that create breeding values and indexes on the other. They are likely to get worse." *David Lindsay, Rampower Project Review 2000*

For these reasons, a significant part of the research and interviewing for this Study has centred on investigation of details of each scheme and how they might interact.

As understanding has developed, the scale of compatibility issues has contracted.

- **Overall assessment: W*ith investment, energy and good faith, a single, a national database for sheep genetics information could be constructed.*** Should the owners be convinced, several of the current data collections together would provide a strong start to the database, which should then grow.

  There would be issues to be addressed in forming up a national database. The most important of these appear to be:

- Pedigree and accuracy: Various schemes are taking different approaches on what is practical and needed in pedigree (knowing a lamb's sire, dam) [4.2.2].
- Some entrenched positions: All user groups would need to adjust to new forms of reporting. Such technology change is common nowadays. Users say they want a common system, but originators may feel differently about change [2.4, 4.2].
- Investment – deriving a common system that brings together current resources voluntarily, and carefully translating key blocks of information will take time and resources, raising issues of priority and policy [3.6].

3.2.1 Different ways and integration questions

The more detailed workings of main quantitative genetics services, their associated data collections and analysis approaches, including questions of compatibility are considered in PART 2, section 4.2, under the following headings.

4.2.1 Summary of sheep genetics data collections [also 2.3.1 above]
4.2.2 Enterprises, pedigree, accuracy and links
4.2.3 Traits recorded, measurement and data integrity
4.2.4 Data collection, delivery, processing
4.2.5 Preparing BVs, indexes, comparisons, reports

At the end of each sub-section in 4.2, an assessment is provided of any identified issues, and recommended steps to address them. These appraisals are set out below in same form as in 4.2. For full understanding, section 4.2 is the better reference.

4.2.2 Enterprises, pedigree, accuracy and links

Appraisal: **Better data should be a bonus not a barrier**

- ***Developers of a single system should address realistically practicalities and costs*** to studs of collecting pedigree / environment records, and prepare tools to assist. Relative value added by pedigree/environment data needs to be considered.
- ***Using proposed Lambplan Accuracy reports bluntly for all EBV calculations could disenfranchise*** many Merino breeders now involved and deter new clients.
- ***There should be enough linked data in CTSE, Merino Benchmark, Fine wool, SA trials and Lambplan to realise a powerful single database –*** all records discrete but some linked. Any records from ABS' client collection and other current holdings would be welcome additions.

4.2.3 Traits recorded, measurement and data integrity

Appraisal: **Few compatibility issues; room for collaborative development**

- ***Data in various collections share a few to many common traits.*** A growing single database would have large subsets (fleece / carcase priorities) with rising links.
- ***Lambplan offers the more extensive trait recording, calculation and reporting set-up*** and could be further adapted, as could BVEST to an extent. Rampower 2000 is designed for more streamlined usage.
- ***Both public QG systems concentrate on measured 'objective' traits*** although Lambplan can record many visual scores. Neither Lambplan or Rampower 2000 offer the developed scheme for ram and wool 'type' or 'style' (including crimp) that could be vital to wider acceptance and use of a sheep QG system [2.4.1]. Neither presents itself as open to custom by breeders using elite wool selection approaches. … \

- ***Development of a practical Quality Scheme*** for a single genetics system should draw on the work and experiences of Lambplan, Merino Benchmark and CTSE.
- ***There is opportunity to build confidence in QG systems, improve data quality*** and to aid breeders by practical standardisation of on-farm recording and measuring procedures. Service officers could be accredited for a range of tests. Such a high-resource effort might be realistic if a large number of potential users could benefit.

4.2.4 Data collection. delivery, processing

***Appraisal*: A basic sheep ID is established; work is needed to extend use.**

- ***Systematic animal identification is needed for wide across-flock comparisons*** and ID should look toward this. Lambplan, Merino Benchmark and CTSE are using the same sheep ID format, although the issue of changing ID can still arise.
- ***Extending this ID scheme in a practical way for new data entering other collections, should receive priority*** if a decision is made to work toward a single national database. Incentives are needed to use the ID and to retain one ID for life.
- ***A second stage would include sorting through other current data collections,*** where accessible, for links and useful data and aligning IDs and records.

Appraisal: **A foundation for data analysis exists; data collection is a challenge.**

- ***Differences among the OVIS, BVEST and PEST systems are not big, and do not seem to concern scientists involved in sheep industry genetics.*** The larger source of potential differences among BLUP systems arises from calculation adjustments and parameters.
- ***The OVIS genetic analysis system should be able to service BLUP and associated processing requirements for the sheep industry as a whole***, with data accumulating at over 500,000 animal records a year, for many years. As for all systems, improvement would continue (eg. to handle embryo transfers).
- ***The logistics of data collection from on-farm, via measurers, and transfer to a database point, is a more challenging issue for any larger QG system for sheep.*** Lambplan collects 110,000+ new animal datasets a year, through stages supported by software and some specialists. Active development of QG services could *give a data flow five times larger* – if target markets were achieved [2.1].
- ***Should a single database system arise, the sheep industry would be very dependent on its services, management and planning.*** Procedures and performance would need to develop to ensure services, using experience from Lambplan and other groups.

4.2.5 Preparing BVs, indexes. comparisons, reports

Appraisal: **Compatibility issues can be addressed, after top-level decisions**

- ***Divergences in Adjustments and Parameters for sheep BLUP processing should be minimised by a single database and BLUP evaluation***, well maintained, responsive to input and not lagging research. Various service consultants would be less inclined to define their own parameters.
- ***A common BLUP result reporting language is needed. Current mixed use of EBVs and EPVs, in different units, adds forbidding confusion to an already complex set of concepts.*** Some users will need to adjust in order to develop a system more inviting to new users. Step changes do need to occur as technologies develop.[72] Two sets of figures could run in parallel for a limited time.
- ***From the analysis for this Study, it is recommended that a sheep industry genetics common language be built from current approaches, using***:
  - ***EPVs (Expected Progeny Values)***: these are logical and understood in the Merino arena where the major market growth is sought. Lambplan users are large in number, but mostly well-experienced and should be able to adjust to EPVs. The industry could consider a new name, such as Gene Power Values.
  - ***Units of measurement (test or score)*** for the trait to quantify the EPV difference from a trait baseline (not % deviation). These are logical and real.
- ***Different baselines present a challenge. Alignment of data collections with various bases can be achieved.*** Genetic links among the sets would be used for alignment (advice from AGBU). A set of baselines would be needed for key sub-sets of a database. Alignment should give priority to main baselines in use (so, adjust Lambplan Merino data to CTSE bases).
- ***Any system will need to provide within-flock and across-flock analyses and reports,*** to attract and service a large part of the sheep genetics marketplace.
- ***Selection Indexes do not need to be standardised.*** A feature of SI is that they should reflect the Breeding Objectives of the user. Various service providers should develop indexes to suit general and specific client needs, but calculate SI rankings from EPVs processed in a standard way.
- ***A set of Sheep Industry Indexes that guide selection towards marketplace driven objectives*** (recognising sub-markets, and taking a forward view) would be important, if industry organisations decide to take a genetics leadership role.
- ***There will be data ownership issues under any changed arrangements. A breeder's commercially sensitive information should be protected.*** Once records enter a database, the data should be open for use in database operations, for unidentified comparisons within and outside the database, and for research.
- ***Decisions on industry priorities and the envisaged form of an Australian Sheep Genetics System, will influence handling of these issues.*** An 'Integration Project' would be needed, as part of the planned development.

[72] In recent times, wool testing changed from an Airflow system to Laserscan with considerable associated benefits. Test results were not identical, but the change was successfully implemented and the industry adjusted. The Dairy Industry QG system (ADHIS) has also recently changed its comparison baseline, with explanation to users.

3.3 Key elements of a potentially successful system

A vision for a single sheep genetics system is set out in 3.1. Current arrangements and technical interfaces are considered in 3.2. From these, plus the insights in Chapter 2, a set of Key Elements of a potentially successful system can be defined. These should be refined with closer examination of markets, stakeholder feedback, as ideas emerge on costs and returns, and as policy and management questions are considered.[73]

Key element 1: An overall system, oriented toward markets and targets

1A: ***Scale*** - able to provide its services, directly or through advisers, to an estimated:

a 1,600 breeders/studs and some 500,000 new animals for analysis each year [2.1.1] – being 800 Merino studs (320,000 animals), 800 meatsheep/others (180,000)
b 400 specialised commercial sheep producers, spread widely [2.1.2]
c Plus, a range of genetic advice providers, industry businesses, researchers [2.3].

1B: ***Market flexibility*** - to support market segments and various needs, including:

a General reports for wide audiences, specific reports for those seeking them
b Support to public or private consultant advice services of varying expertise [2.3]
c Catering for diversity of opinion on ways, while providing industry guidance [3.1]
d Engaging and offering services to 'elite wool' and traditional sectors [4.1.6, 4.1.7].

1C: ***Service innovation*** – useful products at viable prices, explanation and advice to encourage usage among target markets and to build custom, via

a A viable common language for use and comparisons by many participants [2.4]
b Client services that can recognise levels of contribution to the data system [2.3, 2.4]
c Seriously addressing the question of selection for Type or Style [2.2.2, 4.1.6, 2.4]
d Ongoing streamlining of processes for clients from paddock to selection decisions.

Key element 2: A strong genetics base sufficiently powerful in capability and capacity, and responsive, and cost effective

2A: *Technology power* – to enable use of quantitative genetics to the scale in 1A, and to encourage both client interest and rapid genetic advance, via

a A high-capacity BLUP system able to cater mechanically for various adjustments, groups, different parameter sets, growing quantities of linked data, various reports
b Mechanisms for bringing together accumulating data in differing systems [2.3, 3.2]
c Considered approaches to privacy, intellectual property and contracted services.

2A: *Technology flexibility* – to encourage much higher usage of the QG system

a Capacity to run small within-flock and large Across-Flock analyses [1.3, 4.1.1, 2.4]
b Capacity to positively deal with varying levels of animal pedigree data [2.4, 4.2.1]
c System support to front-line genetics and new research, with an eye to costs.

Key element 3: Management to achieve stakeholder objectives, via

a Optimal use of technologies, different expertise, co-operative arrangements [2.4]
b Management and service delivery to meet performance targets and contracts [3.6]
c Business thinking and planning, to achieve income-cost balances set by stakeholders
d Taking a genetics leadership role to the level sought by the sheep industry [2.4].

[73] The 'key elements' come from the analysis points through Chp 2 and Chp 3. The investigations behind the analysis are not repeated here. For explanation of 'why', cross-references refer to the relevant sections.

3.4 Options: Degrees of change and leadership

Four options are considered, with gradients of change and industry leadership. These are: 1. Continue current arrangements; 2. Develop a common language for the current arrangements; 3. A consolidated service database; 4. A pro-active system.

3.4.1 Continue present arrangements

Features: Eight QG public/industry groups and 2 private providers loosely linked by BLUP software, key parameters and some communication. Not sufficient strength to be a 'system'. Power rests with data holdings, research funds and status, and having some clients – with competition for all three. Most QG groups recover little of the true costs of services. Some commercial enterprises receive high service at low cost.

Services to Merinos are moderate in scale, run by public sector officers involved in various other activities. Results have been achieved, but less than 10% of total studs and less than 20% of the target market has adopted QG. Perhaps 20% of rams sold have QG selection behind them, with some flow on effects. Within this set, across-flock evaluations are growing.

Lambplan reaches near 50% of terminal sire studs and 70% of rams sold. All analysis and reports are across-flock. Genetic gain from QG selection is evident. Adoption is much lower in maternal sire breeds. Lambplan recovers over half of costs and has a strong set of QG tools and processing resources.

Potential: The concerns identified in Parts 2 and 3 relate to the current arrangements – which involve sizeable funding by MLA, Woolmark and State governments.

- Continuing with present arrangements would not address these concerns and issues, and the problems would get worse.
- There is low potential for attaining a target sheep industry marketplace for QG services of 2,000 users (or even 1,500) and no far-seeing vision to achieve this.
- The wider marketplace is not very interested in current offerings and what's involved. The 130 or so Merino breeders now using QG might double in five years with strong marketing by service groups and individuals. Lambplan use is flattening at about 600 members but could grow with marketing.
- OVIS technology could readily service a system with 2,000 clients (500,000 new animals a year). Logistics for data collection and reporting need development.

Issues: On the surface, this is the simplest option, as there is much involved in achieving major change. However, concerns about current arrangements can be expected to compound. Most in the genetics service sector are now expecting change.

Any new developments would require co-operation among a range of industry and government entities, at both policy levels and genetics services levels. It is anticipated Woolmark and MLA would support change directions with funding decisions.

3.4.2 Current set-up, common language

Changes - Outline

- Collaborative effort to introduce a common identification system for sheep of all breeds used in industry trials and QG breeding programs.
- Collaborative development of a common language covering sheep breeding values, reporting units, and report styles for all future reports.

Aims:
- One animal being identified the same way in as many trials, analysis schemes and data collections as a possible, for current and future use.
- Results for the same animal in different reports to be identical or similar with reasons for differences centred around the animal and its progeny, not scientific format. Common approach to explaining differences.

Further work: Align sheep identification, and across-flock comparison baselines used in different data collections. This would start to involve adjusting the historical data in collections (which is a larger exercise) [3.4.3].

Potential: A standardised sheep ID for new animals entering trials and analysis should not be difficult to introduce, with co-operation, and would set a positive foundation for future use of data in across-flock evaluations.

Developing a common language could bring the eight QG service groups and other private providers closer together and should reduce confusion in the quantitative genetics marketplace, if it were followed.

Issues: Standardising language and ID among existing and some anticipated service providers is at best an interim measure.

- ***A common language would deteriorate in short time without a centre of focus.*** As has been seen, the propensity of service providers is to 'add-difference' rather than follow set forms of presentation. Some breeders also add their own twist. A common language needs an originating focal point.
- ***Potential for achieving a target market for sheep QG services of 2,000 users*** is a little higher. Less conflict and better understandability could persuade some to try a QG system. Many will continue outside.
- The small-scale, within flock, consulting focus of most services would continue. Common sheep ID will assist future across-flock analysis but will not achieve it.
- The resources across sheep industry services are used no more efficiently, with no possible reduction of service delivery costs through economies of scale.

3.4.3 Consolidated service database: calculation power

Changes - Outline

- A joint industry Database Exercise to define and implement all arrangements for a powerful, cost-efficient single sheep genetics database with distributed input and access to by many users, under reasonably open terms and conditions. Identify arrangements and conditions to attract the industry target markets.
- Agreement on processes and responsibilities for maintenance, development and ownership of the database, reporting, data collection and input, roles.
- Collaborative development of a common language covering sheep EPV reporting by those utilising the database, plus common sheep ID.
- An Integration Project to align (in terms of sheep ID, baselines, EPVs, report units, links, etc) as many useful records as possible from data collections willing to contribute records to a national industry database.

Aims

- To address issues identified in this Study as much as possible.
- To achieve a workable, powerful, useful, single national database service, with distributed access to all interested (including service providers and researchers outside current groups).
- To make best use of resources groups can contribute and of new ideas
- Common ID and language for input, calculations and reports (as for Option 2).
- Defined roles/contracts for the parties, with the Database operation being an 'engine room' for breeder and industry service activities developed by various genetics service providers under their plans and programs.

Potential: Bringing present and future data collections into a single database with a robust common language, should increase capacity of genetics service providers to deliver within and across flock reports to clients, more cost efficiently (costs being spread across more users). This, plus a well-designed database operation, should attract clients with input data, plus researchers.

Issues: As an 'engine room' the Database Operation would be constrained in its wider contribution to sheep industry genetics and development.

- ***Potential for developing a larger sheep industry market for QG services is better but not high***. Powerful QG services would be more available, however marketing and explaining of QG and promotion to involve more possible users (elite wool, other scanners) would rest with current arrangements (industry entities, 8-12 genetics advisers, most in consultancy style). Few new advisers are expected. Government centres, now expected to charge a full cost recovery price for advice to individual commercial enterprises, will face issues with marketing costs.
- How the single database evolves will depend much on the person(s) appointed to develop and run it. A front-room manager and/or geneticist will, over time, drive a higher profile operation.
- A range of policy and legal issues would likely arise in restricting access to 'genetics service providers'. Some breeders or breeder groups may seek direct processing of their data – bringing the need for advice and a higher profile.

3.4.4 A proactive system: services for an advancing industry

Changes - Outline

- ***A joint industry Sheep Genetics Agency Project*** to define and implement all arrangements for a authoritative, cost-efficient sheep genetics bureau, taking a genetics development leadership role, mainly by providing wide industry database and QG reporting services to genetics advisers and a range of users
- Agreement on processes and responsibilities for maintenance, development and ownership of the database, access, reporting, data collection and input, roles in industry genetic development, advisory committees, accountabilities
- ***A Market Needs sub-project*** : Identify arrangements and conditions to attract industry target markets and build usage, including animal/wool type and style, elite wool, QG demands, data collection and reporting, support to advisers
- ***A Language sub-project*** : Collaborative development of a common language covering sheep EPV reporting by the database to users, plus common sheep ID
- ***An Integration sub-project*** to align (in terms of sheep ID, baselines, EPVs, report units, links, etc) as many useful records as possible from data collections willing to contribute records to an industry database.

Aims

- To address issues identified in this Study as much as possible, including the need for industry leadership and pro-activity to develop use of quantitative genetics services without prescribing breeding decisions.
- To achieve a workable, powerful, useful, single national database service, with distributed access to many users (encouraging service providers and researchers).
- To make best use of resources and ideas current or new groups can contribute.
- Common ID and language for input, calculations & reports, communicated widely.
- Defined roles/contracts among the Agency and various stakeholders and clients, including recognition of various contributions by stakeholders (data, expertise, funding). Defined Agency responsibilities in genetics leadership and marketing.
- A commercialised basis to operation. Making industry investment widely available, and services as price-attractive as possible, by spreading costs.

Potential: ***This option offers the chance of achieving a major increase in use of Quantitative Genetics across the Australian sheep breeding industry*** (up to 2,000 users), via market-focussed development of a leading service agency that builds on experience and existing scientific and technical resources. Given that adoption of QG principles is crucial for more rapid genetic gain, this option offers a pathway.

Issues: This would be a higher profile activity, potentially controversial.

- ***A range of policy and priority questions on investment of resources arise for the wool and meat industries,*** plus broader questions such as competition policy.
- How the Agency evolves will depend much on the person(s) appointed to develop and run it, and on Industry advising or decision committees. The Agency would need to perform well in many senses. Parts of the sheep industry will depend on it.
- Positive competition among genetics advisers and service providers is important, and the Agency should not reduce this. Mechanisms to introduce competitive accountability into the Agency's operations should be considered.

3.5 Apparent best option – look to the marketplace

In determining a direction of change, it is critical that industry organisations 'look to the marketplace'. Not just to current market interest and activity, but to the probable marketplace and sub-markets for sheep genetics services into the future.

The Vision for an Australian Sheep Genetics System [3.1] and the more specific Key Elements of a potentially successful system [3.3] were developed from investigation into the marketplace [Parts 1 and 2]. The Table below shows assessments of how each of the four Options does or should meet the Key Elements. In each, the assembly of services is viewed as a whole (ie. services for wool and meatsheep together).

5 = arrangements well meet this Key Element 3 = moderately, reasonably 1 = inadequately	**Option 1** **As at present**	**Option 2** **Common language**	**Option 3** **Database operation**	**Option 4** **Proactive Agency**
	Current	Potential	Potential	Potential
Key element 1: An overall system oriented toward markets and targets				
1A: ***Scale***				
a target 1,600 breeders, 500,000 new animals pa	1	1	2-3	5
b 400 commercial producer breeders	1	1	3	4
c wide range of service providers	2	2	4	5
1B: ***Market flexibility***				
a general wide-use reports & specific reports	3	3	3	5
b support a variety of consultants and advisers	2	2	4	5
c work with diversity of opinion giving guidance	1	1	2	5
d engaging elite wool and traditional sectors	1	1	1	3
1C: ***Service innovation***				
a viable common language	1	3	5	5
b recognising levels of data contribution	3	3	4	4
c addressing type and style needs	1	1	1	4
d streamlining processes paddock to selection	3	3	4	5
Key element 2: A strong genetics base sufficiently powerful, in capability and capacity, responsive, and cost effective				
2A: *Technology power*				
a high capacity BLUP system	4	4	5	5
b solid mechanism for bringing data together	2	2	4	5
c approaches to privacy, IP, contracted services	3	3	4	5
2B: ***Technology flexibility***				
a within flock and wide across-flock	2	2	5	5
b positively addressing animal pedigree issues	3	3	4	4
c system support to front-line research	3	3	4	5
Key element 3: Management to achieve stakeholder objectives				
a optimal use of technologies, expertise	1	1	3	4
b manage to performance targets /contracts	3	3	5	5
c business planning, cost/income balances	2	2	4	5
d a sheep industry genetics leadership role	2	2	2	4

Assessment: **On Options for change and development**

- ***Introducing a common language and ID alone appears to not be worth the costs*** in terms of expenditure and disruption to current arrangements and communications, although Option 2 could lessen confusion to some extent.
- ***Options 3 or 4 should bring advances. Under Option 3, Merino breeders seriously using QG services would obtain stronger selection information in a common language,*** with probable higher rates of gain (as for meatsheep now). Option 3 would rely on current advisers and consultants and any newcomers, to promote use of QG services. Marketplace expansion would be moderate or slow.
- ***Option 4, additionally offers industry leadership in developing and promoting market-oriented, flexible, quantitative genetics services, plus potential for much wider adoption of these QG services in the sheep industry***. Option 4 could reduce scientific and organisational barriers to industry wide access to benefits of past and ongoing R&D investment.
- ***Other considerations, wider than the genetics marketplace, would also likely influence Woolmark and MLA support for a Consolidated Database, or a proactive Sheep Genetics Agency***, or for more limited change, including :

  - Does the outlook for sheep (especially wool) industry benefit from Quantitative Genetics justify current or higher R&D investment vis-à-vis other priorities?
  - Should an Agency or Database be required to operate on a commercial basis, giving priority to business development and viable financial operation?
  - If not, in recognition of 'industry-good', what proportion of grant funding might be anticipated, and how much income will need to be earned from users of a Database or an Agency? (Pricing would affect usage, number of clients would affect costs and prices).
  - What degree of subsidised assistance to individual commercial enterprises is reasonable and under what circumstances ?
  - Does the development of a proactive Agency or an engine-room database fit better with the planned directions and 'industry positioning' of MLA and Woolmark ? at this time?

These questions are outside the scope of this Study, but form part of the environment that would define a useful, and so, potentially successful new Australian sheep genetics system.

On balance, from the analysis in this Study,

- ***IT IS RECOMMENDED that Woolmark and MLA give in-principle support to development of a joint-industry Australian Sheep Genetics Agency as focal point to an integrated genetics service system.***
  - Some additional preparatory and planning work would be needed before decisions to proceed, including on potential to harness existing systems.
  - Option3 – a Consolidated Database – should remain under consideration during these further assessment stages.

3.6 Towards an Australian Sheep Genetics Agency

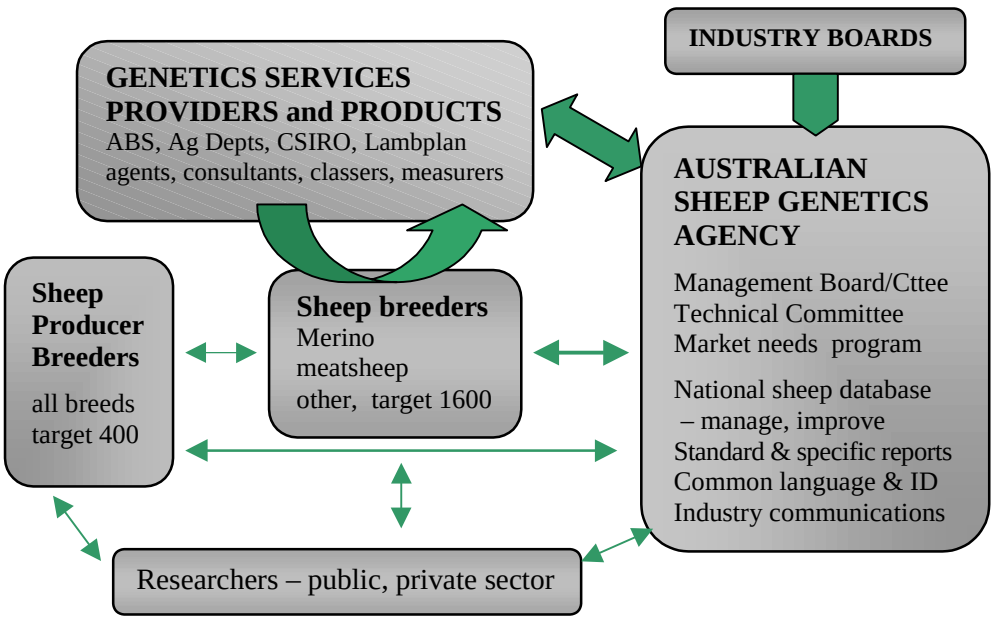
Planning and development should focus on achieving a model Australian Sheep Genetics System, which:

- is marketplace oriented, noting a range of market segments
- offers return on monies invested to many in the industry – so it is used
- is genetically powerful, but flexible to service needs
- obtains strength by urging current systems together, and building, and by supporting a diversity of genetics advice providers
- has an accessible and neutrally available service centre
- promulgates a common language for industry wide products through informative and professional communications
- builds a broad and varied client base including breeders, producers, and a range of advisers, businesses, researchers
- is able to aim for commercialised operation by spreading costs
- leads in a considered way, building broader market interest in Q genetics
- learns from the past in terms of market needs, science and management

Within an emerging new system, the proposed Australian Sheep Genetics Agency (ASGA) would take a pivotal service function – anticipating and meeting the needs of many sheep industry participants including specialised service providers.

ASGA would also take a lead role in sheep genetics evolution – to attract and service various clients, to build the database, to build breeding industry use of QG.

An Australian Sheep Genetics System – probable interfaces



There is no suggestion of meat or wool industry organisations looking to run all parts, although R&D funding could reinforce priorities. A challenge is to encourage current and additional genetics marketplace participants to join into a new genetics system.

3.6.1 Development steps and an Agency framework

A decision to proceed with an Australian Sheep Genetics Agency would place substantial responsibility on the industry owners, and on the development and ASGA management team, to achieve an Agency that would be seen by industry members as successful, within five years.

.a. Stages toward ASGA and a new System

- ***An in-principle decision to develop an Agency***, [say, January 2001] specifying
  - broad expectations and timeframes
  - probable form of joint or single industry ownership (or alternatives)
  - broad priorities and guidance on approach to achieving ASGA

- ***Appointment of ASGA project head, industry communications, discussions***

- ***Preparatory stages and further evaluation*** [February to May 2001]
  - Action on sheep ID in currently funded trials
  - Full marketplace and industry issues assessment
  - Strategic and Business Plan (out 5-10 years including financial projections)
  - Implementation Plan – negotiations, collaboration, involvement, responsibilities
  - Market needs sub-project (products, services)
  - Language sub-project outline
  - Technology and Integration sub-project outline

- ***Decision to proceed, or otherwise*** [June to August 2001]
  - Organisation structure and management defined
  - Implementation targets
  - Key performance targets for major items
  - Measures of success at 3 to 5 years
  - Financial parameters
  - Review Consolidated Database as an option.

- ***ASGA Project Implementation*** [September 2001 to 2002]
  - Financial, organisational, client interface, contractual matters
  - Language, Technology and Integration Sub-projects – with industry
  - Progressive implementation, formal launch first half 2002.

Without pre-judging the findings of the preparatory work and more detailed investigations, a framework for ASGA development can be provided at this stage.

This Framework gives a 'picture' of how ASGA might be positioned and functioning in five years time, and of how its performance might be gauged. The framework relates to the Key Elements of a Potentially Successful System [3.3, 3.5].

.b. A Framework for Development – picturing ASGA in 5 years

Measures of success (performance should increase each year towards targets)

- Usage by clients (not genetic gain)
- Number of breeders and producer-breeders as users through service providers, or direct – compared to targets and start-up client levels
- Level of participation and usage by current genetics services providers
- Level of involvement by other existing and new genetics service providers
- Sheep industry awareness of the QG genetics system, and feedback
- Indicators of ram selling and buying market changes
- Database services accessed by a range of users, including researchers

Key Performance Targets should be set for these, for service delivery and finances.

Organisation and management

- A joint Wool and Meat industry owned and managed organisation
- As a Pty Ltd company or a Joint Venture
- Management and technical committees in place, functioning positively
- Headed by a strong manager and communicator with genetics expertise/knowledge
- Efficient organisation; staffed to build user confidence and to deliver on contracts
- Sufficient time for a balanced genetics leadership role in the sheep industry
- Several pricing categories to reflect data contributions and other inputs to ASGA
- Achieving income and cost targets set by owners (aiming for full cost recovery).

Marketplace targets, products and services

- QG products and services to assist breeders and advisers across the industry
- Including elite wool practitioners, traditional breeders, scanners and others
- Arrangements to handle varying levels of pedigree in place
- Serious and useful QG approaches to animal and wool type and style in place
- 70% toward target user levels (through genetics advisers or directly) of:
  - 1,600 breeders/studs and 500,000 new animals for analysis each year
  - (800 Merino studs, 320,000 animals, 800 meatsheep/others, 180,000 animals)
  - and, 400 commercial sheep producer-breeders
- Providing useful general reports for wide audiences, and specific reports for clients
- Minimal prescription on what QG reports are sought and how used by clients
- But providing guidance through EPV reports for many traits, plus Industry Indexes
- Within-flock and Across-Flock analyses as sought, with across-flock growing.

Service delivery

- Strong relationships with and support to genetics service providers and advisers
- A viable common language in place, and used for EPV comparisons by many
- Service commitments, of all types, being met 95 % of the time
- Explanation and advice services in ASGA evolved sensibly to meet market needs.

Genetics technology and database

- Using OVIS software, developed as needed, to process very large linked analyses
- Database contains all useful available genetics data, aligned but each record separate
- Database accessible to a range of genetics system participants, and in use
- A streamlined, user friendly, accuracy-checking data collection system in place utilising accredited measuring/testing service providers.

.c. Notes on Form of Organisation, Management, Competition issues, Intellectual property, Potential for commercial operation, Models

➢ *Form of organisation*

Joint wool and meat industry leadership of the creation of ASGA and the evolution of a new sheep genetics systems, will be important to its success. Appropriate R&D investment would support the change direction. A separate jointly owned company, or a joint venture are possibilities. A JV offers greater flexibility, but would need to be well structured to engender industry confidence.

As large-scale genetics services become widely used (as currently in Lambplan), the potential escalates for legal action on consequences of advice, data, mistakes. Without limiting enterprise, this needs attention in preparatory and implementation stages and will affect decisions such as form of organisation through to contracts for services.

➢ *Management*

If ASGA develops as envisaged, into a pivotal service plus genetics leader, and builds its user base, the sheep industry will be very dependant on this entity for key information. Confidence will also be important to building the customer base.

Strong management, communication and 'inclusiveness' skills would be critical for the head of ASGA, plus vision, planning and doing capacity, attention to the big picture and detail, and focussed business management. Top level genetics skills will be needed in the team, perhaps in the same person.

For a Consolidated Database (Option 3), putting development, management and service out to tender is a possibility. Ongoing industry management and direction would still be needed. ASGA, with its joint industry leadership role, would be more appropriately developed as a fresh entity harnessing existing skills and resources.

➢ *Competition issues*

Active competition in a marketplace that rewards innovation and performance, spurs market oriented products and services. Competition characterises the sheep breeding industry. It is important that the evolving new system encourages real competition among service providers and does not unduly protect or support some entities. ASGA database services should be open and accessible, within reasonable use conditions.

AGSA itself should (and must) compete fairly where it is supplying services that could be provided by others. Adoption of QG depends as much on specialised service providers (ABS, AgWest, Lambplan, independents) as on a powerful database facility. However, there could be trade practices implications in ASGA refusing services to some and not others. ASGA should define and sell an (evolving) set of services that aim to achieve industry objectives and meet marketplace needs.

A further competition dimension is the possibility of an ASGA being seen as an arrangement needing authorisation under *Trade Practices Act* (such as obtained by AWEX). This should be examined in the preparatory stage.

➢ *Intellectual Property*

Formation of an entity such as ASGA nowadays, could become tangled in intellectual property issues (IP) on the chance that some especially valuable piece of knowledge could arise. Except for front-line research, IP debates should not be allowed to hold back development of a new genetics system. IP has the potential to become a new frontier for old arguments among scientists.

➢ *Potential for commercial operation*

Woolmark, MLA and a range of industry participants are interested in the question of whether a fresh entity such as ASGA could or should operate commercially. Some argue that there are 'industry good' reasons for not expecting commercial income steams. Others consider that quantitative genetics is not 'a public good' and adds little, at a significant cost, at least in Merino breeding.

Sheep breeders are willing to pay for some genetics advice services. Sheep classers charge business rates. Breeders using the services of Watts or Swan are understood to commit to thousands of dollars a year. Lambplan clients with large studs are paying this a year and perhaps a few of ABS. Most QG services are subsidised, and some users have done well. Yet, if people see no or little 'gain', any charge is too high.

ASGA could operate on commercial principles, with income covering costs, when its custom reaches a specified level of users (through service providers or directly). At an *operational* cost (without R&D) of, say, $600,000 a year, 2,000 users would need to pay an average $300 a year for EPV reports and general communications. This would be a viable price, even when specialist advisers charge fully for their time. At 1,200 users, cost recovery would be $500 a year; at 800, an average charge of $750.

Roughly, ASGA would likely need at least 1,200 breeder/producer users paying an average $500 a year to be in the vicinity of commercially viable. This is possible.

MODELS: No direct parallels, but considerable experience to tap

There is no direct parallel to the system identified as needed for the extensive Australian sheep industry. However, a number of existing genetics service schemes provide part-models, and would be sources of experienced insight on a range of issues.

The Lambplan system is a key model and elements of Breedplan should be reviewed.

There are insights to be gained in detailed discussion with ***Sheep Improvement Limited*** management in New Zealand. SIL has aimed to provide a national genetics database.

In the dairy industry, ADHIS Pty Ltd (Australian Dairy Herd Improvement Scheme) runs an impressive core service, with a high industry profile and distributed service delivery. ADHIS produces monthly Australian Breeding Value reports on key sires, with ABVs for 40 traits, ranging from the economic to the aesthetic. New ABVs are formed on considered industry request using hundreds of records to start with and taking 1-2 years. ABVs in development are 'rear legs/rear view' and condition score. Dairy industry users combine ABVs as they choose. ADHIS calculates an Australian Selection Index (protein, fat, milk) and is developing a Total Merit Index to bring in workability traits.

Woolmark Company – The Rampower Project

Rampower strategies and projects – summary	Activities, targets, expected outcomes
A1: Training the trainers. *NSW Ag, Orange AC, CSIRO, CRC, NSW TAFE*	Upgrading skills of trainers at tertiary institutions, purpose designed manual, balanced hands-on and theoretical genetics, four workshops, student skills competition
A2: Woolgrower adoption – 'Better Breeding technology'. *Primary Ind. SA & consultants*	Progeny tests on commercial farms in South Australia to demonstrate income-producing capacity of rams of different bloodlines. 37 trials underway, plus field days. Observations of understanding and interest.
A3: Material for breeding technology workshops for wool producers. *NSW Ag with CSIRO QDPI, DNRE, PI SA Tas AgWA consultant*	Develop a flexible but standardised resource package for effective sheep breeding workshops – both presentation material and participants manual (commercial sheep breeders). Used by a range of people. Complete in 1998.
A4: Workshops on breeding technology for commercial producers *Rampower co-ordinator (Hassalls) with CSIRO, State Ag Depts*	Arrangements for workshops across Australia, resource package stays with presenters, and manual with attendees. Over 30 in 1999/2000, 15 to 45 participants each.
B1: Establish Merino breeding advisory service. *CSIRO L Industries*	Three year project (to June 2000) to establish CSIRO 'Select Breeding Services' building on experience from New England Fine Wool and Nemesis projects.
B2: Development of Merino breeding consultancy services. *NSW Ag. Advanced Breeding Services*	Activities to assist and develop private 'breeding consultancy' industry, including software packages to help interaction with clients, training and support services, a newsletter *Merino Breeding Briefs*, software for fleece testing laboratories.
C1: Maintenance of a national merino sire database & publication of breeding values from central test evaluation schemes *CSIRO, NSW Ag ABS*	To maintain and update a central database for all National Merino Sire evaluation; analyse and produce common breeding values for all sires (approx 200 sires/year); distribute reports widely to breeders, AI centres; increase use of high BV sires particularly via AI. Benchmark participating ram breeding flocks
C2: Creation of genetic links between sire evaluation schemes and promotion of such schemes and results. *Rampower co-ordinator*	To achieve inclusion of link sires in all sire evaluation schemes allowing formation of a single national database. To increased participation by ram breeders in sire evaluation schemes and wider understanding and use of schemes.
D1: Merino bloodline performance for production, quality and profit – *NSW Ag with CRC wool.*	Australia wide unbiased wether comparisons. Most trials on commercial farms, limited in NSW by OJD footrot, but expanding in WA. Costs of managing and measuring increasingly paid by trial participants. Results published in *Merino Bloodline Performance* and on the internet.
E1: Increasing demand for objective evaluation of wool sheep. *DNRE Vic*	To progeny test rams of varying breeding values in up to 20 commercial flocks and involve growers through trials and field days at progeny test sites.
E2: Proving effect of alternative selection strategies and increase adoption of genetic technology in SA. *SARDI, Adelaide U, Rampower*	Compare breeding results after selection using traditional classing, soft rolling skin classing, an objective index base and a control flock. Breeders involved in selection and workshops, field days. First project to include SRS/Elite approach. Four breeder/classers using each demonstrate selection and results over some years. A merino-meat flock now included.
E3: Demonstration of fleece weight and FD improvement by within flock selection in fine, medium, broad wool Peppin Merino. *NSW Agriculture at Trangie*	Continue within flock selection started in 1995 comparing selection by indexes and sheep classer based selection for different Merino wool types. In five years, dollar value of fleeces in selected lines 11-40% above control lines. Sheep classer involved recommending clients attend the field days.
F1: On-going round trials and accreditation programs for fleece testing labs, and develop software. *Rampower co-ordinator (Hassall & Associates)*	To conduct twice yearly round trials of the 25 laboratories (95% of fleece testing) in the Rampower accreditation scheme. Checks uniformity and accuracy. Publicise accreditation to breeders. Support labs and clients by providing and explaining the Rampower software (processes data to breeding values and calculates the Rampower Index.

Communications

Over the course of this Study, discussions were progressed, in person, by telephone and by email, with the following people, some at length, others more briefly. My thanks for the insights, information and for many frank assessments.

Sheep Breeders

Mr Andrew Burgess 'Ruby Hills' Walcha
Mr Garry Cook WA
Mr Guy Fitzharding, also Director MLA
Mr Wal Merriman President, Australian Association of Stud Merino Breeders
Mr Robert Mortimer 'Centre Plus'
Mr Martin Oppenheimer 'Petali Merinos'
Mr Bill Webb Merinotech WA
Mr Graham Wells, 'One Oak'

Australian Merino Sire Evaluation Association
Mr Peter Ralston (chairman)
Mr Rob Ashby (SA member)
Mr Knox Heggaton (Tas member)
Mr Bill Sandilands (WA member)
Mr Robert Plush (Vic member)
Mr Hugh Nivison (NSW member)
Lambplan Advisory Committee
Mr Bill Richardson
Discussions with a range of meatsheep breeders 1999-2000.

Genetics services providers

NSW Agriculture (including ABS)
Mr Allan Casey, Dr Kevin Atkins,
Mr Pat Taylor, Dr Arthur Gilmore
Dr Neal Fogarty
Program Managers :
Mr Dick Kearins, Mr Bill O'Halloran
Executive: Mr John Wilson Reg. Director
CSIRO Dr Ian Purvis Dr Andrew Swan
Select Breeding Services, Lindsay Brash
Mackinnon Project (Melb U) Linda Hygate
Agriculture WA
Dr Johann Greeff , Dr Bronwyn Clarke

South Australian R&D Institute
Dr Raul Ponzoni, Cheryl Pope
DNRE Victoria Dr Forbes Brien
Independent geneticists:
Dr James Skerritt, Ms Sue Jarvis
LAMBPLAN
Mr Gerald Martin, Chair, MLA Director
Dr Robert Banks, Dr Alex Ball
Database manager Mr Stephen Field
Soft Rolling Skins, Dr Jim Watts
Elite Wool, Dr Paul Swan
Dr Euan Roberts

Others in science and services

Professor David Lindsay UWA
Animal Genetics and Breeding Unit (AGBU)
Director, Dr Hans Graser
Dr Julius van der Werf UNE
Prof Brian Kinghorn UNE
Dr Susan Meszaros TGRM
Mr G McCann, Macquarie Artificial Breeders
Mrs Lorraine Hewitt, Australian Fibre Testing
Mr Paul Cocking, Riverina Wool Testing
Mr Roland Gill, New England Fibre Testing
Ms Jane Parsons, Allstock Technology

Meat & Livestock Australia
Mr Richard Brooks, Managing Director,
Dr Len Stephens, Dr Ben Russell

The Woolmark Company
Mr Russell Pattinson
Mr Scott Williams
National coordinator Rampower, Ian Rogan,

Dr K Abbott Sydney U
Mr Robert Poole ADHIS Pty Ltd (Dairy)
NZ Dr Ken Geenty SIL
Dr David Cottle WRONZ

Abbreviations and Glossary

AAMSB	Australian Association of Merino Stud Breeders
ABS	Advanced breeding Services (NSW Agriculture)
AI	Artificial Insemination
BLUP	Best Linear Unbiased Prediction procedure
BV	Breeding value (estimated as an EBV or EPV)
CRC	Co-operative Research Centre (here the proposed Sheep CRC)
CTSE	Central Test Sire Evaluation
CV	Coefficient of variation of fibre diameter
EBV	Estimated breeding value
EPV	Expected progeny value
EW	Elite Wool method of sheep selection
FD	Fibre diameter (average)
MLA	Meat & Livestock Australia
QG	Quantitative genetics
QGS	Quantitative genetics system
SBS	Select breeding Services (CSIRO Livestock Industries)
SI	Selection Index
SRS	Soft Rolling Skins method of sheep selection
WM	The Woolmark Company Pty Ltd

- Glossary key source: *Animal Breeding - Use of new technologies*, 2000, eds. B Kinghorn, J van der Werf, M Ryan (with permission); Also: Agriculture Western Australia Farmnote – Genetics for sheep breeders, *David Windsor*, Ms Sue Jarvis, genetics consultant.

Across-flock: A comparison of animals from two of more different breeding flocks, generally also from different studs or properties. Within-flock refers to comparisons of a set of animals from a animals a single breeding flock usually in one year.

BLUP : Best Linear Unbiased Prediction (of breeding values) is a powerful statistical method. BLUP combines information on an animal's performance, the performance of its relatives and any known environmental differences to produce an Estimated Breeding Value. Can be used to separate the genetic and environmental factors influencing animal performance.

Breeding objectives relate to the goals of the breeding program - the traits to be improved. An economic approach calculated economic weights to be assigned to each important trait. A 'desired gains' approach involves defining the relative amount of genetic change desired for each trait.

Correlation: the extent to which genes that determine one trait also influence other traits (that may be more easily seen or measured).

CV FD (%), Coefficient of Variation of Fibre Diameter: The variation in the diameter of fibres counted. Compares the width of the distribution of fibre diameters for samples with different mean fibre diameters. A narrow fibre diameter distribution will have a lower CV FD

Estimated breeding value (EBV): An EBV is the estimate of an animal's breeding value – the estimated genetic difference between an animal and the average of a group. An EBV is an animal's estimated superiority after adjustments.

***EPV (Expected Progeny Value)*:** The amount by which an animal's progeny are expected to be superior to the progeny of the whole group. This is generally half the value of the animal's EBV for the same trait.

Genetic marker: A section of DNA which differs between animals, and can be tested for easily in the laboratory. Genetic markers are mostly not genes, but they are contained in genes.

Genotype: The genotype make-up of an animal. Used loosely in animal breeding to describe genetic grouping such as a breed or a trait-based classification (such as 'a fat genotype').

Heritability: The proportion of parental superiority which is expected to be transmitted to the next generation. Fibre diameter heritability is about 50%.

Inbreeding is the mating of animals which are related. Measured by the *inbreeding coefficient*, which is the probability of the 2 alleles at a randomly chosen locus being identical by descent.

Index selection involves the construction of a multiple score system, based on a number of component criteria, to give an overall selection criterion (an index) which can be used to rank animals for selection purposes. The criteria can be phenotypes of animals and their relatives (as in a classical selection index, weighted by selection index weights), or estimates of breeding values (typically from a BLUP analysis, weighted by economic weights).

Individual selection, or mass selection, is selection on animals own phenotypes alone, without use of information from relatives, or correction for environmental effects.

***OFDA, Optical Fibre Diameter Analyser*:** The OFDA measures the diameter of 2mm clean fibre snippets. Snippets are pressed between glass slides which are scanned under a microscope with a camera linked to a computer program. The computer program analyses the images and assesses the diameter. The 2mm fibre snippets are obtained by coring the mid-side fleece sample.

Phenotype is the observable merit for a given trait, as measured or recorded for an animal.

***Progeny test*:** A comparison between lambs born to a group of rams which were mated to randomly selected ewes at the same time. Pregnant ewes and progeny for all sire groups are run under identical conditions for the period of the test.

Quantitative Genetics (QG) is the science of exploiting natural genetic variation to give genetic improvement of quantitative or metric traits. It can be used for any multiple-gene inherited trait. QGS – quantitative genetics system for providing selection services.

Selection is the choice of animals to be used as parents. by ranking animals on selection criteria..

Selection accuracy is the correlation between true breeding values and estimated of breeding value. Selection response is directly proportional to selection accuracy.

Selection criterion: The information used to rank animals in order to select the best for breeding. The selection criterion is generally an estimate of breeding value, or a selection index using information (either phenotypes or BLUP EBVs) from a number of traits.

Selection Index: A multiple score system, based on a number of component criteria, to give an overall selection criterion (an index) which can be used to rank animals for selection purposes. Criteria can be phenotypes of animals (as in a classical selection index, weighted by index weights), or estimates of breeding values (from a BLUP analysis, weighted by economic weights)

Selection response is the effect of selection on merit of progeny or later descendants. It is measured as a deviation of the merit expected if parents had been chosen at random, rather than by selection on a selection criterion.