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Sheep genetics after 20 years: Driving innovation in genetic evaluation for the Australian sheep industry and beyond

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Introduction

Sheep Genetics (SG), a business unit of Meat & Livestock Australia (MLA), was established in 2005 to deliver a national, across-flock genetic evaluation system for Merino, maternal, and terminal sire breeds. Through its core products MERINOSELECT and LAMBPLAN, SG has provided a standardised and industry-wide genetic evaluation language that has enabled comparable Australian Sheep Breeding Values (ASBVs) across flocks, production environments, and breeding objectives. Over the past two decades, the program has been defined by continuous improvement in the genetic evaluation, sustained R&D investment, strong industry ownership, and development of the supporting infrastructure that enables producers to access, interpret, and apply genetic information on-farm. These foundations have supported substantial increases in data volume, participation, and genetic gain across the Australian sheep industry. This paper investigates how industry engagement has evolved alongside major developments in SG evaluation systems, tools, and digital infrastructure over the last two decades both in Australia and overseas.

Evolution of Genetic Evaluation Systems

The SG evaluations have evolved through a series of deliberate technical enhancements designed to respond to advances in scientific methodology, changes in industry data recording practices and emerging industry requirements. As outlined by Collison *et al.* (2018), these developments have included substantial refinements to evaluation models and have been driven by extensive collaboration between industry and research organisations, including the Sheep Cooperative Research Centre (CRC), its partner institutions, MLA, Australian Wool Innovation (AWI) and domestic and international research groups. In addition to these developments, SG implements annual analysis enhancements that deliver continual improvements and refinements to the evaluations. Table 1 highlights the most significant technical updates, noting that these are complemented by ongoing incremental enhancements incorporated routinely into the evaluation framework. Many of the advancements in multi-breed genetic evaluation in Australia have been underpinned by dedicated research data projects, most notably the Sheep CRC Information Nucleus Flock (INF; van der Werf *et al*. 2010) and its successor initiatives, which have provided structured multibreed data sets with genomic data since 2007.

Table 1. Major technical advancements implemented in the SG evaluations

Year implemented	Technical advancement
1989	Across flock within breed LAMBPLAN evaluations (Banks 2000)
2000	Across breed LAMBPLAN for Terminal breeds (Brown *et al.* 2000)
2005	MERINOSELECT launched and Sheep Genetics begins (Brown *et al.* 2007)
2012	Across breed LAMBPLAN for Maternal sire breeds (Brown *et al.* 2012)
2013	Eating quality ASBVs launched (Swan & Brown, 2014)
2017	Single-step genomic BLUP launched for all LAMBPLAN and MERINOSELECT evaluations (Brown *et al.* 2018)
2018	New reproduction trait model for merinos and maternals (Bunter *et al.* 2018) Genotype only products able to be derived (Swan *et al.* 2018)
2019	Improved alignment of genomic and pedigree information in multibreed LAMBPLAN evaluations (Gurman *et al.* 2019)
2025	Combined LAMBPLAN research evaluation (Walkom *et al.* 2025a)

Adoption and Use of Genetic Tools by Industry

SG has experienced substantial growth in the number of animals submitted annually for genetic evaluation. Growth in SG evaluations since Collison *et al.* (2018) is reflected in the increasing number of animals entering the LAMBPLAN Terminal, LAMBPLAN Maternal and MERINOSELECT evaluations, with average annual submissions since 2017 of 177,148, 99,349 and 255,854 animals, respectively. This expansion in evaluated animals has been accompanied by a marked increase in the volume of performance records and genomic information captured within the SG database (Table 2). Concurrently, industry adoption of Australian Sheep Breeding Values (ASBVs) by commercial producers has increased substantially, with the proportion of producers using ASBVs in ram purchasing decisions rising from 34% in 2016 (MLA, 2020) to 55% in 2022 (MLA, 2023) with a simultaneous improvement in genetic gain resulting in a $4.2 billion AUD return over the 20-year period from 2005 (Banks *et al.* 2025).

Table 2. Summary of the Sheep Genetics evaluations as of January 2026.

Count of Animals	LAMBPLAN Terminal	LAMBPLAN Maternal	MERINOSELECT
In Pedigree	4,271,401	2,912,096	4,531, 825
With a genotype	248,249	121,212	724,265
Recorded for weight	3,642,665	2,261,364	3,327,313
Recorded for wool	n/a	738,691	2,646,793
Recorded for reproduction	n/a	917,646	1,974,909
Recorded with ultrasound scan	2,486,879	737,405	1,270,023
Recorded for carcase	43,161	12,463	9,389

To support the growing number of participants in Sheep Genetics and accelerate genetic gain, extension and producer engagement activities were tailored to target improvements in data

quality (Guy & Brown, 2024). Previous studies have shown that data quality and breeding objectives differ regionally, both within and across breeds, influencing the rate and direction of genetic progress (Bunter *et al*., 2025; Stephens *et al.*, 2018). In response, SG delivered the Data Quality Score (DQS) report, which evolved into a formal reporting framework supporting targeted extension activities. These reports are used in one-on-one client consultations and through the SG service provider network to identify data quality constraints and prioritise improvement actions. The effectiveness of this approach was demonstrated by Martin & Granleese (2024), who showed that improved pedigree recording in Merino flocks over time was associated with positive impacts on genetic gain.

Development of Enabling Digital Infrastructure

The SG database was substantially redeveloped in 2022, representing the most significant upgrade to its data infrastructure since inception. Core databases were consolidated into a single cloud-based AWS database system, improving scalability, performance and data integration across evaluations. This integrated digital infrastructure underpinned the development of combined LAMBPLAN multi-breed genetic evaluations, enabling consistent analysis across breeds and merging of data into a single source (Walkom *et al.*, 2025a). A key outcome of this redevelopment was the introduction of direct data upload by breeders and service providers, enabling near real-time validation reports and feedback prior to formal genetic analysis. This feedback loop supports rapid identification and correction of data issues and timely improvements in data quality. Data submission has shifted from being undertaken entirely by SG staff to a distributed model, with approximately 34% of files uploaded by SG administrators, 33% by service providers and 33% directly by breeders.

The redevelopment of the SG search site in 2020 laid the foundation for the 2022 database upgrade, improving the accessibility and presentation of breeding value information for seedstock and commercial users. The resulting reporting architecture now underpins key outputs, including real-time DQS reports. In parallel, SG has continued to invest in tools that support direct user interaction with evaluation outputs, including a customised MateSel interface available to breeders and service providers since 2014 (Kinghorn, 2011). Ongoing evolution of these systems will be required to support increasing data volumes, evaluation complexity and future industry requirements.

Positioning Sheep Genetics for Future Industry Needs

Over the past decade, SG has expanded beyond ASBVs to deliver additional genetic products that address a broader range of industry needs. This includes the introduction of Flock Profile, a commercial genetic benchmarking tool, for MERINOSELECT clients (Swan *et al.* 2018), with the development and release of Combined LAMBPLAN (Walkom *et al.* 2025a) enabling similar flock-level products to be delivered in the future for non-Merino breeds. In 2025, genomic-only genetic predictions for individual animals were commercialised for MERINOSELECT using the methodology described in Swan *et al.* (2018) similar to the Flock Profile product, and these will be expanded to other breeds in the future.

Ongoing development of new traits remains central to future positioning, with upcoming evaluation enhancements incorporating outcomes from the AWI-funded Merino Lifetime Productivity (MLP) project (Ramsey *et al*, 2023), the development of flystrike ASBVs (Dehnavi *et al,* 2025), shedding score traits (Walkom *et al,* 2025b), and traits arising from methane emissions and feed intake research (Aldridge *et al,* 2025). Together, these advances in products and traits align with MLA's strategic objective to better connect genetics across

the supply chain supporting increased adoption and demand for superior genetics to promote genetic gain in the seedstock sector.

Conclusions

SG has evolved its genetic evaluation systems alongside advances in science and industry needs. Continued refinement of evaluation software and investment in digital infrastructure have enabled larger, more complex analyses and improved delivery and use of ASBVs by producers. Looking ahead, SG evaluations will underpin new tools for the commercial sheep industry, with breed-agnostic genetic descriptions supporting consistent characterisation across production systems, improved genetic gain, and stronger alignment between genetics, production outcomes and market requirements.

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