

# final report

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# SmartShepherd system fast tracking of product innovation and validation stages

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## **Executive summary**

The SmartShepherd system is an innovative technology solution that enables livestock breeders to collect maternal pedigree quickly and cost effectively. Maternal pedigree is the key to unlocking the genetic potential of a farmer's herd or flock, significant productivity gains can be achived by tracking which animals produce profitable offspring. Additionally, there are numerous animal welfare issues that can only be addressed by knowing the mothering ability of dams.

This project was undertaken to fast track the innovation and validations stages of the SmartShepherd system. This project has contributed to the release of a commercial ready product being available early 2018, making it possible for Australian livestock farmers to benefit from this innovation during the 2018 breeding season. The SmartShepherd System has demonstrated 96% accuracy within 48 hours of being placed on a mob of sheep.

The Australian red meat industry will benefit from availability of a new maternal pedigree system that is more accurate and less labour intensive than traditional mothering up and far more cost effective than genomic testing. This will enable Australian farmers to determine maternal pedigree on many more mobs, which will increase the speed of genetic gain for livestock, resulting in productivity gains for the entire industry.

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# 1 Background

This project was undertaken to fast track the innovation and validations stages of the SmartShepherd maternal pedigree system. The SmartShepherd system aims to provide livestock breeders a maternal pedigree system that addresses the shortcomings of genomic testing, Pedigree Matchmaker and traditional mothering up.

Over the past 10 years it has been demonstrated via the <u>Pedigree Matchmaker (PMM)</u> system run by the Sheep CRC, that it is possible to determine maternal pedigree by using digital technology to replicate the mothering up process. PMM utilised technology available at the time, by leveraging RFID technology and the use a gate where animals were encouraged to walk through. Unfortunately due to a number of factors the system has not been widely adopted , these factors include; a very long wait to get results (40+ day); not enough data to provide results when used in wet areas; pedigree results being no more accuate than traditional mothering up; and in one extreme circumstance the system was responsible for the death of large number of lambs.

In recent years there has been some significant developments in the area of wireless technology, with costs coming down and low power options becoming available, it is now possible to build on the work carried out by the Sheep CRC and leverage this new technology to provide an innovative solution that not only over comes the issues inherent with Pedigree Matchmaker but also provide Australian farmers with a maternal pedigree system that is more accurate and less labour intensive than traditional mothering up and far more cost effective than genomic testing. This will result in Australian farmers being able to determine maternal pedigree on many more mobs, which will increase the speed of genetic gain for livestock resulting in productivity gains for the entire Australian red meat industry.

# 2 Project objectives

The key objective of this project will be to assist in the development of technology that supports high value growth for the Australian red meat industry, this will be achieved by ensuring that Australian farmers gain early access to innovation that will create a competitive advantage.

The activities of the project have been broken into two key areas;

- i) Product innovation and development;
- ii) Product and market validation;

#### 2.1 Product Innovation and Development

Product innovation and development will involve activities that result in the availability of commercially viable solution. The results of the product and market validation will be used to inform each subsequent product innovation and development phase.

#### 2.2 Product and Market Validation

Product and market validation will involve activities that generate information that will inform the next product innovation and development phase. Additionally, validation of the SmartShepherd solution against known pedigree will be performed.

# 3 Methodology

MLA is committed to investing in top quality scientific research, performed by suitably qualified, experienced and registered researchers and organisations. In experiments that involve livestock, MLA acknowledges that such research needs to be done under the auspices of a recognised Animal Care and Ethics Committee (AEC). The responsibility for obtaining AEC approval lies with the researcher. MLA has in the past not specifically asked for evidence that such AEC approval had indeed been obtained.

#### 3.1 Product Innovation and Development Activities

The following activities were carried out during the product innovation and development phases, the requirements for these activities where obtained via farmer surveys, field trials, expert interviews and the outcomes of the product and market validation phases.

- Review data obtained from the product and market validation
  - Use data to inform product design, development and manufacturing decisions.
  - Initially we used previous information obtained from interviews with farmers and industry experts and also from previous smaller trials.
- Hardware Development
  - Casing design via CAD (Computer Aided Design) software
  - Prototyping casing design utilising 3D printing
  - Casing material review and selection
  - PCB (Printed Circuit Board) layout and optimization
  - Optimize BOM (Bill of Materials) to reduce costs
  - Iterative Prototyping and testing
  - Design for manufacturing review
- Software Development
  - Firmware development
  - Android App development
  - Web application development
- Manufacture Devices
  - Tooling was carried out, this included CNCing moulds, solder paste stencils, device programmer and jigs.
  - o Develop QA (Quality Assurance) process and testing equipment
  - o Sources components and materials
  - Manufacture PCBA (Printed Circuit Board Assembly)
  - Injection moulding of casing
  - o Part assembly

#### 3.2 Product and Market Validation Activities

The following activities were carried out during the product and market validation phases, the requirements for these activities where obtained via farmer surveys, field trials and the outcomes of the product and market validation phases.

- Target Market Analysis
  - Type of breeder; studs, mixed and commercial
  - o Locations in various states and countries

- Farming conditions and practices
- What type of livestock; breeds, sheep, cows etc.
- o Other
- Conduct Farmer Interviews
  - o Develop qualitative and quantitative question sets
  - Formal interviews and surveys
  - Analysing the interview and survey data
- Usability Testing
  - Define goals and tasks
  - o Observe and document farmers using product in the field
  - Follow up questions
  - o Evaluate the results
- Validating Solution (see 3.2.1 for further details)
  - Use the SmartShepherd solution to determine pedigree on a mob with known pedigree
  - Compare the results to validate the SmartShepherd solution
- Cost and Scale benefit
  - Compare existing solutions against cost
  - Productivity comparison with existing solution

#### 3.2.1 Field Trial Validation

To validate that the SmartShepherd system provides accurate results, the system was tested on a mob of 110 sheep with known pedigree (determined via mothering up). The methodology is detailed below.

- 1. All ewes and lambs from a single mob of 110 animals were mustered and then the SmartShepherd devices were attached.
- 2. The sheep were then sent back into the paddock where there moved around the paddock feedly for 48 hours.
- 3. The sheep were then mustered again, and the data from the SmartShepherd devices were collected.
- 4. Utilsing the data from the tags, the SmartShepherd web application provided its pedigree results.
- 5. Thes farmer then compared these pedigree results against the known pedigree that was determined earlier on by using mothering up. The farmer never revealed the known pedigree to SmartShepherd staff till he had completed the comparison.
- 6. An accuracy percentage was then calculated.

### 4 Results

The project assisted SmartShepherd in accelerating the product innovation and development and product and market validation phases with the technology solution now achieving successful results, with a 96.36% pedigree accuracy result when compared against known pedigree (mothering up).

#### 4.1 Product and Market Validation

#### 4.1.1 Farmer Survey

our survey has shown that an average farm has 14 mobs, while a larger commercial operation can have 50 or more. There is also a 75% preference on determining pedigree for all or most of their mobs.

#### Summary

- Some farms have a large number of mobs and want pedigree for all mobs
- Average mob size for cattle is much smaller than sheep
- Average mob size for sheep is much larger, especially with commercial operations.
- Sheep stud farmers have strong preference for performing full pedigree on all mobs.
- Commercial Cattle farmers have a stronger preference for performing full pedigree on all mob than Commercial Sheep farmers on average

#### 4.1.2 Field Trial Validation

The SmartShpeherd solution produced a very successful results, with a 96.36% pedigree accuracy result when compared against known pedigree (mothering up).

# **5** Conclusions/recommendations

This project was undertaken to fast track the innovation and validations stages of the SmartShepherd system. This project has contributed to the release of a commercial ready product being available early 2018, making it possible for Australian livestock farmers to benefit from this innovation during the 2018 breeding season. The SmartShepherd System has demonstrated 96% accuracy within 48 hours of being placed on a mob of sheep.

The Australian red meat industry will benefit from availability of a new maternal pedigree system that is more accurate and less labour intensive than traditional mothering up and far more cost effective than genomic testing. This will enable Australian farmers to determine maternal pedigree on many more mobs, which will increase the speed of genetic gain for livestock, resulting in productivity gains for the entire industry.