final report

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Genetics R&D: A bull selection decision support tool

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Executive summary

Genetic information is multifaceted, complex confusing and time consuming to assess (i.e. multiple estimated breeding values and selection indexes). This is especially challenging for commercial beef producers to interpret and digest given bull purchases are an infrequent event. The confluence of these factors means that producers are discouraged from basing their selection decisions on objective information and as a result, the genetic performance of their herds may not be progressing as quickly or as effectively as possible. This impacts upon the potential productivity and profitability of producers, while affecting the overall profitability of the Australian beef industry.

In order to address this, the tools that are currently available need to be simplified and implemented with user friendly interfaces in order to re-start the conversation on the production benefits of genetic improvement. The aim of this project was to use information from the national beef recording and improvement scheme (BREEDPLAN and BreedObject) to develop a decision support tool (DST) which is easy to use and simplifies the bull selection process for commercial beef producers.

The DST (DeSireBull™) was developed using existing genetic tools (BREEDPLAN estimated breeding values and accuracies) and relies on BreedObject bio-economic models (selection indexes) to rank bulls based on genetic merit. It provides an online platform for bull vendors to list their sale catalogues containing all relevant genetic information for their bulls as well as images, videos and other supplementary pre-sale information. DeSireBull™ is easy to use. It allows commercial producers to place emphasis on particular groups of traits, using a behind-the scenes algorithm to demonstrate the consequences of a desired gains approach to selection decisions. Thus, the tool enables commercial bull buyers to source the most appropriate bulls for genetic improvement of their herd. It also provides feedback to the stud breeder on buying behaviour from customers and help inform future breeding decisions based on genetic performance.

It is anticipated that the potential industry benefit from the use of DeSireBull™ will be an increase in the effectiveness of commercial producers when using genetic merit information to improve their herds and the profitability of their enterprise, increase in market signals from commercial producers to beef seedstock breeders and lead to the development of a marketplace where genetic information plays a greater role. The ability of DeSireBull™ to simplify the process of using genetic information for purchasing bulls complements the beef industry's existing strategies for extension and adoption of genetic tools, to increase the rate of genetic improvement within the Australian beef industry.

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1 Background

1.1 Proof of problem

Genetic information is multifaceted, complex confusing and time consuming to assess (i.e. multiple estimated breeding values and $indexes). This is challenging for commercial beef producers to interpret and digest when bull purchases are an infrequent event (Martin-Collado et al. 2015). The confluence of these factors means that producers are discouraged from basing their selection decisions on objective information and as a result, the genetic performance of their herds may not be progressing as quickly or as effectively as possible. This impacts upon the potential productivity and profitability of producers, while affecting the overall profitability of the Australian Beef Industry.

On a national level, genetic improvement within the beef cattle industry has been at suboptimal rates for several reasons. One of them is the lack of market signals coming from commercial producers to studs that reflect that bulls with higher genetic merit are worth more money. This is undoubtedly because of the complexity and time-consuming challenges associated with genetic performance measurement information (Ipsos, 2016). In order to address this, the tools that are currently available need to be simplified and implemented with user friendly interfaces in order to re-start the conversation on the production benefits of genetic improvement (Ipsos, 2016). Until decision support tools are developed to make the process simple and easy to understand and use, the buying behaviour of commercial producers will continue to be influenced by factors other than genetic merit.

1.2 Proposed solution

To develop a decision support tool (DST) called DeSireBull™ which aims to simplify the bull selection process for commercial beef producers. It aims to increase the number of bull buyers who effectively utilize genetic performance measurement information and ultimately improve the quality of their herds. This DST uses existing genetic tools (BREEDPLAN estimated breeding values and accuracies) and relies on BreedObject bio-economic models (selection indexes) to rank bulls based on genetic merit. The tool allows producers to place emphasis on particular groups of traits, using a behind-the scenes algorithm to demonstrate the consequences of a desired gains approach to selection decisions. In addition, DeSireBull™ may serve as a feedback mechanism to the seedstock sector to help inform future breeding decisions, based on genetic performance. DeSireBull™ will ultimately simplify the process of using genetic information for purchasing bulls and will support industry's extension and adoption efforts to increase the rate of genetic improvement in beef cattle.

2 Overall objectives

2.1 Industry objectives

2.1.1 National Livestock Genetics Consortium

The National Livestock Genetics Consortium (NLGC) was developed by Meat and Livestock Australia (MLA) and MLA Donor Company (MDC) after considerable industry consultation to provide increased collaboration, communication and investment in the livestock genetics sector. The primary aim of this initiative is to significantly increase the rate of genetic progress achieved in the sheep and beef

industries. DeSireBull™ has been co-funded by the NLGC as the project aims align with the NLGC Task Force key objectives, specifically **iii** and **iv**, and indirectly with **i** and **v**.

The aims of the NLGC are:

i. To double the annual rate of improvement in industry genetic value by 2022.
ii. To coordinate research, reduce timelines and costs ensuring delivery of world leading genetic improvement.
iii. The seamless transfer of information to industry and provision of easy-to-use data sharing products and services – one national data base accessible by all industry participants.
iv. Improve adoption through unifying the delivery of genetic RD&A across the livestock industry.
v. Deliver an additional $400 million in industry improvements to the commercial livestock industry value chain.

2.2 Project objectives

2.2.1 Project aims

To deliver:

- A world leading genetics decision support tool that will:
  i. Simplify the process of selecting bulls to buy;
  ii. Match available bulls and their genetic information with the specific needs of the bull buyers;
  iii. Allow producer to compare and benchmark all bulls available for sale in Australia;
  iv. Provide feedback to the stud breeder on buying behaviour from customers.
- A decision support tool developed under strict scientific rigour that will use start-up science principles to ensure an agile, seamless development and delivery process to maximise adoption/usage.

2.2.2 Project outcomes

Expected outcomes of this project are:

i. Increased effective use of genetic merit information by producers;
ii. Increased market signals reaching bull breeders from commercial producers, using genetic merit information of their bulls;
iii. Continued effective use of BREEDPLAN by bull breeders, as there will be higher demand from buyers for genetic information;
iv. A more transparent beef genetic marketplace where genetic information plays a greater role;
v. An increased demand for bulls with good genetic merit for economically important traits;
vi. An easy to use, accessible decision support tool;
vii. A potential revenue stream associated with its commercialisation strategies.

3 Methodology

3.1 Project milestones

In order to achieve the project objectives, the following project milestones were defined by the workplan initially agreed on by MLA and NSW Department of Primary Industries (Table 1).

Table 1. Initial DeSireBull milestones

	Description	Start Date	Completion Date
1	Upfront payment upon contract execution and upon the contribution payment being made to the Donor Company	21/03/2018	21/03/2018
2	Preliminary fieldwork to establish features needed to be included in the minimum viable product (MVP) of the Decision Support Tool (DST)	22/03/2018	30/06/2018
3	Development of MVP using an Agile process: including results obtained from user acceptance testing with relevant stakeholders	01/07/2019	20/12/2018
Go / No Go	Dependent on completion of milestone 3 and data access requirements around a national genetics data platform *ML A may terminate in accordance with Clause 14.3 & 14.4	21/12/2018	21/01/2019
4	Final working DST + Final report detailing the deliverables and project outcomes + Plan to ensure the ongoing maintenance and updating of the DST	22/01/2019	18/12/2019

From early work carried out in preparation for Milestones 2 and 3, including discussions with companies capable of the development phase, consistent feedback was to combine the two and complete them in parallel. This would enable continuous feedback from stakeholders at each key development stage to ensure a reliable and user-friendly tool. A request to amend the milestones was approved in June 2018. The amended and current milestones are outlined in Table 2.

Table 2. Amended DeSireBull milestones.

	Description	Start Date	Completion Date
1	Upfront payment upon contract execution and upon the contribution payment being made to the Donor Company	21/03/2018	21/03/2018
2&3	Development of a Minimum Viable Product (MVP) using an Agile process. This process includes the development done in sprints with feedback obtained from stakeholders and producers at each stage of this process. Feedback obtained at each stage of the development process will ensure that the development and testing are done in parallel to ensure greater acceptance and user friendliness of the end product.	22/03/2018	20/12/2018
Go / No Go	Dependant on completion of milestone 2 and data access requirements around a national genetics data platform *ML A may terminate in accordance with Clause 14.3 & 14.4	21/12/2018	21/01/2019
4	Final working DST + Final report detailing the deliverables and project outcomes + Plan to ensure the ongoing maintenance and updating of the DST	22/01/2019	30/06/2020

3.2 Procurement process

A procurement process was undertaken to identify and engage an appropriate software developer for the project. The outcome of the process was based on the ability for the company to meet the requirements of the NSW DPI's tender process and the project requirements at a competitive price. Circul8, Sydney, was contracted as the software developer for the decision support tool.

3.3 The developer's approach

Circul8 and NSW DPI staff held a planning meeting to detail the approach to the development of the DST. The main points are summarised in sections 3.3.1 and 3.3.2.

3.3.1 Introducing Circul8 to the project

During the planning meeting the problem was presented to Circul8 and explained in terms of the impact the problem has on the beef industry. The solution to the problem was then described as a decision support tool that is aimed at the commercial beef sector. This is summarised in Fig. 1 below.

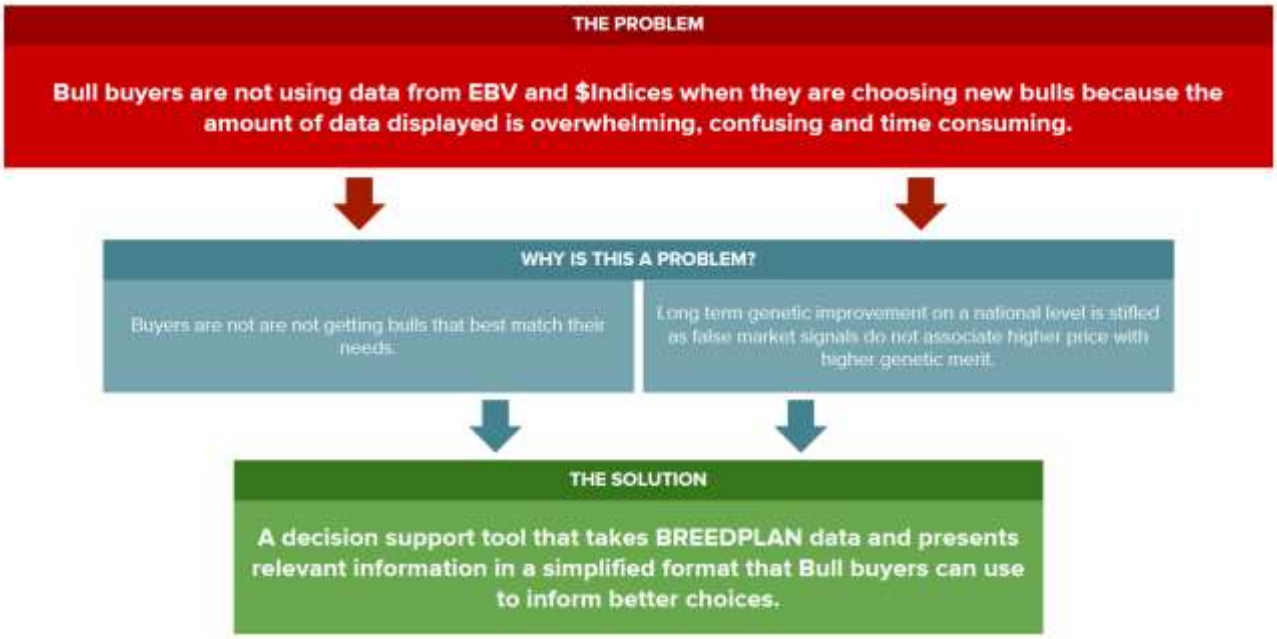


Figure 1. The problem, why and the solution, as summarised by Circul8.

3.3.2 DeSireBull™ objective hierarchy

Circul8 and NSW DPI worked to separate the project outputs and expected outcomes into a clearly defined hierarchal structure as:

1. Main goals (project level)
2. Tool requirements (product level)
3. Desired outcomes (general)

This is depicted in Fig. 2 below.

Figure 2. Hierarchal structure of project objectives and expected outcomes.

3.4 Circul8 development stages

Product development and stakeholder engagement were run in parallel in order to obtain user feedback at each stage of development. The stages of development are outlined below. In order to complete stages 3.4.1 – 3.4.8, a series of 4, 2-week "sprints" were conducted in accordance with Milestone 2 objectives. These sprints included design, development, review and enhancement phases. Following the completion of the minimal viable product (MVP) in December 2018, a further 6 sprints were conducted, informed by stakeholder feedback in order to enhance and refine the MVP. These enhancements were completed in August 2019. Additional work to integrate the tool into existing genetic information pipelines commenced in September 2019 and was finalised in June 2020.

3.4.1 Research:

i. Familiarize with existing market research and field work done so far by NSW DPI and its partners (Meat & Livestock Australia and Animal Breeding and Genetics Unit (AGBU)).
ii. Discovery of demographics, motivations, behavioural patterns and goals of the end users (bull buyers and sellers).
iii. Understand how the customer will be using this product
iv. What other options are there in the marketplace - differentiation?
v. Define the blueprint / specification (what the tool does and how)

3.4.2 Wireframing:

i. Document and wireframe the tool and understand future functionalities.

ii. Develop detail sketches of the envisioned product in order to uncover usability issues.

3.4.3 Technical Feasibility Assessment:

i. Assess the prospective format and platform of the tool against data formats, access and availability in order to achieve the required functionality.

3.4.4 Prototype:

i. Build a basic prototype that allows the concept to be tested with prospective users.
ii. Provide the stakeholders with the first look at the tool in order to validate information gathered in previous stages.
iii. Validates the tool's functionality, assumptions, and helps to give an understanding of the scope of future work.

3.4.5 Design (Multi-stage process)

i. The UX designer, architects the interaction between design elements in the tool
ii. The UI designer, builds the look and feel of the tool
iii. The outcome of this process will provide a clear visual direction with an abstraction of the final product

3.4.6 Development (Multi-stage process)

i. The development of the application will be broken down into smaller modules, and agile methodology will be applied to each of these small parts. This will help with flexible planning, progressive development, early deployment and constant improvement.
ii. Two-week sprints will be conducted to develop each module.

3.4.7 Testing (Multi-stage process)

i. The application will be tested for usability, compatibility, security, interface checks, stress, and performance.
ii. User acceptance testing will be conducted with some people in the target audience.

3.4.8 MVP Deployment

i. Launch a Minimum Viable Product (MVP) with features defined and planned during the early stages of this project.

3.4.9 Enhancements / Further Developments

i. After the launch of the MVP, there will user feedback that will enable for enhancements to be made and for de-bugging to occur.
ii. Further Developments will take place in order to build on the features of the MVP. At least four two-week sprints will occur at this stage.

4 Achieving the objectives

In order to ensure the project objectives were being met a steering committee was formed comprising of representatives from key research, adoption and extension organisations within the Australian Beef industry (4.1). The steering committee provided valuable insight and feedback on each of the developmental stages within the project. The use of an agile process involving short sprints has ensured that each stage in the development of the decision support tool was adequately achieved. A summary of what was implemented/achieved within each development stage is provided (4.2).

4.1 Steering committee

A steering committee was formed with representatives from industry organisations concerned with the research, adoption and extension of tools aimed at increasing rates of genetic improvement in the commercial beef industry. The group met quarterly throughout the planning and development of the decision support tool and were consulted on matters such as technical information, user interface design, perceived user experience as well as adoption and extension strategies. Occasionally, members of the Circul8 project team also joined the committee meetings to explain aspects of design, development and stakeholder engagement processes, and to liaise directly with those organisations who are likely to use/promote the tool to their clients.

4.2 Development stages

4.2.1 Research:

i. Pre-Project R&D

During the months of August and September 2015, NSW DPI surveyed more than 1,000 bulls sold at 9 of the biggest auction sales across NSW and VIC. From the 954 bulls purchased, the highest correlation with price paid at auction was the weight of the bull at sale day (0.41) (Suarez 2015, unpublished data). This coincides with findings published by Robinson more than 20 years ago, as well as with unpublished studies done in NZ for the Angus breed (Blair H. pers comm 2015) and in Australia by the Herford breed (Ball, 2016). In early 2016 we developed a DeSireBull prototype in collaboration with one of our partners (Telstra) to gather evidence to show the need for such a DST tool in the marketplace. An indicative DST was rolled out at several field days, with overwhelming support received from producers. In July 2016 a NSW DPI team enrolled in a full time 12 week start-up incubator program to apply start-up science principles to the DeSireBull project. This exercise was completed on 7 October 2016 and gathered significant amount of information on the problem, the market, the solution, and the channels for adoption/commercialisation that will be implemented during a multi-stage development.

ii. Discovery of demographics, motivations, behavioural patterns and goals of the end users (bull buyers and sellers).

During the discovery phase involving Circul8, an audience identification exercise was conducted to try and ascertain the type of audience that the tool will need to communicate with.

During this exercise, two key users were initially identified: buyers and sellers. Further research uncovered a number of additional sub audiences within each segment (buyers and sellers) as well as

an additional segment (agents). Each of these sub audiences present different opportunities and require different experiences while using the tool.

These groups can then be further broken down into 6 potential user types for DeSireBull™ (Fig. 3). Once the potential target audiences were identified, like-minded users were grouped into audience groups, in order to start building out detailed user type matrixes which provide additional insights into how they think and how they can be activated. From farmers to corporates, small and large, each has slightly different needs, motivations and expectations from a tool like this. A deep understanding of these factors is needed to make informed decisions when planning out the content/structure and user journey of the tool.

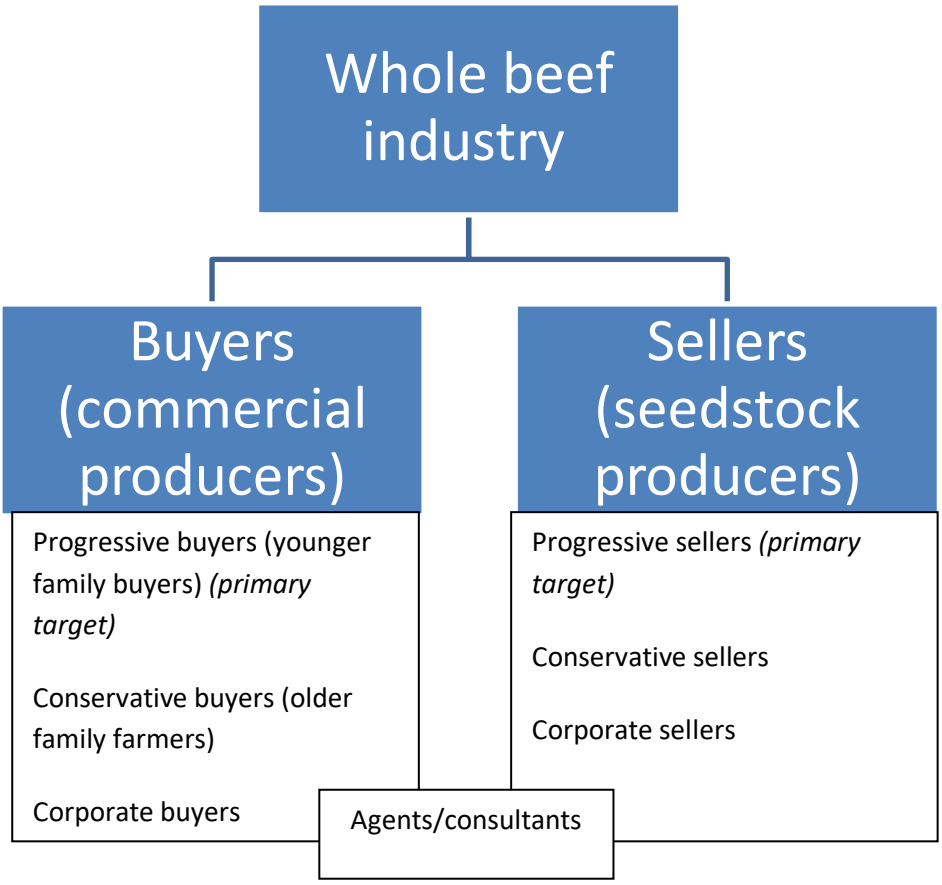


Figure 3. Industry target audience and user types.

During the exercise, the user experience of each subgroup was explored considering their gender, age, location, platforms they use, needs/wants, pain points/frustrations, conversion point and possible blockers. The results for the user experience of all 6 subgroups were summarized in Figures 4 and 5.

It was concluded that from the type of buyers described in Fig. 4, the first priority and early adopters will be the younger family farmers. The second priority will be the corporate farmer, followed by the older more conservative bull buyers who are considered a low priority at this stage of the development process.

User Type	Buyers		
	Family Farmers (older)	Family Farmers (younger)	Corporate Farmers (younger)
Sex	Even split (wife will be doing a lot of the research)	Slightly more male skewed	Male
Age	Late 40s to 70	30's	40's
Location	Rural Australia	Rural Australia	Rural Centres
Platform	1. Desktop (PC) 2. Smartphone	1. Smartphone 2. Desktop (PC) 3. Social media (twitter)	1. Desktop (PC) 2. Smartphone 3. Tablet
Needs / Wants	• Family focussed - wants to set family up for the future • The best bulls • Increased productivity • The right decisions	• Family focussed - wants to set family up for the future • Less idealistic - more profit driven than older farmers • Develop the farm	• Profit • Data • Results
Pain Points / Frustrations	• Complicated data • Data out of date • Connection / Infrastructure • Time poor • Poor long term results	• Complicated data • Data out of date • Connection / Infrastructure • Time poor • Lack of industry evolution / progress	• Time poor • Pressure / risk / accountability
Conversion Point	First educated purchase based primarily on using information from desirebull	First educated purchase based primarily on using information from desirebull	First educated purchase based primarily on using information from desirebull
Possible Blockers	1. Stubborn 2. Conservative POV 3. Internet 4. Education 5. Time poor 6. Trust/privacy 7. Usability	1. Internet	1. They might not be the actual decision maker on the sale
Priority	3	1	2

Figure 4. User overview – buyers

From the type of sellers described in Fig. 5 the first priority is the progressive seller which will be targeted as early adopters and will be the focus for the first stages of the development of the tool. The second priority will be the agents followed by the older more conservative bull sellers which will be the lowest priority.

User Type	Sellers		
	Agents	Progressive Sellers	Conservative Sellers
Sex	Male	Male	Male
Age	30 - 60	50	55
Location	Rural Centres	Rural Australia	Rural Australia
Platform	1. Modern devices & industry platforms	1. All modern devices	1. In person - very oldskool
Needs / Wants	• Point of difference against other agents • Competitive advantage • Maximise profits	• To influence buyers • Data motivated • Market share • Profitability	• Does not want change • Want people to buy based on looks • Wants to keep things as they are
Pain Points / Frustrations	• Data is too complicated	• Lack of influence • Buyers making bad/uninformed decisions	• Tech is a threat • Scared of change • Everything to lose with new tech
Conversion Point	People making purchases based on their recommendations using our tool	Buyers making a purchase with them based on genetic data	Sign up to learn more about our platform
Possible Blockers	1. Conservative POV 2. Change of process 3. Education	1. Uninformed buyers 2. Buyers not using the platform	1. Fear of change 2. Loss of profit 3. Conservative POV
Priority	2	1	3

Figure 5. User overview – sellers

iii. Understand how the customer will be using this product.

The MVP user journey was mapped out taking several personas into consideration. During this exercise it was discovered that it was best to give users the ability to use the product without needing to sign up/create an account. However, in order to access the full functionality and benefits of the tool, it is requested that users create an account. While mapping the sign-up process it was discovered that sellers needed to have a slightly different sign up process. Sellers have existing information in the form of their Herd and Society ID. These will be used to associate listings to their newly created account.

The baseline functionality goal of the MVP is to allow users to search for bull listings. In order to develop the tool, user "stories" were created in order to give direction for the development. User stories for the initial stages of development are detailed in Table 3 below. Some features may or may not have been included based on sprint planning sessions and the nature of the agile development process.

Table 3. User stories mapped out for users (general), buyers, sellers, agents and site owners

User Stories
As a user I want to be able to search for bulls
As a user I want to be able configure my search for bulls with the 9 search criteria
As a user I want to be able to sort my search results via breed
As a user I want to be able to sort my search results via retain heifers
As a user I want to be able to sort my search results via heifer bulls
As a user I want to be able to sort my search results via Target market
As a user I want to be able to sort my search results via cow size
As a user I want to be able to sort my search results via marbling
As a user I want to be able to sort my search results via cost of feed
As a user I want to be able to sort my search results via ween rate
As a user I want to be able to sort my search results via location
As a user I want to be able to see all bull listings
As a user I want to be able to see the about page as per the designs
As a user I want to be able to see the terms and conditions page as per designs
As a user I want to be able to see privacy policy page as per designs
As a user I want to be able to see contact page as per designs
As a user I want to be able to save bull listings to my shortlist
As a user I want to be able to see all my short lists
As a user I want to be able to name my short lists
As a user I want to be able to remove listings from my short lists
As a user I want to be able to save my search preferences

As a user I want to be able to name my search preferences
As a user I want to be able to see all my search preferences
As a user I want to be able to modify my search preferences
As a user I want to be able to set an email notification of new listings for my search preference
As a user I want to be able to see the listing index/listing sales page
As a user I want to be able to see the summarised BreedObject metrics
As a user I want to be able to see the full BreedObject data
As a user I want to be able to see the pictures of the bull on the index/listing sales page
As a user I want to be able to see the sales blurb from the seller on the index/listing sales page
As a user I want to be able to see the sellers email address
As a user I want to be able to save the listing as an image
As a user I want to be able to add notes to listings in my short lists
As a user I want to be able to change my first name
As a user I want to be able to change last name
As a user I want to be able to change my email
As a user I want to be able to change my location
As a user I want to be able to change my newsletter preferences
As a user I want to be able to change my notification settings
As a user I can see that I am able to complete my profile
As a user I can see the profile completion bar
As a user I can see the home page as per the designs
As a user I can see the search results page as per designs
As a user I want to see the short list page as per designs
As a user I want to see the search preferences page as per designs
As a user I want to see the account page as per designs
As a buyer or agent I want to be able to see the sign in/up page as per designs
As a buyer or agent I want to be able to sign up

As a buyer I want to be able to see my account confirmation email as per designs
As a seller I want to be able to listings to off market listings
As a seller I want to be able to add my off market listings to shortlists
As a seller I want to be able to share my shortlists
As a seller I want to be able to share my off market listings
As a seller I want to be able to see views on each of my listings
As a seller I want to be able to add a sales blurb to my listing
As a seller I want to be able to add pictures to my listing
As a seller I want to be able to remove pictures from my listing
As a seller I want to be able to change the auction date of my listing
As a seller I want to be able to change the Breedplan data of my listing
As a seller I want to be able to see the sign in/up page as per designs
As a seller I want to be able to sign up
As a seller I want to be able to login in
As a seller I want to be able to see my account confirmation email as per designs
As a site owner I want to see google analytics integrated
As a site owner I want to see SSL certificate integrated
As a site owner I want to see the domain associated with the server
As a site owner I want to see the data sent and pulled is encrypted
As a site owner I want to see the design for the home page
As a site owner I want to see the design for the About us page
As a site owner I want to see the design for the search results page
As a site owner I want to see the design for the account page
As a site owner I want to see the design for the sign in/create account page
As a site owner I want to see the design for the search preferences page
As a site owner I want to see the design for the short list page
As a site owner I want to see the design for the privacy policy page

As a site owner I want to see the design for the terms and conditions page
As a site owner I want to see the design for the contact us page
As a site owner I want to see the design for the listing editing page
As a site owner I want to see GTM integrated on the site
As a site owner I want to be able to see Cloudflare integrated
As a site owner I want to be able to see various tags in GTM

iv. What other options are there in the marketplace – differentiation?

ABRI's Internet Solutions online catalogues and sorting facilities intend to facilitate the search and sort of bulls available for sale in catalogues or within the database. These facilities are mainly used by stud breeders due to the required prior knowledge of EBVs, Indices and accuracies in order to use them appropriately. In addition, bulls can only be compared if they are listed within the same sales catalogue.

BreedObject has been assisting breed societies and some individual breeders to develop their own $Indices for more than 20 years. These Indices are attempting to formalize a breeding objective to help producers breed more profitable cattle. Breed societies have been using BreedObject to develop $Indices in an attempt to define predetermined breeding objectives to cover a range of market end points. Some breeds have up to 4 $Indices which are displayed in dollars and represent a whole supply chain profitability in a per cow joined basis. Individual producers can choose to set up their own breeding objective through a questionnaire at the BreedObject website in order to produce a $Index that will help them identify those bulls that better meet their breeding objective.

Both these tools have been a step in the right direction towards simplifying the process of selecting the right bulls by commercial producers, however there's still a long way to go to get broader adoption, especially in making these type of tools easy to access and use by the average commercial producer. DeSireBull combines all these previous efforts with new ideas and approaches to simplify the process even further and encourage producers to utilize the available information to assist them in buying the bulls that will better meet their needs and increase their profitability.

v. Define the blueprint / specification (what the tool does and how).

DeSireBull is based on the Desire algorithm developed by Professor Brian Kinghorn (2013) to allow for an interactive and real time display of the impact of each decision does on all other correlated traits, as well as the $Index used as a starting point.

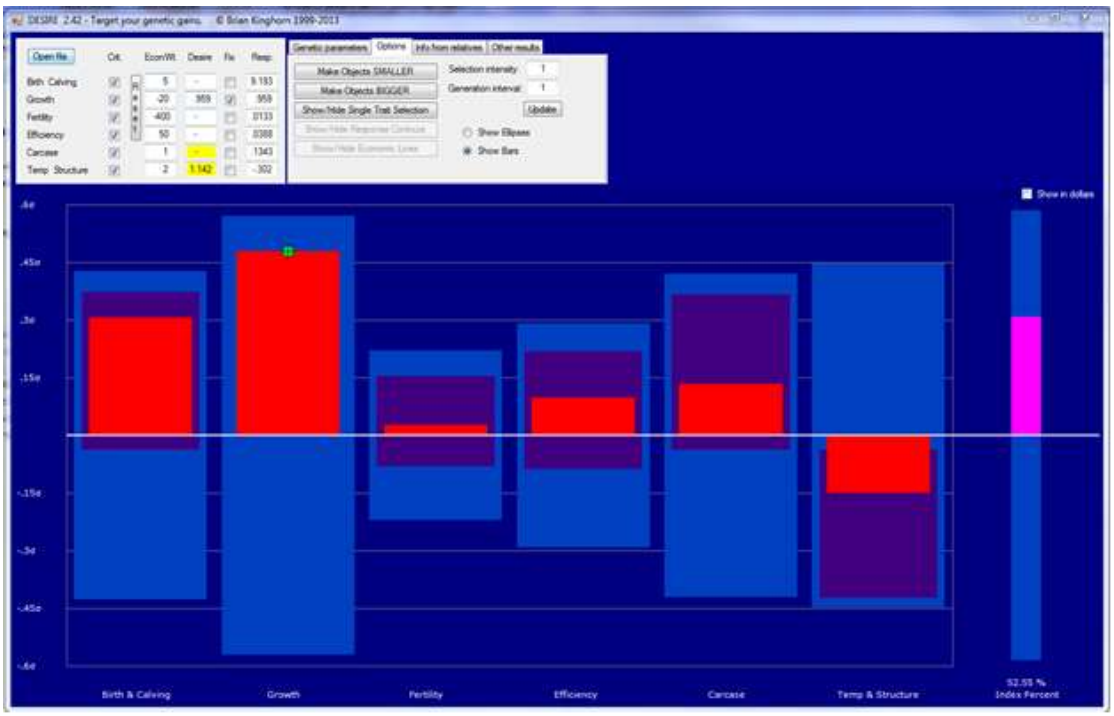


Figure 6. Kinghorn's DeSire interface (outcome) (2013).

DeSireBull currently uses an Industry derived $Index, chosen by the user as the starting point for the selection process. The tool displays the EBV components of these indexes as "EBV Subgroups" and allows producers to refine their search based on the performance of bulls within these subgroups. Using the principles of Kinghorn's DeSire algorithm, the tool dynamically displays the correlated response to $Index value and to other EBV subgroups once a change is made in the subgroup section. This allows the user to identify the impact of any changes he/she makes and how this differs from the Industry derived $Index. Search results then show bulls ranked based on the overall $index value, taking into consideration the subgroup preferences of the user.

4.2.2 Wireframing:

i. Document and wireframe the tool and understand future functionalities.

User testing was conducted in conjunction with the development of the wireframes in order to incorporate user feedback. In order to develop appropriate wireframes for the Minimum Viable Product, the scope of the functionality of the project needed to be defined. Two groups of functionalities were identified in this process, those that will be "nice to have" (Fig. 7), and those that will be "required" (Fig. 8). The latter summarizes critical functionality, without which the project cannot succeed, and these were a part of the core foundations of the first iteration of this tool.

Figure 7. "Nice to have" functionality for the minimum viable product.

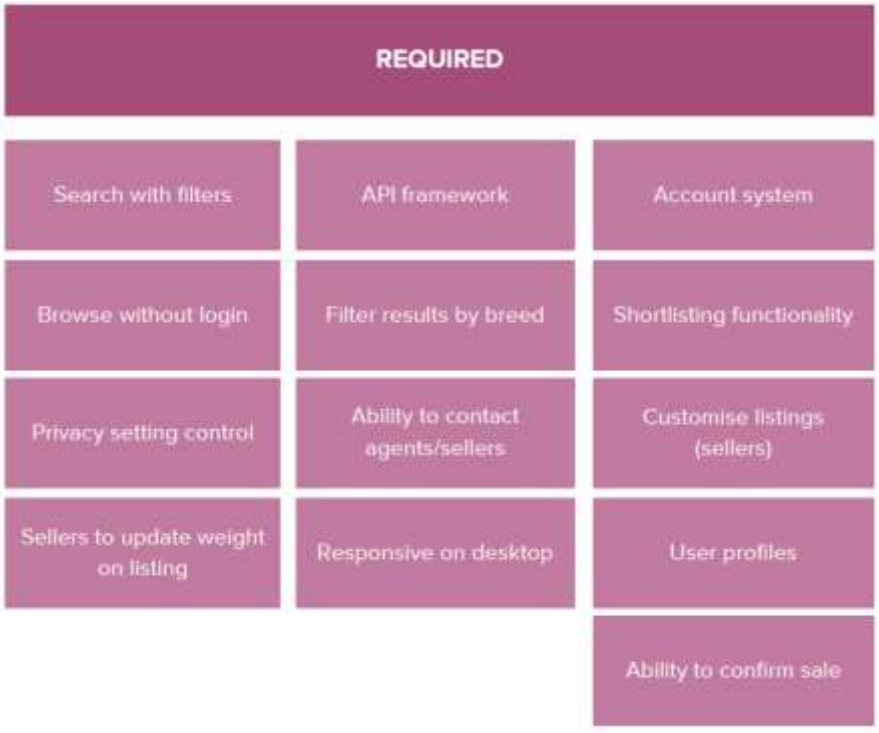


Figure 8. "Required" functionality for the minimum viable product.

The major wireframes built for the MVP were therefore:

- Homepage
- About us
- Login
- Sign Up
- Forgot password
- Account (seller)
- Your listings (seller)
- Account (buyer)
- Search
- Results
- Shortlist (buyer's account)
- Compare (buyer's account)
- Share
- Further information
- Contact us
- Privacy statement
- Disclaimer statement
- Copyright statement
- API framework

ii. Develop detailed sketches of the envisioned product in order to uncover usability issues.

One of the challenges with building this decision support tool was presenting key data in a simplified format that is easy for the audience to interpret. Initially, a "five-star rating" approach was used to identify the "best" bull (Figures 9 & 10). Each trait subgroup was rated out of 5 and an overall rating was calculated as an average of these scores. Testing this concept with consumers concluded that there was not enough information provided with this approach and that it was over-simplified. The design approach to this rating system was re-evaluated and a more graphic representation of the rating was created which was well received by the audience. The new approach is detailed in section 4.2.4.

Figure 9. Initial sketch of 5-star rating system, basic results section.

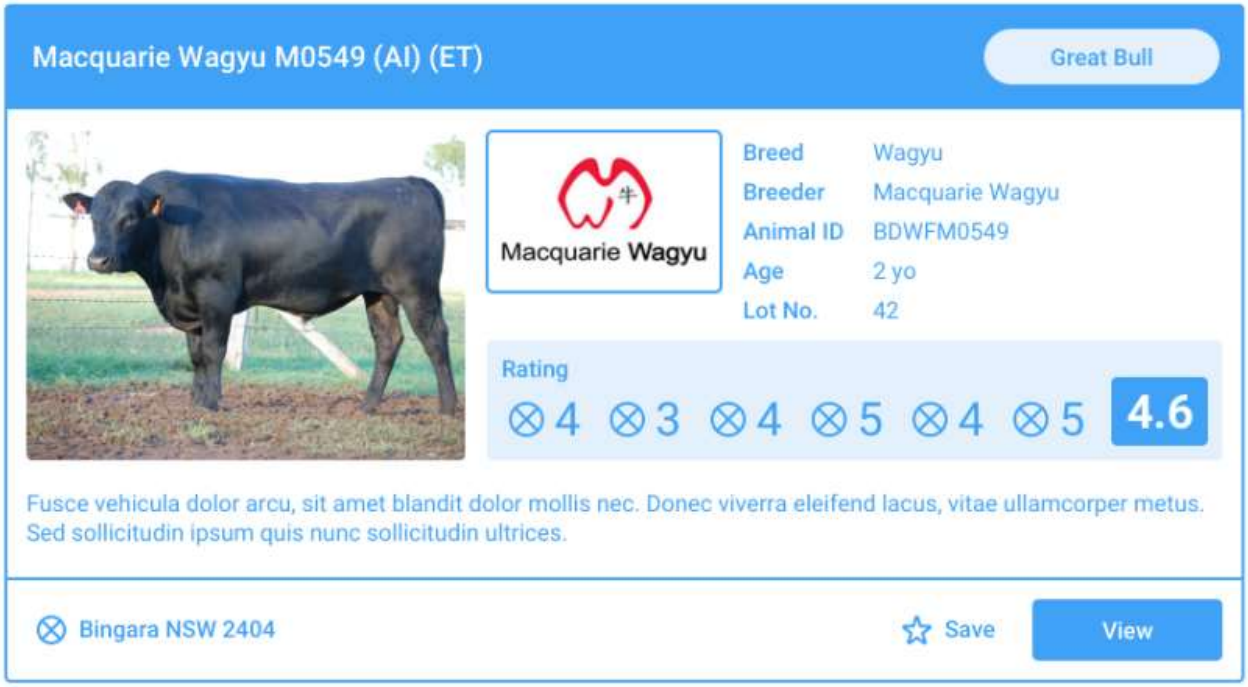


Figure 10. Initial sketch of 5-star rating system, more detailed results section.

4.2.3 Technical Feasibility Assessment:

i. Assess the prospective format and platform of the tool against data formats, access and availability in order to achieve the required functionality.

The Minimum Viable Product was built from front to back. This means that the front-end (user interface) was built before the backend (APIs to existing databases etc.). This was done to ensure that the tool was meeting user requirements in functionality and user friendliness. Initially the intention was to develop both a webpage and an application for Android and Apple products (Figures 11 & 12).

Browser	Platform	Version
Chrome	Windows 10 - Latest version or most appropriate version at start of each sprint	Latest version or most appropriate version at start of each sprint
Chrome	MacOS - Latest version or most appropriate version at start of each sprint	Latest version or most appropriate version at start of each sprint
Chrome	iOS - Latest version or most appropriate version at start of each sprint	Latest version or most appropriate version at start of each sprint
Chrome	Android - Latest version or most appropriate version at start of each sprint	Latest version or most appropriate version at start of each sprint
Firefox	Windows 10 - Latest version or most appropriate version at start of each sprint	Latest version or most appropriate version at start of each sprint
Firefox	MacOS - Latest version or most appropriate version at start of each sprint	Latest version or most appropriate version at start of each sprint
Safari	MacOS - Latest version or most appropriate version at start of each sprint	Latest version or most appropriate version at start of each sprint
Safari	iOS - Latest version or most appropriate version at start of each sprint	Latest version or most appropriate version at start of each sprint
Edge	Windows 10 - Latest version or most appropriate version at start of each sprint	Latest version or most appropriate version at start of each sprint

Figure 11. Compatible webpage/desktop platforms

Device	OS	Version
iPad Pro 2	iOS - Latest version or most appropriate version at start of each sprint	Latest version (iPad Pro 2) or most appropriate version at start of each sprint
iPad	iOS - Latest version or most appropriate version at start of each sprint	Latest version (6th Gen) or most appropriate version at start of each sprint
iPhone 8	iOS - Latest version or most appropriate version at start of each sprint	8 Version
iPhone X	iOS - Latest version or most appropriate version at start of each sprint	X Version
iPhone 2018 (TBC new model)	iOS - Latest version or most appropriate version at start of each sprint	XS (TBC)
Pixel 2	Android - Latest version or most appropriate version at start of each sprint	Pixel 2
Pixel 2018 (TBC new model)	Android - Latest version or most appropriate version at start of each sprint	Pixel 3 (TBC)
Samsung Galaxy S9	Android - Latest version or most appropriate version at start of each sprint	S9
Samsung Galaxy Note 9	Android - Latest version or most appropriate version at start of each sprint	Note 9

Figure 12. Compatible mobile and tablet devices

However, through user testing it was deduced that a mobile/tablet application was not high on the user's priority list as their usual practice was to complete bull searches on desktop devices anyway. The aim was to then focus on producing a better webpage/desktop MVP with function to allow users to print listings and/or shortlists. The homepage is mobile responsive however the search filter, bull detail page and account section of the website is optimised for desktop display only.

Access to the full tool and its functionality is therefore restricted to devices larger than these following responsive breakpoints:

- Mobile- 320px
- Tablet- 768px +
- Desktop- 1024px +

When commencing the development of the backend of the tool, a series of "dummy" data sets were developed in order for data to be read, extracted and populate the front-end automatically. These datasets were supplied as basic ".txt" files. These files contained information on NSW DPI owned animals to form a "BETA" MVP that could then be user tested. This is shown in Fig. 13 below.

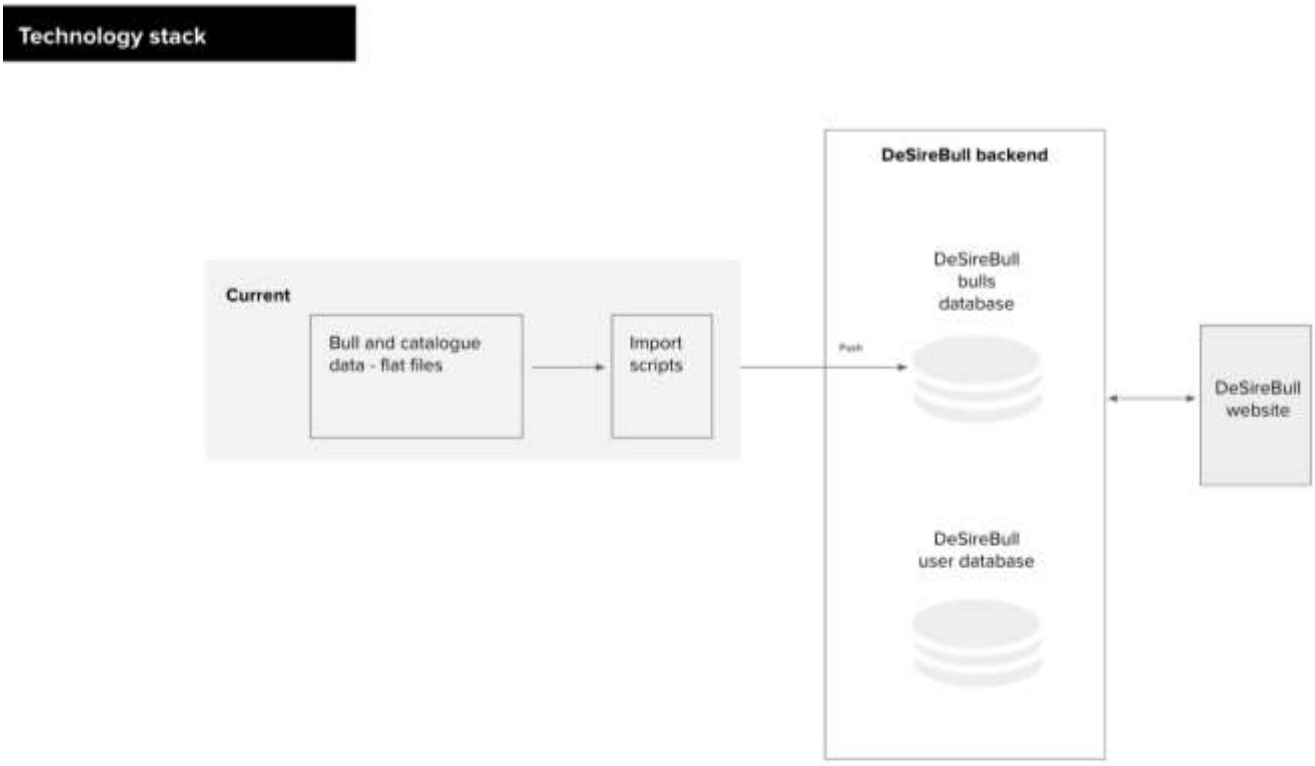


Figure 13. Initial data flow to test DeSireBull MVP using flat files (.txt files).

Following user testing of the MVP, efforts were then made to determine the best format for the import of data from potential commercialisers. Two alternatives have been built. The first is a DeSireBull application programming interface (API) that allows commercialisers to write directly to the tool. The second is via a file transfer protocol (FTP) that allows the commercialiser to upload files to then be pushed to the DeSireBull API. This is shown in Fig. 14 below.

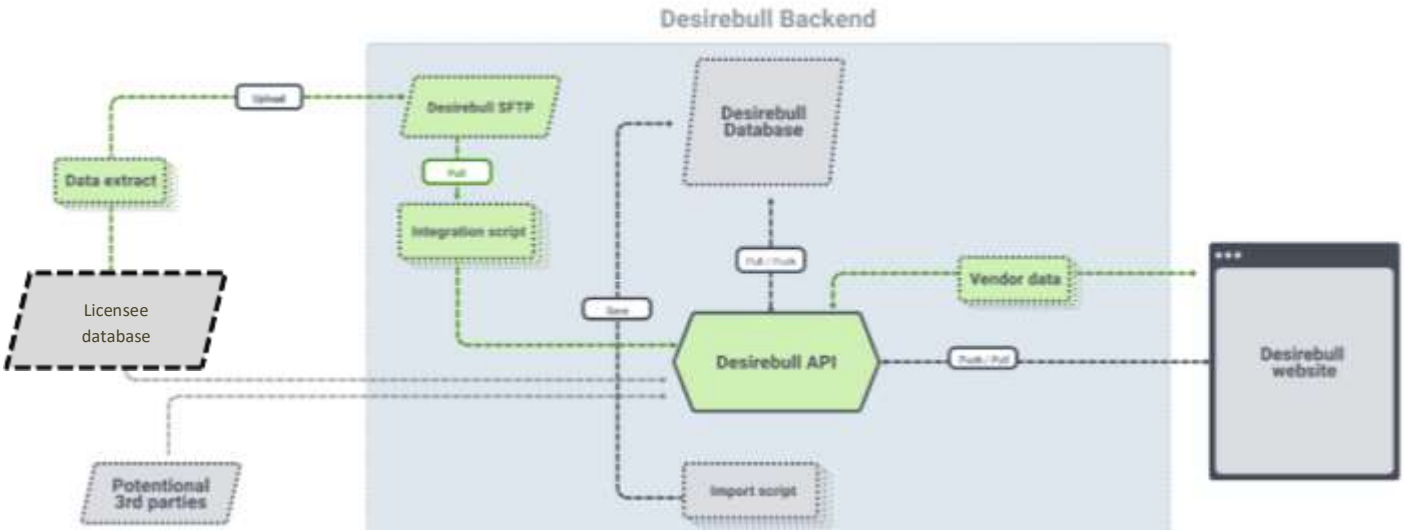


Figure 14. Map of DeSireBull's data flow (backend) showing options for data transfer from external database to DeSireBull's API.

4.2.4 Prototype:

i. Build a basic prototype that allows the concept to be tested with prospective users.

From the initial scoping of user stories with Circul8 a basic prototype that was then tested with prospective users. This initial prototype was static and not interactive but allowed the concept of the decision support tool to be tested. A series of surveys were conducted to capture feedback from a wide audience. A summary of these surveys is provided in section 4.2.7.

The initial prototype took into consideration the feedback on the initial wireframe. A graphical approach was taken to display the 5-star subgroup rating in a spider graph (Fig. 15). Each of the subgroups was represented by a wedge in the spider graph. Each wedge was broken into 5 sections and the number of sections coloured indicated the rating of the subgroup out of 5. An "Overall bull rating" is also included and is representative of the bulls ranking within breed for its overall $Index value.

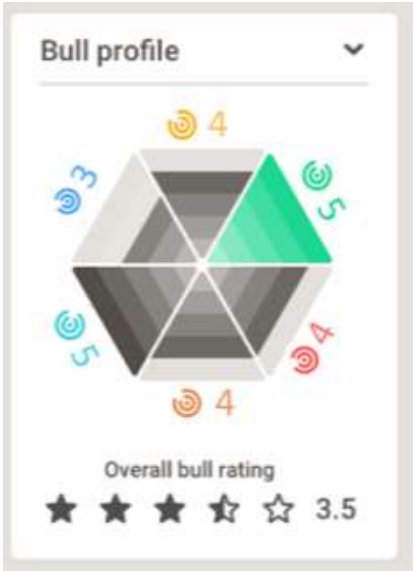


Figure 15. "Bull profile" depicting subgroup spider graph and "Overall bull rating"

Fig. 16 shows the search and results page of the first prototype. The search filters can be seen down the left-hand side of the screen including the ability to refine search on each EBV subgroup as well as sale type, breeder and age. Conceptually, the results on the right-hand side would adjust in real time as search criteria are applied. Results cards display subgroup spider graph, 5-star overall rating, basic sale information and animal description.

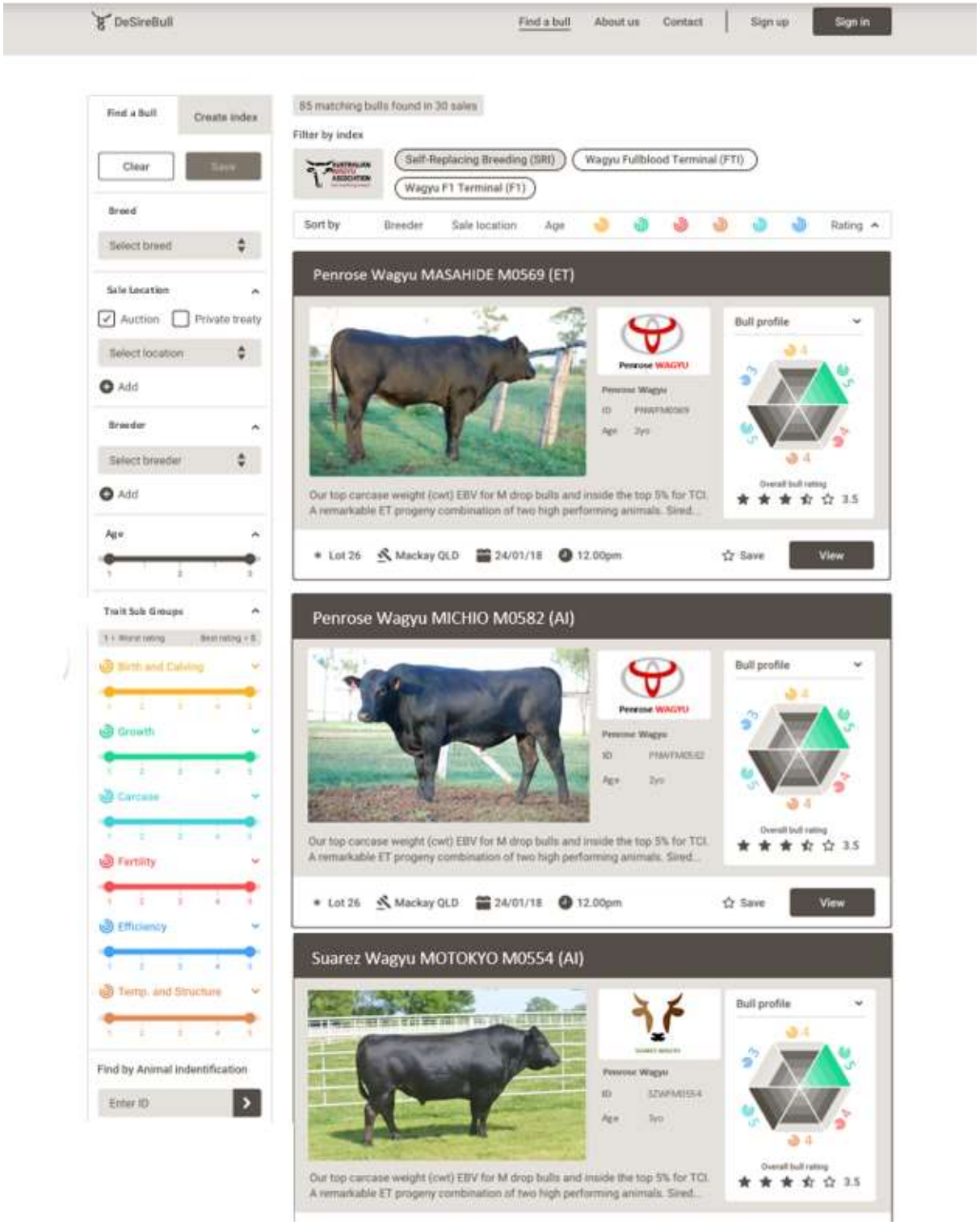


Figure 16. DeSireBull results section - prototype 1.

Fig. 17 is a depiction of an individual bull's listing with more detailed information on both the animal and the sale. The display includes sale information, basic animal information, description, index values and percentile bands, EBV subgroup values as a 1-5 rating displayed as a spider graphand and individual EBV components of each subgroup.

Figure 17. DeSireBull bull listing page – prototype 1.

Fig. 18 is a continuation of the bull's listing page. This display includes more comprehensive animal information including genetic condition status, pedigree, structural and temperament information as well as traits observed and individual EBV values and accuracies.

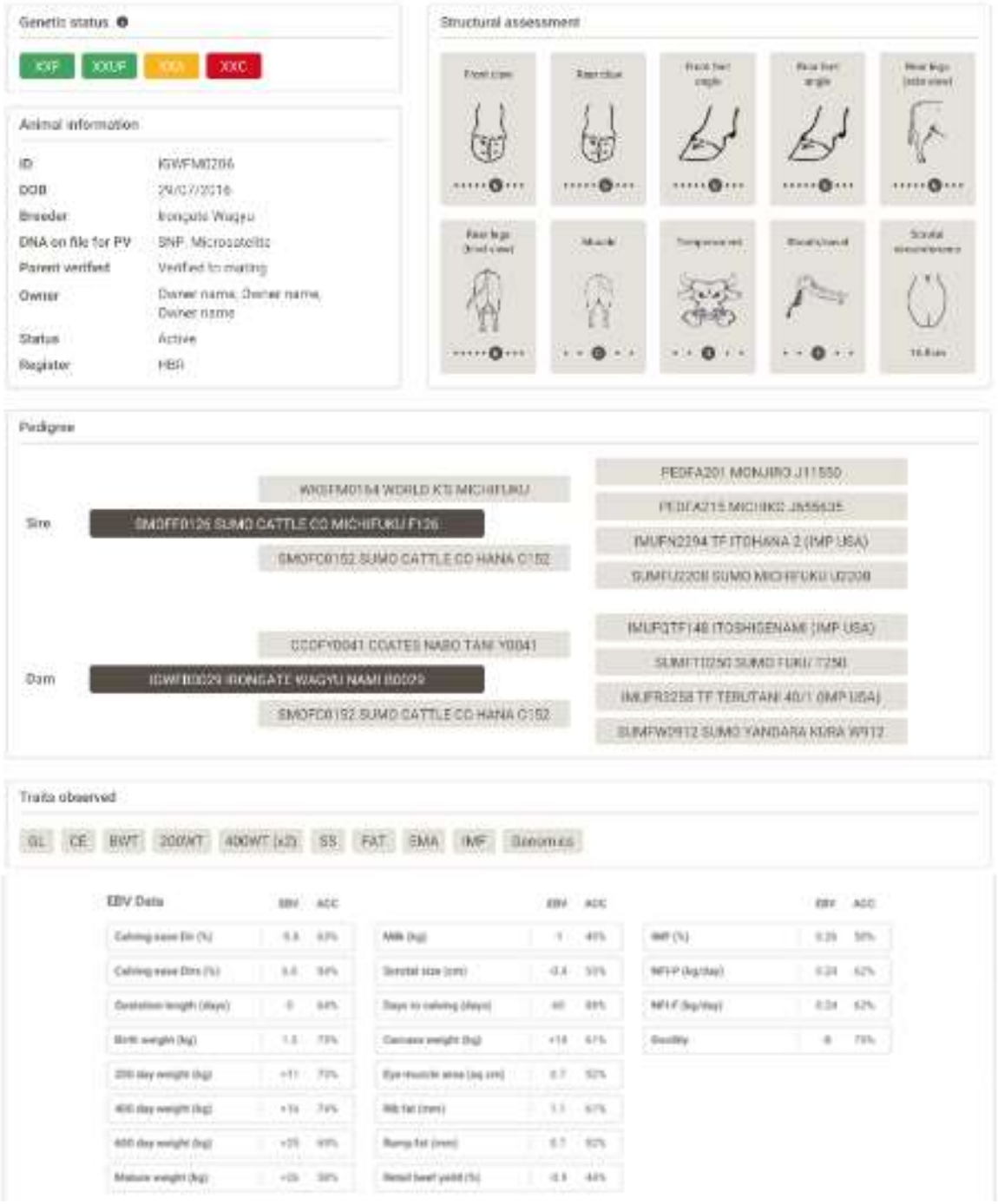


Figure 18. Continuation of DeSireBull bull listing page– prototype 1.

After validating the data and information supplied in the prototype through survey feedback, a second prototype was developed. This prototype was developed as a first minimal viable product that could be tested for functionality with users as well as the user experience (UX). Changes made from prototype 1 to prototype 2 were mainly to improve user friendliness and the user interface (UI) and are shown in Figures 19-22 below. In addition, the prototype was semi-interactive, allowing users to click and alter certain search criteria and enter the bulls' detail page. A series of face-to-face interviews were conducted on this version 1 MVP to better capture feedback for concept, design and functionality of the tool.

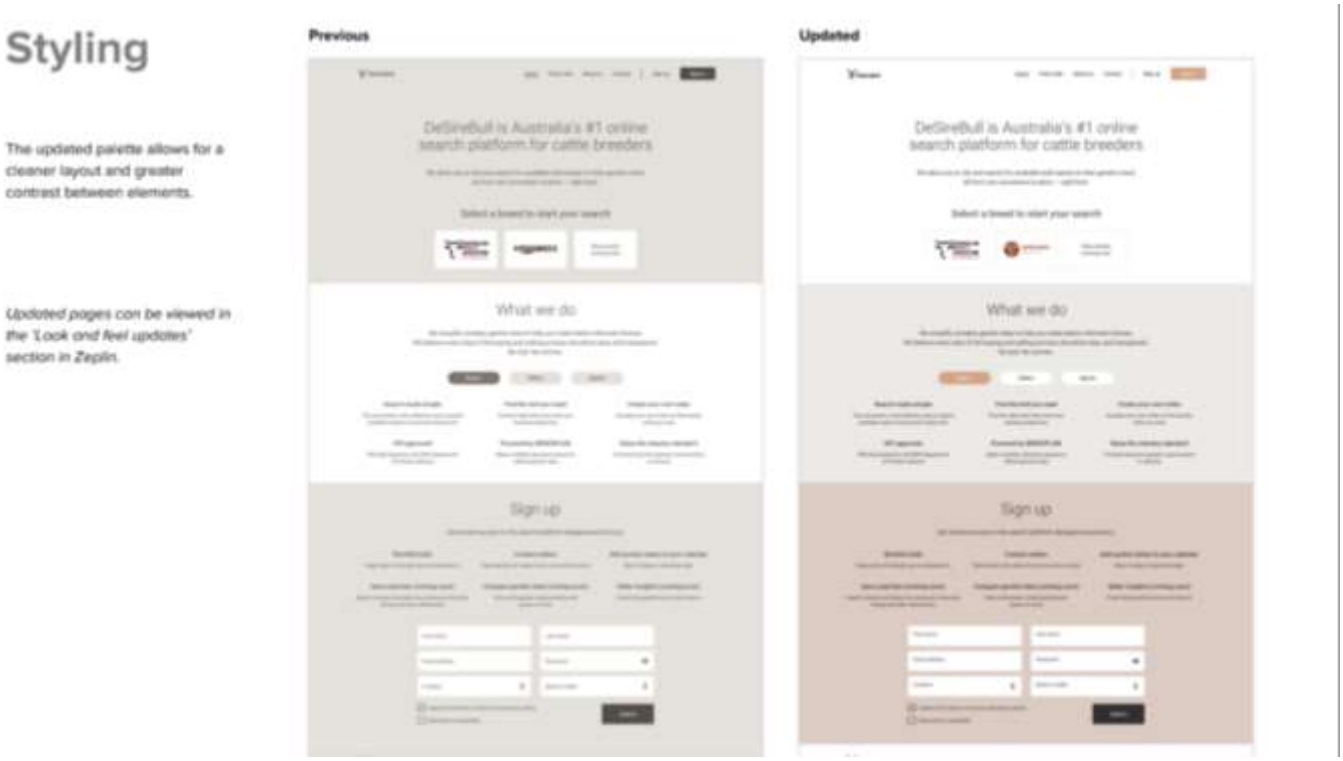


Figure 19. Changes to DeSireBull Homepage – prototype 1 to 2.

As with prototype 1, prototype 2 also included a “Create Index” tab intended to be used to allow producers to create their own index based on a summarised version of the 88 question BreedObject Questionnaire (Fig. 20). This section was shown to stakeholders to gather feedback on how they perceived its importance and to get an indication of its usage.

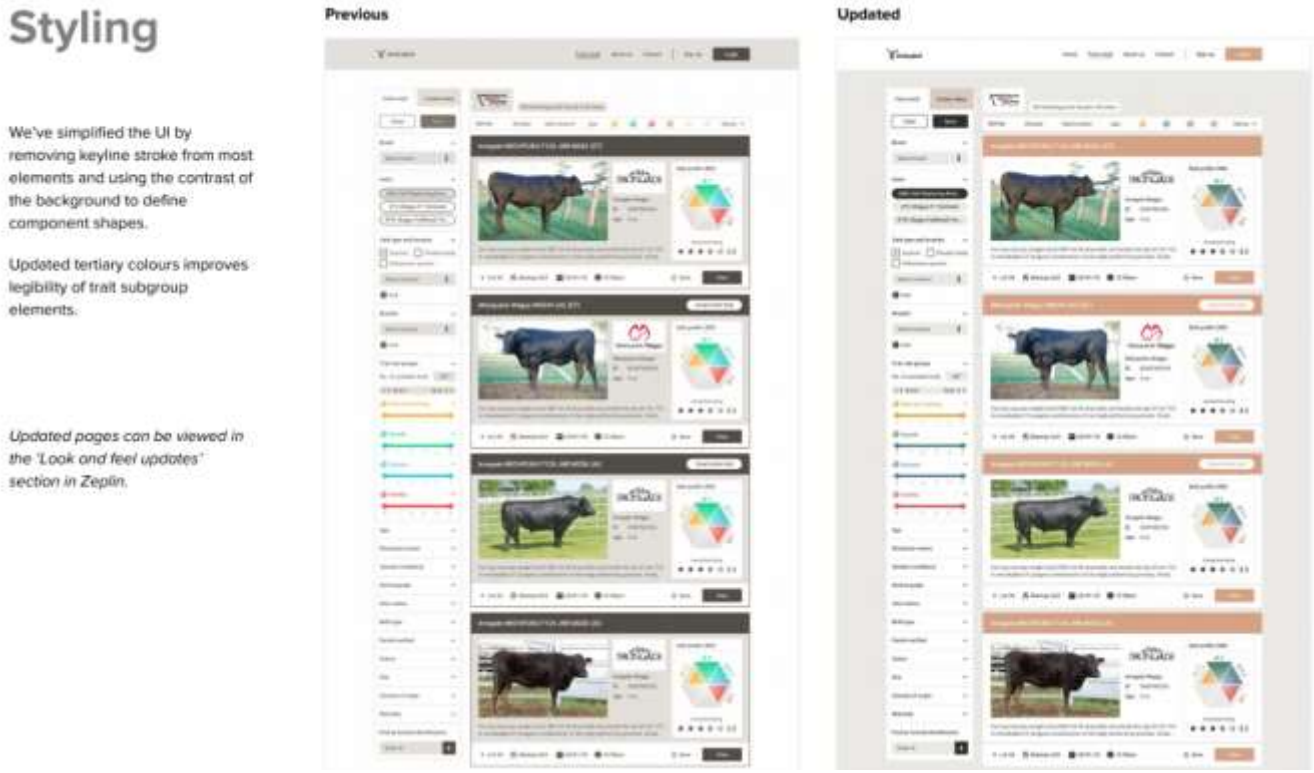


Figure 20. Changes to DeSireBull search/results page – prototype 1 to 2.

While the information provided on the bull listing page remained unchanged, the UI was modified to provide a “cleaner” interface, increasing white space to reduce the “over-crowded” feel (Figure 21-22).

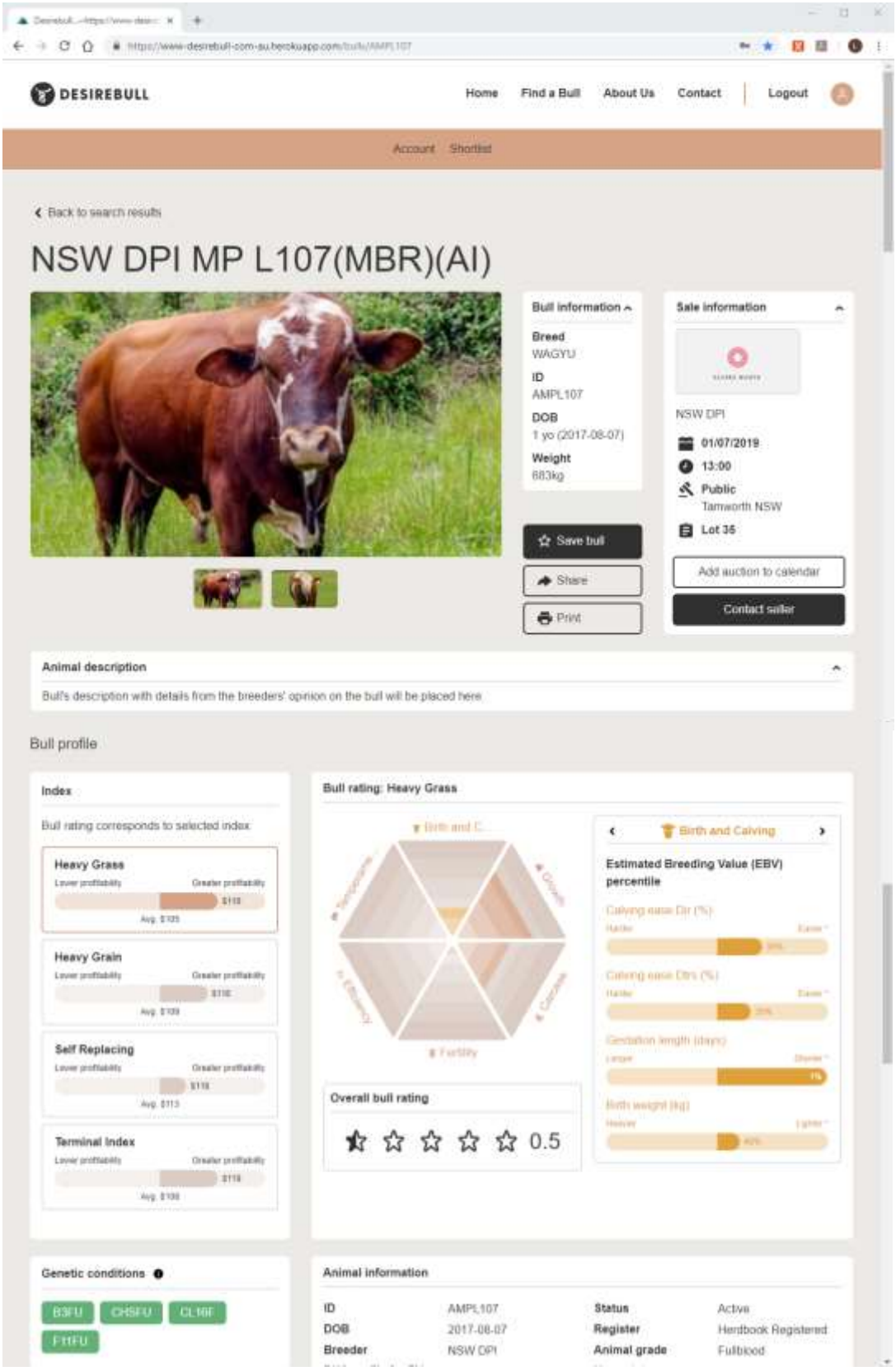


Figure 21. DeSireBull bull listing page part 1 – prototype 2.

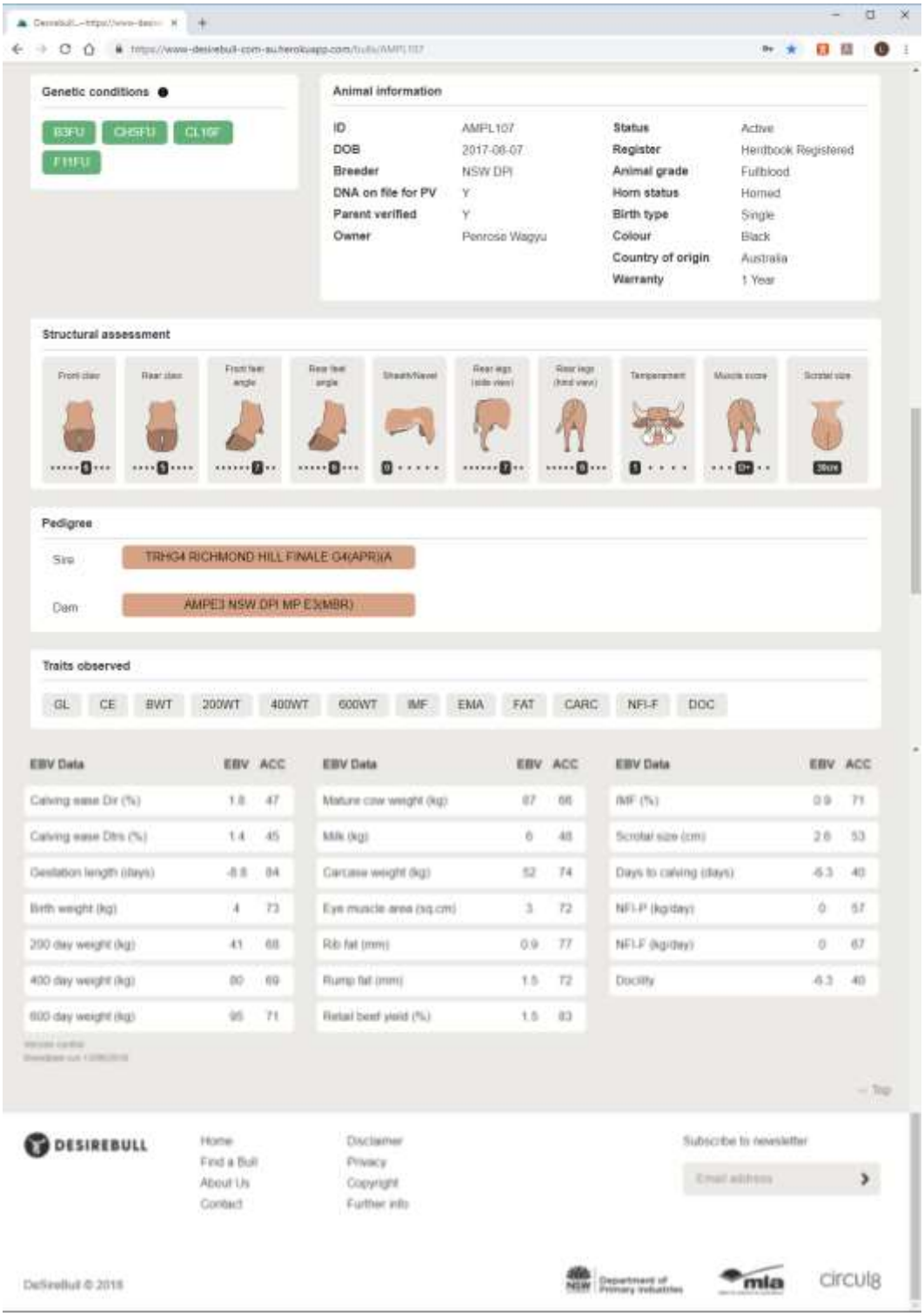


Figure 22. DeSireBull bull listing page part 2 – prototype 2.

Provide the stakeholders with the first look at the tool in order to validate information gathered in previous stages.

Steering Group meetings were held before and after the completion of development of each prototype. The group provided valuable feedback on the content and design of the tool and gave useful insights in regard to the context of tool usage. The steering group also provided suggestions as to who should be approached in order to conduct user testing of the two prototypes.

ii. Validates the tool's functionality, assumptions, and helps to give an understanding of the scope of future work.

The prototype has been useful in validating the tool's functionality and assumptions as well as identifying key aspects that need to be addressed in future development.

4.2.5 Design (Multi-stage process)

i. The UX designer, architects the interaction between design elements in the tool

Brand Design

The name DeSireBull (working title) was identified as an option from a survey NSW DPI conducted involving a range of potential names (eg: BullObject, Bullseek, Bullrank, Bullfind, EASelect, Bullseeker, Selectabull, Bullsearch, Findabull). DeSireBull was selected as this name fits with the engine we are using (Brian Kinghorn's 'Desire' algorithm) and has been well received by the majority of prospective users spoken to.

Inspiration and visual language

The main visual reference for the ideas presented in this portfolio came from the drawings of Pablo Picasso (Fig. 23), who was well known for his simplification and abstraction exercises using the image of the bulls. Picasso was also inspired by the rhythm and movement of the Spanish bull fights. The quick paintbrush strokes needed to represent the dynamics of these moments were one of the marks in his style. A rounded stroke was used in some of the drawings to, at the same time, represent and make the designs more suitable for the modern smart mobile technology media. The Spanish "toradas" — especially from their advertising posters — came the choice of colours for this project (Fig. 23). The ochre yellow, red and sandy-browns also make a reference to the Australian outback country.

The abstract bull

This is the most abstract representation of the bull's face through the DNA string. Through extreme graphical synthesis, the face and the string become one. The simple, continuous line and the applied hand-drawn tracing style add interest to the simple shape and also make subtle reference to the iron cattle brands. A thin, more elegant typeface was chosen for the text to balance the slight "roughness" of the symbol (Fig. 23).

Figure 23. Inspiration for initial DeSireBull branding.

ii. The UI designer, builds the look and feel of the tool

In terms of design and layout, a more subtle and cohesive colour scheme was implemented that complemented the earthy tones used for the inspiration of the DeSireBull brand (Fig. 24). Conscious effort was made to ensure the tool did not appear over-crowded, and that the focus of the audience was drawn to the data presented by the tool.

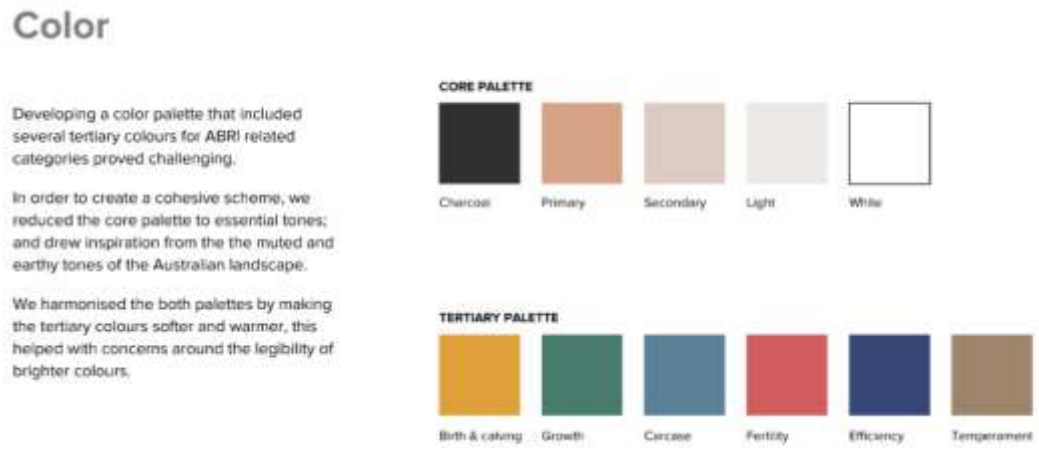


Figure 24. Colour palette for prototype 2.

iii. The outcome of this process will provide a clear visual direction with an abstraction of the final product

During the face-to-face interview process conducted with prototype 2, questions were asked around the look and feel of the site. From this process it was deduced that changes needed to be made to the graphical representation of the EBV subgroups. Preference of users was to have a bar graph similar to the exiting graph used by BREEDPLAN to display EBV percentile bands (Fig. 25). It was also expressed that being able to search for animals on the percentile band scale would be preferable and make more sense to the user than the proposed 1-5 scale. In addition, a re-brand of the site was conducted to align with design of existing graphs used to display genetic information called percentile bands tables (Figures 25 and 26).

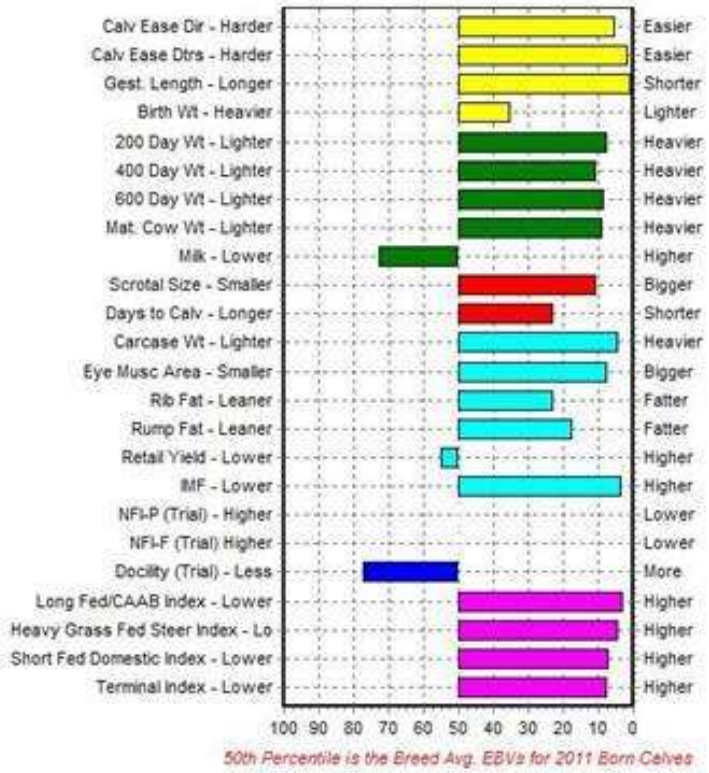


Figure 25. BREEDPLAN percentile bands table for individual bull. Traits grouped together represented by same colour bars. Yellow are birth and calving traits, green are growth traits, red are fertility traits, aqua are carcase traits, dark blue are temperament traits, pink are index values.

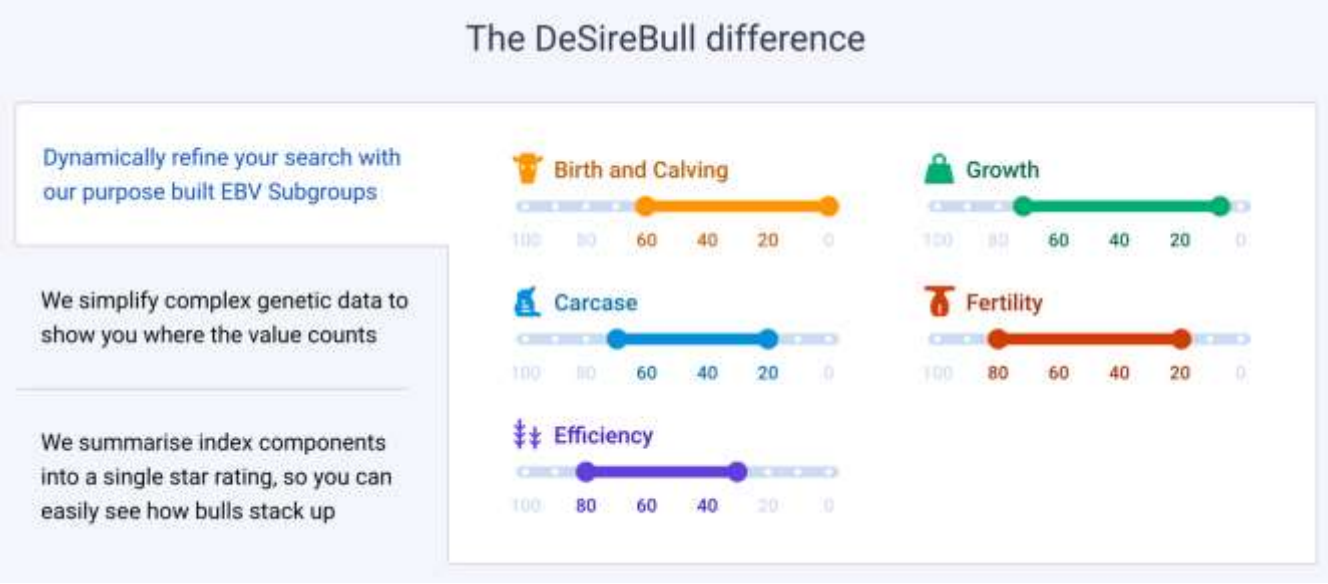


Figure 26. DeSireBull has mimicked the colours used by BREEDPLAN.

4.2.6 Development (Multi-stage process)

i. The development of the application will be broken down into smaller modules, and agile methodology will be applied to each of these small parts. This will help with flexible planning, progressive development, early deployment and constant improvement.

The original workplan for development included the following modules:

- Discovery
- Creative development
- MVP release
- Evaluation and measurement
- Creative development (continued)
- MVP update
- Measurement and feedback

Repeated 3 times

- Handover and Future Plans

ii. Two-week sprints will be conducted to develop each module.

The creative development modules were further broken down into two weeks sprints in order to ensure progressive development of the tool. There are 7 sprints in total, with the first 4 completed in order to meet Milestone 2 objectives and the final 3 intended to complete the project. Details of each module and sprint are detailed in Figures 27 and 28 below.

Task Name	Duration	Start	Finish	Predecessors
Desirebull Product Development	**331d**	**15/08/18**	**20/11/19**	
Discovery	**22d**	**15/08/18**	**13/09/18**	
Workshop and Research (DPI)	3d	15/08/18	17/08/18	
Statement of Work, Functional Specifications, Technical Feasibility, Refined budget and timeline. Organisation of Backlog, User stories and Additional Research	10d	20/08/18	31/08/18	3
Client Review (DPI)	3d	03/09/18	05/09/18	4
Documentation Amendments	3d	06/09/18	10/09/18	5
Client Approval (DPI)	3d	11/09/18	13/09/18	6
Creative Development (Sprint 1) - 2 Week Sprint	**19d**	**14/09/18**	**10/10/18**	
Sprint Planning (DPI)	1d	14/09/18	14/09/18	7
Design & Copy	10d	17/09/18	28/09/18	9
Sprint Review (DPI)	3d	01/10/18	03/10/18	10
Sprint Approval (DPI)	5d	04/10/18	10/10/18	11
Creative Development (Sprint 2) - 2 Week Sprint	**17d**	**11/10/18**	**02/11/18**	
Sprint Planning (DPI)	1d	11/10/18	11/10/18	12
Development	10d	12/10/18	25/10/18	14
Sprint Review (DPI)	3d	26/10/18	30/10/18	15
Sprint Approval (DPI)	3d	31/10/18	02/11/18	16
Creative Development (Sprint 3) - 2 Week Sprint	**16d**	**05/11/18**	**26/11/18**	
Sprint Planning (DPI)	1d	05/11/18	05/11/18	17
Development	10d	06/11/18	19/11/18	19
Sprint Review (DPI)	2d	20/11/18	21/11/18	20
Sprint Approval (DPI)	3d	22/11/18	26/11/18	21
Creative Development (Sprint 4) - 2 Week Sprint	**18d**	**27/11/18**	**20/12/18**	
Sprint Planning (DPI)	1d	27/11/18	27/11/18	22
Development	10d	28/11/18	11/12/18	24
Sprint Review (DPI)	3d	12/12/18	14/12/18	25
Sprint Approval (DPI)	3d	17/12/18	19/12/18	26
MVP Release	1d	20/12/18	20/12/18	27

Figure 27. Timeline for modules and sprints (MVP)

Task Name	Duration	Start	Finish	Predecessors
Desirebull Product Development	**331d**	**15/08/18**	**20/11/19**	
Evaluation & Measurement	**81d**	**21/12/18**	**12/04/19**	
MVP Out with Users	60d	21/12/18	14/03/19	28
Reporting & Research	16d	15/03/19	05/04/19	30
Backlog Planning (DPI)	4d	08/04/19	11/04/19	31
Evaluation Meeting (DPI)	1d	12/04/19	12/04/19	32
Creative Development (Sprint 5) - 2 week sprint	**44d**	**15/04/19**	**13/06/19**	
Sprint Planning (DPI)	3d	15/04/19	17/04/19	33
Development	10d	18/04/19	01/05/19	35
Sprint Review (DPI)	2d	02/05/19	03/05/19	36
Sprint Approval (DPI)	5d	06/05/19	10/05/19	37
MVP Update	**1d**	**13/05/19**	**13/05/19**	**38**
Measurement & Feedback (DPI)	23d	14/05/19	13/06/19	39
Creative Development (Sprint 6) - 2 Week Sprint	**44d**	**14/06/19**	**14/08/19**	
Sprint Planning (DPI)	3d	14/06/19	18/06/19	40
Development	10d	19/06/19	02/07/19	42
Sprint Review (DPI)	2d	03/07/19	04/07/19	43
Sprint Approval (DPI)	5d	05/07/19	11/07/19	44
MVP Update	**1d**	**12/07/19**	**12/07/19**	**45**
Measurement & Feedback (DPI)	23d	15/07/19	14/08/19	46
Creative Development (Sprint 7) - 2 Week Sprint	**70d**	**15/08/19**	**20/11/19**	
Sprint Planning (DPI)	3d	15/08/19	19/08/19	47
Development	10d	20/08/19	02/09/19	49
Sprint Review (DPI)	2d	03/09/19	04/09/19	50
Sprint Approval (DPI)	3d	05/09/19	09/09/19	51
MVP Update	**1d**	**10/09/19**	**10/09/19**	**52**
Measurement & Feedback (DPI)	20d	11/09/19	08/10/19	53
Handover and Future Plans	**31d**	**09/10/19**	**20/11/19**	
Documentation and Handover preperation	30d	09/10/19	19/11/19	54
Handover Meeting & Future Plans Meeting (DPI)	1d	20/11/19	20/11/19	56

Figure 28. Timeline for modules and sprints (post-MVP)

Due to changes in project management within the Circul8 team, the timeframe of these sprints had to be adjusted and an additional three sprints were completed on top of the original seven proposed. With the remaining time left on the project (originally until December 2019) the aim was to partner with a breed society and identify a seedstock producer to test the DST will real sales data and capture feedback from their clients - commercial beef producers. However, to achieve this a dataflow pipeline needed to be developed with the Agricultural Business Research Institute (ABRI) in order to provide genetic information to populate DeSireBull.

To achieve this, an additional module was added to the project termed “Integration”. It was initially estimated that three 2-week sprints would be sufficient to complete this work. However, as ABRI were going through a transitional period at the time, the scope of the work that needed to be done was grossly underestimated. After many changes to data structure and format, final testing is currently being conducted on the integration script and is expected to be completed by June 30, 2020.

4.2.7 Testing (Multi-stage process)

i. *The application will be tested for usability, compatibility, security, interface checks, stress, and performance.*

At every stage of development, before changes/upgrades/updates were released "LIVE" to the DeSireBull BETA website they were tested by the software developer on a staging website. This enabled a greater level of quality control before released to the public to view and test.

ii. *User acceptance testing will be conducted with some people in the target audience.*

After the development of prototype 1, a series of surveys were released to the public with the assistance of the DPI communications team, steering group and MLA. These surveys focused on the visual design and content of three significant pages - the 'Create Index' page, 'Search & Results' page, and the 'Bull Listing' page. As respondents were directed to a list of surveys – most just completed the first survey - Create Index page: 114 responses; Search & Results page: 38 responses; and Bull Listings page: 37 responses. The demographics of respondents is shown in Fig. 29 below.

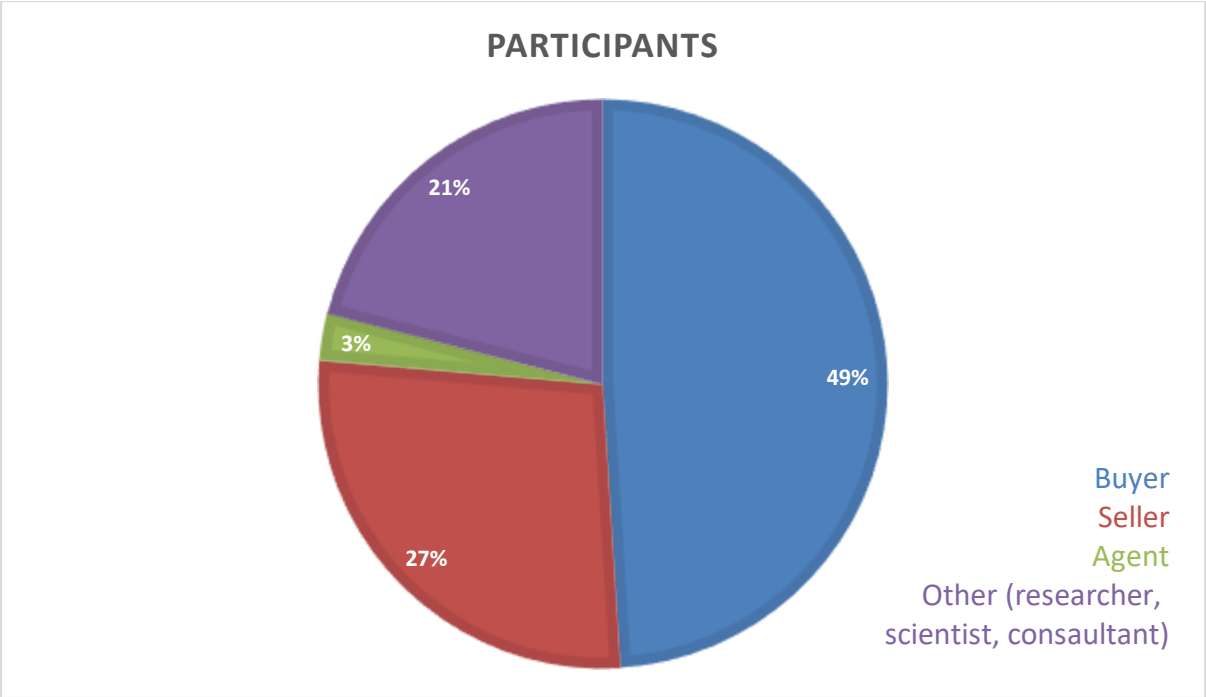


Figure 29. Demographics of survey participants.

Some trends can be identified within the answered surveys. It was found across all three surveys, approximately 90% of participants research bull information online prior to a sale. Such information includes: EBVs, pedigree, phenotype and independent assessment data, index value, genomics, photos and stud information, all of which are included in the DST. Participants have given insightful feedback regarding the design and content of the three pages. Feedback considered crucial for the release of the MVP were identified and changes were made accordingly.

Following the development of prototype 1 (first MVP), a series of face-to-face interviews were conducted with 8 seedstock and commercial producers from the New England region. The interactive MVP allowed users to test the search features and click into bull listings page for further details. From these interviews 8 main insights were deduced. The project team

prioritised these insights and developed "how might we" statements to address them (Table 4). From this further investigation into how we can meet/resolve these insights were conducted and resolutions were built into the next MVP. Following the development of the MVP, validation interviews were conducted with 3 out of the original 8 users. Further enhancements were then made to produce the final MVP.

Table 4. Insights, proposed solutions and resolutions from user interviews.

Insight	**"How might we"**	**Incorporated resolutions**
Users have pre-set objectives in mind before they search, and this is often 2-3 criteria	Ensure that the search is simple enough for users who want to hone in on a small number of search criteria and not get confused by too many options?	New search structure New functionality to refine search results. Via location/region, catalogue/s, age, genetic conditions, horn status. Simplified 'sort by'
Users find the profile graph and trait subgroups unclear, particularly how they relate to EBVs	Better connect the relationship between EBVCs and the profile graph and make it easier for users to understand?	Rename sliders to "EBV Subgroups" Develop multiple graph options that relate more clearly to EBV percentile bands graph
User don't understand or trust the 5-star index rating	Make the rating more useful?	Rename it so it is clear what it refers to De-prioritise the rating as users want to make their own assessment Enable users to make their own assessment (insight 4)
Users want to use the shortlist to compare, rank and self-rate	Improve the shortlist so that users can more easily compare and rank animals and prepare for upcoming auctions?	Re-design shortlist cards for better comparison between bulls Allow easy printing of shortlist Provide space for personal notes on bulls Allow users to self-rank/rate bulls Allow users to share shortlists
Pedigree of bulls is really important	Prioritise bull's pedigree when searching or viewing information about bulls?	List available pedigree higher on bull listing page Include sire/dam on results card
Users are single breed focused and expect the tool to work specifically for their breed	Make sure we only show information that relates to specific breeds?	Ensure the backend and import process can support multiple breeds and new breeds can be added
Relationships with breeders and live visual assessment is still an important part of the process	Disrupt the bull buying process without overlooking the importance of existing relationships and visual assessments	Emphasise location range as search criteria over selection for specific breeders

		Build ability to contact sellers directly Provide quality photos and video footage to support structural scores.
Mobile devices are not essential for searching yet	Make key aspects of DeSireBull work when out and about?	De-prioritised for future work

4.2.8 MVP Deployment

i. Launch a Minimum Viable Product (MVP) with features defined and planned during the early stages of this project.

The first DeSireBull MVP (prototype 2) was launched in December 2018 in accordance with Milestone 2. This MVP was used to gather feedback from users. Features of MVP v1 allowed users to:

- Sign up
- Search for the best bull using EBV subgroups, Selection Indexes and by applying specific search criteria
- View all information available on that bull, and
- Save bulls to their shortlist

Other pages included in MVP1 were:

- About us
- Further info
- Contact
- Disclaimer
- Privacy policy
- Copyright

Feedback from MVP v1 was collated and prioritised and was used to develop a second MVP (Figures 30-35). Validation interviews were conducted on MVP v2 and users were presented with options for the graphical representation of EBV subgroups (Fig. 36).

Figure 30. DeSireBull MVP v2 Homepage

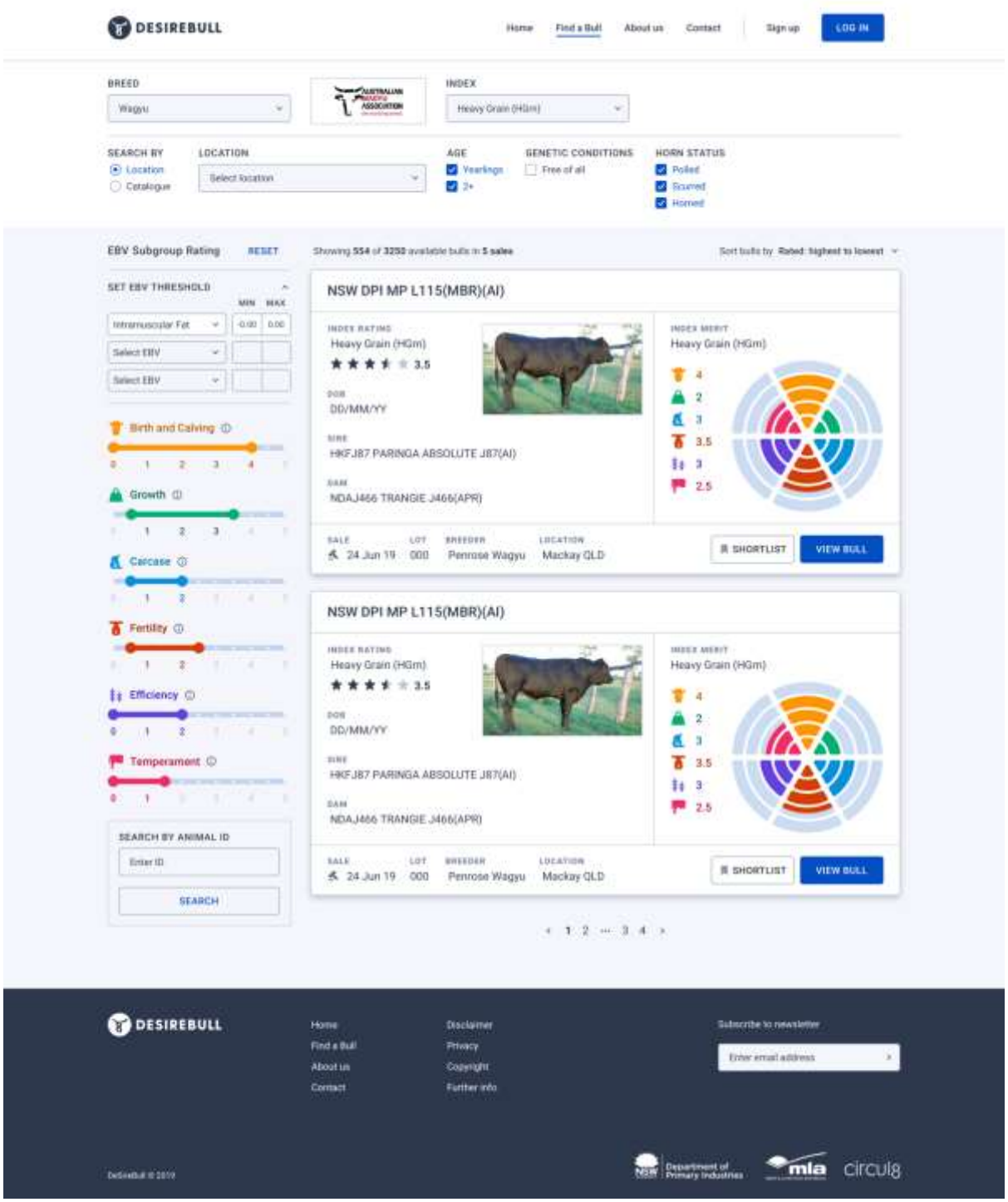


Figure 31. DeSireBull MVP v2 search/results page.

Figure 32. DeSireBull MVP v2 bull listing page.

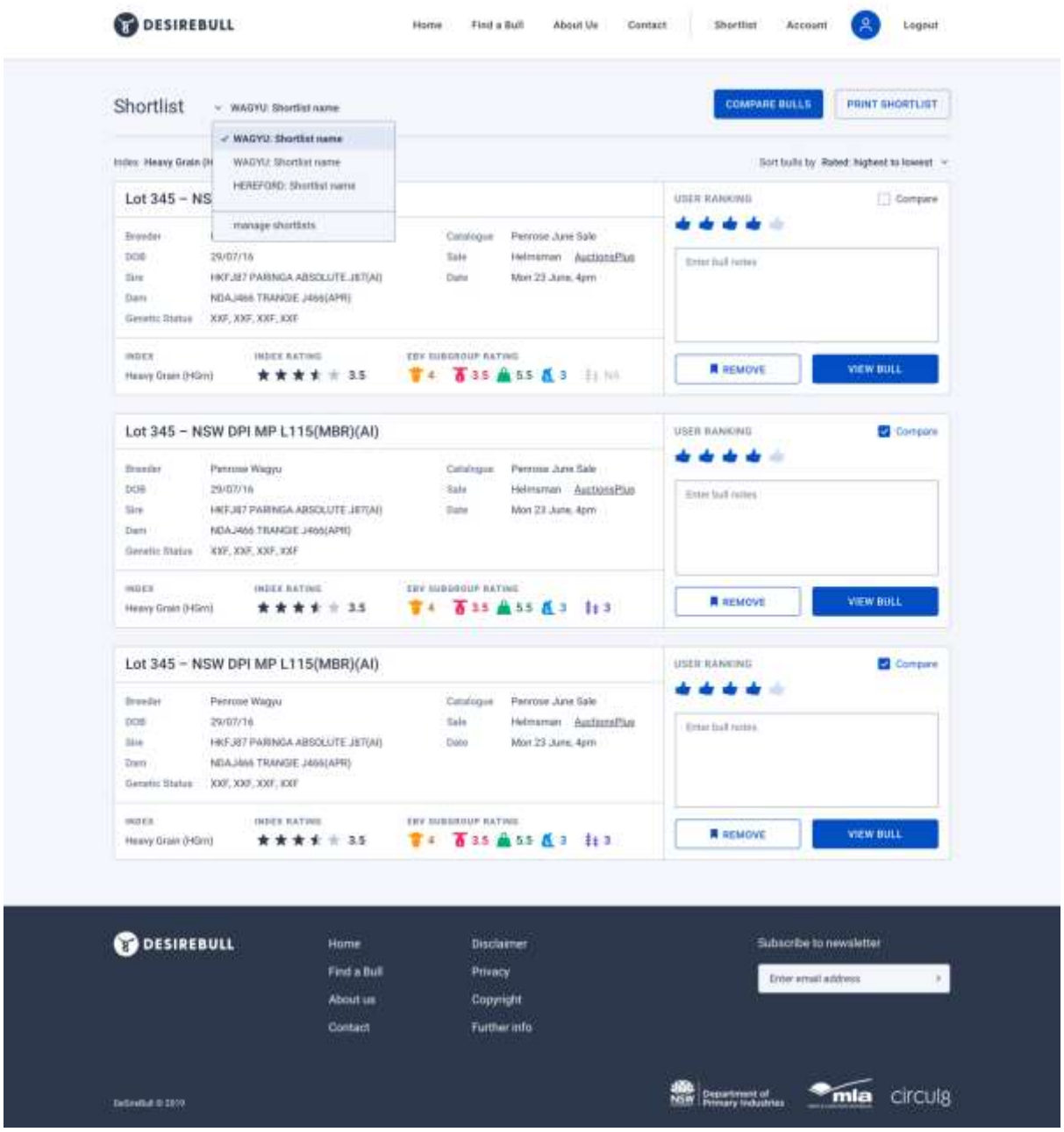


Figure 33. DeSireBull MVP v2 shortlist page.

Figure 34. DeSireBull MVP v2 print shortlist page.

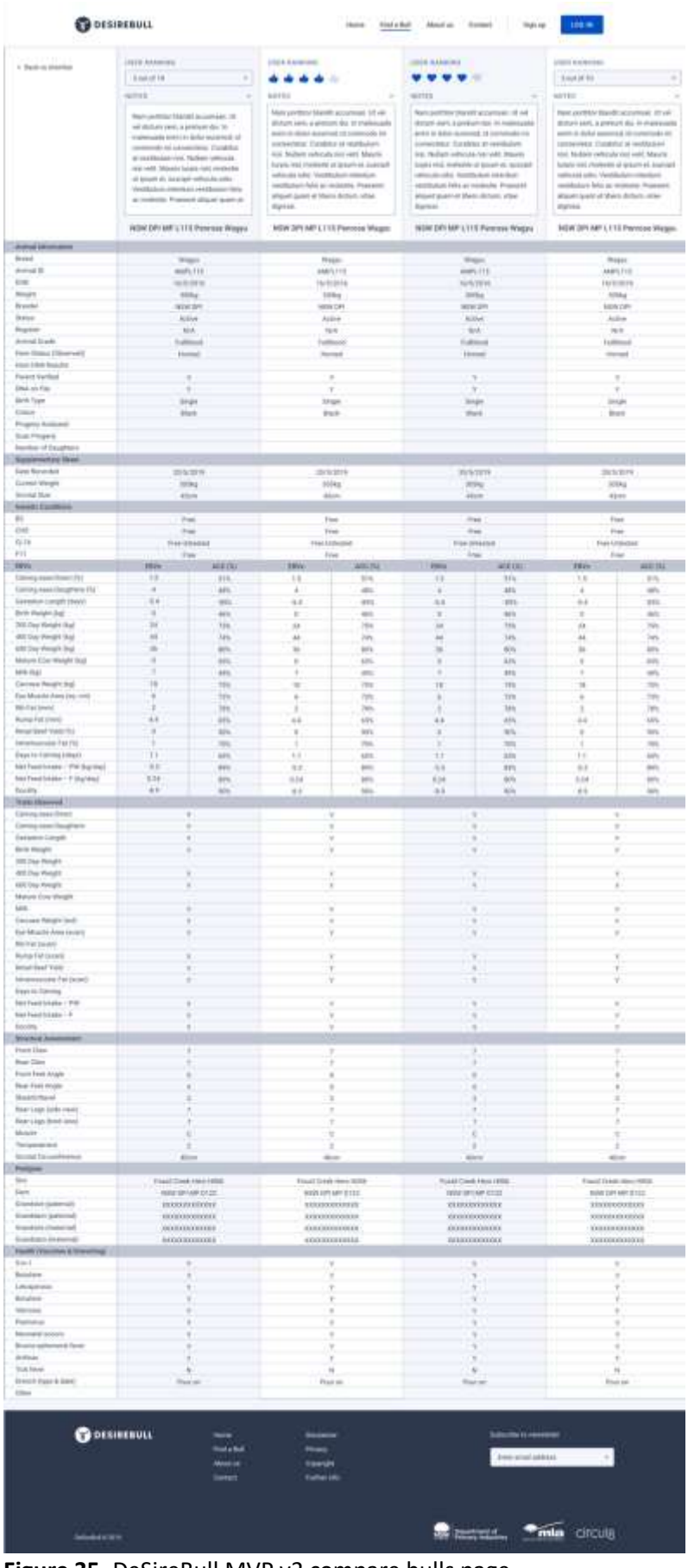


Figure 35. DeSireBull MVP v2 compare bulls page.

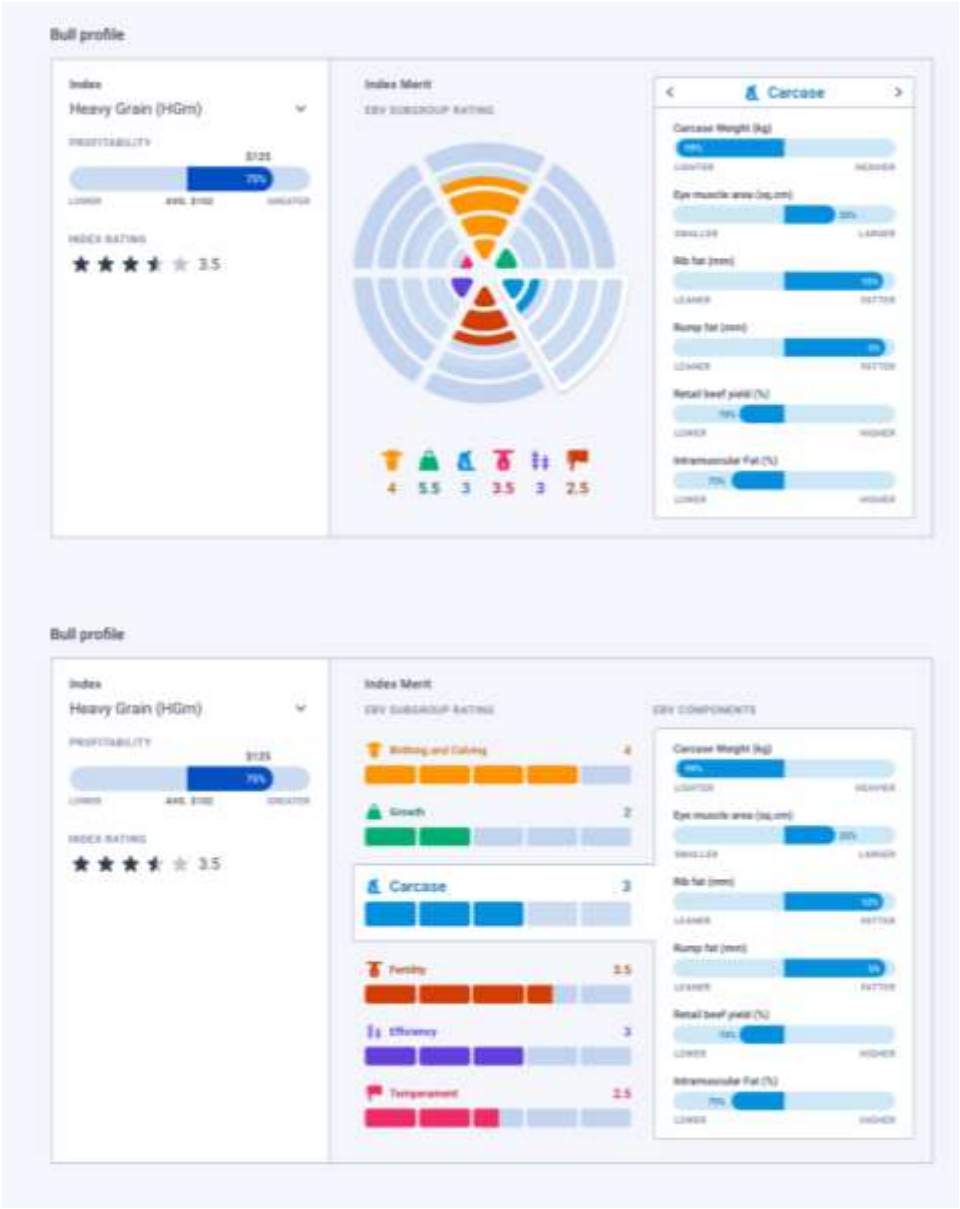


Figure 36. Design options presented to users in validation interviews.

From the validation interviews, changes were made to the EBV Subgroup graph (Fig. 37). MVP v3 can be found at: www.desirebull.com.au. Images of the main changes to MVP v3 are provided in Figures 38-42 below.

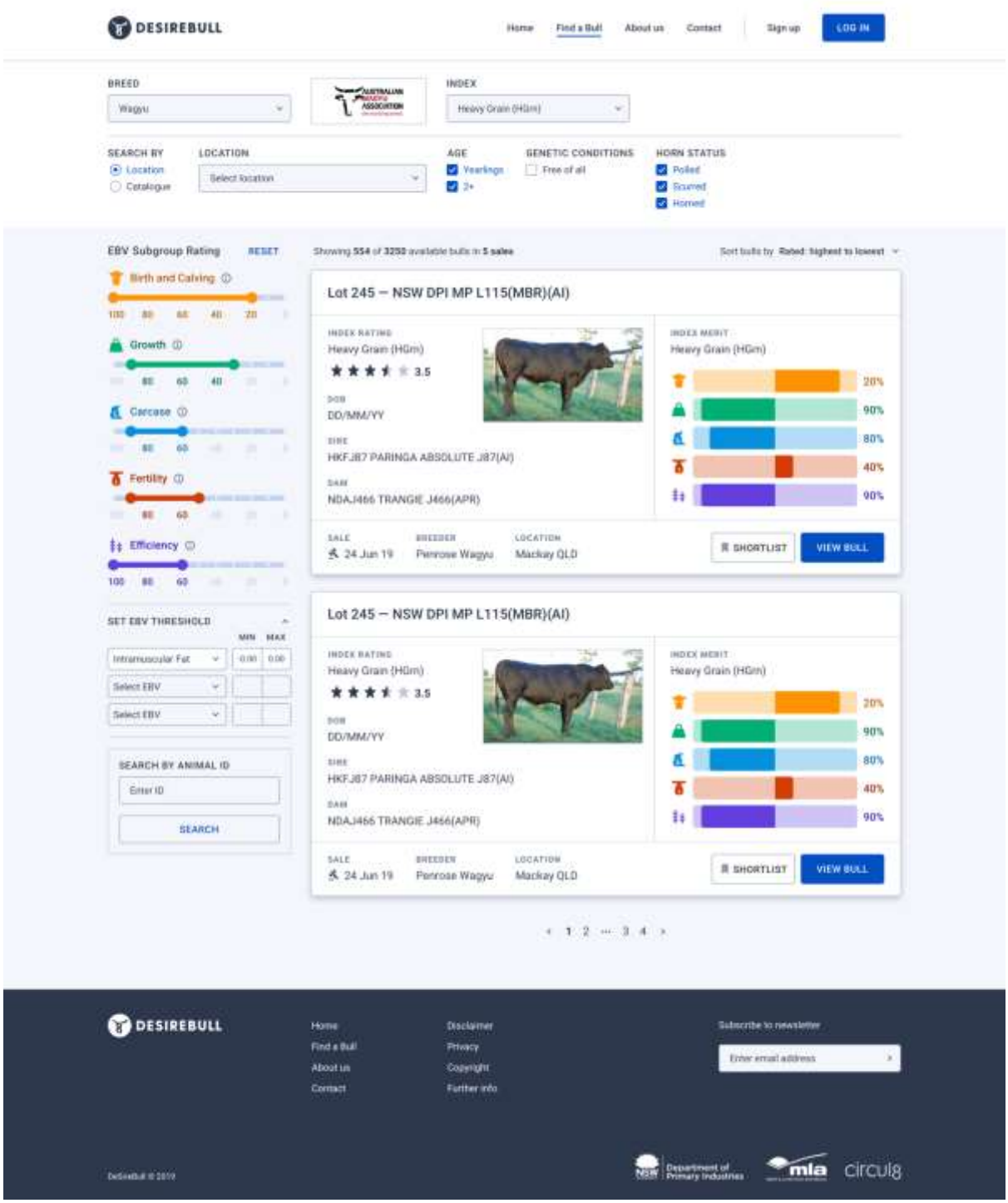


Figure 37. DeSireBull search/results page proposed for MVP v3.

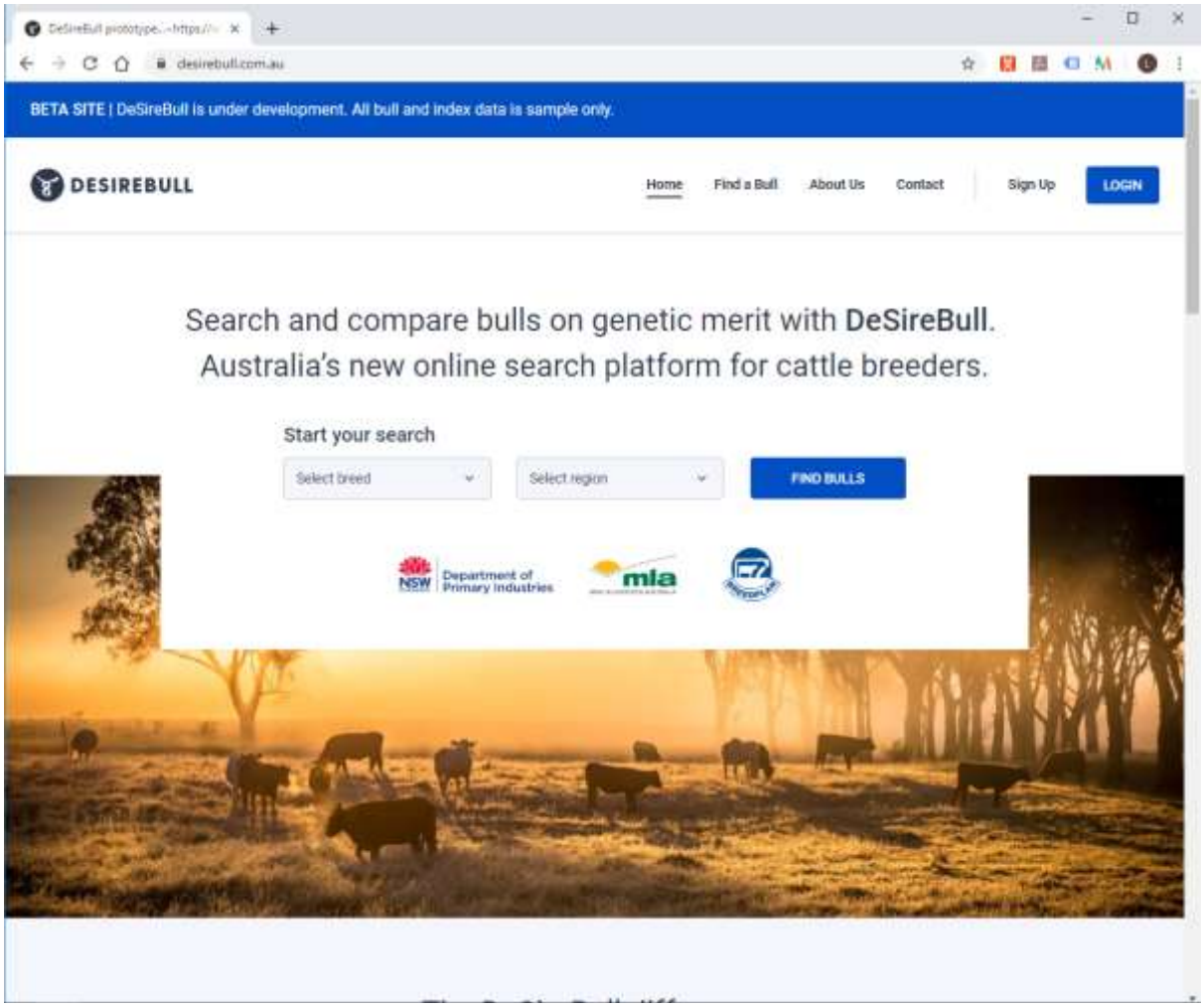
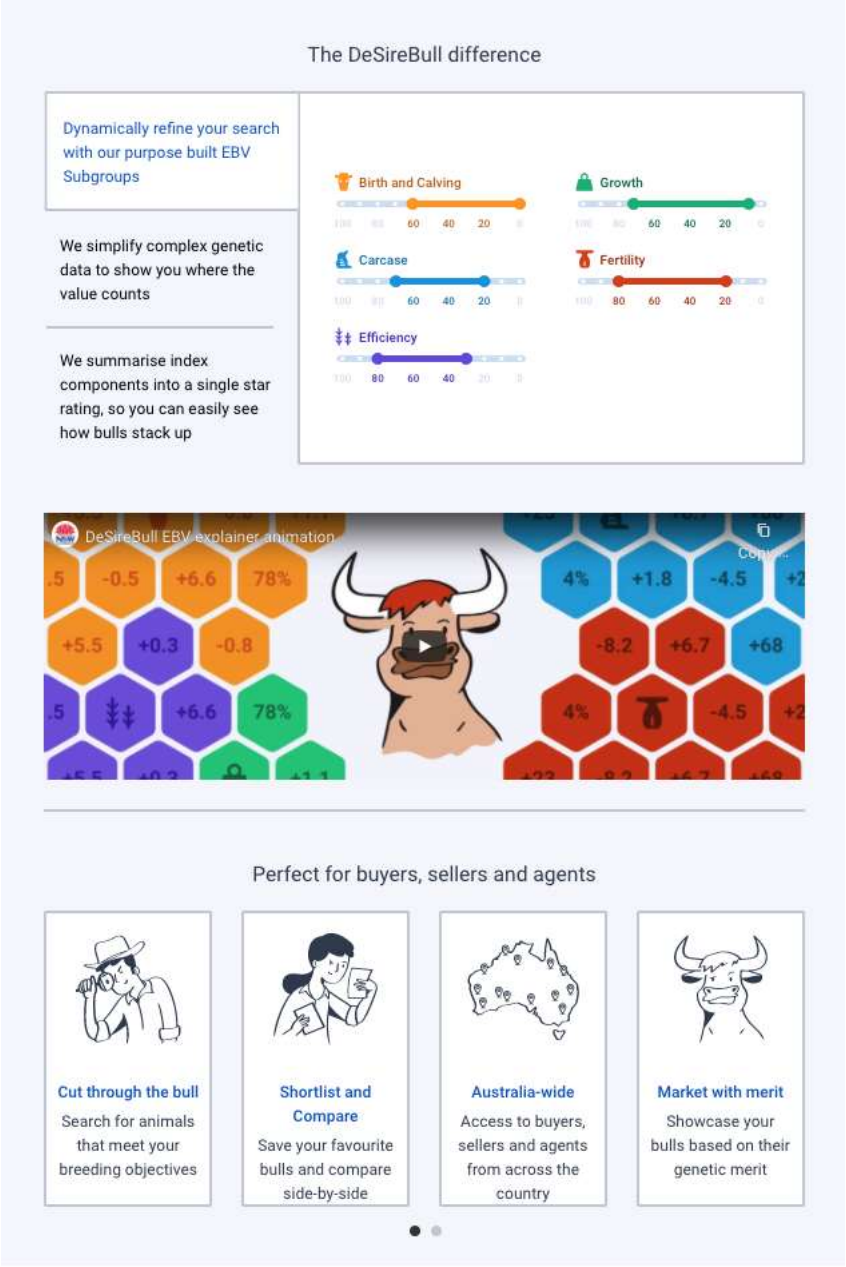


Figure 38. DeSireBull MVP v3 Homepage (part 1).



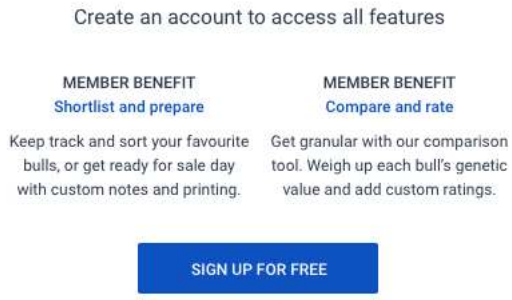


Figure 39. DeSireBull MVP v3 Homepage (part 2).

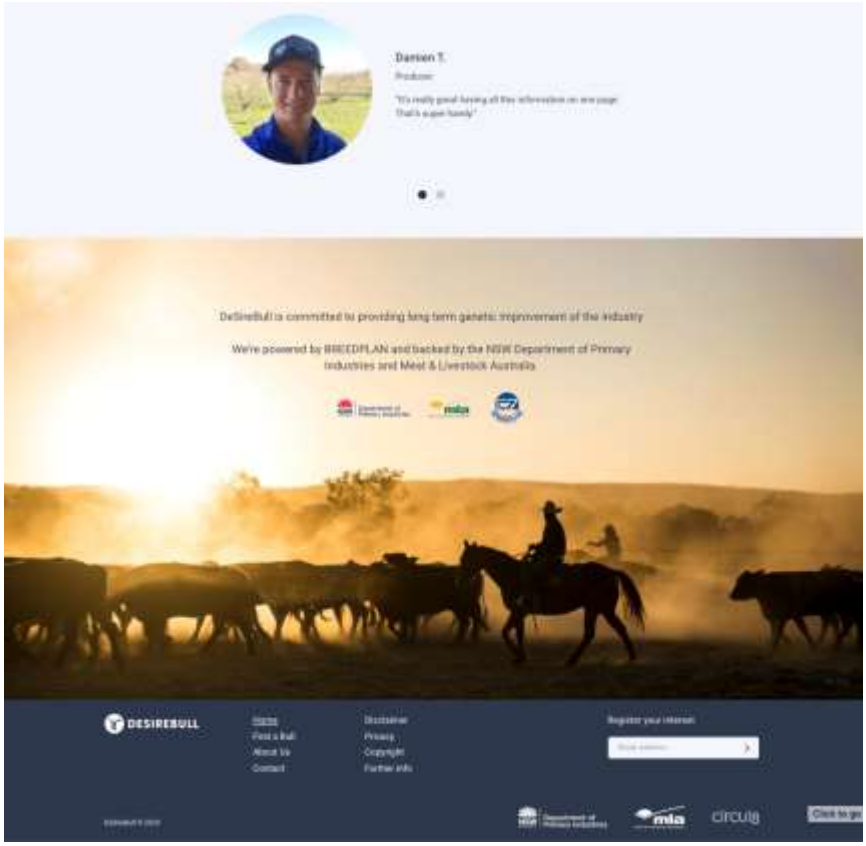


Figure 40. DeSireBull MVP v3 Homepage (part 3).

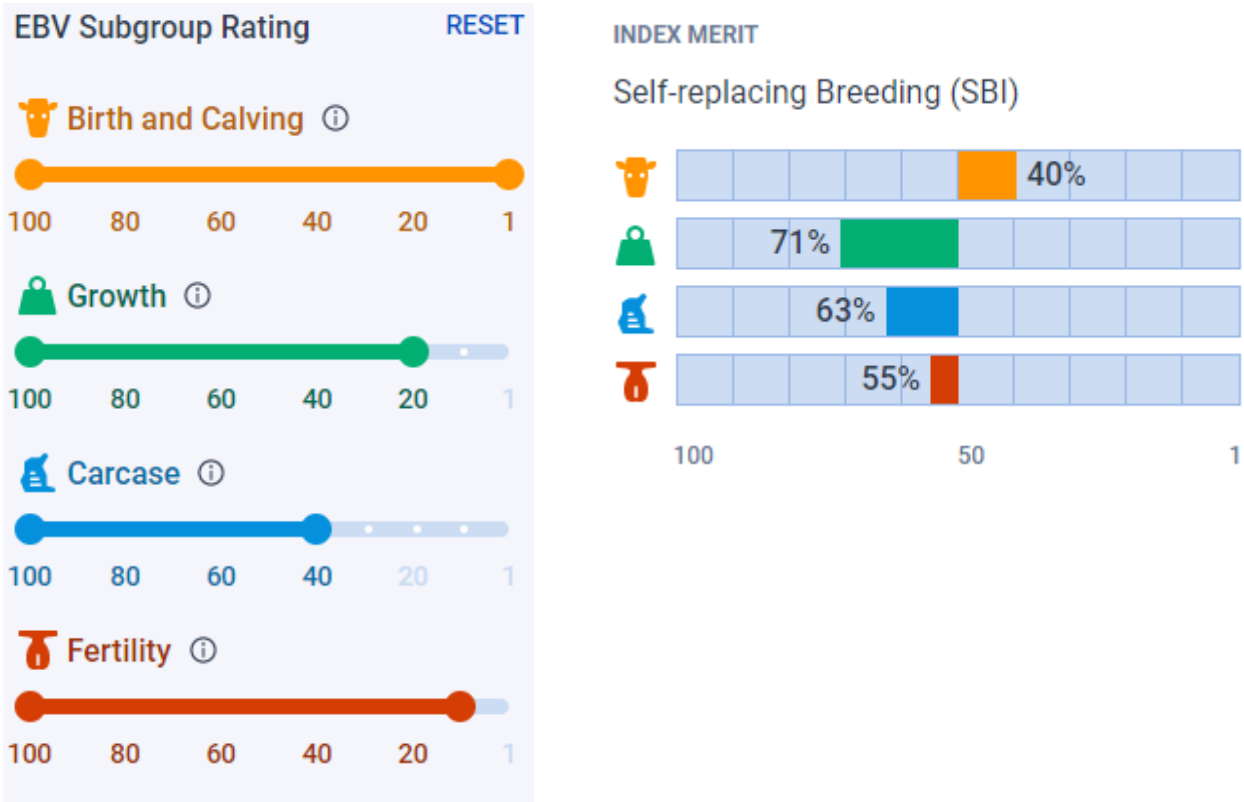


Figure 41. DeSireBull MVP v3 updated EBV Subgroup Rating search bars (left) and Index merit graph displaying EBV Subgroups on bull results card (right) - Search/Results page.

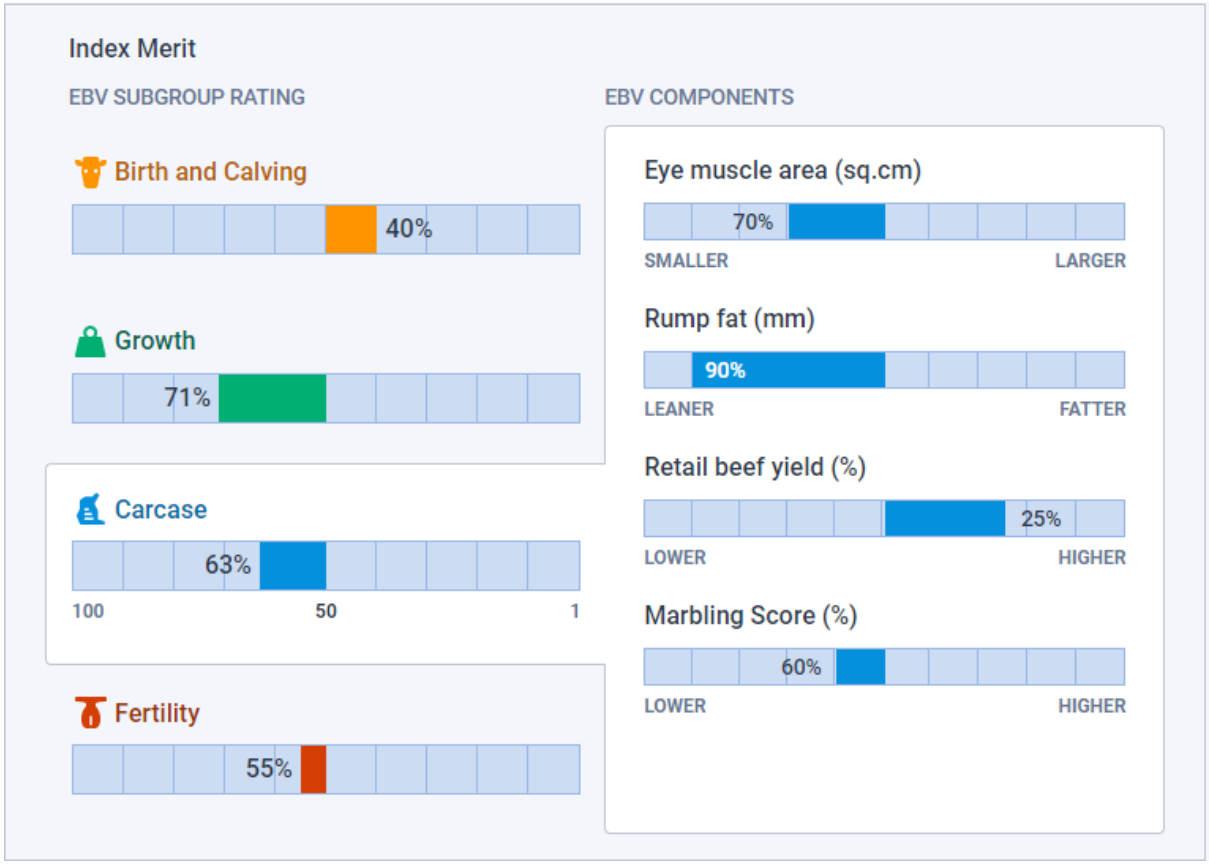


Figure 42. DeSireBull MVP v3 updated Bull Profile on bull listing page.

4.2.9 Enhancements / Further Developments

i. After the launch of the MVP, there will be user feedback that will enable for enhancements to be made and for de-bugging to occur.

Following the launch of the third MVP, efforts were focused on engaging with breed societies who met specific data criteria (the latest version of BreedObject selection indexes) in order to get real data into the tool and test the dataflow from the backend of the tool. For this exercise, Herefords Australia were willing to assist, and NSW DPI owned animals were used to create test "sales catalogues" through the existing catalogue process of the Agricultural Business Research Institute (ABRI). This allowed for de-bugging and further enhancements to be made.

This process identified that the tool was unable to obtain structural information from Breed Societies or ABRI. As a result, a further three interviews were performed to gather information on how a seller may wish to use the tool to upload this information as well as a pdf version of their catalogue. The feedback mechanism of DeSireBull was also validated in these interviews.

ii. Further Developments will take place in order to build on the features of the MVP.

Developing the seller interface required an additional two 2-week sprints to be complete. The design outcome of this work is shown in Fig. 43 below. The feedback mechanism of the tool informs sellers of how many times their bulls have been added into a user's shortlist. It presents the top three animals in the seller's profile under 'Your sales' and allows them to download the full list of insights as an excel spreadsheet. In this section, sellers are also able to upload pdf versions of their sales catalogues and download the template for uploading structural and pre-

sale phenotypical data for their bulls. The functionality of the vendor interface is provided in the final version of the tool.

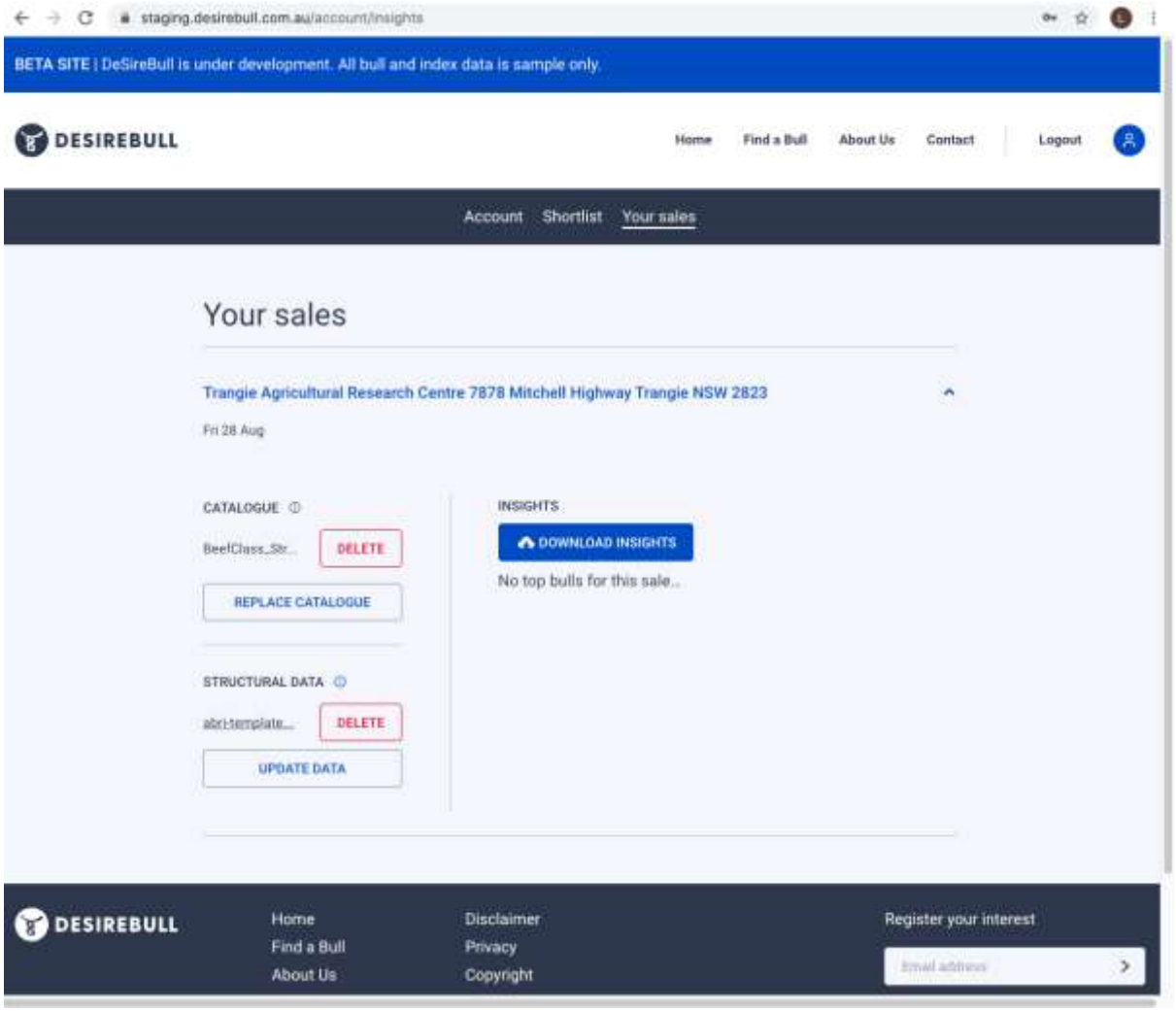


Figure 43. DeSireBull MVP seller interface.

5 Discussion

5.1 Insights

5.1.1 Practical implication for industry

The seedstock (stud) sector is the driver of genetic gain. They need to continue to select breeding animals using selection indexes (preferably customised indexes) to enable maximum genetic gain in their herd. Commercial producers are able to use DeSireBull's purpose-built EBV Subgroups since their breeding objectives may not align directly with the seedstock enterprise from which they purchase their animals. Ideally, commercial producers would develop their own customised selection indexes, however it is noted that this is unlikely in the current market as adoption of genetic information remains low. Therefore, they are encouraged to use trait subgroups when selecting breeding sires in order to minimise the loss of genetic gain within their herd when compared to single- or few-trait selection. DeSireBull™ helps commercial producers to do just that.

5.1.2 Unanswered questions/additional research recommended

Now that DeSireBull™ is fully functional, the upcoming bull sale period provides an opportunity to road test the tool in a small project and collect information and experiences from clients, vendors and other relevant industry practitioners to help work out the process of full deployment of the tool for industry use.

5.1.3 Draft extension messages

It has been identified that DeSireBull has multiple target audiences and that extension material should be developed and supplied accordingly. A short clip explaining how EBV Subgroups work has been developed as part of the project to assist users and help with extension material. The multiple target audiences of the tool and the associated extension messages are outlined below:

1. Seedstock producers – continue to select using overall index (industry index or their own customised index) and encourage their clients to use trait subgroups.
2. Commercial producers – educate them on the benefit of using DeSireBull's trait subgroups to select animals which allow compromise in traits to be improved without severely impacting overall genetic gain.
3. Agents/consultants can use the tool to identify animals for their commercial clients, or to manage sales for their seedstock clients
4. Current beef extension officers - upskill so they are able to further educate their audience on genetic information and the correct use of available decision support tools to maximise genetic gain, productivity and profitability.
5. Beef Champions Network/Veterinarians/ET and AI teachnicians – Partner with them to educate participants who are then able to assist DeSireBull's extension throughout their own networks, be that seedstock or commercial producers.

5.1.4 Improvements to project delivery

Circul8's multi-stage approach to the design, development and testing of the tool worked really well in this project. It allowed for confirmation of design and functionality before features were developed and allowed for bug fixes to occur before the tool was released to the public. It also enabled an agile development process that was able to allow for user feedback at every stage.

Although a thorough scope out of the project was completed before commencement of tool development, the project would have benefited from a more formal stakeholder engagement process. There was clear demand from commercial producers for a tool that simplified the bull selection process. However, the value proposition of the tool could have been improved by asking more direct questions relating to market analysis such as: who would be willing to pay for the use of the tool (seedstock or commercial producers), how much would they be willing to pay and how often. In addition, the build of the backend of the tool (data flow) would have been more streamline if collaboration with potential commercialisers and Breed Societies was initiated earlier in the project.

In order to ensure the correct delivery of genetic information (BREEDPLAN estimated breeding values and BreedObject selection indexes) the tool needed to be integrated with the existing delivery pipeline through the Agricultural Business Research Institute (ABRI). At this time the

organisation was going through a staged transitional period with their online interface with the breeds identified as the most ideal to test DeSireBull. Because of this transition, it took longer than expected to integrate DeSireBull with ABRI as there were multiple changes to how this was to be completed. The NSW DPI and Circul8 worked together with ABRI to:

- integrate the DeSireBull™ database with ABRI so that bull and sales data can be used directly from ABRI following all data rights agreements.
- create a new way for vendors to independently upload structural and pre-sale phenotypic data to DeSireBull™.

To effectively test the tool, it was established that we needed to mimic a vendor and submit a sales catalogue to be uploaded to DeSireBull™ via a breed society. In order to achieve this, NSW DPI partnered with Herefords Australia to submit a sales catalogue that contained fake sales data but correct indexes and real genetic data for DPI-owned animals. Multiple sales catalogues have been created to test the tools functionality of automatically updating the website every 24hrs. This functionality has been tested and proven to work. The tool is now ready to be tested with real sales and data.

5.2 Meeting project objectives

The objectives of the project have been achieved. We now have a working DST DeSireBull™. The tool:

- Simplifies the process of selecting bulls to buy;
- Matches available bulls and their genetic information with the specific needs of the bull buyers;
- Allow producers to compare and benchmark all bulls available for sale in Australia;
- Provide feedback to the stud breeder on buying behaviour from customers.

6 Conclusions/recommendations

A decision support tool (DeSireBull™) has been developed using existing genetic (BREEDPLAN and BreedObject) tools and information to rank bulls based on genetic merit. It provides an online platform for bull vendors to list their sale catalogues containing all relevant genetic information for their bulls as well as images, videos and other supplementary pre-sale information. It allows commercial producers to place emphasis on particular groups of traits, using a behind-the scenes algorithm to demonstrate the consequences of a desired gains approach to selection decisions. It also provides feedback to the stud breeder on buying behaviour from customers. The ability of DeSireBull™ to simplify the process of using genetic information for purchasing bulls complements the beef industry's existing strategies for extension and adoption of genetic tools, to increase the rate of genetic improvement within the Australian beef industry.

DeSireBull™ is now a fully functional DST. Ongoing maintenance and updates will be provided by NSW DPI and Circul8 up to June 2021. NSW DPI has drafted a Business Plan for the owners of the tool (NSW DPI and MLA) to consider the pathways for deployment of the tool for industry use.

The upcoming bull sales period provides an opportunity to road test the tool and collect information and experiences from clients, vendors and other relevant industry practitioners to help inform the process of identifying the appropriate service provider(s) for the tool and the pathway to full

deployment of the tool for industry use. The expectation is that the service provider(s) will cover the cost of ongoing maintenance and updates of the tool. In order for this tool to be successful in its industry aims it is crucial that it is commercialised and adopted as quickly as possible with enthusiastic service provider(s). There are a number of options for the commercialisation of DeSireBull™, each of which will directly or indirectly impact the genetic progress of the Australian beef industry. Options for the commercialisation of this tool include but are not limited to:

- Domestically through existing genetic evaluation/information providers (preferred)
- Internationally by selling the tool's framework to overseas genetic evaluation/ information providers (e.g. IGS)
- Allowing the tool to be more flexible in its data requirements (i.e. allowing breed societies on earlier versions of selection indexes the ability to use the tool).

7 Key messages

7.1 Changing behaviours

As a result of the project, it is anticipated that commercial producers will have a decision support tool that simplifies the bull selection process. It is envisaged that the tool will enable more informed selection decisions and that these decisions will lead to greater productivity and profitability for commercial enterprises. In addition, the tool provides a feedback mechanism to seedstock producers. It is envisaged that this feedback mechanism will inform seedstock producers of their most "valuable" animal based on the genetic merit of the animals and help to inform future breeding decisions to supply bulls matching market demand.

7.2 Benefits of the tool

It is anticipated that the tool will allow some flexibility in commercial producers' selection decisions without completely compromising genetic gain. As a result, the rate of genetic gain in the commercial sector as well as the entire beef industry is expected to lift, aiding the NLGC's aim to double the rate of genetic gain by 2020. As a result of improved rates of genetic gain, it is expected that producers will witness an increase in the productivity of their herds and be rewarded with increased profitability.

8 Bibliography

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