Lean Beef

Large scale calf rearing for dairy beef and the application of Lean Management in agriculture

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by Thomas Snare

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Executive Summary

Dairy bull calves are currently an underutilised by product of the Australian dairy industry. The current practice of killing these calves at birth or processing at four days of age is gaining increasing negative publicity. With dairy origin beef contributing significantly to the total beef production of many countries including the USA and UK there is an opportunity to value add to this coproduct of dairy production.

Lean Management, developed Toyota in Japan, has been extensively utilised by manufacturing businesses worldwide to drive improvements in productivity, with improvements typically in the realms of 20 to 30 percent. To date, little has been done to implementing Lean principles within agriculture in Australia.

The key objectives of this research included:

- To evaluate calf rearing systems utilised around the world for dairy beef production, in particular those operating at large scale.
- To understand the major factors driving success in these businesses.
- To determine which production models fit best with Australian seasonal calving patterns.
- To evaluate the use of Lean management in agriculture.
- To understand which aspects of Lean management work well on farm.
- To determine the best process for implementing Lean on farm.

The research was undertaken in New Zealand, Japan, Western and Northern Europe and the Mid-west USA, seeking the utilisation of dairy bred bull calves and in particular the practical aspects of rearing at large scale. The author also completed a Lean management tour of Toyota in Japan and spoke to various consultants world-wide working with the implementation of Lean management in agriculture.

Findings from the research include large scale calf rearing is achieved most successfully collectively rather than individually, utilising a contract rearing model.

There is a quality issue with the Jersey and Jersey cross bull calves produced by the Australian dairy industry which can in part be corrected by the use of beef genetics post AI.

The seasonal nature of dairy production in Australia means lower asset utilisation in comparison to year-round calving systems in other countries.

Implementation of Lean on farm requires basic theory training of all people on the team followed by on the ground action.

Visual management boards, 5s and Standard work are tools that work well in agriculture.

The successful development of dairy beef in Australia will be best achieved through a cooperative or integrated rearing model.

The dairy industry must take responsibility for the quality of the bull calves that it is producing, utilising beef genetics where possible to increase the carcase quality of these animals.

The dairy industry must follow the beef market more closely a look for opportunities to value add.

Calf rearing should utilise existing facilities where possible to minimise capital outlay while paying attention to the environmental conditions required for optimal animal health.

Successful implementation on farm will be best achieved through on going coaching from an external advisor.

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Foreword

This journey started in 2007, during the second year of my agricultural science degree at the University of Tasmania. We were on a week-long field trip looking at agricultural enterprises in the north of Tasmania which included a tour of the Woolnorth property in the state's far North-West. Along with tours of the dairies, wind farm and remains of the sheep unit was a short stop to look at the Technograzing bull beef unit.

The figures stuck – 4.4 dairy bred Friesian bulls per hectare yielding over 1000kg live weight gain per hectare, nothing but grass, no hay, no silage. Coming from a small family farm at Boat Harbour in North-West Tasmania, with limited working capital and having a distaste for making hay, this counter intuitive idea of extremely low input but high output livestock farming was very appealing.

On completing university, I moved to New Zealand for a year and worked on 'Burleigh' for Harry and Chloe Wier, owners of Kiwitech International, Harry being responsible for the development of the Technograzing concept. Burleigh is a 160ha property and at the time was primarily focused on dairy origin beef rearing and finishing, while also being a test site for Kiwitech's grass farming innovations. It was at Burleigh that I not only developed my interest in dairy beef but also was introduced to the idea of Lean management – not that I took much notice at the time.

Since returning to Tasmania, I have been involved in redeveloping the home farm into a Technograzing unit as well as working on installations of intensive grazing units in both southern Brazil and Uruguay. I currently manage the TIA Dairy Research Facility for the University of Tasmania and I am involved with some pasture measurement contracting on a couple local dairy farms.

In 2014, I was given the opportunity to enrol in a post-graduate certificate in Lean Management Systems, which was being offered by the University of Tasmania for the first time. Looking to gain some business and management experience, I enrolled in the course not really knowing what to expect. The content and delivery of the course was excellent, exposing me to a different way of working and thinking, one that was very foreign to the agricultural work places I had previously been used to. The majority of what we studied was in the context of manufacturing, which is obviously quite a controlled environment. I wondered if and how these management techniques could be applied to agriculture.

Dairy beef and Lean management may seem like an odd combination of topics to try to massage into a single study, however, given that we are effectively starting from a near blank slate, from a dairy beef perspective, in Tasmania the use of Lean management principles offers a good foundation from which to start.

So, what about Lean management? Essentially Lean is about productivity. Productivity is a measure of the effectiveness of the effort that we put into work; the percentage of time spent doing value adding work vs the time doing 'other stuff'. Only a small proportion of the work that we do each day actually adds value to the product that we are producing – changes the product from one form to another. The remainder of the time can be

considered waste. Some of this waste is necessary and unavoidable within the given working environment for example; walking cows two kilometres to the dairy just to be milked adds no value to the milk and actually costs production. However, it may be unavoidable due to the location of the fixed infrastructure and the layout of the farm. Avoidable waste is process related and can be eliminated over time. For example; time spent searching for a spanner which turns a two-minute job into a 30-minute job.

Productivity improvement, through the use of Lean management, is achieved by a mix of theory and tools which can be used to stabilise processes and systematically expose and eliminate waste. The goal is to develop a workplace culture that always seeks to improve the way that work is done.

Acknowledgments

Firstly, I would like to Dairy Australia and Nuffield Australia for this investment in me. This has truly been a life changing experience.

Secondly, I would like to thank the team at the TIA dairy centre for their support and interest in my studies. In particular, I would like to thank Mark Freeman for stepping in to fill for me while I was away and for his help in editing this report.

Finally, I would like to thank all the people who have welcomed me into their businesses and homes. The generosity that has been shown to me, a stranger, by these people over the past two years has been quite incredible and will not be forgotten.

Objectives

1. To evaluate calf rearing systems utilised around the world for dairy beef production, in particular those operating at large scale.

2. To understand the major factors driving success in these businesses.

3. To determine which production models fit best with Australian seasonal calving patterns.

4. To evaluate the use of Lean Management in agriculture.

5. To understand which aspects of Lean Management work well on farm.

6. To determine the best process for implementing Lean on farm.

Chapter 1: Introduction to Lean Management

Lean management is based on the Toyota Production System (TPS) developed by Toyota in Japan during the 1950's. In the early days Toyota and its employees were referred to by Tokyo as '*a bunch of farmers'* due the fact the more isolated facilities in Nagoya were mainly staffed by ex-rural workers (J.P. Womack, 2007). Since those early days Toyota has grown to be a world leader in manufacturing efficiency and product quality. TPS was developed by Eiji Toyoda and production engineer Taiichi Ohno to address the short comings of the mass production model developed by Henry Ford.

Fords 'flow' production model pioneered in the early 1900's, utilised interchangeable parts. Standard work and conveyance systems where components moved through sequential steps on the production line. Specialised machines and processes were used to perform each of the manufacturing and assembly steps. This was in contrast to the conventional 'craft' vehicle fabrication techniques of the time, which relied on general purpose machines producing parts individually, which then more often than not had to be modified by hand to fit correctly on the vehicle. While standardised parts and processes in combination with the moving production line greatly improved the production efficiency of Ford's plants in comparison to his competitors, Taiichi Ohno concluded, after a post war tour of Fords facilities in Detroit, that the system was rife with waste. (J.P. Womack, 2007)

Lean is about making profit through understanding and creating value for customers, while working to eliminate all non-value added processes from the production system. Processes which do not create value are referred to as waste. The Japanese word for waste is 'Muda' and this includes wasted effort, materials and time. Toyota has identified seven key wastes which they continuously work to eliminate from their production system. These are: overproduction, waiting, over processing, inventory, motion and defects. As with the motor vehicle industry, in agriculture farmers are predominately price takers and therefore their main lever for increasing profit is through cost (waste) reduction.

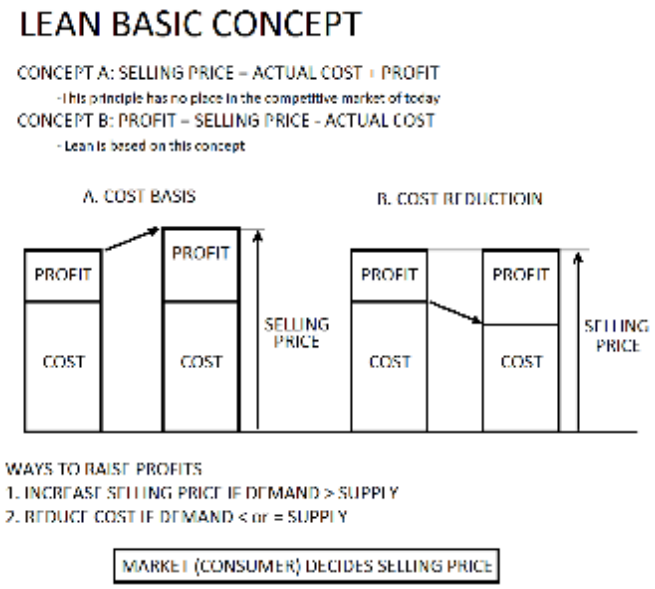

Figure 1: The Lean basic concept (GPS Training Center, 2015)

Application to agriculture

So why and how is a management system developed in the motor vehicle manufacturing industry applicable to agriculture? With farms in Australia consolidating and increasing in size, there has been a shift towards less reliance on family labour and more towards salaried labour, with salaried labour increasing from 35% to 58% of farm costs over the past two decades (Potard & Keogh, 2015). This means there has been a change in the communication dynamics of the workforce and potentially the motives of employees. Salaried employees may not have the opportunities to become part of the business that family members do and so working conditions and job satisfaction may be more important for these individuals.

Lean management works to improve working conditions and job satisfaction through improving the working environment and by creating the opportunity for them to take ownership of improving the way they work. Lean can also facilitate transparency between the farm owners and employees, helping employees to better engage with the main priorities of the business.

The first part of this study hopes to describe how Lean is being implemented on farms around the world with a focus on the implementation of Lean and of the Lean tools being used in agriculture.

Implementation

Lean management has been implemented on farms in a number of countries with varying levels of success. Agriculture specific Lean implementation programs were observed in New Zealand, Sweden and Denmark. In all the farming businesses visited, implementation of Lean was facilitated by either public or private businesses providing training and on-farm coaching.

Venture Southland, New Zealand

One of the highlights of the travels through New Zealand was a day spent with Scott Whyte from Venture Southland. Venture Southland is an economic development agency for the Southland region and has been involved in introducing Lean management to businesses within that region. Initially, the program was limited to manufacturing businesses, utilising the expertise of Clinton Yates, a Lean coach from Auckland with many years' experience in the auto industry, including working with Toyota in Japan. The results from the initial programs were impressive, with an average 25-30 percent improvement in productivity recorded across participants.

Following the initial success within manufacturing, Venture Southland in conjunction with Dairy NZ, established a pilot program implementing Lean on dairy farms within the region. While, according to Scott, there was a bit of steep learning curve with respect to what was and was not easily transferred from manufacturing to farming, responses to the initial program from participating farmers was overwhelmingly positive. This Lean management program, DairyLift, is now in its third year and is in the process of being rolled out nationally by Dairy NZ.

The Dairy Lift program is a six-month program in which participants receive training in the classroom which is backed up by on farm practical 'homework' and coaching. During the time with Scott, the author travelled to visit Neil Mitchell, manager of North South Farms near Lumsden in Northern Southland.

Neil manages two farms, each milking approximately 1250 spring calving cows. North South Farms had had just completed the Lean management program, the second to run in Southland. Neil explained that the uptake and implementation of Lean varied slightly between the two farms he was managing. One the dairy units had a newer, less experienced team, made up predominately of Filipino immigrants. The other was mostly comprised of native born New Zealanders. Neil explained that the Filipino team took to the program like a duck to water, making more rapid gains than the New Zealand team who were a bit slower to buy into the program and he linked this to the Filipino team having less preconceived ideas about the way things should be done.

Lean Farming & SEGES, Denmark

Lean management principles have been used in Danish agriculture for a number of years. Lean management consultant Susanne Pejstrup, owner of Lean Farming, estimates that there are presently approximately 500 farmers in Denmark utilising lean principles on farm. Lean implementation programs and coaching were initially delivered in Denmark by Seges. Seges is a farmer owned co-op advisory service providing research, agronomy and business management services. There are now independent businesses such as Lean farming providing Lean consultation and coaching.

The Danish implementation model is to provide basic Lean theory training for farm management and then focuses on the use of the tools that make immediate impact on the farm business. This is about getting runs on the board that create motivation and engagement for the farm's team. The focus initially is on three main tools; these being value stream mapping (VSM), Kiazen and 5s. Of interest, is that during training, managers are taught not to use sarcasm or irony. This is because an important aspect of Lean is that everyone working within the business has the opportunity to contribute to improving the way work is done. Sarcasm and irony can have a negative effect on people's willingness to share new ideas. Creating a culture that supports open communication is an important factor in the successful implementation of Lean.

Figure 2: Stieneke Ijdema and her husband Boudewijn started implementing Lean in 2015 on their dairy farm in KeJellerup, Denmark. Their key improvement activities were mastitis management and stock movement within the barns. (Source: Author)

Lean Lantbruk, Sweden

In Sweden, a program titled Lean Lantbruk has been operating since 2012. This program aims to implement Lean on 500 farms within Sweden by 2017. The program is delivered by a mix of public and private agricultural business consultants across Sweden, working across many different industries ranging from forestry to dairy and intensive horticulture. Lean Lantbruk is quite a detailed program that runs for 18 months. The program provides both leadership training for farm managers and basic Lean theory training to all farm staff, along with coaching that supports farm teams in making their own improvements.

Lean Tools

A number of tools have been developed to facilitate the continuous development of a Lean work environment. These tools improve communication and create stability within the workplace. Lean tools, used to good effect in agriculture, include visual management boards, standard work, 5s and 5 whys.

Visual management boards

Visual management boards are a simple way of communicating how a business is performing to all involved in the enterprise. They work in a similar way to that of a car dashboard – simple, easy to read information about a few key measurements critical to the day-to-day function of the business. The key word is visual. Information is generally presented in simple graphs or tables, with measures that are on track marked or written in green and those that are falling behind written in red.

North South Farms visual management board is divided into three main headings; people, pasture and cows. Under each of these headings there are three key metrics. People is divided into safety, milking times (duration of each daily milking) and hours worked per day. Pasture is divided into a grazing rotation plan, average pasture cover and post grazing

pasture residual. In addition to these there was a photo of the difference between a 1700kgDM/ha and a 1500kgDM/ha pasture residual. The cow related metrics were divided into three sheets, the first of which displayed the number of deaths, down cows and effluent management. The other two sheets had simple plots of bulk milk somatic cell count and number of sick cows in the herd. Using the management board to direct discussion, North South Farms have a five-minute team meeting each morning at the milking shift change. The meeting is conducted by a different member of the team each day. A different person is made responsible each day for collecting and recording the information for each of the metrics.

Figure 3: Neil Mitchel with the daily management board at North South Farms, Southland, New Zealand (Source: Author)

Communication involves the two-way exchange of information (Mishra, et al., 2014). The visual management board supports communication, creating transparency between both staff and management. Everyone knows how the business is performing and where the weak points are at any point in time. Everyone has the opportunity to communicate problems in a non-threatening environment and to have ownership over finding solutions.

Figure 4: Visual management board on a dairy beef unit in Gudbjerg, Denmark (Source: Author)

Displayed at the top-left are the average live weight gains made by each of the mobs with these plotted against the target curve at the top right -hand side. The bottom half of the board is how improvement activities on the farm are prioritised. Ideas are ranked in terms of cost and effect in the matrix to the left, with low cost high effect ideas being acted on first. These are then recorded on a plan, do, check, act sheet with the person responsible for completing the work named and an indication of the progress made to date.

Standard work

Standard work is the documented best currently known way of doing a particular task. It explains in detail the steps required to perform a particular task. This aids in maintaining work quality, but also facilitates continuous improvement, by setting and sustaining a standard from which improvements can be made. It also makes clear what the standard is improving accountable.

Training and accountability are two important aspects of Lean. Neil Mitchel for North South Farms in New Zealand talked about the difference between 'can't do' and 'won't do'. 'Can't do' means that the employee has not yet been trained adequately to perform the required task. Neil said that 95% of the time, if a team member failed to complete a task or performed it poorly, it was because they had not had the right training and the fault lay with the manager. Won't do is an attitude issue, which occurs only about 5% of the time and in this case the fault lies with the employee. This highlights the value of standard work by providing clear directions and expectations for every task.

5 s

5s is a tool which forms the foundation for continuous improvement through Lean management. 5s stands for sort, set in order, shine, standardise and sustain.

The sort phase is about identifying what is and is not needed within a particular work space. If the object is needed it stays, if it is not, it is either moved to the location in which it is normally used or if it is not used at all it is thrown away. This removed any unnecessary clutter from the work space.

The next phase is setting things in order – a place for everything and everything in its place. This is about organising the work space in a way that makes required objects easily accessible. An example of this is the use of shadow boards at North South Farms, in Figure 5 below.

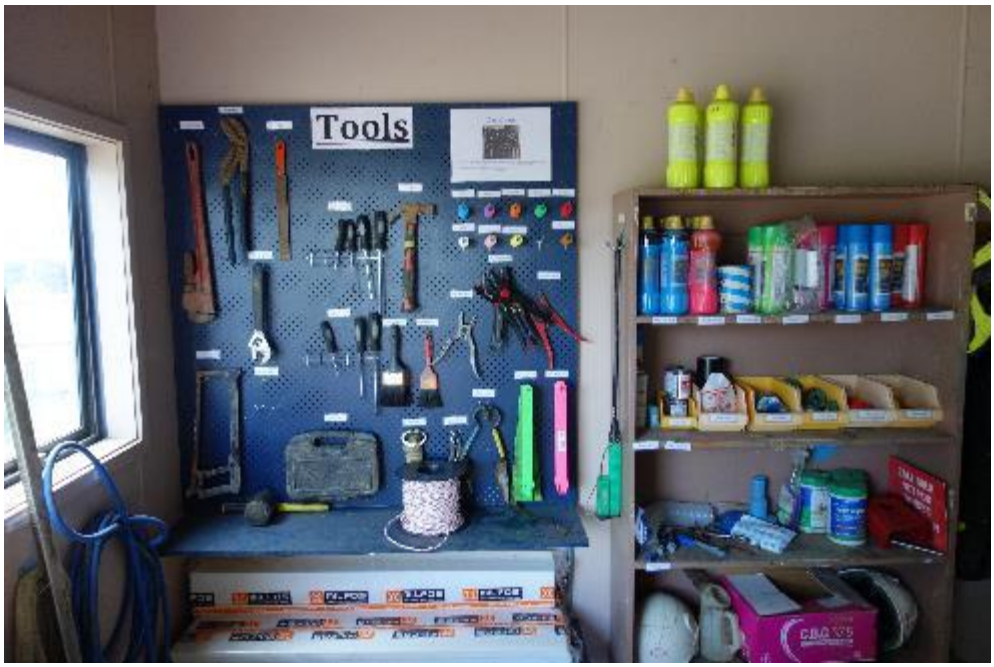

Figure 5: The dairy tool board at North South Farms, Southland, New Zealand (Source: Author)

With the work space set out correctly, the next step is to clean or 'shine' the space and equipment. Regular cleaning makes missing tools, faults and hazards immediately obvious, creating a safer more productive environment.

Once things are clean, standards for maintaining that space in the desired condition can be made to ensure that the improvements are sustained. These last two s's are probably the hardest to follow but most important in ensuring that continuous improvement is achieved. Standards may include written protocols for particular processes or simple photographs of how a work station or storage facility must be maintained. These must be backed up by regular compliance audits of these standards by a person delegated the responsibility for that area.

Toyota wants their people to think with all their mind, to be actively contributing to the improvement of their workplace and the way they work. The environment created by 5s works to promote this. With a clean and organised work environment, people's thinking capacity is not wasted searching for tools to carry out required tasks, rather, people's valuable time is used to create value(product).

The five whys

The manager of North South farms, Neal Mitchel, spoke about the use of the Lean tool 5 whys. Five whys is used to get to the root cause of a problem by, as the name suggests, asking ‘why?’ five times. Neil said he has started to use this when team members come to him with a problem. He said that it forces them to think more deeply about the root cause of the issue and seek solutions, rather than just coming and complaining about a problem.

Chapter 2: Introduction to Dairy Beef

The dairy industry in Australia is here to stay with 6398 farms milking 1.74 million cows producing 9.73 billion litres of milk annually (Dairy Australia, 2016). Dairy is the third largest rural industry in Australia and is one of the few agricultural enterprises that can offer real career progression and wealth creation opportunities to new entrants.

The (well fed) dairy cow is an immensely profitable production animal, with the average Australian cow producing 5730 litres of milk per year (Dairy Australia, 2016). Bull and heifer calves are co-products of this milk production system and can either feed back into the system as replacements for the milking herd, or be processed for beef, as is the opportunity for bull calves. Contrast this to conventional beef production system in which the sole purpose of the cow is to produce one calf, which must absorb the financial and environmental costs of feeding it-self and mother before returning any profit. Beef from the dairy industry, therefore represents a significant opportunity to contribute to Australia's beef production as a whole, while minimising the environmental footprint.

Figure 6: Cows grazing at the TIA Dairy Research Facility at Elliott, Tasmania (Source: Author)

Beef Demand

The medium to long term demand forecasts for Australian beef are positive. With the size of the Australian beef herd currently the lowest for the past 24 years, the main factor limiting growth is on the supply side of the equation. The national beef herd is expected to decrease to 25.9 million head in 2017 before starting to rebuild (MLA, 2016). Demand is predominately export driven, with over 70% of beef produced, exported (MLA, 2016). Demand for Australian beef is forecast to remain steady in the medium term, however, South American product is expected to create some increasing competitive pressure in Asian markets, particularly China (MLA, 2016).

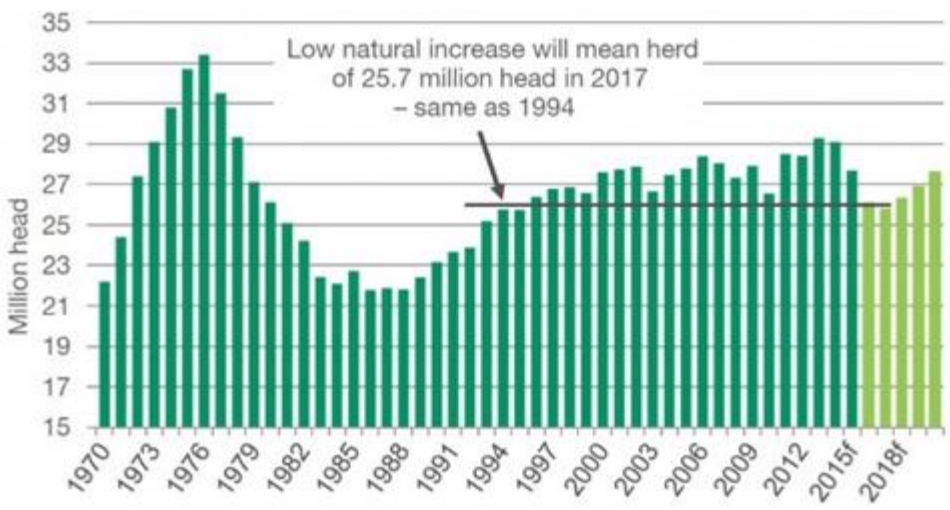

Figure 7: Australian beef herd projections (MLA, 2016)

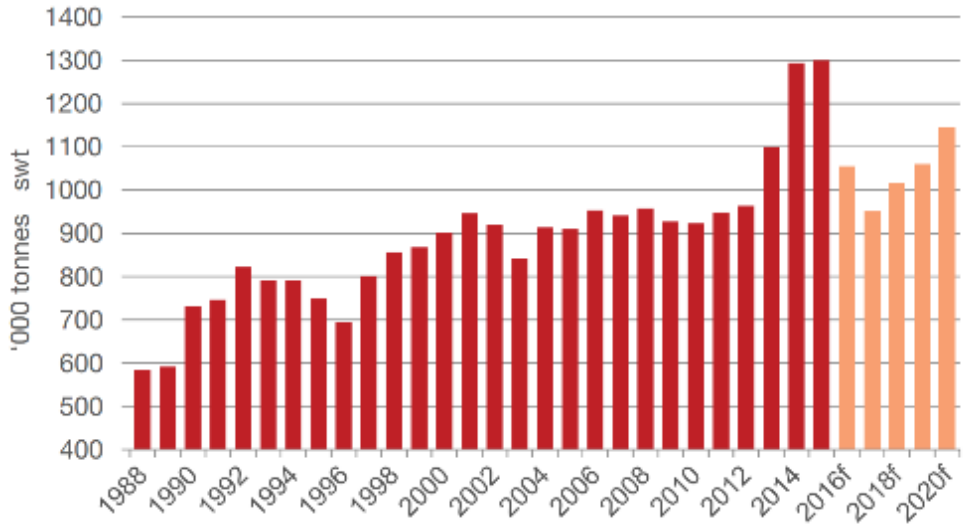

Figure 8: Australian beef export projections (MLA, 2016)

Why is there limited development of Dairy beef within Australia?

With strong markets and a good outlook for Australian beef it is difficult to understand why there is almost no development of dairy based beef production in Australia. One possible explanation for why this may be the case, is the relative size of the dairy industry to that of the beef industry. With 25.7 million cows in the Australian beef herd and only 1.74 million cows in the dairy herd (MLA, 2016) (Dairy Australia, 2016), dairy is only ever going to be a very minor contributor to total beef production in Australia. On the other hand, dairy based beef production in New Zealand is well developed, with this being a reflection of the national cattle herd. The New Zealand herd consists of 5.0 million dairy cows (Dairy New Zealand, 2015) and .98 million beef cows (Beef and Lamb New Zealand, 2016). This being the case, over 70 percent of the beef produced in New Zealand is of dairy origin. This trend is reflected in the majority of countries within the EU, where beef production is in decline and dairy production has been increasing.

At present, beef from the dairy industry is largely limited to cull cows. The utilisation of bull calves is low, with approximately 700,000 being processed each year. Bull calves that are processed at a young age are utilised for veal, pharmaceutical products, leather and pet

food. The yield from these small animals is very low and correspondingly is the financial return to dairy farmers.

Until recently, there has been little need in Australia to explore the development of dairy based beef production. Processors in the southern regions are focused on the high value prime beef markets and are generally running at full capacity during the seasonal turn-off periods. This being the case, there has been little demand for the development of dairy based beef production. While the current contraction in the Australian beef herd and correspondingly high prices, may create some incentives to pursue dairy-based beef production, other factors such as public perceptions of how the dairy industry deals with its surplus calves, are becoming more of the drivers for change.

The idea of transporting and killing young dairy calves is not popular with the public. Animal rights groups have taken ownership of this issue and are actively campaigning against the slaughter of bobby calves, which is the industries status quo. Value adding to these animals, by rearing and finishing at heavier weights, seems like an obvious solution, but to date, has gained little traction. The main barriers to the growth of dairy beef industry are calf quality, rearing costs and markets.

Calf Quality

The predominantly seasonal, pasture based dairy production system found in the southern regions of Australia, has influenced the type of animal we breed. Perhaps the most important factor for the profitability of a seasonal calving herd is fertility. Calving date is critical for matching peak pasture supply with peak cow demand. A focus on fertility has seen a shift toward Jersey/Friesian crossbred type cows. While these animals typically have a good balance of fertility and milk production, the carcase traits (particularly of the Jersey and Jersey Friesian cross bred animals) are not suited to prime beef production.

Meat quality from dairy breeds is generally good, with high intramuscular marbling and associated tenderness. Sensory panels cannot detect any taste or tenderness differences with dairy origin beef in comparison to those of traditional beef breeds. The difference lies with carcase conformation and dressing percentage. A small framed Angus will have, on average, 5% greater dressing percentage in comparison to a Friesian steer (Schaefer, n.d.). In addition to this, the prime cuts are generally smaller and more elongated, particularly in the case of rib-eye in dairy bred animals (Schaefer, n.d.).

Figure 9: Friesian steers grazing at Boat Harbour, Tasmania (Source: Author)

Calf Rearing

The second barrier to the development of a dairy beef industry within Australia, is the cost of rearing. Approximately one third of the lifetime cost of a dairy beef animal is incurred during the first 12 weeks of its life (MLA, 2007). Calf rearing is generally a low margin activity with high capital outlay and moderate risk. The low margins achieved per unit (calf) mean that to be profitable, calf rearing units must be large enough to achieve economies of scale. While scale is important for profitability, operating at scale does create some additional management challenges, both from an animal health and financial perspective.

Market

The market for dairy bred bull calves (dairy genetics) is not well developed in Australia. Finished dairy bred steers, particularly straight Friesian and beef cross genetics, fit well into the existing beef markets, although the volume of animals produced is low. However, some bull beef production for the 95CL manufacturing market exists, but again, the volumes are low. Dairy origin veal production (both white and pink) is limited to a small number of niche producers.

Looking at the Australian beef market, particularly with the current supply shortages, there does not seem to be any limitations for the development of dairy beef in Australia, other than achieving the initial critical mass in the rearing phase. Processors are prepared to come to the table, provided that volume and quality can be guaranteed.

Internationally, dairy origin beef is produced and marketed under three main systems, these being veal, bull beef and beef cross prime steers/heifers.

Veal is a high-end product, mainly observed in Europe, particularly favoured in Italy and taken from Friesian bulls finished at eight months to produce a 150-160kg carcase. Veal is divided into two types white and pink. White veal is produced by feeding the calf milk, through to slaughter, in combination with a concentrate ration with a controlled iron content. Attention to iron levels in the feed is required to ensure; that the meat does not become dark in colour, while also ensuring that the animal does not become anaemic. Pink veal calves are weaned from milk early in life and then fed a mixed ration diet through to slaughter. Management of dietary iron levels is not necessary for pink veal.

Figure 10: White veal production in the Netherlands (Source: Author)

Bull beef production was observed in the UK, northern Europe and in New Zealand. Two main markets for dairy bull beef were the 15-month finished bull and 24-26 month finished bull markets. The 15-month bulls are processed for both grinding beef and prime cuts. The 24+ month reared bulls are processed exclusively for the manufacturing beef market.

Figure 11: 'Barley bulls' Cornwall, United Kingdom (Source: Author)

Beef cross programs were observed to operate widely in the UK, Ireland and in the USA. Probably the strongest marketing for the products were observed in the UK with certified Angus and Hereford programs running with a number of different supermarkets. These cattle were almost entirely marketed as prime steers and heifers at 18 to 24 months of age.

Figure 12: The Author with Steven Connolly from ABP Blade Ireland with beef cross steers and heifers being monitored under a genetic evaluation program, Ireland (Source: Author)

Rearing for dairy beef

Dairy beef rearing systems were observed in New Zealand, Europe and the United States, operating at a range of production scaled from a 1500 calf bull beef rearing business in New Zealand through to fully integrated veal production in the Netherlands rearing and processing 1.5 million head per year. The key components of the production system to be discussed are genetics, calf procurement, the environment in which the calves are reared, feed and feeding regimes.

Genetics

Genetics play significant role in the lifetime performance of a dairy beef animal. The main genetics in use within the dairy herd globally are Friesian, Jersey and crosses between the two.

Friesian cows come from a limited gene pool and so the genetic variation between animals is generally quite small. This is favourable from a beef production point of view, as limited variation means greater product consistency. Dairy beef production, observed around the world, was predominately based on Friesian genetics. This is due to the larger body size of the Friesian, in comparison to Jersey and also meat colour characteristics, with Jersey producing a more yellow fat, which consumers find undesirable.

Pure bred Jersey animals are not well suited to beef production due to smaller carcase size and their characteristic yellow fat. Pure bred Jersey and smaller type cross bred bull calves were not well utilised around the world. However, Jersey crossed with beef genetics has produced some good results, as was observed at Riverview in Minnesota. Riverview currently milks close to 63,000 cows and has been progressively converting their dairies to 100 percent Jersey genetics. This is because the higher solids components of Jersey milk is better suited to cheese production. Sexed semen is used to produce replacement heifers. Limousine beef genetics are used on return cows and lower genetic merit animals. These beef cross animals feed into the Wulf Cattle, the beef arm of Riverview, with 15,000 dairy beef animals being finished annually. The muscling and colour traits of European type limousine genetics correct the natural deficiencies of the Jersey. Jersey crossed with Glebvieh was also observed in the USA, with the female Jersey Glebvieh cross being utilised as a beef breeding cow, which was then crossed back to Angus in the hoop beef system. The advantage of the Glebvieh Jersey cross is that it is a small, early maturing cow having a correspondingly low maintenance cost. Again, the European genetics of the Glebvieh aid in correcting any deficiencies of the Jersey carcase.

Figure 13: The author with Jerry Wulf from Wulf Cattle with Jersey/Limousin cross steers and heifers on the feed lot, Morris, Minnesota (Source: Author)

Jersey/Friesian cross animals were not widely utilised for beef production, although some bull beef producers preferred the larger type cross bred animals, as they mature and finish earlier than straight Friesian bulls.

Procurement

Sourcing quality calves is fundamental. Calf quality not only has a significant effect on performance at an individual level but also has implications for the group as a whole, as is the case with infectious disease. The main procurement methods observed in the businesses visited were: purchase direct from farm, through stock agents and from the sale yards. Regulation around the transfer of stock in some countries, particularly the EU, had an influence on the on the quality of the stock available.

The majority of the calves purchased by the large-scale units observed in New Zealand and for supermarket supply programs in the UK, were direct from the dairy farmer. This procurement method relies on the development of good relationships between the dairy farmer and the calf rearer. The quality of care taken at the dairy farm level, in particular ensuring that all calves receive timely and adequate colostrum, is critical for the lifetime performance of the calves purchased. Few farms were testing compliance to best practice colostrum management through blood testing of purchased calves. More common, were handshake agreements to take all male calves produced by an individual farm which complied with certain weight and breeding specifications. The calf rearer is responsible for providing routine collection of the calves and often will pay a slight premium (10%) on the market price of the calves purchased to promote adherence to best practice management.

This procurement method is best for ensuring calf quality. However, it does create significant additional workload for the rearer.

The next best option is the use of a trusted stock agent. This ensures the traceability and quality of the stock, as seen with direct farm purchase. However, there is the additional cost involving a third party clipping the ticket on the way though. However, in some cases the use of stock agents can create some additional value. Good examples of this were the Blade and Van Drie Group operations, which were rearing 25,000 and 1.5 million head, respectively. Both businesses were using internal and external stock agents to source stock. The stock were then processed in batching units where stock were collected, weighed and sorted (generally with respect to weight and breed) before being sent to contract rearing units. This process ensured rearing units received a more or less uniform product, facilitating all in all out mob rearing, allowing better asset utilisation for the contract rearer.

The third method of procurement is though saleyards. This is quite common. However, it carries higher risk than the previous two methods as there is not the contact with the original producer and therefore no guarantees as to the colostrum feeding practices and disease challenge on the originating farm. Stock movement regulations in some countries go some way to mitigating the risk involved with purchasing stock from the saleyards. For example, in the UK, stock must be seven days of age before they can be transported. In the Netherlands, this is 14 days. With the main risk period in terms of infectious disease being the first ten days of life, these regulations facilitate lower disease risk stock making it to market. These laws however, create additional cost and inconvenience for the dairy farmer, due to the fact the bull calves are staying on farm longer and therefore are a drain on resources.

In Australia Bobby calves must be a minimum of five days of age to be marketed through sale yards. Calves less than five days of age may be transported direct from a dairy farm to a rearing facility provided that the calves are fed within six hours of transport, there is thick bedding in the transport vehicle, the calves are protected from cold and heat, the calves are not consigned through sale yards and the journey time is less than six hours. (Department of Agriculture, Fisheries and Forestry, 2012)

Transport and induction to rearing facilities

Transport and introduction of calves to the new rearing environment can be quite stressful. This, combined with the mixing of calves from various origins, can create elevated disease risk. This risk can be mitigated somewhat through the use of appropriate transport techniques and tailored induction treatment protocols.

Transport of calves on the rearing units in New Zealand, mainly consisted of custom, solid sided tandem trailers and small trucks. These were divided internally into a number of small pens to reduce the mobs size and therefore the risk of crushing. Of interest was the unloading technique utilised by Top Notch Calves where a slide was utilised for unloading calves. This made the process much quicker and less stressful for the calves.

Riverview transport their heifer calves to both Arizona and New Mexico, at between two and four days of age. The calves are batched in large barns fitted with individual topless hutches. Calves are loaded onto semi-trailers twice a week and trucked non-stop to the rearing units. This travel takes approximately 15 hours as a non-stop journey. The stock trailers had partially filled side and the floors were bedded down with wood shavings prior to loading.

Figure 14: Loading calves onto a semi-trailer utilising a large calf pen mounted on a low-loader, Riverview, Morris, Minnesota (Source: Author)

Black Soil, in Iowa and Dakota Plains Dairy in South Dakota utilise Ford F250 trucks fitted with custom made fully enclosed but ventilated calf crates on the tray. These again were bedded down with wood shavings prior to being loaded. Of interest was the management of the calves prior to transport. Calves were fed their entire allocation of colostrum within the first six hours of life and then given free access to electrolytes via teat feeders up until the point of transport. This was typically up to two days after birth. By doing this, they observe that the calves transition better onto the powdered milk diet provided at the rearing units, stay well hydrated during transport. The process is also simpler to manage at the dairy farm level, eliminating the need for transporting and feeding fresh milk.

Figure 15: Calf transport truck, Black Soil Dairy, Iowa, USA (Source: Author)

When inducting calves into new rearing facilities each of the businesses visited had different protocols. Generally, calves are isolated (individually) or grouped into small mobs of around ten calves per pen for the first three weeks of life, before being mobbed into larger groups of

around 30. This is a disease risk mitigation strategy. Smaller mobs limit the potential for disease transfer as well as being easier to monitor for any feeding problems and signs of illness. In New Zealand, all calf rearing units visited, initially mobbed calves into small groups of approximately 12 calves before transitioning them to larger mobs of 40 up to 210. The veal production units in the Netherlands utilise subdivided pens, with every calf being isolated and fed individually during the initial acclimatisation phase. The subdivisions are then removed to allow a single pen for every eight calves through to finishing.

Various vaccination and antibiotic programs were utilised to control disease. In the confinement feeding systems in Europe and the United States, respiratory disease was the biggest issue. In New Zealand, the major risk was navel infection. Some businesses were blanket treating all calves with a long acting antibiotic injection along with probiotic supplements in the milk for the first three weeks of life.

Environment

A clean and comfortable rearing environment is required for the production of healthy, high performing calves. The environment is a major factor predisposing calves to illness. The environment should provide adequate space, be clean, dry and well ventilated but free from draughts (Dairy Australia, 2016).

Calf rearing units generally use either individual housing utilising hutches or group housing, utilising indoor pens. Individual housing systems are favoured across the majority of the EU and USA. The advantages are that they provide a completely isolated environment preventing calf to calf transmission of disease. They also allow individual feeding of calves with no competition for milk and concentrate. This allows easier monitoring of feed intakes and faster identification of sick or ill thrift animals. The disadvantage of hutches, are that they are highly labour intensive to manage. The group housing systems, utilised in New Zealand, were operating with approximately one labour unit per 600 calves versus those in Europe and the USA which were, with a few exceptions, running at approximately half that.

Figure 16: Hutches used for rearing beef cross calves at Riverview Morris, Minnesota (Source: Author)

Group housing was favoured in New Zealand and the Netherlands. The advantage of group housing is that it allows much faster batch feeding of calves, better immune development, better social interaction for the calves and generally lower capital outlay per calf. The

disadvantage of group housing systems is that they are more difficult to manage, with a higher risk of disease transmission and much greater demands on staff's observation skills.

James and Jonathan Lambright, run a rearing business within an Amish community in Shipshewana, Indiana, pay a premium to rearers utilising hutches as opposed to barn rearing systems. This is because they generally have less animal health issues with calves reared in hutches. For the Lambrights, barns represent a lower cost, more labour efficient and more employee friendly option for rearing calves. One of the problems with hutches in their environment, is winter snowfall making the task of twice daily feeding difficult. Snow must often be ploughed away to gain access to the calves and the cold working conditions are not ideal for employees. In comparison, the shed system designed by the Lambright's is snow free and heated utilising wood burners. While the working environment is better for the employees, greater attention to animal health is required because the mesh pens do not fully isolate each of the animals and ventilation in the shed is poorer than in hutches, particularly during cold winters when the wall vents are closed.

Figure 17: Barn calf rearing research facility on the Lambrights farm Shipshewana, Indiana. Calves are in individual pens which can be hoisted into the ceiling for cleaning out between batches. The barn is heated by a wood heater during winter. Calves are bedded on sawdust (Source: Author)

Maintaining a clean, dry environment limits the risk of disease. In a calf rearing facility this means sanitising hard surfaces and managing the bedding material. A variety of bedding materials were used in the businesses visited and opinions vary as to what is the most suitable. Sawdust or wood shavings were utilised in a number of units in the USA and New Zealand. Both seemed quite effective, although some of the producers were of the opinion that saw dust predisposed calves to a greater risk of pneumonia. Wood chips or sawdust were generally spread on top of earth floors, which in purpose built facilities, had metal filled soakage drains to carry away effluent. More chips or saw dust were added on top of the previous layer with each batch of calves introduced to the facility. The floors were then cleaned out once per year. Units in the UK typically utilised straw as a bedding material. Straw is a highly labour-intensive bedding material with additional straw being required for 'bedding down' every other day, if not every day. Straw was generally placed on concrete floors with no drainage, working as a sponge, soaking up the effluent produced by the

calves. Facilities bedded down with straw were cleaned out after every mob of calves and the floors sanitised.

Fences and walls in all observed facilities were generally solid, firstly to prevent draughts at calf level and secondly to prevent contact between calves. Second hand corrugated iron was commonly used for these dividers, being a durable, inexpensive, easily cleaned material.

Feeding

Feed represents two thirds of the cost of production for a newly born calf through to weaning. Cost reduction in rearing is achieved through feeding strategies that promotes rapid rumen development, transitioning the calf from a labour intensive and high cost milk based diet to a lower input, lower cost, concentrate diet and then eventually onto pasture. A variety of milk feeding strategies were observed, utilising both whole milk and milk replacer.

Fresh whole milk was fed opportunistically in combination with milk powder by the larger rearing units in New Zealand. For these units, fresh milk was obtained from farmers whose milk had been rejected by the factories, based on temperature at pick-up time by the collection truck or if there had been low level contamination with antibiotic. For example, one cow within a treatment withholding period being milked into the vat, out of a herd of 300 cows. Dumped milk from treatment cows was not collected. This milk was either delivered to site, as in the case of contaminated tanker loads, or collected by the rearer utilising small trucks fitted with poly tanks.

Figure 18: Truck utilised by Top Notch calves for milk collection. Waikato, New Zealand (Source: Author)

On farm, fresh milk is stored in plastic water tanks. Some rearers add yoghurt culture to the tanks to preserve the milk for longer, one rearer using five packets of EziYo per 20,000L.

Early in the season when the weather is cool, there are few issues with storing fresh milk without refrigeration. The large numbers of calves being fed means fresh milk is rapidly consumed; 4000 calves consuming 5L/calf/day equals 20,000L per day total consumption. As fresh milk is highly opportunistic, it is generally reserved for calves older than three weeks which can handle the variable dietary composition change from powdered milk to fresh milk.

Figure 19: Fresh and powdered milk handling facility at Top Notch Calves, Waikato, New Zealand (Source: Author)

Powdered milk, based either on whole milk powder or whey concentrate, was the preferred method of milk feeding for the majority of farms visited. The advantages of powdered milk is that it's easy to transport and store, the product is consistent, safe and free from any diseases which may be transmitted in fresh milk. Paul Muir, from on farm research Pukawa research station, Hawks Bay, New Zelanad, said they have observed less animal health issues when feeding whole milk powder as opposed to formulations based on whey concentrate. However, all large rearers visited were using whey-based milk replacers and were achieving very low mortality rates.

Milk, whether whole fresh milk or powdered milk replacer was fed warm, being either mixed with warm water, heated within automatic calf feeders or forced through heat exchangers as was any fresh milk fed. The optimum temperature for mixing milk is 42 degrees Celsius. Most rearing units employed a twice-a-day feeding strategy. Units in New Zealand, typically utilised a twice-a-day feeding strategy for young calves and then shifted to once a day feeding when calves were a few weeks old.

Concentrates or calf meal is the biggest individual cost in the calf rearing process, other than the initial purchase of the calf itself. All farms had a strong focus on feed quality, in particular protein and starch levels. All rearers were routinely analysing their purchased calf meals to ensure they were meeting the required standard. Some of the larger operations were manufacturing their own feed as was the case with Van Drie in the Netherlands and Lambright's in Shipshewana, Indiana. Feed typically was a minimum of 16% protein, 45 percent starch and 12.5 MJ/kg metabolisable energy. Most observed feed rations were comprised of 50% whole grain (unprocessed) maize and barley mixed with a protein pellet, typically medicated with cocidiostat.

Management

Attention to detail is critical. It is highly important to have a skilled and observant team following good procedures. It seems that around 600 calves per labour unit is optimal, both financially and from an animal health perspective. The operator must have sufficient time to 'eyeball' every calf and visually assess its health status. Isolating and treating depressed or lethargic calves early, not only greatly improves the likelihood of a positive outcome for the calf, but is also important in controlling the spread of any infectious disease. This process is centred on having good skilled people working in the system.

Recommendations

Calf rearing business model

Before setting out on this study the author's idea of the ultimate calf rearing system was an industrial looking all on one site business, rearing several thousand calves with everything standardised and under the control of one manager. This idea was challenged early on in the travels, with the "a-ha" moment arriving during a conversation with Steven Connelly from Blade ABP Ireland. On looking at a couple of units rearing a few hundred calves per year the author asked if they were considering scaling up the size of their rearing units and he said no. He said that the smaller units were better able to maintain quality and that a mass-produced product was not what their customers wanted.

Lean theory centres on maximising value and eliminating waste. From a broader perspective, value creation should not just be for the immediate customer but for society as a whole. This means that farmers must seek to farm in a way that not only meets the demands of customers but also the expectations of society. For Toyota group companies, the purpose of Lean is to make a profit *while* harmonizing with global society and fulfilling their social responsibilities. They see their social responsibilities as:

- Contributing to society through their products.
- Revitalising their local community through their company.
- Stabilising the livelihood of their employees.

A focus on profit underpins this, as it is required to keep the business stable. So, what does this look like in the context of calf rearing for dairy beef?

As outlined in the introduction, calf rearing is typically a low margin moderate risk enterprise and so scale is important for the profitability of the business. Customers (finishers and processors) want to deal with fewer, larger-scale businesses which can guarantee supply of the product they need. Consumers on the other hand, are becoming resistant to industrial agriculture with concerns about animal welfare and environmental impact.

So, how to satisfy both?

The rearing model that seems to fit the demands of both customers and the end consumer is the contract rearer model where scale is achieved collectively, rather than individually. The core business supplies calves and all the key inputs such as milk, meal and medication to the rearer. The rearer supplies and maintains the main infrastructure and is paid on a per head per day basis. This model allows economies of scale to be achieved, when dealing with all the major inputs, while rearing units maintain a small environmental footprint.

In this production model, the core business acts as a distribution centre, facilitating 'just in time' delivery of inputs into each of the rearers. This reduces inventory and storage waste at each of the rearing units while also allowing the core business to easily track production costs, and determine which units are performing better than others.

Calf Quality

Total Quality Management (TQM) is a management philosophy that is very similar to Lean, sharing many of the same ideas but having a core focus on the management of quality at every stage of operations (Anvari, et al., 2011). The dairy industry has a quality issue with the calves it is currently producing. Smaller type Jersey and cross bred cows are well suited to Australia's pasture based production systems. However, the bull calves, from Jersey based genetics, are not well suited to beef production. Until the fertility of sexed semen is sufficiently improved to be on par with that of conventional semen in terms of conception and genetic qualities, the industry will continue to be producing low value bull calves. This may seem unavoidable at present, however the industry can look at the genetics being used post the AI period of mating.

Post AI, the majority of farms will be using Jerseys as 'clean-up bulls' due to the fact they produce low birthweight, easy calving offspring and are a hardy low maintenance animal. If a particular farm is undergoing expansion and more heifers are required to build the herd, then Jersey clean-up bulls might be a good option. However, if the farm is not undergoing expansion, and heifers – in addition to those produced by the AI program – are not required, then the use of beef genetics to produce a higher quality, higher value calf is a more responsible option i.e. It is not socially responsible for the dairy industry to continue to use clean-up bulls whose offspring are 100% waste product.

Another contributing factor to calf quality is colostrum management on the dairy farm. The timely provision of high quality colostrum is important for the lifetime health and performance of a calf. Ensuring standard operating procedures are in place at the dairy farm level so colostrum is handled and delivered correctly would make a significant difference to the quality of calves reaching the rearing unit.

Quality, Quantity, Quickly.

Facilities

Dairy production in Australia is seasonal. This means that a calf rearing facilities may only be in use 12 to 18 weeks per year. This being the case, capital investment should be kept to a bare minimum, as asset utilisation will generally be quite low. It is recommended that contract rearers adapt existing farm buildings where possible. Toyota operates in a similar way. For most of the suppliers within the Toyota group, space is at a premium. Factories have been built in by other industry and housing and vacant land for development is at a premium. This means that physical expansion, is in most cases, not an option. Instead of investing in facilities, these companies invest in people and process, finding ways to use the space they have more efficiently.

An example of this is the Gifu Auto Body plant in Unuma, Gifu prefecture, Japan which manufactures the Toyota Hiace van. Gifu Auto Body site is completely built in by other industry and housing. The need to increase output necessitated changes to the production line and in particular the welding bay. Limited space and lateral thinking led to what is now the highest density of welding robots in the Toyota group. Making use of vertical space, robots work simultaneously from above, beneath and on each side of the van body.

If construction of facilities is required, attention should be paid to drainage, ventilation and light. From the facilities visited, poly-tunnel type structures appear to represent the best per square meter value (as little as $10 per square meter) with excellent light penetration and ventilation properties.

Markets

The current markets within southern Australia and in particular Tasmania, are centred around grass-fed prime steers. This would dictate that the initial development of dairy beef production should be focused of beef cross and Friesian type steers. These animals will fit straight into existing prime beef markets.

Bull beef for the manufacturing market may be an option, to either fill current supply issues experienced by processors in the southern states and/or with some investment grow the beef industry.

In Tasmania, processors have cattle supply issues between June and October. Through winter, there is generally not enough feed to finish cattle and then coming into the spring, producers require the cattle to utilise the increased pasture growth. There is the potential for the use of dairy bred bulls, finished at 12 to 14 months and 400kg+ live weight, to fill this supply gap. These animals may be integrated into cropping programs, grazing winter cover crops. Bulls are well-suited to this finishing system, as the production of lean muscle tissue requires less energy than the fat cover required to finish a steer. Bulls also express much higher compensatory growth potential in early spring, meaning they will reach the required bodyweights faster. To finish bulls outside of this window of opportunity would require further investment in processing capacity.

Tasmanian processing facilities are filled during the main spring summer turn off period with high value prime beef. This means there is not the capacity to handle large numbers of lower value bulls for manufacturing beef. There may be the potential to develop a small to medium scale ‘hot bone’ line that runs either parallel to existing processing facilities or as a small independent facility. Hot boning is a process utilised for processing manufacturing beef in which carcases are not chilled prior to boning out and boxing. This means that less effort is required to bone out the meat (20% less) and less energy is required to chill/freeze the product as no waste bone etc has to be cooled, just the boxed product. This would open up the potential for the development of bull beef in Tasmania.

Implementation of Lean on farm

Successful implementation of Lean on farm requires 100% buy in from management, basic theory education for the farm team and ongoing coaching from an external consultant. From the implementation models observed, the Danish and New Zealand approaches seemed most effective, providing basic training before working on gaining rapid improvements in the workplace.

A good starting point for the implementation of Lean would be to provide basic training on waste identification and work on implementing 5s in a small part of the business. Making

rapid effective improvements in a small part of the business is important to motivate and further engage team members.

The creation of Lean management programs tailored to agriculture, providing both theory training and ongoing on farm coaching, is required for the uptake of Lean management on farm in Australia. In the absence of this, there are many consultants working within the manufacturing industry which may provide a similar service.

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Plain English Compendium Summary

Project Title:	Large scale calf rearing for dairy beef production and the application of Lean management in agriculture

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Objectives	To evaluate calf rearing systems utilised around the world for dairy beef production, in particular those operating at large scale To understand the major factors driving success in these businesses To determine which production models fit best with Australian seasonal calving patterns To evaluate the use of Lean management in agriculture To understand which aspects of lean management work well on farm. To determine the best process for implementing lean on farm.
Background	Dairy bull calves are currently an underutilised by product of the Australian dairy industry. The current practice of killing these calves at birth or processing at four days of age is gaining increasing negative publicity. With dairy origin beef contributing significantly to the total beef production of many countries including the USA and UK there is an opportunity to value add to this coproduct of dairy production. Lean management, developed Toyota in Japan has been extensively utilised by manufacturing businesses worldwide to drive improvements in productivity, with improvements typically in the realms of 20-30%. To date little has been done to implementing Lean principles within agriculture in Australia.
Research	My research took me to New Zealand, Japan, Western and Northern Europe and the Mid-west USA. It looked at the utilisation of dairy bred bull calves and in particular the practical aspects of rearing at large scale. I also completed a lean management tour of Toyota in Japan and spoke to various consultants world-wide working with the implementation of Lean management in agriculture.
Outcomes	Large scale calf rearing is achieved most successfully collectively rather than individually, utilising a contract rearing model. There is a quality issue with the Jersey and Jersey cross bull calves produced by the Australian dairy industry which can in part be corrected by the use of beef genetics post artificial insemination. The seasonal nature of dairy production in Australia means lower asset utilisation in comparison to year-round calving systems in other countries. Implementation of lean on farm requires basic theory training of all people on the team followed by on the ground action. Visual management boards, 5s and Standard work are tools that work well in agriculture.
Implications	Successful development of dairy beef in Australia will be best achieved through a cooperative or integrated rearing model. The dairy industry must take responsibility for the quality of the bull calves that it is producing, utilising beef genetics where possible to increase the carcase quality of these animals. The dairy industry must follow the beef market more closely a look for opportunities to value add. Calf rearing should utilise existing facilities where possible to minimise capital outlay while paying attention to the environmental conditions required for optimal animal health. Successful implementation of Lean on farm will be best achieved through committed management and ongoing coaching from an external advisor.