Contextualising the Future of Work in the Australian Cotton Industry

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Acknowledgements

This project began in October 2017, and over this time the research has expanded in scope. The study contained within this report was originally proposed to understand the facilitators and barriers to using technology to improve farming systems in the cotton industry and the impacts of adopting new technology on workforce skills required and workforce planning in cotton businesses. Since the beginning of this research, other industry events have focused on the future of Australian agriculture including the National Farmers Federation 2030 Round Tables in 2018, and the launch of the inaugural Evoke Ag event in 2019 which brought new insights to the forefront. While this project sought to fulfil its original aims, it was also apparent that other factors challenging and enabling the future adaptation of cotton industry businesses would enrich the research.

This research project has been strengthened by the support and collaborative activities with the attendees of the CRDC Science Forum – Build adaptive capacity of the cotton industry. This 2018 event was a gathering co-ordinated by People Program research manager, Rachel Holloway and included representatives from CRDC, including Ian Taylor, Jane Trindall, and Ruth Redfern, other researchers including Gordon Stone, Jeff Coutts, Jana-Axinja Paschen, Lynette McLeod, Trudy Staines, Ruth Nettle, Jennifer Moffatt, and Oliver Knox; Cotton Australia representatives Ali Briggs (Education Co-ordinator), Rebecca Fing, (Workforce & Training Co-ordinator), Angela Bradburn (Policy Officer), Claudia Vicary (Agskilled Project Co-ordinator); Cotton Info representative Warwick Waters; myBMP manager Rick Kowitz; and several Growers including Nuffield Scholars Daniel Kahl and Renee Anderson, Peter Tuohey, Emma McCullagh, Kate O'Callaghan, and Dave Walton. The opportunity to test ideas and learn from the diverse knowledge and perspectives of those interested in cotton industry workforce development has proven invaluable in accelerating my understanding of the issues under investigation and guiding this research.

I am very grateful to Rachel Holloway who offered considerable support and guidance throughout the project. Cotton Australia and CottonInfo representatives, as well as fellow members of the Australian Association of Cotton Scientists, gave great assistance by connecting me into their networks of innovative growers. I also acknowledge Professor Peter McIlveen's assistance in the project design and analysis of the data.

The case studies contained in this report are in-depth and detailed in describing the adaptive ways that change and strategic workforce management is approached in different contexts. This has only been possible due to the generosity of the growers, managers, agronomists, and workers that have shared their knowledge and experiences through the different iterations of this project – I am incredibly grateful to all the participants. While not all individuals' accounts have been captured within the case studies presented, all interviews conducted led to a greater understanding of the future of work on cotton farms and in this way, all participants have informed the analysis and inferences made.

Over the course of this research project, the increasing volatility, uncertainty, complexity, and ambiguity that characterises the world of work was evident in the unprecedented severity of the drought that spread through cotton production valleys. More recently, the industry is bouncing back following substantial rainfall, but it is the 'black swan' event of an international pandemic and consequent border closures restricting access to seasonal labour that may now limit production. We may not be able to precisely predict our future, but we can prepare by improving our ability to proactively adapt to the ever-shifting forces that impact work in the cotton industry. I hope that by sharing the innovative approaches to work that are happening within the cotton industry businesses profiled in this report, that others can gain insights into a variety of approaches to adapt and strategically develop their businesses and support the people that power the industry to grow into new ways of working. By doing this we ensure that collectively, the cotton industry is ready to approach future challenges, whatever they may be, in a way that ensures a sustainable, productive, and profitable industry in the years to come.

Nicole McDonald

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May 2021

Executive Summary

"The future belongs to those who prepare for it today." -Malcolm X

"The only way you can predict the future is to build it." -Alan Kay

Purpose

This project was initially developed in response to the shift in the Australian agriculture industry to a new stage of transformation: the rise of digital agriculture. Reports on the future of the industry described potential scenarios and the current research has attempted to explore what this may mean for the workforce capacity and capability requirements of the Australian cotton industry. Building capacity in the cotton industry workforce involves equipping people to proactively drive change and innovation within the industry and on–farm, ensuring the Australian cotton industry maintains a competitive advantage in the future. The research presented in this report examines how people at the forefront of change are successfully adapting as individuals and as businesses to survive and thrive into the future and identify what these changes may mean more broadly for the future of work in the cotton industry.

Project Objectives and Research Aims

The objectives of the 'Understanding and Planning for the Future Cotton Industry Workforce' project were to undertake research to:

1. Provide an understanding of 'drivers of change' which will impact the future cotton industry workforce.
2. Identify the future skills required within industry and on-farm and prioritise the skill development areas to facilitate innovative farming practices.
3. Identify strategies to maximise skill development and transference of skills to raise employer and employee confidence and capacity in adopting future advances in cotton farming.
4. Assist Growers in adoption of new technologies on-farm, including workforce planning while implementing new technology introduction, transition, and maintenance periods.
5. Provide recommendations for future workforce planning considering impacts of 'drivers of change' on industry, growers, and workers.

The research aims of 'Contextualising the Future of Work in the Cotton Industry" included

1. Understand factors influencing technology acceptance and adoption.
2. Understand grower and workforce experiences of transition that occur with the introduction of technology.
3. Understand entrepreneurial behaviours and the mindsets, skills and structures that encourage entrepreneurship or intrapreneurship within cotton businesses.
4. Understand the function of the knowledge network and consultants work in extending and influencing on-farm change.
5. Understand influences on attraction, retention, and development of workforce and how this occurs in adaptable businesses.
6. Identify other factors that may shape the future of work and workforce requirements for the Australian cotton industry.

Research Design

The overall research design consists of two distinct parts: (a) an analysis of the 2018 Grower Practices Survey, and (b) a multi-case study of cotton farming and allied industry professionals to explore different factors associated with the future of work.

Analysis of the 2018 Grower Practices Survey

The Grower Practices Survey is an annual survey of cotton growers that collects information about the past season crop production and other related issues. The questions are updated each year, keeping the survey as succinct as possible, while ensuring a wide range of data capture over time. In 2018, the opportunity was provided to researchers within the 'people' research stream to capture data relating to the on-farm workforce demographics/structures, attitudes of employers towards workforce and technology adoption relating to automation. Expanding on the descriptive analysis presented within the 2018 Grower Practices Survey Report, an analysis of this data directly related to the first aim of the research project.

Multi-Case Study

The remainder of the aims are addressed using multi-case research. The owners/workforce of adaptable cotton industry businesses clustered around a specific context were treated as single cases. The adapting cotton industry is more broadly considered the target collection to be studied (Stake, 2013). A pragmatic approach was taken, and these cases are not uniform in the roles that participants hold or the number or types of perspectives that have been included. Each has been written to focus on different factors of interest that were generated either from the literature or the data and aligned with the aims of the research. In this way, these instrumental case studies are facilitating

further understanding of the future workforce requirements for the Australian cotton industry, the skills and abilities needed to adapt and the structures and systems that attract, develop and retain desirable workers (Stake, 1995).

Semi-structured interviews were initially conducted with growers. Depending on the size of the business and research questions that were further generated from the interviews, employees of the enterprise were also invited to participate. The interview schedules used are listed in Appendix A. When selecting participants, every effort was made to include a range of different businesses, larger and smaller enterprises with various levels of staffing, irrigation and dryland cropping, and farms in different production valleys. The addition of a case study on an agronomy consulting business recognises the rise in higher skilled allied professions and offered a different perspective on practice change in the industry. Existing theory and academic literature have been used in the analysis process to guide interpretation. Member checks were conducted with all growers to ensure the accuracy of the researchers' interpretation of the transcript data and to ensure the ethical standards of research were upheld for participants.

Key Findings

The key findings and implications of the research in relation to the research aims are summarized in the tables below.

Aim 1: Understand factors influencing technology acceptance and adoption.

Findings	Implications
Factors that moved people from being disengaged regarding technology solutions to considering technology solutions for their farm business included: • Perceived usefulness of automation to save time and solve labour issues (such as the limitations experienced when needing to quickly hire and upskill workers to increase production after drought). • Perceived usefulness of technology to solve a production issue that is a strategic priority (if priority production issues are not solvable through technology, then grower attention may be focused on practice change other than technology adoption). • Dissatisfaction with the status quo and a perception that automation is potentially more efficient and effective than current approaches to task performance. • An influential person within the business is in a growth stage in their career or the owner's business is in a growth stage. • Time and resources allow for effective strategic planning in the business and exploration of digital agriculture solutions (growers who have structured their roles to dedicate time and energy to strategic planning are able to pay attention to future opportunities offered by technology use). Factors that moved people from considering technology solutions to adoption of technology solutions included: • An economically sound business case tailored to the farming enterprise can be made for adoption. Not all technology is economically viable in all farming systems. • There is a known pathway to implementation and perceived ease of use for technology, including access to reliable support from providers. • Grower/manager is upskilled in digital transformation of the business including implementing infrastructure (connectivity) and collection/management/use of data. • Grower/manager has the leadership capability to engage workforce in technology acceptance and coaching of skill development for effective technology use by workforce – effective use is essential to realise the economic value of precision technology. • Grower/manager trusts that technology will deliver results. There is a reasonable 'plan B' that can be utilised if technical issues arise, ensuring that production is not negatively impacted if technology fails.	• Technology providers must have a strong understanding of the production issues that matter to growers and the farming systems that surround these issues to develop useful solutions. • The threats and opportunities to cotton farm businesses that may be addressed with digital agriculture (e.g., fluctuating labour demands, societal trust, resource management) must be made clear for growers to factor technology solutions into strategic planning activities in preparation for when cost, reliability and relative advantage in performance makes these viable to adopt. • Growers supported to maintain a growth mindset within their business will be well placed to adapt in their business. • Growers benefit from the expertise of others to identify the initial business case for technology adoption. This may mean observing the successful implementation of technology in different farm business contexts to evaluate the business case for themselves (e.g., field days at different growers' farms using technology) or access to specialist consultants who can advise on the business case for their specific farming businesses. • Growers skilled in digital transformation processes, including technical aspects associated with infrastructure implementation, data collection, management and use, and leadership/coaching of the workforce through the digital transformation will be able to take advantage of the benefits that technology adoption offers. • Growers require access to skilled service providers to fix/maintain digital technology.

Aim 2: Understand grower and workforce experiences of transition that occur with the introduction of technology.

Findings	Implications
• Personality factors and orientations that were described by people effectively engaged in a change process included: an openness to experience, humility, curiosity, and willingness to challenge the status quo. These qualities help people to approach change rather than avoid it and to be willing to learn. • Growers trialled new technology, making a gradual expansion of new approaches to growing cotton as the value proposition was established. • Ease of use influenced perceived usefulness of technology and leads to acceptance. • Barriers to technology acceptance and use were related to physical or cognitive issues experienced by some on-farm workforce. • A colleague who had experienced benefits in using the technology and could offer support improved other workers trust that the technology would be useful. This encouraged technology acceptance and persistence to learn skills required for use. • Transformational leadership practices were important to encourage workforce to stay engaged during a change process. • Growers/managers skilled understanding of individual differences meant they could tailor their support to workers needs and maintain good relationships during a change process. • Ensuring that trust was maintained, workers felt valued in interactions with their employer/manager, and psychologically safe at work when digital technology increased transparency of workplace behaviours was important for a positive experience associated with change on-farm. • People's positive experiences with technology use builds confidence, skills, interest in and acceptance of digital agriculture.	• Technology needs to be designed for diverse users, including different literacy levels or physical abilities. • Growers understand the processes to conduct effective trials on-farm and use evidence to understand the value proposition of new technology for their business. • Growers identify a team member to champion new technology use on-farm and support peers in their adoption. • Digital agriculture raises the skill level required of managers/supervisors in relation to workforce management. Growers/managers/supervisors who are skilled in transformational leadership would be effectively able to support workforce through changes to their roles on-farm, including those that involve technology acceptance. • Psychological safety would appear to be important to learning cultures but further exploration of this concept in context is required to identify any contextual nuances that need to be considered before investing in upskilling around this concept. • The principles of transformational leadership that were identified in the current research project align with the recommendations of Coutts & Stone (2019) for additional myBMP HR Level 3 people management practices. This strengthens that argument for the inclusion of these performance indicators to clarify best performance practices that cotton farm businesses require to be innovative and effectively manage change with regards to their workforce.

Aim 3: Understand entrepreneurial behaviours and the mindsets, skills and structures that encourage entrepreneurship or intrapreneurship within the cotton businesses.

Findings	Implications
• In addition to the personality factors that influence successful engagement in a change process, factors including a dissatisfaction with the status quo, mastery goal orientation, creativity and grit are integral for those who create change through entrepreneurship or intrapreneurship. • High engagement and ability to think strategically, to identify threats and find opportunities was evident in large cotton businesses and small to medium cotton businesses that were enacting entrepreneurship. • The ability to communicate with diverse people in agriculture and industries outside of agriculture was important to find new economic opportunities. • Business owners' acceptance of the costs associated with the learning curve (trial and error) was required for employees to engage in intrapreneurial behaviour. • Employees were able to argue for the adoption of their ideas through building a business case to present to growers/owners. • Mentorship from entrepreneurial growers encouraged the development of the entrepreneurship and intrapreneurship skills (communication, strategic thinking, developing a business case for new ideas, acceptance of the learning curve costs).	• Entrepreneurial development opportunities from primary school through to adults employed in cotton farm businesses would help to build the pipeline of people attracted to the industry who excel in these endeavors. • Growers who can redesign their jobs to allow the time and energy to engage in strategic planning and upskill in strategic thinking and foresight can seize opportunities and manage future threats. • Growers who have developed relationships with those that are entrepreneurial are provided with supportive learning opportunities to develop their own entrepreneurial skills.

Aim 4: Understand the function of the knowledge network and consultants work in extension and influencing on-farm change.

Findings	Implications
• Networks are sources of information and collaboration that enable innovation. • The strengths of connections and diversity of experiences within the network influence innovation potential. • Diversity within the network requires more skillful communication to enhance connections and collaboration. • The knowledge network needs to flow between researchers to growers, and growers to researchers. Agronomists provide an important conduit for translation of knowledge and can offer their own insights to both parties. • Knowledge shared between networks include technical knowledge (how to perform tasks) and career knowledge (how to manage career in the cotton industry). • It is important to find ways for different members of the cotton industry, whose access to different sources of knowledge may be restricted by physical distance, to form connections that can improve their learning.	• Initiatives to connect networks across production valleys can strengthen knowledge across the industry. • Agronomists are central to innovation systems and their knowledge can be valuable for researchers and growers alike. • Consider use of digital communication to encourage diverse and collaborative networks across professions in the cotton industry. • Facilitating connection to the knowledge network is particularly important for new entrants who may have a low level of social capital within the industry. Limited connections reduce their access to peer-to-peer learning or to collaborate in ways that benefit the industry.

Aim 5: Understand influences on attraction, retention, and development of workforce and how this occurs in adaptable businesses. (Development and Retention)

Findings	Implications
Development and Retention: • Growers who are adapting and persisting in the industry are committed to their own professional development and structure the work demands to allow themselves time to work strategically on the business. • To prevent turnover due to burnout, jobs need to be designed with adequate recovery time and individuals need the ability to manage time and energy to balance work and home roles. • Cotton growers widely acknowledge the value of their employees, wanting them to feel committed to their roles and part of the business. • Developing individual employee expertise in an area of farm production means knowledge and skill proficiency is distributed amongst the team and the grower/manager is not the only source of on-the-job support or training for employees on farm. • Providing a career path with increasing responsibilities for workers who want to develop professionally is important to retain them in the business. • Creating an environment where workers can contribute ideas. speak openly about issues at work, and receive tailored guidance, support, and feedback on their performance led to their ability to adapt to changes and work autonomously on-farm. • Adoption of automation could positively influence retention. It was proposed that a reduction in the seasonal workforce and with a greater proportion of the workforce that are unified by shared values and a commitment to their work would lead to a more enjoyable and satisfying workplace. • Adoption of automation could negatively influence retention. It was proposed that a reduction in the overall agricultural workforce due to automation could mean a reduction in the local community population. This could impact access to essential services (health/education) or social activities (sport) that contribute to the livability of a place. This would make it difficult to retain or attract the skilled employees.	• Professional development for growers to improve the social sustainability of their business involves the following skills: strategic planning; delegation skills; redesigning work roles to distribute knowledge, skills, and responsibility amongst the team; time and energy management; people management; creating a psychologically safe work culture; workforce succession planning and communication/negotiation/collaboration skills. • Performance reviews, career conversations, and providing opportunities to develop mastery are important for employee retention. • The cotton industry can benefit from proactively working with communities in cotton growing regions to strategically improve the liveability of these areas. This would reduce the risks that the expansion of automation could negatively impact community demographics and access to services.

Aim 5: Understand influences on attraction, retention, and development of workforce and how this occurs in adaptable businesses. (Attraction)

Findings	Implications
Attraction: • School-Industry partnerships with high school or tertiary institutions, are a strategic way to influence the next generation to aspire to a career in the cotton industry. In the current study, these were created with schools that have some form of pre-existing relationship with growers. The benefits of this include values congruence between the school context and the farm context. • Transition programs such as the Cotton Australia gap year program give people with no connection to industry a supported pathway to gain the skills and the networks that lead to a professional identity associated with the cotton industry. They also provide an opportunity to test out work in unfamiliar locations. • Mining continues to be a competitor for talent, but the lifestyle offered on farms may hold more appeal for workers, particularly if the farm uses digital technology and is progressive, and strong local community connections can be established for the employee. • Adequate telecommunications are considered an essential service (particularly by the next generation) that is necessary to facilitate standards of living that include digitally connected lives (e.g. social media, streaming entertainment, external education). Unreliable access to the internet could be a factor that negatively impacts job and career choices for the next generation.	• The talent pool attracted to careers in cotton could be expanded if school-industry partnerships between cotton growing businesses and high schools/tertiary institutions were extended beyond pre-existing relationships and facilitated in a strategic way with supports that connect students to the lifestyle/communities in cotton production valleys. • Transition programs could improve attraction to the industry if they target the points of high school to work; undergraduate studies to work and postgraduate studies to work. • The different seasonal peaks of the Northern and Southern regions provide the opportunity to design a graduate program that rotates agricultural science graduates to new areas where they may be supported to try different work in the cotton industry. • Ensuring digital connectivity of farming businesses is important for employee lifestyle factors that could impact their satisfaction when working remotely. Perceptions of lifestyle affect attraction to the cotton industry.

Aim 6: Identify other factors that may shape the future of work and workforce requirements for the Australian cotton industry.

Findings	Implications
Data Collection, Management and Use: • The task-demand of effective data collection, management and use is potentially creating a new role for farm businesses. Professions with transferable skills (e.g. book keepers) may be upskilled to offer these services. • At the moment the economic return on investment for creating a paid position to perform these tasks is not evident to many in the industry. Some participants expressed that there was little relative advantage when changing current practices given the production priorities of the business. Transparency: • There is a rise in consumer desire for transparency with regards to Australian agriculture. • Cotton growers engaging in best practice management can confidently provide transparency but to build trust these narratives need to be supported with data. • Growers who are able to validate their good environmental practices with data may be able to extract premiums for their products or generate alternative revenue streams from stewardship programs. Social Licence: • The narratives that accompany data that validates good practice need to be communicated in ways that make sense to the consumer to effectively build trust, e.g. discussing the amount of water used per bale of cotton means nothing to people without a frame of reference to comprehend this information. • Skilled communication that connects diverse stakeholders, and the wider community, to credible information about the cotton industry and establishes shared values may be particularly important for further establishing the cotton industry in areas of Northern Australia.	• Digital transformation of businesses and establishing effective data collection, management, and use is needed now to ensure cotton farm businesses are well placed to take advantage of opportunities that will rely on validation of their farm management practices. • The combination of data to validate claims, good communicators and transparency are central to the social licence and future of the cotton industry, and the people who work in it.

Recommendations

From the current research the following series of recommendations are made for (a) collaborative activities (b) mentoring to develop knowledge, skills, and collaboration, (c) skill development activities, (d) adoption of best management practices for innovative people capability performance standards, and (e) future research, development, and extension activities.

Collaborative Activities

- Industry provides opportunities for agtech companies to connect with a diverse range of cotton growers and their employees during the development phase of products to improve the usability of technology and explore the value proposition of adoption across different contexts.
- Industry field days and tours focused on implementation and use of technology solutions are complemented with video case studies or zoom meeting debrief/recaps that allow wider dissemination of knowledge discussed at these events.

Mentoring to Develop Knowledge, Skills and Collaboration

- Growers are supported to develop their entrepreneurial skills and strategic thinking with a mentoring process from other experienced entrepreneurial growers.
- A mentoring program across roles (e.g. grower-researcher relationship, agronomist-grower, researcher-agronomist) supports collaborations that benefit innovation as these cross-profession relationships facilitate different perspectives of challenges or problems that the industry faces.

Skills Development Activities

Upskilling opportunities are required in the following areas:

- Digital transformation processes, including technical aspects associated with infrastructure implementation, data collection, management and use, and soft skills aspects associated with leadership/coaching of the workforce through the digital transformation.
- Trial design, implementation, and analysis of results to determine whether initial use of technology or innovative practices should be upscaled within the enterprise.
- Transformational and Entrepreneurial leadership to develop innovative cotton businesses and the workforce capacity required for innovation on-farm.
- Social Sustainability development skills including: strategic planning; delegation skills such as redesigning work roles to distribute knowledge, skills and responsibility amongst the team; time and energy management; people management; creating a learning culture; and communication/negotiation/collaboration skills.

Adoption of Best Management Practice for Innovative People Capability Performance Standards

The evidence from the current project strengthens the recommendations of Coutts & Stone (2019) for additional myBMP HR Level 3 people management practices to be adopted. These are detailed within the *Towards an Innovative Cotton Workforce* report as:

Employees are viewed as key contributors to decision-making and planning in the farming system and a process is in place to include them in line with their roles and experience.
Checklist

- Managers provide an overview of the farm enterprise to new employees which includes the 'vision' for the farm in the future;
- Staff have a clear understanding of their roles and that of other employees as well as clarifying where there is scope for proactive input;
- Managers provide a regular update on issues, opportunities and decisions needed in relation to farm operations;
- A system is in place for regular discussion and feedback from staff;
- Experienced staff are offered opportunity to comment on consultant recommendations in line with their understanding of specific farm/paddock needs.

Owners/managers have the training and/or acquired skills in leadership and ('higher-level') personnel management to ensure that staff are efficiently and effectively deployed, clearly understand their roles, are provided with the necessary skills and support to feel valued and rewarded.

Checklist

- Managers undertake professional development in higher level personnel management skills and/or have competence in these skills through experience and practice;
- There is a personnel plan in place for the farm specific to the current staff which shows their roles, experience and responsibilities;
- There is a mentoring system in place where new staff are formally linked with a more experienced staff member and/or the manager to guide capacity development and contribution to the farm;
- A reward system is in place which acknowledges those staff who contribute positively to the farm.

The Owner/Manager uses a set of personnel performance metrics to gauge improvements over time and, where possible, where the farm fits within industry performance.

Checklist

- Farms have a list of monitoring/evaluation metrics for this purpose [included in this report] and collect data against these metrics;
- The metrics are reviewed annually to measure changes/trends and inform future personnel management planning.

Farm owners have the strategic business skills required to be able to react and adapt in a changing and challenging market and climatic environment.

Future Research, Development and Extension Activities

- The industry invests in understanding attraction, development, and retention of the skilled workforce required to install, fix, and maintain digital technology including the skills transitions that may be required of mechanical tradespeople.
- The processes for establishing effective School-Industry partnerships are developed, documented, and widely disseminated to cotton industry businesses. This includes connecting with Trudy Staines (CSIRO) and Jenny Hughes (Cotton Australia) depending on the student cohort (primary/secondary school or tertiary institution) and a brief self-paced training session on facilitating effective career education experiences.
- Transition programs are designed to provide career development, connection to local communities, and the work opportunity structures that assist with aspiring to work in the cotton industry at the points of (a) high school to work, (b) undergraduate study to work, and (c) postgraduate study to work.
- A specific grad-gap (an agriculture science graduate program) is designed to rotate promising students through a range of careers (policy, research, agronomy etc.) and different production valleys including Northern Australia.
- Further research is conducted on the concept of psychological safety, testing the robustness of this concept for establishing a learning environment on farm and identifying any context-specific limitations that could impact the usefulness of such an approach on-farm.
- The industry invests in a program of resources and training to support best management practice for innovative cotton businesses to manage the future workforce skills and capabilities identified in the current project. Investigation into strategies for the successful integration of these resources into on-the-job skills development for owners through to entry level employees is required.
- Systems to assist growers and employees to strategically plan, execute, and validate employee personal and professional development activities (e.g. skills passport systems) are investigated for the value they may provide in (a) growing workforce capability across the industry, (b) introducing micro-credentials that may be updated as future skill needs change, and (c) creating visible pathways for career progression.

In summary, this project sought to explore the process of change as occurring in innovative cotton industry businesses and to identify the workforce skills, structures, and processes that help businesses adapt, survive, and thrive into the future. The in-depth case studies provide examples of best practice and identify issues that may prove challenging as megatrends such as climate change, the rise of digital technologies, changing demographics, and transparency and trust, shape the future of work in the cotton industry. These case studies also provide

insight into a range of strategies that different types of businesses are employing to manage risk and approach threats to find opportunities for economic growth. The next steps are to take the knowledge generated from this project and create a pathway and implementation program that results in the integration of best practice to manage future workforce skills into cotton industry businesses.

Chapter One: Introduction

Global trends such as (a) rapid urbanisation, (b) climate change and resource scarcity, (c) shift in global economic power, (d) demographic and social change, and (e) technological breakthroughs are shaping the future of work across all contexts (Price Waterhouse Cooper, 2017). More recently, the global pandemic of COVID-19 has disrupted the world of work with essential services such as agriculture experiencing the effects of disrupted supply chains and restricted access to seasonal workforce through border closures. Indeed, the world of agricultural work continues to face new and ongoing challenges that impact the workforce requirements for the future productivity of the Australian cotton industry. The volatility, uncertainty, complexity, and ambiguity of the future of work has led to increased interest in understanding how individuals can plan and be prepared with the skills and abilities required to successfully navigate the changing context. Furthermore, with expectations of the continuance of a "fourth industrial revolution" and the rise of digital agriculture (RIRDC, 2016), the cotton industry must develop a deeper understanding of how to strategically unlock the capability of people to drive this change. It is essential to identify the types of workers, skills, and workforce structures that will ensure cotton farm businesses are adaptable and benefit from the opportunities for improved productivity, efficiency, and sustainability that technology promises.

This project involved two studies. In the first study, the research for *Understanding and planning for the future cotton industry workforce* identified drivers of the next generation's career choices and influences on their skills development. It described a range of adaptability skills and technical skills that help these individuals transitioning to new work to succeed and thrive within the cotton industry. In this second study, the research aims to explore drivers of change at the industry and farm/agribusiness level to better understand the adaptability of organisations. Several relevant national reports that discuss the future of work are reviewed to identify areas where deeper context-specific knowledge may illuminate factors influencing the future of work for the Australian cotton industry. Furthermore, the academic literature regarding the social implications of digital agriculture, and theories relating to technology adoption and acceptance are used to inform the research.

The Future of Work

There is an extensive body of work that exists in the form of industry and consultant reports that aims to identify potential futures, factors influencing potential futures, and strategic areas for development to drive change and capitalise on developments in the world of work for agriculture. For the purposes of the current research, four have been selected to be reviewed. These include:

- Tomorrow's Digitally Enabled Workforce
- The Future of Australia's Agricultural Workforce
- Agricultural Innovation – A National Approach to Grow Australia's Future

- National Agricultural Workforce Strategy

The contents of these reports shape or frame the research. Examining the discussions, the predictions, and the arguments outlined in these reports inform the research aims of the current study.

Tomorrow's Digitally Enabled Workforce

Tomorrow's Digitally Enabled Workforce (Hajkowicz, Resson, Rudd, Bratanova, Hodgers, Mason, & Boughen, 2016) proposes that the requirements for the future workforce depend upon workforce transitions. This includes how individuals adapt to change at work or change their jobs, and how workforce structures including the number of people, the kinds of roles, and the permanency of labour requirements shifts. The report lays out four potential future scenarios based on the rate of change across two axes: the level of task automation that occurs in the workplace, and the institutional change that can occur with workforce structures including employment models and organisational designs. These include:

1. Lakes (low task automation/limited institutional change): Technology adoption is limited and little change to workforce structures leaves Australia lagging behind the rest of the world;
2. Harbours (high task automation/limited institutional change): Automation systems are fully realised, and with little institutional change, workers are displaced;
3. Rivers (low task automation/significant institutional change): Technology has been slow to advance with little impact of task automation on jobs, but workforce structures and cultures change with the rise of peer-to-peer economy;
4. Oceans (high task automation/significant institutional change). Technology advancements are matched with institutional change that creates socially inclusive employment models however there are concerns whether individuals adapt to these opportunities or whether this leads to a digital divide.

Implications from the scenarios for individuals include the requirement for new mindsets and development of new capabilities, and a baseline of digital literacy skills as well as numeracy and literacy skills not previously required for all workers. The expected job market dynamic is predicted to require greater adaptability, resilience and entrepreneurial capabilities and career self-management skills to remain open to job and industry transitions. While this report is not specific to Australia's agriculture industry, it does highlight factors that are expected to be important in understanding and planning for the future workforce requirements for farming businesses with the rise of digital agriculture continuing to occur in the cotton industry.

The Future of Australia's Agricultural Workforce

In the Future of Australia's Agricultural Workforce (Wu, Dawson, Fleming-Munoz, Schleiger, and Horton, 2019), the two drivers of development were found to be

(a) the level of regional development, and (b) the advancement of technology and uptake of digital agriculture across the sector. Considering the state of these two factors, four scenarios were proposed for potential futures:

1. Fast Forward Regions: Strong regional development draws populations from the cities bringing a critical mass for development of infrastructure and services, and R&D investment leads to an influx of technologies purpose built for the local contexts;
2. Regional Revival: Cost of living and lifestyle factors motivate people to leave the city for country regions but insufficient investment in R&D constrains the development of agricultural technologies which limits widespread adoption;
3. Technology Tsunami: Technology development led by multinational companies breaks new ground, becoming affordable and providing automated solutions to replace labour and reduce reliance and requirements for a local-based workforce;
4. Treading Water: Investments in regional infrastructure does not occur and lack of investment in R&D leaves a gap in local technology development while multinational companies focus on markets other than Australia for their digital agriculture advancements.

The report further identifies some key challenges and opportunities that require co-ordination of multiple stakeholders including governments, industry, and regional communities that if done effectively can change the trajectory of work in agriculture. Of particular interest to the current research project is the call to focus on (a) the skills development, education, and career development for the next generation to consider pursuit of work in agriculture, (b) investment in the digital literacy and skill development of the on-farm workforce and this cohorts collaboration with technology developers and trialling of new digital agriculture approaches to farming, (c) addressing issues with employers, including labour companies, to reduce workforce exploitation which causes harm to those involved and reputational harm to the wider agriculture industry, and (d) improvement in the liveability of regional communities including digital infrastructure and access to services. In this way, it is argued that the future of work in agriculture depends on connecting with the next generation; the current workforce adaptability, acceptance and adoption of digital technology; improvement of work conditions on-farm with safe and rewarding jobs on offer; and ensuring that agricultural workers can have a good lifestyle and with access to similar essential supports, such as reliable internet connection, to their city counterparts while living in regional Australia.

Specific issues for the cotton industry were not discussed in the report. However, issues for irrigators such as lack of water availability, the consequent impacts this has on consistent work available for employees and contractors, and the effects this has on the liveability of regional communities, highlights the inter-relatedness and complexity of challenges that industries such as cotton face when seeking to attract, develop and retain their workforce. The uncertainty of water availability is an issue that affects the attraction and retention of capable

people to work in the industry, with local knowledge and skills lost when workers exit industry in times of drought. This loss of knowledge and skills constrains production when the drought breaks and water is available.

Agricultural Innovation – A National Approach to Grow Australia's Future

In the Agricultural Innovation – A National Approach to Grow Australia's Future report (Ernst & Young, 2019) the agricultural innovation culture and ecosystem are examined to identify opportunities for improvement that will drive productivity and profitability of the Australian agriculture industry. From this report, a vision for the future of agricultural innovation is identified.

The report argues for the need to shift to a dynamic culture where entrepreneurship and openness to risk taking is encouraged to ensure Australian agriculture does not lag behind other more developed agricultural innovation ecosystems around the world. The importance of a collaborative knowledge network and extension services to inform and encourage farmers to take up new technology and innovations is identified as a priority. It is anticipated that the improved innovation system will build the capability of innovators to transform the agriculture industry driving improved productivity and output capacity throughout the supply chain.

Effective leadership is required to enact the vision identified in this report. Furthermore, attraction and development of people through interventions in the education system will increase aspirations to be a part of Australian agriculture. The report is a strategic document with high level concepts identified that may be influential for the future of agricultural work. These factors require further definition and contextualisation within the cotton industry to understand how the future of Australian agricultural innovation may shape strategic workforce development for cotton farm businesses.

National Agricultural Workforce Strategy

The National Agricultural Workforce Strategy (citation) was released in 2021, after the completion of the current study. While this report did not inform the direction or design of the research, the findings are now examined as these assist with framing the current research. The authors of the report argue that prioritising technology development as the future of agriculture, rather than capability development is "putting the cart before the horse" as only capably skilled people, who understand and prioritise effective business and workforce management and the importance of managing the land in environmentally sound ways are positioned to successfully adopt and integrate technological solutions (p. xviii). The findings of the report are discussed with regards to a central goal to focus on establishing the systems and cultures for the workforce to engage in continuous learning and capability development "because all Agrifood sectors depend heavily on people, in order to prosper in changing times, all of them need to train, and develop their people's capabilities up to 'best-in-class' level" (p. 7) . Three basic principles were identified that direct activities towards achievement of these goals and this includes:

1. Interdependency with co-operation: The agricultural work context is conceptualised as an ecosystem that is a web of interdependencies. When one area of the workforce is compromised this affects other areas. Previously siloed sectors or those who may have worked in opposition to each other need improved co-operation for the whole industry to overcome challenges and grow;
2. Local Empowerment: Grass roots initiatives focused on workforce capability development need to be empowered through support from the various levels of government;
3. Excellence: A genuine culture of continuous improvement and desire to change and adapt that is often associated with production aspects of agriculture needs to be extended and applied to all aspects of the industry and held by all players associated with agriculture.

With regards to workforce trends, there is a growing demand for workforce at both the management and non-management level. This demand stems from high turnover, increases in corporate farming and movement of family farms towards bigger corporate-like operations, as well as the generational changes that are occurring in farming businesses. There is an expected rise in requirements for contractors with farmers needing access to well-trained service providers. Increased focus on sustainability and the developments that come with this, including digitalisation of work, changing community standards, demands for increased environmental management, and the measurement and scrutiny of farming practices will change the skills requirements and standards for agronomists and by extension other occupations in agriculture (Pratley & Kirkegaard, 2019).

In terms of persistent challenges, outdated perceptions of careers in agriculture are barriers to attraction and factors contributing to turnover include amenity and lifestyle factors. Issues around equity with the gender imbalance in senior leadership and participation of Aboriginal and Torres Strait Islander people within the workforce are flagged as areas for intervention, arguing "The importance of equity at every level needs to be stressed, as agriculture needs all available talent and the diversity that comes with it" (p. 32). Concerns about the capability and capacity of advisory services to influence adoption of innovative technology and farming practices are raised and attributed to the decline of intensive extension training that has existed in the past and a shift away from public services to the private sector. In discussing the culture underpinning an overall strategy for the national agricultural workforce, the report states that it must be "imbued with inclusiveness, one that appropriately values and rewards employee inputs, and one that provides conditions of employment commensurate with 21st century expectations and is competitive with other sectors. Employees matter – otherwise they will not be there, as recent sector experience has shown." (p. 44).

Social Implications of Digital Agriculture

A consistent theme throughout much of the future-of-work literature is consideration of the impact of digital transformation on the workforce. Within the peer-reviewed academic literature, the rise of digital agriculture, or agriculture 4.0 and the drive towards sustainable intensification of production has to date paid limited attention to the social implications of these developments. Understanding the 'people' implications of the potential future changes stemming from technology adoption, that are being presented in terms of benefits for productivity and the environment, is needed to adequately plan for attraction, development and retention of the agricultural workforce in an increasingly digital workplace.

According to Vasconez, Kantor and Cheein (2019), there remains a long path to a fully autonomous agriculture industry due to the significant investments required and the complexity of processes and systems involved. It can be extremely difficult to model each environment, crop and task and therefore the continued interaction between people and robots needs to factor in continuous learning and adaptation of machines to new conditions. Some of the most successful autonomous solutions, such as GPS autosteer, have been implemented for repetitive tasks and aim to reduce workload, optimise process times and costs. For other more complex tasks, designing technology to include humans within the system (augmentation), means that decision making corrections and problem-solving as opposed to physical labour will be the skills required from the workforce. In the cotton industry, modelling has identified that the top three areas of productivity improvements will come from digital technologies associated with irrigation scheduling and application, crop nutrition, and optimising quality (Trindall, Rudd, Gillingham, Skinner, Wiseman, Bange, McDonald, Foley & Welsh, 2020).

While benefits for people working on farms linked to increasing automation are often framed as bringing improved work conditions (including visibility, safety, simplicity) and related to better decision making (including access to greater information for feedback from the system and reducing cognitive load), there is also the potential for agri-tech to lead to changes that produce less desirable outcomes (Vasconez, Kantor, & Cheein, 2019; Rose, Wheeler, Winter, Lobley, & Chivers, 2021). Distance created from adopting technology that removes physical work and people's presence could reduce farmers' engagement with and understanding of their land and environment. Devaluing of experiential knowledge, and complexity of data issues including ownership and trust could lead to reduced job satisfaction and exacerbate stressors or mental health problems (Lobley et al., 2018, as cited in Rose et al., 2021). While agri-tech will create jobs, those jobs that are lost or changed through increasing automation may belong to workers who are not sufficiently skilled, prepared, or in possession of the abilities required to transition and adapt to these new roles in agriculture (Rotz et al., 2019). Failure of farms to keep up with the digital revolution and to transition to collect, manage, and present data in a way that attains

transparency and traceability of the commodities they produce may mean they find themselves locked out of future markets (Miles, 2019). Adding to this concern is that smaller to medium enterprises have been identified as being at greater risk of lagging due to the economies of scale that are sometimes needed to make the business case for adoption of new technology (Vasconez, Kanotr, Aut Cheein, 2019). It is therefore important to understand more about cotton farm enterprises digital agriculture opportunities, risks, and workforce adaptability to inform the strategic development of the workforce to purposefully build a desirable future for people in the industry.

A review of the social science literature on digital agriculture by Kelrkx, Jakku, and Labarthe (2019) identified a number of thematic cluster areas including emerging topics and questions to shape future required research. Of particular interest to the current study are the series of questions identified in the farmer identity, farmer skills, and farm work thematic cluster: "How is farm work affected by digitalisation in terms of farmer skills, in terms of quality and joy? What deskilling and reskilling processes are triggered? What is the balance between reliance on digital knowledge, and on experiential knowledge and intuition? What is the extent of trust of farmers in information generated by machines?" (p. 9) These questions and the prior points about understanding both positive and negative consequences of digital agriculture to shape socially as well as economically and environmentally beneficial sustainable change for cotton farm businesses inform the focus of the current research.

Understanding Technology Acceptance

When exploring factors influencing the adoption and acceptance of technology in agriculture, the current study is informed by The Technology Acceptance Model – Version 3 (TAM3; Venkatesh & Bala, 2008). The original TAM is based on two specific cognitive beliefs, perceived usefulness and perceived ease of use. These predict the acceptance of digital technology as indicated by intentions to use and actual use. As this theory was further developed, predictors of perceived usefulness and perceived ease of use were included. Antecedents to perceived usefulness identified by the model are social influence processes, (including social norms, and image), cognitive appraisals (including job relevance, output quality, and result demonstrability), and perceived ease of use (see Table 1.1 for definitions). Antecedents to perceived ease of use appraisals include computer self-efficacy, perceptions of external control, computer anxiety, computer playfulness, perceived enjoyment and objective useability (see Table 1.2 for definitions).

Table 1.1. Definitions of factors that predict perceived usefulness

Factor	Definition
Perceived Ease of Use	The degree to which a person believes that using an IT will be free of effort (Davis et al., 1989)
Subjective Norm	The degree to which an individual perceives that most people who are important to him think he should or should not use the system (Fishbein & Ajzen, 1975; Venkatesh & Davis, 2000)
Image	The degree to which an individual perceives that use of an innovation will enhance his or her status in his or her social system (Moore & Benbasat, 1991).
Job Relevance	The degree to which an individual believes that the target system is applicable to his or her job (Venkatesh & Davis, 2000).
Output Quality	The degree to which an individual believes that the system performs his or her job tasks well (Venkatesh & Davis, 2000).
Result Demonstrability	The degree to which an individual believes that the results of using a system are tangible, observable, and communicable (Moore & Benbasat, 1991)

Reproduced from Venkatesh & Bala (2008).

Table 1.2. Definitions of factors that predict perceived ease of use

Factor	Definition
Computer Self-Efficacy	The degree to which an individual believes that he or she has the ability to perform a specific task/job using the computer (Compeau & Higgins, 1995a, 1995b).
Perception of External Control	The degree to which an individual believes that organizational and technical resources exist to support the use of the system (Venkatesh et al., 2003).
Computer Anxiety	The degree of "an individual's apprehension, or even fear, when she/he is faced with the possibility of using computers" (Venkatesh, 2000, p. 349).
Computer Playfulness	"...the degree of cognitive spontaneity in microcomputer interactions" (Webster & Martocchio, 1992, p. 204).
Perceived Enjoyment	The extent to which "the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use" (Venkatesh, 2000, p. 351)
Objective Usability	A "comparison of systems based on the actual level (rather than perceptions) of effort required to completing specific tasks" (Venkatesh, 2000, pp. 350–351).

Reproduced from Venkatesh and Bala (2008)

Two moderating variables, prior experience of the technology, and voluntariness (which is explained as the degree to which use of the technology is non-mandatory) further influence the proposed relationships identified within the TAM3 model.

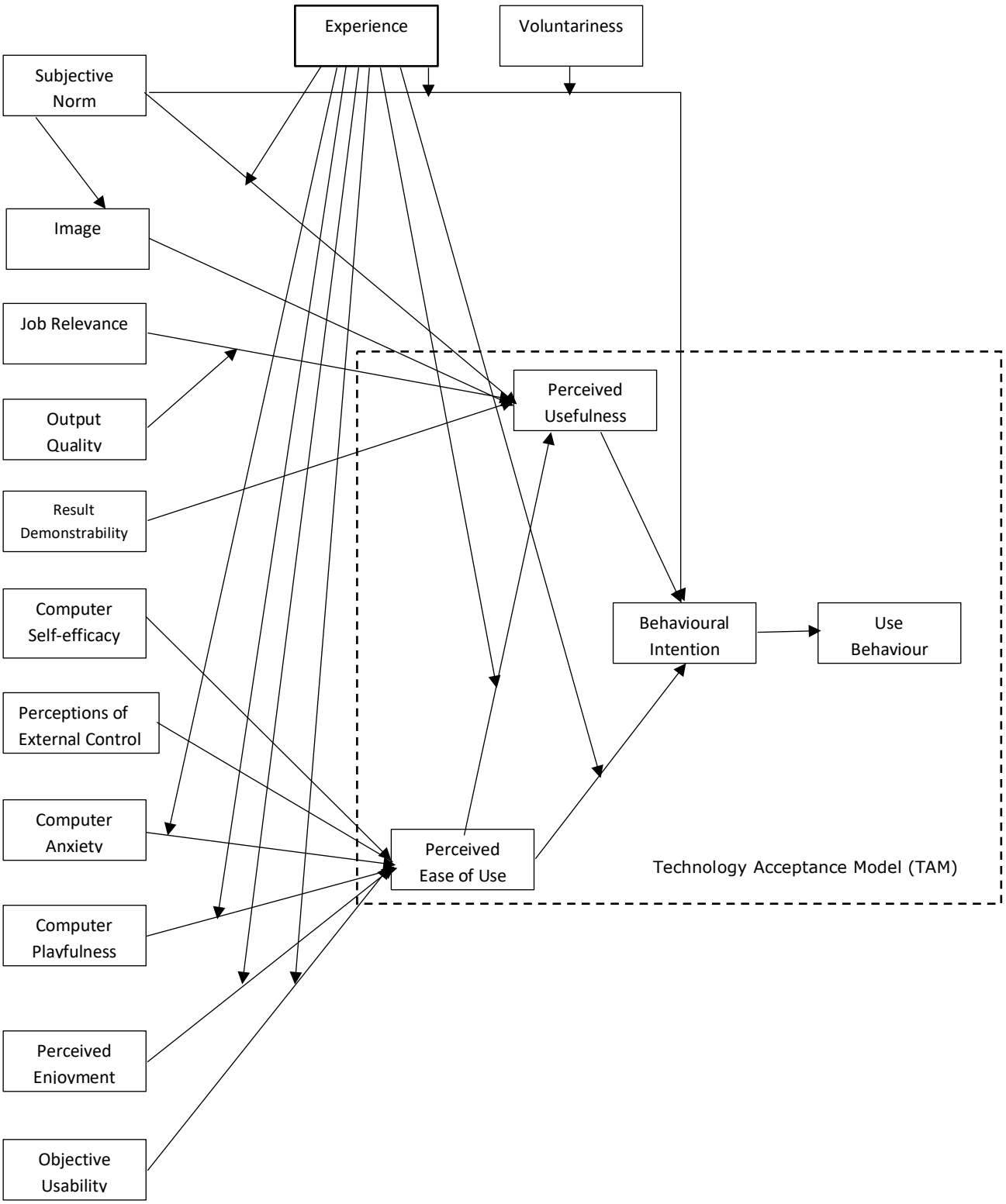

Figure 1.1. The Technology Acceptance Model 3 (TAM-3). Reproduced with permission (Venkatesh & Bala, 2008)

Meta-analyses of earlier iterations of the TAM have found ease of use to be significantly related to perceived usefulness, and perceived usefulness to be significantly related to acceptance (Ma & Liu, 2004). Another meta-analysis of 88 studies found similar results and further tested moderator effects of use types, finding that the model works similarly well for students and professionals (King & He, 2006). A narrative literature review of 145 papers published on the TAM supports earlier findings. This paper also argues that it is in understanding the relationship between the different antecedents to perceived ease of use and perceived usefulness that will inform any intervention that seeks to improve acceptance of technology, identifying "which levers to pull to affect these beliefs and, through them, the use of technology" (p. 268, Yousafzai, Foxall, & Pallister, 2007). Widespread continued use of TAM as evidenced in a recent meta-analysis of various TAM studies further validates the explanatory power of this model and points to the particular importance of positive attitudes and social influence in the model (Feng, Su, Lin, He, Lu, & Zhange, 2021).

Research Aims

In seeking to better understand the future of work from an organisation and industry perspective, several research aims were developed. These included:

Aim 1: Understand factors influencing technology acceptance and adoption.

Aim 2: Understand grower and workforce experiences of transition that occur with the introduction of technology.

Aim 3: Understand entrepreneurial behaviours and the mindsets, skills and structures that encourage entrepreneurship or intrapreneurship within cotton businesses.

Aim 4: Understand the function of the knowledge network and consultants work in extension and influencing on-farm change.

Aim 5: Understand influences on attraction, retention, and development of workforce and how this occurs in adaptable businesses.

Aim 6: Identify other factors that may shape the future of work and workforce requirements for the Australian cotton industry.

Research Design

The overall research design consists of two distinct parts: (a) an analysis of the 2018 Grower Practices Survey, and (b) a multi-case study of cotton farming and allied industry professionals to explore different factors associated with the future of work.

Analysis of the 2018 Grower Practices Survey

The Grower Practices Survey is an annual survey of cotton growers that collects information about the past season crop production and other related issues. The questions are updated each year, keeping the survey as succinct as possible, while ensuring a wide range of data capture over time. In 2018, the opportunity

was provided to researchers within the 'people' research stream to capture data relating to the on-farm workforce demographics/structures, attitudes of employers towards workforce and technology adoption relating to automation. Expanding on the descriptive analysis presented within the 2018 Grower Practices Survey Report, an analysis of this data directly related to the first aim of the research project.

Multi-Case Study

The remainder of the aims are addressed within six case studies. People working in adaptable cotton industry businesses clustered around a specific context were treated as single cases. The adapting cotton industry is more broadly considered the target collection to be studied. A pragmatic approach was taken, and these cases are not uniform in the roles that participants hold or the number or types of perspectives that have been included. Each has been written to focus on different factors of interest that were generated either from the literature or the data and aligned with the aims of the research. In this way, these instrumental case studies are facilitating further understanding of the future workforce requirements for the Australian cotton industry, the skills and abilities needed to adapt and the structures and systems that attract, develop and retain desirable workers (Stake, 2005).

Semi-structured interviews were initially conducted with growers. Depending on the size of the business and research questions that were further generated from the interviews, employees of the enterprise were also invited to participate. The interview schedules used are listed in Appendix A. When selecting participants, every effort was made to include a range of different businesses, larger and smaller enterprises with various levels of staffing, irrigation and dryland cropping, and farms in different production valleys. The addition of a case study on an agronomy consulting business recognises the rise in higher skilled allied professions and offered a different perspective on practice change in the industry. Existing theory and academic literature have been used in the analysis process to guide interpretation. Member checks were conducted with all growers to ensure the accuracy of the researchers' interpretation of the transcript data and to ensure the ethical standards of research were upheld for participants.

A brief overview of the six cases presented in this report is provided in Table 1.3.

Table 1.3 Overview of Case Studies

Case Study	Chapter	Context	Participants	Topics	Research Aims
1	Chapter 3	Kilmarnock Farm	1 x Employer 4 x Employees	Technology acceptance and adoption Workforce management and development Leadership	1, 2, 5
2	Chapter 4	Sundown Pastoral	2 x Employers 3 x Employees	Technology acceptance and adoption Entrepreneurship and Intrapreneurship Workforce management and development Leadership Traceability and Transparency Attraction and education of the next generation	1, 2, 3, 5, 6
3	Chapter 5	Summit Ag Agronomists	2 x Employers	Technology acceptance and adoption Entrepreneurship Knowledge networks Role of consultants	1, 2, 3, 4, 6
4	Chapter 6	Northern Australia	1 x Employer 1 x Employee 1 x Agronomist 1 x Researcher	Workforce attraction and development Grower attraction and development Technology acceptance and adoption Social Licence	1, 2, 4, 5, 6
5	Chapter 7	Dalara Pastoral	1 x Employer	Workforce management and development Leadership Knowledge networks Succession Planning Attraction and education of the next generation	4, 5, 6
6	Chapter 8	Columboola Cotton	1 x Employer	Leadership Workforce management and development Community liveability	2, 5, 6

Conclusion

Understanding the future of work and ensuring the cotton industry is prepared to strategically manage the transitions its workforce will need to undergo is of utmost importance. Many factors are influencing change in the types of workers, skillsets, and the workforce structures that will be required for the industry to continue to thrive. While the literature identifies digital agriculture, entrepreneurship, and continuous learning and development as central to the future of work, the factors have been studied only at a conceptual level. Empirical research is needed to understand the reality and practicality of how these factors shape the changing nature of work for people at the farm level and to identify where intervention could improve the adaptability of businesses. The current research addressed this gap in knowledge and in doing so sought to expand the evidence base that describes the mindsets, structures, actions, behaviours, and skills that are important for the future of work in the cotton industry.

Chapter Two: Technology acceptance, adoption, and workforce in cotton farms

Introduction

The agricultural industry is undergoing a digital revolution with technology adoption changing the workforce required on farms. In Chapter Two, an analysis of the 2018 Grower Practices Survey data extends on the CRDC industry report. Qualitative data are thematically analysed, and descriptive and inferential statistical analyses of quantitative data are used to understand more about technology acceptance, technology adoption, attitudes about workforce, and workforce structures. A simple version of the core constructs identified by the technology acceptance model were tested.

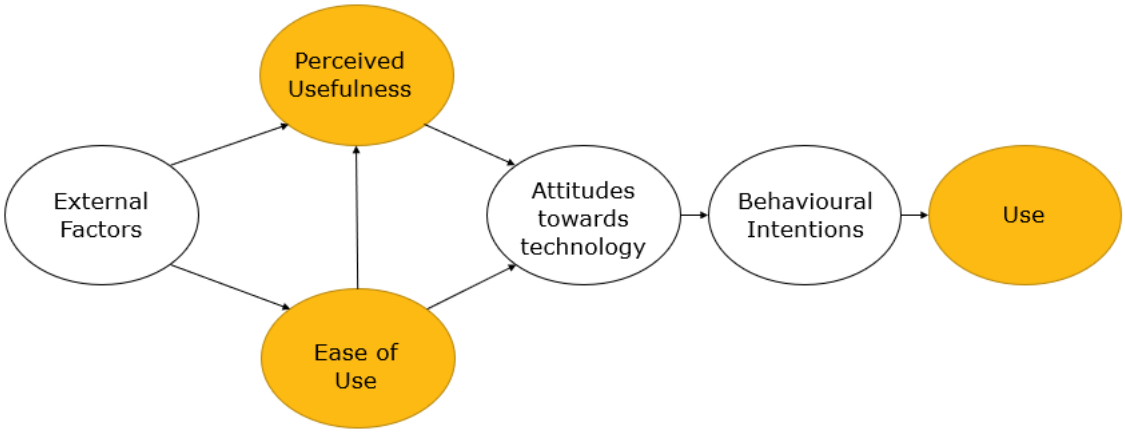

Figure 2.1. Technology acceptance model as adapted from Davis, Bagozzi, & Warshaw (1989). Factors highlighted in yellow were studied in the 2018 Grower Practices Survey.

Methods

Participants

Initial respondents to the survey consisted of 246 growers. Although by the time growers reached the beginning of the questions on automation (module seven) a little over a quarter had dropped out (N = 68). Many of these people had withdrawn by the third module of questions (N = 65) so it is unlikely that an aversion to answering questions about automation or workforce was the cause. A comparison of the participants who dropped out with those retained showed no statistically significant difference in age ($t(210) = -0.99$, $p = 0.32$), size of farm ($t(232) = -.36$, $p = 0.72$), or total area of cotton planted ($t(210) = .39$, $p = 0.69$).

Two participants (Response ID: 120, 166) data were removed due to a large amount of missing data. For one of these participants, this potentially was due to their status as an employee on a corporate farm and hence they felt they could

not answer questions about 'their farm'. For the remaining 176 growers, who were participants for the modules on automation and workforce, ages ranged from 20 years to over 65 years old, with an average age in the range of category 5 (45-49 years old) (mean = 5.24; median = 5.00)[1]. The area of these growers' farms that was dedicated to broad acre cropping ranged from 90 hectares to 62,400 hectares (mean = 3,879.81 hectares, median = 1,495.00 hectares). This was positively skewed, with 95% of growers reporting their farms had less than 11,000 hectares developed for broad acre crop production. Growers were located in the following production valleys: the Murrumbidgee (N = 32), lower Namoi (including Walgett; N = 24), the Darling Downs (N = 22), the Upper Namoi (N = 20), the Gwydir (N = 18), the Macquarie (N = 15), Border Rivers (N = 14), Central Queensland (N = 11), St George/Dirranbandi (N = 10), the Lachlan (N= 6), Bourke (N = 1), Murray (N = 1) and The Ord (N = 1).

Procedure

The data analysed in the current study was collected as part of the larger Grower Practices Survey in June-July 2018. Growers were initially contacted by phone and encouraged to complete the survey over the phone or to complete the survey online. Growers for whom email addresses were available were also contacted through these means and again, invited to complete the survey online. Cotton production for this season was substantial due to a favourable season for irrigated summer crops, although a lack of rainfall throughout the season negatively impacted dryland production.

Measures

Demographic Questions

Demographic questions including age, area of farm developed for broad acre cropping, and location of farm. These were used to investigate any nuances between groups of cotton growers.

Adoption of Technology

Participants were asked "Are you currently using any automation (including automation for irrigation) on your farm? Examples of automation include unpiloted air and ground vehicles, intelligent decision systems, AI, etc." They were able to select from three categories (1) *Yes, I currently use automation on my farm*, (2) *No, but I'm considering options for the future*, and (3) *No, and I have no plans to implement the use of automation on my farm.*

Participants were able to interpret automation however they wished and could report what technologies they were using and what they were considering. On review some growers in the "yes" category indicated that the automation they were thinking of was GPS autosteer tractors. This automated technology is

[1] Age was measured as an ordinal variable with categories listed as (1) under 20, (2) 20-34, (3) 35-39, (4) 40-44, (5) 45-49, (6) 50-54, (7) 55-59, (8) 60-64, (9) 65+

already widely adopted across industry, and it is likely that many people in either of the "no" categories currently also use this type of automation. Therefore, the decision was made to change the research question to "Are you currently using any automation other than GPS tractor autosteer on your farm?". The data was reviewed and recategorised such that those who only referred to GPS autosteer tractors as their automated technology used were assigned to category (2) *No, but I am considering options for the future depending* or (3) *No, and I have no plans to implement the use of automated technologies*, depending on their responses to questions about what other technologies they were considering for the future.

Perceived Usefulness Scale and Perceived Ease of Use Scale

The Perceived Usefulness Scale and Perceived Ease of Use Scale were developed in conjunction with other researchers on CRDC-funded workforce projects and reviewed by a panel of experts from CRDC before inclusion in the Grower Practices Survey. To meet the current project objectives, these are specifically focused on workforce related benefits that impact the organisation of labour on farm and the changing skills profiles required to successfully implement digital technologies on farm. For future CRDC projects investigating adoption of digital agriculture technology and practices, there is potential for these scales to be expanded. It is recommended that inclusion of items developed to capture economic and environmental drivers of perceived usefulness and more specific items included to capture the ease of use for automation and other digital technologies would provide a more complete measure.

The Perceived Usefulness Scale was designed to measure growers' perceptions that automated technology provided them with benefits such as (a) reduced labour costs, (b) more efficient workforce performance, and (c) reduced the time and effort required managing staff or performing tasks, allowing them to find better work-life balance, or work on other parts of the business. The Perceived Usefulness Scale consisted of 5-items that were rated on a Likert-Type Scale from (1) *strongly disagree* to (5) *strongly agree*.

The Perceived Ease of Use Scale was designed to measure growers' perceptions that (a) they could easily adopt digital technology in terms of the skills required to operate and maintain, (b) they could easily integrate digital technology into their existing farming systems, and (c) that they could attract new workforce with sufficient skills, or their existing workforce were adaptive to develop the skills required to adopt new digital technologies. Perceived Ease of Use consisted of 4-items that were rated on a Likert-Type Scale from (1) *strongly disagree* to (5) *strongly agree*.

Open-ended Questions Regarding Technology Use

Qualitative data was collected with regards to the types of automation currently being used, the types of automation being considered for use, and reasons for not currently adopting automated technologies (other than GPS auto steer tractors) on farm.

Workforce Structure

Several questions were asked about workforce structure and the following are considered within the current study: (a) reduction in workers after implementation of automated technology, (b) total number of workers employed on farm, (c) the fraction of permanent employees on farm, (d) the fraction of entry-level employees on farm.

Attitudes and Practices Related to Workforce

Three measures were developed to capture attitudes that growers held towards their workforce and the level of agreement that they were performing MyBMP Level 3 HR actions aimed at managing their workers' development and performance, as well as reflecting on feedback they gain from their workers that stay or leave the business. These scales were (a) The People Management scale, (b) The Satisfaction with Workforce Scale, and (c) The Value of Workers Scale.

Research Questions

After screening and assumption testing of the data, the following questions have guided the analysis of the data generated from the Grower Practices Survey data.

1. What are the automated technologies that are currently used by growers?
2. What technologies are being considered?
3. Why are people not currently using automated technology on farm?
4. Are there relationships between attitudes to technology adoption, HR practices, and attitudes to workforce, farm size, number of employees, proportion of full-time employees, proportion of entry level employees?
5. What variables predict the following group membership: (a) Yes, using automation (b) No, but considering, (c), No and not considering?

Results

Growers have been sorted into three groups based on their adoption and acceptance of automated solutions. These were (a) Yes, I am currently using automation (other than GPS auto steer) on my farm (N = 52), (b) No, but I am considering automated solutions (N = 74), and (c) No, and I have no plans to implement automation (N = 50).

Growers currently using automation other than GPS auto steer machinery on their farm were using automation for several tasks including: (a) seeding, (b) irrigation, (c) fertiliser application, (d) spray application, (e) crop monitoring and collection of field data by satellite, (f) soil moisture management, (g) module tracking, and (h) reducing reliance on the workforce. Qualitative responses to questions about technology being considered were analysed at the group level and are presented in Table 2.1. These responses ranged from referring to specific technologies to being more general in terms of the purpose for which these automated technologies were to be used, or motivational factors for seeking these out.

Table 2.1 Comparison of Growers currently using automated solutions and those who are considering automated solutions for type of technology and motivation to adopt.

Grower Group	Yes, I am currently using automation (other than GPS auto steer tractors) on my farm (N = 52)	No, but I am considering automated solutions (N = 74)
Automated solutions being considered	Irrigation (centre pivots, padman stops to open channel gates remotely, automated pumps, pump monitoring) Robotic sprayer Automation to shut down machinery. Doing more with tractors/automated tractors and sprayers Mapping and inventory (data collection) Crop Monitoring Energy (solar generator) *Not considering more automated solutions beyond what is currently used (N = 17)*	Irrigation (automated bankless system, water gate automation/channels remote stop and start, water level monitoring, pump monitoring) Sprays and chemical application (unmanned spray vehicles, Variable rate fertiliser, Weather stations to inform spray decisions) Weed management (Robots for killing weeds/automated vehicle with microwave for hard to kill weeds/weed seeking technology) Seeding and planting (precision) Crop monitoring and management (canopy temp sensors, drones, Field mapping, NDVI scans) Driverless tractors Scouting (pests) Wi-Fi for all areas of the farm
Motivations for considering other automated solutions on farm	Accuracy and Ease of Management (everyone knows what is happening) Labour saving/ run a smaller, better skilled workforce/Reduce workload. For demonstration purposes For efficiencies	Save time, money, reduce workload, Save on labour.

Growers who were not currently using automated technology beyond GPS autosteer were asked to provide reasons. The range of answers provided are presented in Table 2.2. Descriptive statistics for (a) demographic variables (Table 2.3), (b) technology acceptance variables at the item level (individual questions) and the higher order constructs (perceived usefulness and ease of use) (Table 2.4), and (c) attitudes and practices related to workforce variables at the item level (individual questions) and the higher order constructs (people management, value of workforce, and satisfaction with workforce) (Table 2.5) are presented below.

Table 2.2 Comparison on barriers to adoption between Growers considering automated technology and those with no plans to adopt.

Grower Group	No, but I am considering automated solutions (N = 74)	No, and I have no plans to implement automation (N = 50)
Reasons for not adopting automated technology	**Structural/Environmental Reasons – 14 responses – 19%** Bad telecommunications/Doesn't suit our design of farm /We have not had the cotton crops to warrant the outlay at this point. **Cost of Equipment and Implementation – 26 responses 35%** Cost/Cost of implementation/ Weighing up pros and cons to cost involved. **Investing elsewhere in preparation for automation – 5 responses 7%** Resources are being spent on development/Priority is first to change layout to a bankless system, second priority to automate. **Technology is not ready (yet) – 14 responses 19%** The technology is not good enough to be used at the moment/Nothing suitable off the shelf Waiting for the technology to be working (proven) **Trust (Low) – 1 response 1%** low trust in them **New to cotton – 3 responses 4%** New to the cotton growing industry / using what they already have **Skills challenges – 2 responses 3%** My staff keep changing so we haven't bothered to train them. I am not sure how to implement the automation on my farm **Reliable support from providers is needed – 4 responses 5%** Reliability and long-term support from automation providers are not guaranteed Physically getting someone to quote and implement in a timely manner is a challenge **Time – 4 responses** Haven't got around to it/ We were waiting for the right time **No need (yet) – 1 response 1%** We haven't seen a need as yet **No response – 14 non-responses 19%**	**Structural/Environmental Reasons – 8 responses 16%** No irrigation facilities/ We use contractors/Our current system is not set up to make use of automation/No water/It simply does not suit my situation as a sole operator. **Cost of Equipment and Implementation – 15 responses 30%** Cost is a big factor/Cost is too high/Cost v value to set up and maintain. **Other investment priorities – 1 response 2%** Other areas of improvement offer better returns. **Technology is not ready (yet) – 9 responses 18%** Not good enough yet, technology is not there yet. /Don't quite believe it is fully developed Not convinced that they would do the job intended at the moment for the cost/Lack of reliability **Trust – 2 responses 4%** Just a bit hesitant lack of trust/ Still need a human to go and look at the area/more trust in a human to look at field and make a decision **It won't save me money on labour – 1 response 2%** Not going to be a labour-saving method for me **Happy with the status quo – 4 responses 8%** I am a luddite/ You can't automate syphons/ Not necessary, we are used to the way we have always done it **No Need – 2 responses 4%** I can't see an economic need at this time/ Nothing available that I need to use **No response – 10 non-responses 20%**

Table 2.3 Descriptive statistics for demographics by Automated Technology Adoption Group

	All Growers (N = 176)		**Yes, I currently use (N = 52)**		**No, but considering (N = 74)**		**No, no plans (N = 50)**	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Age category	5.24	2.15	5.13	2.10	4.91	2.02	5.84	2.32
	Median	**Range**	**Median**	**Range**	**Median**	**Range**	**Median**	**Range**
Broad acre cropping area	1495	90 - 62400	2250	90 - 57000	1500	100 to 62400	965	141 to 8600
Total Employees	5	1 to 110	6	1 to 110	5	1 to 68	4	1 to 43
Proportion of Full Time Employees	0.8	0 to 1.00	0.8	0 to 1.00	0.8	0 to 1.00	0.9	.21 to 1.00
Proportion of Entry Level Employees	0.17	0 to 0.93	0.20	0 to .93	0.17	0 to .76	0.00	0 to .71

Note. M = Mean, SD = standard deviation. Age was measured as an ordinal variable with categories listed as (1) under 20, (2) 20-34, (3) 35-39, (4) 40-44, (5) 45-49, (6) 50-54, (7) 55-59, (8) 60-64, (9) 65+; Area of broad acre cropping is measured in hectares; Proportion of Full Time Employees is the number of full-time employees divided by the total workforce; Proportion of Entry Level Employees is the number of entry level employees divided by the total workforce.

Table 2.4 Descriptive statistics for technology adoption items and scales

	All Growers (N = 176)		Yes, I currently use (N = 52)		No, but considering (N = 74)		No, no plans (N = 50)	
Items	M	SD	M	SD	M	SD	M	SD
Automation will save me money on labour costs	3.83	0.98	4.06	0.87	4.07	0.75	3.24	1.14
Automation will improve my work/life balance and allow time away from the farm	3.53	1.01	3.65	0.95	3.69	0.95	3.18	1.10
Automation will allow me more time to work on other important aspects of the farm business	3.82	0.88	3.96	0.77	3.97	0.81	3.44	0.97
Automation will help reduce the effort required to manage workers on my farm	3.56	1.00	3.67	0.92	3.77	0.88	3.12	1.10
Automated technology will do a better job than manual labour approaches on my farm	3.03	0.99	3.40	0.89	3.18	0.93	2.42	0.91
I have the skills, or I can learn the skills, to use new automated technology on farm	4.06	0.75	4.29	0.54	4.22	0.56	3.60	0.97
I can easily hire others with the skills to operate/maintain automated technology on my farm	3.22	1.09	3.25	1.17	3.31	1.08	3.06	1.00
Automated technology is easy to integrate into my current farm management systems	3.09	1.11	3.35	1.05	3.18	1.09	2.70	1.13
My workers are capable of adapting in their work roles	3.54	0.95	3.71	0.89	3.61	0.98	3.26	0.92
Scales								
Perceived Usefulness	3.55	0.77	3.75	0.66	3.74	0.67	3.08	0.83
Perceived Ease of Use	3.48	0.72	3.65	0.63	3.58	0.70	3.16	0.76

Note. M = Mean, SD = standard deviation

Table 2.5 Descriptive statistics for attitudes toward workforce items and scales

	All Growers (N = 176)		Yes, I currently use (N = 52)		No, but considering (N = 74)		No, no plans (N = 50)	
Items	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
I have encouraged workers to give me their suggestions and feedback about farming matters	4.24	0.80	4.29	0.83	4.27	0.65	4.15	0.97
I have had open discussions about skills development opportunities with workers on farm	4.04	0.86	4.12	0.91	4.00	0.85	4.00	0.85
I have regularly provided feedback to my staff in relation to the performance of their jobs	3.97	0.89	4.04	0.85	3.99	0.87	3.88	0.98
Feedback from exit interviews with workers leaving the business has helped me reflect on how I manage workers	3.32	1.05	3.49	1.03	3.32	1.01	3.15	1.11
I have been able to trust workers on my farm to perform their job with little supervision	4.03	0.89	4.08	0.87	4.03	0.83	3.98	1.00
I do not really care who I have employed on farm as long as the job gets done (R)	4.04	1.04	4.06	1.22	4.01	0.95	4.08	0.99
Getting the right employees on farm is critical to my business success	4.44	0.77	4.57	0.78	4.41	0.65	4.33	0.91
It is important to me that workers feel like a valued part of my farm business	4.46	0.70	4.59	0.73	4.44	0.65	4.38	0.73

Note. (R) indicates reverse scoring completed such that a higher score is a more positive appraisal. M = Mean, SD = standard deviation

Table 2.5 (continued). Descriptive statistics for attitudes toward workforce items and scales

	All Growers (N = 176)		Yes, I currently use (N = 52)		No, but considering (N = 74)		No, no plans (N = 50)	
Items	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
I am satisfied with the staff we have on farm	4.14	0.85	4.27	0.80	4.04	0.92	4.15	0.77
I find it difficult to get the staff I need for the farm to be at its most productive (R)	2.69	1.21	2.73	1.31	2.61	1.19	2.79	1.15
A lack of adequately skilled staff is negatively impacting my farm business (R)	3.27	1.19	3.18	1.14	3.28	1.19	3.35	1.26
A lack of engaged staff is negatively impacting my farm business (R)	3.41	1.10	3.45	1.05	3.31	1.10	3.50	1.17
Scales								
People Management	3.89	0.68	3.99	0.74	3.89	0.61	3.79	0.72
Value of Workforce	4.24	0.63	4.32	0.67	4.22	0.56	4.19	0.69
Satisfaction with Workforce	3.38	0.87	3.41	0.80	3.31	0.89	3.45	0.91

Note. (R) indicates reverse scoring completed such that a higher score is a more positive appraisal. M = Mean, SD = standard deviation

Following the calculation of descriptive statistics, the data were screened for multivariate outliers and four cases were removed. These consisted of more than one variable with scores that were considered an extreme value, and these can distort relationships when looking for general trends within the data. Spearman's Rho correlations were calculated for the following factors: (a) perceived usefulness, (b) ease of use, (c) people management, (d) value of workers, (e) satisfaction with workforce, (f) total number of employees, (g) proportion of full-time employees, and (h) proportion of entry level employees; to examine potential relationships amongst the variables (Table 2.6). The selection of a non-parametric test was due to levels of skewness and kurtosis of the people management factor, the value of workers scale, and each of the employee structure variables that meant the data violated assumptions of normality. Correlation coefficients between r = .1 and r = .29 are considered small associations, coefficients between .30 and .49 are considered medium associations, and co-efficients above 0.5 are large associations.

Table 2.6 Correlations between technology adoptions scales, attitudes to workforce scales and workforce structure

Factors	PU	EoU	PM	VoW	SwW	Total E	P.FT
Perceived Usefulness (PU)							
Ease of Use (EoU)	**.44****						
People Management (PM)	.10	**.15 (p = .053)**					
Value of Workers (VoW)	.09	**.14 (p = .080)**	**.47****				
Satisfaction with Workforce (SwW)	-.02	.09	.10	**.25****			
Total Employees (Total E)	**.24****	.10	**.19***	**.19***	**-.15***		
Proportion Full Time Employees (P.FT)	-.09	.06	-.01	.04	**.25****	**-.33****	
Proportion Entry Level Employees (P. EL)	.10	-.12	.11	.01	**-.27****	**.44****	**-.44****

*Note * p < .05, ** p < .01*

Finally, a multi-nomial logistic regression was conducted to identify what factors are significant predictors of group membership. The use of different reference groups was explored. The results presented in Table 2.7 utilise those who were not currently using automated technology and had no plans to adopt as the reference group. Perceived usefulness was a significant factor in distinguishing between the reference group and both those who were considering new automation solutions and those who were currently using automation on farm. Two age groups for growers (20-34 years old and 45 – 49 years old) were significant factors to distinguish between the reference group and those who were considering new automation solutions. However, the wide confidence intervals means that these age group findings should be interpreted with caution.

Table 2.7 Multinomial Logistic Regression Results

	B(SE)	95% CI for Odds Ratio		
		Lower	Odds Ratio	Upper
Yes, I currently use vs. No, and I have no plans				
Intercept	-6.84 (1.64)**			
Area of broadacre cropping	.00 (.00)	1.00	1.00	1.00
Age 20-34 years old	1.35 (1.01)	.53	3.86	28.09
Age 25–39 years old	.59 (.91)	.30	1.81	10.85
Age 40–44 years old	.66 (1.09)	.23	1.93	16.32
Age 45-49 years old	1.40 (1.05)	.52	4.07	32.07
Age 50–54 years old	.68 (.92)	.32	1.98	12.11
Age 55-59 years old	.11 (.93)	.18	1.11	6.90
Age 60 – 64 years old	.60 (.99)	.26	1.82	12.73
Ease of Use	.09 (.10)	.91	1.10	1.33
Perceived Usefulness	**.26 (.08)****	**1.11**	**1.30**	**1.51**
No, but I am considering vs. No, and I have no plans				
Intercept	-7.71 (1.74)**			
Area of broadacre cropping	.00 (.00)	1.00	1.00	1.00
Age 20-34 years old	**3.03 (1.28)***	**1.69**	**20.60**	**250.83**
Age 25–39 years old	2.20 (1.20)	.86	9.00	94.87
Age 40–44 years old	2.36 (1.32)	.79	10.55	140.89
Age 45-49 years old	**3.18 (1.30)***	**1.88**	**24.05**	**308.52**
Age 50–54 years old	2.27 (1.21)	.90	9.63	103.33
Age 55-59 years old	1.46 (1.22)	.39	4.30	47.31
Age 60 – 64 years old	2.40 (1.23)	.98	10.97	123.10
Ease of Use	.07 (.09)	.90	1.07	1.28
Perceived Usefulness	**.27 (.07)****	**1.14**	**1.31**	**1.50**

Note. Bold denotes statistically significance results. *$p < .05$, ** $p < .01$.

Discussion and Conclusion

The 2018 Grower Practices Survey has provided data to consider with regards to acceptance and adoption of automated technology on cotton farms. Growers were sorted into three categories: (a) those who have already adopted automated technologies, (b) those who have not but are considering solutions, and (c) those who have not and have no plans to adopt automated technologies. Overall findings from this chapter that are discussed further include:

- Reasons such as drought, finances, infrastructure, and legacy farming systems may prevent even those interested in automation from adoption.
- Growers considering technology can see the usefulness of automated solutions and are confronting ease-of-use barriers to implementation.
- Growers considering technology have a growth mindset and are less satisfied with the status quo compared to those not considering automation.
- All groups indicated they highly valued their workforce.
- Good people management practices are associated with perceptions that workers are adaptable and can be trusted to work autonomously.
- Ease of use is related to perceived usefulness of technology and perceived usefulness is the factor that differentiates those not considering automation with those that are considering automation or have already adopted.
- The age/stage of life that growers are at in their career may influence their consideration of automation solutions.

When comparing the reasons for why people are not currently implementing automation on their farms yet for those 'considering' with those 'not considering' automated solutions, the two groups offer similar responses in many areas including structural reasons such as business/farm setup and capital cost outlays. Where they differ is that fewer people 'considering' technology reported an absence of need (yet) compared to those with no plans to implement automation. Growers who are considering automated solutions are more specific about ease-of-use barriers such as working out how to integrate technology, skills required, time needed to investigate, and needing to see reliable support. This shows greater acceptance of and critical engagement with automated technologies while highlighting barriers to adoption. Those 'considering' are also more likely to report that they are investing elsewhere indicating a growth and development approach to their farm business even if that does not include current adoption of automated technologies. In contrast, for those who are not considering any automated solutions, some (8%) disclosed an attachment to their current infrastructure and practices and hesitance to look beyond the status quo on their farm.

All groups are similar in the high level of value they place on their workforce, their use of best practice people management approaches and their levels of satisfaction with their workforce. The greater the proportion of workers on farm that were permanent, the more satisfied growers reported being with their workforce. The more entry level employees the less satisfied growers were with their workforce and there was also a small negative correlation such that the larger the number of employees on farm the less satisfied growers were with their workforce. Larger teams had more entry level employees and more casual workers compared to smaller teams.

There are some small correlations of interest at the item level between some of the attitudes to workforce scales and perceptions of ease of use (although neither reached significance). A closer look at the item level correlations revealed that the items "I have encouraged workers to give me their suggestions and feedback about farming matters" and "I have regularly provided feedback to my staff in relation to the performance of their jobs" are correlated with "My workers are capable of adapting in their work roles to use automated technology on my farm" ($r = 0.25$, $p < 0.01$; $r = 0.20$, $p < 0.05$). These two people-management practices are also related to reports of greater trust in employees to complete tasks with less oversight ($r = 0.69$, $p < 0.01$; $r = 0.54$, $p < 0.01$), and "I am satisfied with the staff we have on farm" ($r = 0.43$, $p < 0.01$; $r = 0.39$, $p < 0.01$). Seeking feedback from staff is also particularly important for preventing workers becoming disengaged ($r = 0.26$, p , 0.01). This suggests that good people management practices that promote a two-way relationship and exchange of ideas are important for retention of valued workers and helping workers to adapt in changing workplaces.

Like the findings of other TAM studies, the current research found a moderate correlation between ease of use and perceived usefulness. Further investigation shows the correlation between ease of use and perceived usefulness is stronger for those who are already using automated technology on farm ($r = 0.53$, $p < 0.01$) compared to those who are not using automated technology on farm ($r = 0.32$, $p < 0.01$ for those considering, and $.r = 0.39$, $p < 0.01$ for those not considering). This indicates that ease of use appraisals are particularly important for assessing the usefulness of technology for those further along the adoption curve (accounting for approximately 28% of the variance) but for those yet to adopt, their skill levels, ability to integrate technology, or the adaptability of their workforce accounts for less variance (15%) with regards to their assessment of the usefulness of automated technologies.

Perceived usefulness of automated technology is an important factor in determining the likelihood that someone is already using automation solutions or considering using automation solutions compared to those who have no plans to implement automation solutions. With one unit increase in perceived usefulness, the odds that growers are considering or have adopted automated technology rose by approximately 30%. Understanding the value proposition of automated

technology is important to start growers on their way to exploring and engaging in consideration and eventual adoption of digital agriculture.

While the analysis is underpowered in terms of sample size, it is interesting to note that belonging to the age group 20-34 years or 44-49 years also could predict a greater likelihood to be considering technology compared with those who had no plans. It may be that these two age groups represent growers who are at the start of their career and keen to explore new digital tools to use within their business, or growers who have children in teen years/early adulthood who are considering the future of their business for the next generation. The treatment of age by groups, as opposed to a continuous variable allowed for this non-linear relationship to be identified. The smaller sample contributes to the very large confidence intervals for these findings, and as such these results should be cautiously considered. Nonetheless, it does indicate further research on life stage could be important in considering the growers' willingness to dedicate time and effort to engage in activities that leads to acceptance and adoption of digital technologies into their farming businesses.

Chapter Three: Kilmarnock Farm: Transformational Leadership Facilitating Change and Adaptation of the Workforce

Introduction

Andrew and Heike Watson own and operate two farms spanning 4000 hectares in the Namoi Valley with a mix of irrigation (1650 ha), and dryland (1200 ha) cropping, with the balance being grazing and support land. While cotton is a major focus of farm activities, with approximately 80% of farm income attributed to this crop (Smith & Watson, 2018), they also grow durum wheat, canola, chickpeas, and sorghum, with plans to add corn to their rotation. At the time of the interview, (Spring 2019), they had harvested 660 ha of irrigated cotton, and 330 ha of dryland cotton in the 18/19 season and were facing an even drier season with no river water allocation for 2019/20.

On the back of the Murray Darling Basin buyback efficiency scheme, the Watsons have been able to invest in exploring a number of different irrigation systems including automated methods, lateral move irrigation, and a large pipe through the bank system. Other new technologies already adopted include GPS in machinery and variable rate machinery (with further interest in exploring variable rate technologies). Since the interview, the Watsons have been exploring the use of drone application of beneficial insects to control for silver leaf whitefly with promising results.

The Watsons are considered early adopter growers and have developed a reputation as an employer of choice, rarely needing to advertise and generally approached by people seeking work. Their staff members range in age from 32 years to 65 years old, with the newest serving employee starting 18 months ago and the longest serving employee with them for the last 25 years. All have experienced adoption of new technology or changes to farm management during the period of their employment. The interviews with Andrew and most of his permanent staff (staffing at the time consisted of 4 full time employees, 1 part time employee) sought to understand more about technology adoption and the changing workforce requirements on farm. Over the course of the case study, it became clear that successful change management and technology acceptance on this farm was underpinned by Andrew Watson's utilisation of behaviours that can be categorised as *transformational leadership,* establishing a *psychologically safe environment* and developing his team by operating as a *connector manager.* These concepts are further explored within the following questions:

- How does the grower strategically plan and adapt to change in farming?
- How are workers changing in their jobs on farm?
- What influences technology adoption for the grower?
- What influences workers acceptance of new technology on farm?

How does the grower strategically plan and adapt to change in farming?

The adaption process within the farming business is influenced by the Watson's approach to personal development, the inclusion of workforce priorities in their strategic approach to their business, and the people management practices that they use to achieve their strategic vision.

Personal Development

Andrew Watson's skills and abilities that are applied to his farming business have been developed through several activities and experiences including, but not limited to:

- Tertiary education and training – Agricultural Economics (honours degree), Applied Finance and Investment and Technical Analysis (graduate diplomas), Australian Institute of Company Directors course.
- Industry supported development programs – Nuffield scholar.
- Industry representative positions – Cotton Australia Chairman of the Board, NFF Policy Council, Farmer reference panels with the GRDC, Land & Water Australia, Cotton Catchment Communities CRC, NSW Irrigators Council and Namoi Water Board;
- On-farm work experiences – multi-generational farming family, second generation on the current properties, focus on sustainable farming and environment regeneration activities within the family business.
- Other past work experiences – work integrated management training with previous employers including National Australia Bank, NSW Agriculture and Namoi Cotton Co-op, owning and operating a contracting business, entrepreneurial endeavours developing machinery, participating in research and development trials with CRDC.

When discussing adopting innovation on farm, it was acknowledged that there is a culture of openness to new ideas in the farming communities within which Andrew is a member, noting "*The cotton industry always seems to have braved the forefront of a lot of change*". Learning is recognized as an ongoing process. Finding information and identifying and exploring future opportunities for improvement is done in several ways that include (a) accessing networks of early adopter growers, (b) on-farm experimentation, (c) direct approaches from machinery dealers, researchers, ag-tech entrepreneurs, and (d) discussions with other people associated with the farm business including Heike (business partner/wife) and an agronomist. Having a good knowledge of the wide range of solutions and strategies that can be used to improve sustainability is important. Maintaining an awareness of what is happening in the wider cotton industry, national agriculture industry and global farming enterprises helps Andrew to be aware of various solutions to reduce inputs, maximise yields, and tackle pest and disease problems.

Workforce Strategy

Strategic workforce planning and management is part of the overall business

strategy for the farming operation. This is made clear in a statement of purpose that is informed by the economic, environmental, and social values of the farm business: Kilmarnock is a profitable, ecologically sustainable and safe farming business where people want to work.

As Andrew explains:

> *Firstly, it's got to be profitable, otherwise you're not going to be here. Second, we've got a pretty strong belief in ecological sustainability. We need to work on that. We actually enjoy doing what we do and we'd actually like the people who are here to enjoy what they do and feel safe doing so. So that's pretty important.*
>
> *The part about enjoying stuff is people actually want to come to work. So they get up in the morning and they want to come to work because we make it fun or enjoyable or it has some purpose for them too, and they feel empowered by the business that their decisions will be listened to. So that's the overall purpose.*

The Watsons have then written a clear list of objectives that guide their work. Included in these are two points that explicitly relate to their role as employers:

> *There is a safe work culture in which people want to work.*
>
> *The business helps to educate and train young people in agriculture.*

Other objectives relate to actions to ensure economic sustainability for the business, environmental sustainability particularly reduction in chemical inputs, collegial and supportive relationships with fellow growers, social sustainability for the farm, industry and community, and an inclusive culture for family involvement in the business. While these objectives may not directly be about workforce development, they set the business culture and performance standards that shape the work context that people experience in their employment.

<u>People Management</u>

> *Engineering risk out of the workplace is the best option, but to have an underlying culture of safety means risks are better identified in the beginning, and is the birthplace of engineering outcomes that reduce or eliminate risk*.

Andrew's approach to human resources and people management was to establish the workplace culture that would encourage the behaviours that effectively and efficiently achieve the outcomes of the business. Not having a skilled, capable, and engaged workforce that are adapting to change could be a production limiting factor. With this risk identified, effective actions have been taken to mitigate this risk.

I see that as a threat, not being able to get those staff or those people. But having said that, we've recognized as a threat for quite a while and so I currently do have the staff to do what I need. If that makes sense? So we've been actively working to train the guys we've got and to get them thinking about remembering things for the next year, or getting guys on board who have got the ability. So I see it as an ongoing threat, but I don't see it as an imminent one.

From Andrew's experience, get people management right and, (a) employees are retained which brings efficiencies in being able to trust their decision-making capabilities and ability to work autonomously, (b) worker engagement is improved such that they want to come to work and are dedicated in their jobs, and (c) a reputation as an employer of choice is established, making it easier to attract good candidates when needing to hire.

Workforce Development Strategies: transformational leadership, psychological safety, acting as a connector manager.

The overarching approach and day-to-day activities of workforce development on Kilmarnock can be understood through the theoretical lens of transformational leadership. Transformational Leadership is defined as "a set of behaviors of leaders who motivate followers to perform and identify with organizational goals and interests and who have the capacity to motivate employees beyond expected levels of work performance" (Sarros, Cooper, and Santora, 2008, p. 146). According to Bass (1985), these behaviours occur across four dimensions: (a) inspirational motivation, (b) idealised influence, (c) intellectual stimulation, and (c) individualised consideration. These four leadership behaviours are also important for managing change on the farm in terms of influencing workers acceptance of change and willingness to adapt.

Inspirational Motivation

Inspirational motivation can be characterised as leaders communicating a shared vision and inspiring followers to dedicate themselves in working towards high performance standards that are clearly explained and expected of them. This happens on Kilmarnock in four ways, (a) an annual performance review that discusses the achievement of past goals and setting of future goals, (b) regular informal feedback about job performance, (c) developing a shared strategy for implementing changes, and (d) in the day-to-day discussion of farm activities and communicating why these are important.

So we have an annual review, which is essentially one meeting a year which (staff members) are told is going to happen and they can bring anything forward. I bring forward my overall view of how they were for the year. However, I have developed the philosophy with me and the staff where if they're doing something wrong, they hear about it. But the flip side is if they do it right they hear about that too. So, you know, you know, I always

tell them you're doing a good job here. That's quite a regular conversation to the point of almost weekly. Informally, I guess I'm there every day talking to them and we will make a real practice of talking about things. – Andrew Watson

When investigating the potential for technology adoption and new farm management strategies, Andrew will get more senior staff involved by bringing them into investigating and evaluating the new technology, making them part of the discussion of what the future on farm will be and through this will facilitate their commitment to the collective vision for the farming enterprise.

I involve them in the discussion. So when I did a tour down south to look at this new irrigation system I took one of my managers down, we went and had a look and we went to the factory that makes them and discussed it and came back and then came up with a plan to develop that. I try and involve the guys in that. If we're going to go and look at a new tractor or a new type of technology I generally take the two managers along. Or we'll get a demonstration here and then afterwards we'll sit down and say, what do you think? I'll try and involve them in those steps and I find that that really brings them along. – Andrew Watson

In turn, this approach to managing and motivating people flows down the chain, with this leadership capability particularly being noted as an important skill for his new farm manager.

He's so good at talking about the end game. This is what we're trying to do with his job. And I guess he's bringing the others along a bit on that sort of focus because that's kind of the way I think. "So what are we trying to achieve here?" - That's how I've always tried to get people to think and sometimes (the staff) get a bit tied up in the minutiae of greasing the bearings as opposed to "what are we trying to do here?" You need a balance and I guess (the farm manager) brings that view of the, what are we trying to achieve thing and trying to get the others just thinking along those lines too. - Andrew Watson

<u>Idealised Influence</u>

Idealised influence refers to leaders who are good at 'talking the talk' to also be 'walking the walk', acting as a role model and ensuring actions are consistent with the shared vision. People management practices were aligned with the farm business' purpose statement and objectives. Two examples included (a) setting behavioural standards and encouraging staff to adopt a mindset that makes the farm a safe workplace where people want to work, and (b) giving staff learning experiences to test their ability to make crop decisions.

Underpinning this is a culture that epitomises psychological safety. A psychologically safe environment is one where people "feel comfortable sharing concerns and mistakes without fear of embarrassment or retribution" (Edmonson, 2019). Psychological safety is associated with transformational

leadership and a range of other work design characteristics that may be fostered through the different facets of transformational leadership. While this concept is introduced with regards to idealised influence, it is also through intellectual stimulation and individualised consideration that worker autonomy, interdependence, and role clarity can be developed, and through which a psychologically safe environment takes shape (Frazier, Fainshmidt, Klinger, Pezeshkan, & Vracheva, 2017).

At Kilmarnock safety is not simply a checklist but a culture. As Andrew explains:

> *We've tried to encourage the culture of "That's dangerous. Let's not do it until we work out a way that it's safe", or "I don't feel comfortable doing this, right, stop. Let's go find some answers."*

Creating an environment where staff are unafraid to speak up about concerns or find help is further established on Kilmarnock by encouraging the team to support each other. The added benefit of this is they assist each other's learning and this process and culture was described by all team members. This helps facilitate people adapting to use new technology.

> *Everyone on farm has got different skills. We each call each other just to get ideas on things, that's where we can get over the technology gap in some ways. Just trying to ring someone else and they might have one hint to get to that stage and then you might be able to figure it out from there yourself.* -Employee 1

Beyond support from colleagues, the team culture was central to people wanting to come to work.

> *Interviewer: What's important for you to get your particular job done well on farm?*
>
> *Employee 2: Uh, probably trying to get it done to the best of your ability it is 50%, and then I like having a bit of fun at work. I don't come to work, do my job and go home. You know, I come have a bit of a joke with the boys. Make the day interesting. Have a chat. That's the way I like to do my job and do it as best you can.*

One example of building this culture and supporting learning, was through an annual competition on farm, where staff (and Andrew) were each given their own area of the crop to irrigate, and a yield competition was held. Through this fun experience, and with their employer participating alongside them, staff developed their knowledge of the impacts that decisions could have on the crop and expanded their decision-making skills.

> *There's a fair bit of humour involved in that. But it does get them thinking about their patch. You know, one of them will come to me and say, well, there's a few weeds in here is that going to impact on the yield? And I say,*

yep, what are we going to do? (Or they ask) well, if I start irrigating on Sunday, that's probably better than if I start Monday morning? – Andrew Watson

Andrew spoke of his desire to lead by example and the value of showing workers he was willing to also do what was asked of them. However, he also acknowledged the time pressures this could add to his own work, which requires many other tasks other than managing staff.

They're also getting repetitive boring work… we still need to go pick up siphons in 40 degrees…And that's why I do it myself. I guess one of the things I've always said is if I'm not prepared to do it myself I can't expect others, which then puts a lot of pressure on you as an operator to be the guy doing all the work in the office as well as having to change siphons and physically help pick some items up.

Intellectual Stimulation

The dimension of intellectual stimulation involves leaders actively seeking team members' suggestions and feedback as well as encouraging them to ask questions and challenge assumptions. Andrew does this by asking further questions to encourage staff to think through challenges. This is done in a supported manner, encouraging workers to give their solution for a shared problem (i.e. what are we going to do?).

Someone comes to me and tells me this is broke and oh this is not working. I say, well what are we going to do? You know, I want them to think about the answers. So they actually come and say, this is broken and this is how we're going to fix it. Is that alright? So, that's what we encourage them to do. – Andrew Watson

This is the "safe spot" where problems are shared but individuals' opinions are valued and staff are encouraged to engage in critical thinking about their work.

I'm not just presented with problems, I'm presented with answers. So that gives you a lot of efficiencies. - Andrew Watson

To do this more efficiently, Andrew employs whereever possible a connector manager style - he will give guidance in areas where he has expertise but he has also spent time ensuring other team members have expertise that can be called on to support each other on farm or direct access to other experts off-farm.

I also encourage a lot of conversation between them, understanding the different skill sets between them. So that when there's a welding problem, go and get the guy who's a good welder. Because it'll be done right. If there's a problem with a spreader and one guy's an expert in it, but you are driving it, just ring him up and ask him how to fix it. – Andrew Watson

As the different workers explain:

When it comes to workshop skill sets everyone rings me. I mean for repairs

and those sort of things ---only because I've been doing it for a fair while. They'll ring Andy and Andy says just ring (staff member), he'll tell you all about it – Employee 1.

Of late Andy has put a new farm manager on … I wouldn't say he's really tech savvy but he can work things out, quite well with technologies… he's only young still but he's not silly, he's pretty well switched on. So I've given him a few calls. But other than that Andy just sends a phone number to us and says, "Yeah, ring this fella." It could be someone from a technology brand that's actually sold the machine to Andy, but that's how we sort of get around things. – Employee 1

I talk to a few techs and a few different people. There's a John Deere mechanic we know in town and he comes out and I talk to him about a fair bit of mechanical stuff. If I've got a problem with a tractor, I usually give him a call and he'll help you out. Andrew, he sources a lot of people that work with him on his farm and when I came on he introduced me to everyone and I now speak to them. – Employee 2

You either ring up the tech fella that we buy the gear off and just ask them. Or Andrew's got his head around it a little bit. There's still things he doesn't know on there. But you just talk to other employees. Some of us have got more of an idea than others. – Employee 3

<u>Individualised Consideration</u>

Individualised consideration means that leaders seek to understand their staff as individuals and work to support their needs. For example, supporting individuals to understand their strengths and develop their expertise is part of ensuring their needs for autonomy and competence are met. Ensuring each team member's wellbeing is prioritised and they are able to meet their commitments outside of work is also part of individualised consideration.

Spending the time to thoroughly understand the different skill sets and interests each worker at Kilmarnock brings to the job is an important part of managing the team. Identifying any skills gaps or individual differences in how people approach their work (slow and attention to detail, or faster and bigger picture) also helps when considering what abilities or orientations to look for when hiring new team members.

So the older guys are perfectionists. Everything they do has to be right, so they work slower. They think about it, they'll stop and bring the machine up in the shade and fix something. They're absolute perfectionists. (The newer farm manager) is not quite as much of that, but is really committed to the final outcome of the job. So less absolute focused on the minutiae but understanding the outcome of the job. (Our other operator) is a real mix, much less of a perfectionist. He can get onto a job and sort of forgets about the outcome a bit but if you can get him focused, his skillsets amazing. - Andrew Watson

Working with individuals to develop their expertise and to take ownership of certain tasks or operation of specific machinery is part of the way the workforce is structured to get a good performing team.

> *We've tried to employ people with different skills, but we've also developed skillsets over time. One of the things is I give each staff member responsibility for a certain operation. One is in charge of the header, one's in charge of the picker, one's in charge of fertilizing and they've all got one or two or three specific skillsets. When they know how to do that, they are responsible for maintaining it and for telling me what we need to do for it for the following year… And then we'll train them further on that. So if it's a spray rig and the spray rig day is on I'll send the two guys who drive the spray rig to attend*. - Andrew Watson

The confidence that their employer has in the employee's ability to develop skills makes them feel supported and motivated to put the effort in to continue to learn at work.

> *Andrew put his trust in me, thought that I could learn and it's been good so far. I quite enjoy it. It's very different. You're just always learning new things*. – Employee 2

As the skillsets and workers' abilities change on farm, Andrew is managing people into roles that get the most out of their experience and ensure their contributions are still valued. Making people feel valued is not only about their work contributions but caring for their wellbeing and enabling them to meet commitments outside of work. The benefit of this approach to people management is that it creates a psychological contract such that staff will go that extra mile when they are needed at critical peak production times. As Andrew states:

> *We encourage anytime they've got family issues, or they want to go and watch the kids run a marathon, or they've got, counselling issues, or doctor's appointments for their kids, they just let me know and go. They help work around the problem of them not being there but we work it into the program. School open days, all that stuff. And that means when I need someone on a weekend, there's no hesitation.*

It is also through individualised consideration that Andrew encourages team members to be understanding and supportive of each other.

> *What's been really important is we have a harmonious team. And you always will have someone a bit out of whack. It just depends on what's causing that, whether they're actually a person who's never going to get on with anyone or whether they are going through a circumstance in their life, And I guess I do remind them all that pretty much, you've been here long enough, I've seen you go through this phase too*. – Andrew Watson

The workers interviewed for this case study noted the support given and reported feeling highly engaged at work, committed to their jobs and happy in their roles. Different workers at different stages of their career had different motivation at work. With new technology, some only wanted to learn the minimum they needed to know to perform their jobs and consequently were only interested in on-the-job learning. Others were keen to develop in their roles and engage in external training, looking to bring new ideas back and integrate new skills into their job performance.

Transformational Leadership and Change on Farm

Each aspect of transformational leadership works to enable staff to adapt to change on farm. This is illustrated in this example given by Andrew:

Interviewer: And so your current staff, have they adjusted to the changes that you've made on the farm? For example, how do you manage that change? When you brought in the lateral move irrigators, did they adjust to that okay? Are they using the available technology or are they even taking an interest in any of this sort of stuff?

Andrew: *Yes, they all have apps on their phones. The two spray rig operators use our weather stations as a guide to where they should be spraying. That gives them the range of whether they're allowed to do that, whether they can be spraying or not* (idealised influence of performance standards).

An example (of adapting) being the guy who's a trained mechanic was very interested in laterals and was happy to be the guy who learnt to run them and operate them in my absence (individual consideration).

I think they certainly have evolved. I involve them in the discussion (inspirational motivation).

And they'll say "well, what about doing it like this?" And you go, "Oh, I didn't think of that?" So we get a bit more horse power out of people, by giving them some incentive, some ideas and some excitement. You know, send them off to Agquip with a list of things they've got to try and find the answer to. (intellectual curiosity)

In the interviews with workers, it was clear that Andrew's leadership in encouraging workers engagement with technology, by getting them to investigate and offer feedback, was particularly useful to help them persist in learning new technology.

Technology's not that important to me or the way I go about my job. But it's important to Andy and that's probably the thing that counts. I'm pretty hands

on with things, but I'll have to learn… For instance, the new irrigation system that Andrew is running. It's hard to get your head around when you first do it but after a while it's not too bad… I'm just focused on getting my job done and that's all I seem to worry about. But Andrew is always looking at new technology and then he'll ask us to get on the internet and have a look. And give him a bit of feedback about what we think. – Employee 1

Well I haven't actually used it yet but Andy used it last year so he'll give me the run down. We'll go from there, we'll probably learn on the go. – Employee 2

It comes to Andrew and then he relays it onto us…he's is pretty smart Andrew. He does a lot of that (technology investigation) himself. He'll ask our opinion. – Employee 3

How are workers changing in their jobs on farm?

I don't think my job has really changed at all but it's the tools that I can use to do the job that have probably changed a bit - Andrew Watson-

Immediate factors that are influencing changing priorities for the business workforce strategy can be sorted into three categories: (a) production issues on farm, (b) skills required for automated technology, and (c) location specific factors. Other trends that have the potential to change the workforce required for the farm include the rise of on-farm data management, although the value proposition for developing this part of the business has not yet been clearly identified. There is expected to be a gradual increase in the demand for workers who have the skills to thrive in a digital agriculture environment and for growers to develop their expertise around integrating digital tools and data management into their existing farm systems.

<u>Production Issues for the Farm</u>

As well as being guided by the business purpose, the current direction of activities that have direct and indirect workforce implications are in considering solutions for three current production issues including: (a) soil and disease constraints, (b) rainfall management, and (c) labour force management in a variable climate.

Verticillium wilt was identified as a threat to future cotton crops, and there were concerns that the lateral move irrigation system had contributed to this on farm. As the system offered water savings, and reduced labour requirements compared to siphons, it was still seen as useful for the future but would not be expanded beyond what was already in use. It was possible that a corn rotation crop would assist with this managing the prevalence of this disease in the cotton crop. If this crop is added to the farm then this changes the value proposition for some precision planting equipment. As Andrew explains:

(the corn industry) can show return on investment on better planting technology. Inherent in the way corn grows is that they've measured it down to the point (plant spacing variation down to 0.1 cms and consequent yield loss) they know that in the corn industry. Cotton may be not as exact because we've got a plant that will compensate for some variations in planting… in the corn industry it is worth upgrading your planter, but it's not as apparent in the cotton industry….currently the accepted thinking with the local research is that corn as a rotation is very important to managing vert. So now we will look to grow corn when we have water. And we'll need to invest in the yield maximization of corn, which as I said to you there is an ROI on that planter to upgrade.

An increased value proposition to upgrade to the precision planter potentially adds to the amount of digital technology on farm which impacts the skillset required for workers.

The variable climate has implications for access to water and consequent production levels on farm. This has motivated cotton growers to explore and invest in technology that can improve water use efficiency such as the automated irrigation systems that are currently used on Kilmarnock. Adding to the value proposition for investment in automated irrigation, the variable climate and changing production levels also brings workforce challenges as labour requirements reduce and expand. The most recent severe drought experienced across the eastern states of Australia brought with it challenges for growers to hold on to skilled workers. This puts them in a vulnerable position for when rain events occur and production needs to quickly increase. In discussions with Andrew, it was revealed that it is not technology that is driving the reduction of the workforce, rather climate is driving the reduction of the workforce due to reduced production. He is turning to technology solutions to quickly upscale operations when his farm can return to full production. Automation prevents the potential restrictions that could occur as a result of challenges associated with finding the capable and motivated workforce required for increased operations when the drought breaks.

We have the machinery capability to plant four times what we're planting now, and to harvest that. What we don't have is the ability to irrigate four times the crop. Essentially, the way we've now structured this, we would only likely grow twice what we're growing now. We probably still don't have the labour force to grow a crop twice the size of what we are now without a bit more investment…. So the opportunity for us now is to look at investing in different irrigation systems that coming out of the drought won't require the labour force to do it. Because that will be our single biggest constraint. – Andrew Watson

Technology is reducing the need to settle for hiring unskilled labour and the consequent pressure of training and assimilating new workers into the team during peak production years. The potential economic savings from having a

smaller, stable workforce as a result of greater automated systems on farm is not so apparent with Andrew noting "it is *actually costing us more labour wise because we've got to go for a higher skilled type of person"*.

Skills Required for Automated Technology Adoption

The skillset required for workers on-farm was changing as new equipment was adopted, but this was gradual, and every attempt was made to upskill existing workers and encourage them to persist in learning on the job. A valued employee can have the right attitude and other skills outside of digital agriculture proficiency that make them an asset for the farm, but as the business strategically moves towards potentially a smaller workforce, the workforce's adaptability and skill proficiency becomes more important.

> *My underlying theory is if they want to be here and they really want to try, you could probably train most people. And we've certainly kept guys on as we had a broad enough range of jobs that could be done here that there was something that (those less skilled or less adaptable) could do all the time. (But as the skills required and the number of staff employed on farm changes) it certainly means there's a type of person who we probably used to employ who now we probably can't afford to*. – Andrew Watson

In describing this change in technical skill proficiency Andrew described a current situation:

> *The laterals I've got are monitored by our phones. But there's a bit of a technical thing in setting them up and making them do exactly what I want them to do. I've got one of my guys who can do that, and me. Two of the guys might be able to move them out of the way if they need to do farming operations but they would struggle to set them up doing what we want to do. And so that's an example of just having guys with enough nous to be able to do that.*

The main tension at the moment is that while workers are increasingly needing to have good digital literacy and the skills to work with new technology, they also still need to be willing to do the traditional manual tasks of farm work.

When interviewing the workers, they had noted that the skillsets were changing, increasing the skills required of those in management positions, and potentially decreasing the skillsets required in more straight-forward labour roles (e.g. GPS autosteer means people don't need to develop the manual skills proficiency to drive in straight lines).

> *It's probably for the managers or the whatever, they've got to be up to date with it. Whereas the operator maybe it is decreasing the skills*. – Employee 3

Location Specific Factors and Lifestyle

The presence of mining in this region means other jobs are available with higher wages, although the mining lifestyle was perceived as a drawback particularly for workers in a more established stage of their careers. However, in trying to

attract the next generation who are interested in digital technology and in an exploration stage, the mines could still be a competitive challenge to attract talented young people. As Andrew explained, *there's a definite advantage to having younger agile minds who are fully immersed in digital technology involved in this stuff. But again, they're getting that (the chance to use technology) out at the mines, you know, in a lot of circumstances.*

The key attraction for each of the workers, younger and older, on Kilmarnock was the life that is working in agriculture, including the variety of tasks, working outdoors, the challenge of solving new problems, and the satisfaction of seeing the progress made from their efforts. As employee 3 states:

> *You're doing something different every day and you're outdoors. It's pretty flexible. It's very flexible. Like there's a lot of mining jobs around this area, but it's just doing the same thing every day. Whereas we're doing different things all the time. And it's a bit of a pleasure to see your outcome once you do grow a crop.*

For an older employee who had owned his own farm and was now involved on Kilmarnock part-time, his affinity for the lifestyle was linked to the purposeful life he had and continues to lead:

> *I think it was the independence and the self-reliance on myself, and the challenge. You knew that most things as you went along were of your own determination or volition. If you made a mistake, well you had to wear it, and if it wasn't right you had to change to something else or find a different way to do it. – Employee 4*

Similarly, the young farm manager was intrinsically motivated in his work by the challenges that farming presents:

> *I don't like doing the same routine all the time. I find that it's boring and you lose, motivation to go to work I think. I like the challenge in farming where each day a new problem arises and you've got to try and solve it.*

The replacement of monotonous tasks with automation, such as the expansion of automated irrigation and reduction of siphon use, and the exploration and adoption of new technologies on farm mean that Kilmarnock may be well placed to continue to attract people with the problem-solving skills and an openness to ideas. Recruiting people with these qualities will help the Watsons form a workforce that will adapt to future changes on farm.

<u>On-Farm Data Management</u>

Part of the value proposition of digital technology is the ability for these new tools to capture information about inputs and activities involved with growing cotton. The measurement of these aspects of production creates an abundance of data that may or may not be deemed useful for the business. The complexities involved with data management either requires a grower to: (a) carve out time from their current role/responsibilities and develop skills and processes to do this effectively, (b) develop someone else within the business to do this, or (c)

outsource these tasks similar to the way farming operational tasks can be outsourced to contractors. If the usefulness of the full extent of data available through the technologies becomes apparent, data management skills will become a priority for cotton farm businesses. Andrew was already considering how to add this skillset to the business with a centralised farm data management platform.

What influences technology adoption for the grower?

In relation to the selection of technology on farm, perceived ease of use and perceived usefulness were discussed. Andrew's inherent interest in learning about technology (a motivating factor), and the time it takes him away from other tasks associated with his role on farm (noted as a limitation) were also discussed. Ultimately, the ability to extract sufficient value from the technology in comparison with the costs associated was identified as the key driver for whether a technology was initially considered, trialled and adopted. Assessing the return on investment for new technology was complicated due to the many factors that could influence this appraisal. The same technology may have a different return on investment depending on the different farm management strategies being used.

Grower Perceived Ease of Use

Ease of use appraisals centred on three main areas where effort was expected to be required to adopt the technology. This included (a) workforce capability, (b) integration into the existing work structures, and (c) access to support, solutions and manual alternatives if the technology fails.

<u>Workforce Capability</u>

As discussed previously, Andrew is proactive at involving his employees when considering adopting new technology or machinery that they would be responsible for using. Their skills and confidence to operate the machinery is important because it is through an adequate performance standard when using the technology that the value of the technology is realised. Use of technology may be limited by employee's literacy skills whether this is reading ability (literacy) or navigation of computer screens (digital literacy). This is further exacerbated when new technology has not been designed with the target user's standard of literacy skills in mind or is complicated in its design. People who are valued members of the team and highly skilled in other machinery operations, who have reading difficulties, could struggle to monitor the machinery and fail to respond to alerts/instructions for actions that need to be taken in the operation and servicing of the equipment.

Literacy:

> *One of the difficulties I find is computer screens on tractors now. When you start the tractor up, there's a whole lot of screens come up with (different things that) need to be serviced and if you don't actually read it you miss something. We've had tractors that have missed services because (an*

operator who experiences reading difficulties) ticked away on that without reading it. –Andrew Watson

Digital Literacy:

We do actually talk about that a bit with the staff. If we were to get a system like that, does anyone think they could run it? We trialled the newest version of this planter . The monitoring screen was incredibly complicated. It took me a bit to get my head around it and I showed a couple of the other guys and they didn't in the short time we had. What worries me then is the screen wouldn't be monitored properly. And the advantage of that stuff is if you manage things to perfection. That's essentially what it's all about. – Andrew Watson

With regards to the potential to add a central data management platform to be used for farm management, Andrew discussed the specific skill set that may need to be outsourced from his existing workforce capacity. The transferable skills of his bookkeeper was a potential solution, but he also noted her skillset was in demand and she may not have the capacity to take on more work.

Is it really to the point where I upgrade and get my bookkeeper to do more in terms of this stuff? Because that's one of the most highly qualified people on this farm. She's been a chartered accountant for 20 years and she comes off a farm. She gets it all and has an amazing ability to coordinate things. When I'm talking about this (data management) program, maybe that would be something that she could take over and run for me. So that's thinking outside the box a bit. I don't just need guys in tractors, I need a business run. At the moment the squeaky point at the top of the bottle is me. How much I can do and how much I can get other people to help me do that? – Andrew Watson

<u>Integration into the Existing Work Structures</u>

One of the challenging things about developing the skills required to operate new machinery required for different task performance on farm, is the seasonal nature of these tasks. Tasks may only need to be performed at certain times of the year which can make it difficult to get the sustained practice required to commit new processes to memory or integrate new skills into existing repertoires. The more intuitive and easier it is to operate and integrate the technology into the legacy systems on farm, the more it will be seen as a useful addition to the farm. Additionally, if the technology is adding to the existing workload and is not easy to integrate by adding another task demand, there may be barriers to seeing the usefulness of such an addition to the farm business. The specific example discussed with Andrew was in management of farm data.

For me, someone who looks at that data (and uses those) techniques once a year, I just don't remember, you know. I've had it explained to me. I've

downloaded one year's worth of my header yield data from whatever crops we're harvesting and got it transferred through. I just don't remember how to do it every year because it's something you look at once a year. And there'll be a certain amount of, to my mind, illogical steps. There's a frustration for me in having all these multiple sources of really good information, but not having an easy way to combine them somewhere. – Andrew Watson

Data management was made more complex by using different system providers (e.g. not all machinery was John Deere) and the lack of interoperability between systems acting as a barrier to central data storage. Finding an adequate solution is not easy to do. Andrew was actively considering solutions and could see the potential value of technology other farmers were using to manage their data but the time involved to adopt and use this sort of technology was a major factor in working through the value proposition.

(Some farmers I know) have a great big screen with all their enterprises, with their current gross margin up to date blinking at them every day. This is what's working on their farm. That is some more technology which I'm looking at if it's worth the money. We're just tiptoeing our way through that one a bit. It's got to be all me doing it. And I'm not just sure whether I've got the time to devote to that. – Andrew Watson

Access to Support, Solutions and Manual Alternatives

Beyond being able to use technology, ease of use also hinges on how quickly a solution can be found to keep work on track if something goes wrong with the technology. This means considering how simple the technology is to fix, accessibility to support for repairs, and if there is an easily implemented second option to continue work on tasks. These factors were mainly discussed in comparing recent investments in two different automated irrigation systems: the lateral move irrigators, and the Large Pipe Through Bank systems.

An experience with one of the lateral move irrigators had been a source of frustration, when it broke down at Christmas time (a peak time for irrigation activities on the farm). The complexity of the machinery means it was not possible to diagnose the issue remotely and then fix with instruction over the phone.

I've always had a pretty good relationship with all the mechanics who are part of the service industry and their bosses, I talk to a lot of people. On Christmas Eve, it stopped. There are seven wires that run from one end of the machine to the other. So the signalling capability of them telling me exactly what's causing it is (very) difficult. – Andrew Watson

The risks associated with this machinery was not only through technical faults.

These lateral move irrigators, you have to irrigate pretty much all the time. So you've got about a day and a half or two days grace before it next needs to be irrigated…. If you get it bogged, it's three days just to let it dry out to

get it out. So we've identified those as risks. We're certainly working on ways to deal with bogging, we're learning every year about what can go wrong. – Andrew Watson

With this system there is no alternate approach that could be implemented to ensure irrigation happens as scheduled. This is contrasted with the Large Pipe Through Bank system, where a manual work- around solution if the automation fails is possible.

Very simply, so the worst case, the channel breaks, I've got excavators. Next stage, the automation part of it breaks, no problems, It's a winding handle. You wind the handle to shut a gate. So it just means someone's going to get up at midnight to do the shift rather than programming it to do it automatically in the middle of the night. So realistically there's very little issues relating around that. So that's why, these are the big reasons I'm heading towards this. – Andrew Watson

The simpler and less complicated technology is, the less effort is required to overcome barriers to adoption and effective use, and the easier it is to follow through with adoption. These ease-of-use factors are part of what is considered to determine the usefulness and relative advantage of adopting a new technology on this farm.

Grower Perceived Usefulness

Perceived usefulness is based around the perceived relevance of certain technology to the farm in terms of overcoming barriers to achieving production goals, and whether the technology provides a relative advantage in the effectiveness of prioritised performance areas on the farm. Alignment with the farm business strategy, exposure through social learning networks to better understand the context of what makes ag-tech useful, and the presence of government rebates all influence a grower's assessment of whether investment and adoption of a technology is useful for their farm. Independent specialist support to determine ROI is also valued.

There's also a real industry around proving how that stuff does make returns and I support that. At least they're trying to prove some return on investment. – Andrew Watson

<u>Interest in Ag-tech that is a Strategic Fit for the Farm.</u>

Whether the technology is addressing a prioritised 'pain point' for Andrew's farming operation was an important determinant of whether it was considered useful at that point in time. For example, more investment in data collection and data management was not a priority because it was unclear how this could be useful beyond what is already known regarding the farm.

There's a lack (of capacity to take on this task at the moment). Is it yield constraining? At the moment, I don't think so. Thirty years' experience with

this farm tells me we haven't got the variation across our fields that relates to something I can do something about, other than disease. We can manage it because I know that field is a bit red, so we irrigate it differently to that field, which is a bit black, I know that stuff.

I've got history to teach me that and I've got my father still here to also teach me that. So yes, there's an ability to do more technical stuff. There's probably a lack of time and possibly lack of will. You know, if I had a son who was 21 right now who was very interested, they'd probably be driving that stuff all the way. – Andrew Watson

Andrew's acknowledgement about the next generation driving the investigation and potential adoption of digital agriculture was based on the level of interest associated with digital technologies and computers that is demonstrated by younger generations. Interest does drive attention and an openness to trying to find the usefulness or value of ag-tech. Andrew noticed his own interests had shifted over the years to focusing in on ag-tech that could strategically strengthen the farm business's profitability, rather than what was simply new or innovative.

Back in my late thirties, I was happy to be seen to be an innovator. I'm less interested in that now. I'm probably doing what I'm doing now more based on proper observed need rather than the sexiness of it. Maybe that's just a maturing of things, and a bit of experience too. - Andrew Watson

Other than improvements to profitability, technology that facilitated team performance was also valued. Strategically, Andrew has prioritised the effective managrment of his employees to work as a cohesive team in the pursuit of production goals.. This meant that a work organisation platform, in this instance Trello, was a useful addition to the farm.

Trello is a job management app where I list the jobs. Everyone can access it. If they see the jobs and the photo, and their initials there, they know that's their job. And when they finish, they slide across to another board so that I can go and check it and see it has been done. – Andrew Watson

<u>Social learning and Observing in Context to Assess Benefits of Ag-tech</u>

Social influences were important in terms of being connected to a knowledge network that could share information and examples of how technology was useful in farming business.

Digital ag… I reckon there's a healthy set of scepticism in Australian cotton as to the actual value of all this sexy stuff. Yes it sounds good, but realistically, what's that translate to in terms of gross margin? I've just been to the States and seen a guy there whose quite large farm was set up so that every application of anything, seed, fertilizer, spray, was controlled by his computer. All his staff had to do was drive to the paddock and tell the

> *GPS what field they're in and that would set the seeding rate in the planter….And so, you know, that is probably right at the cutting edge, some would argue the bleeding edge, of where digital technology is on a broad scale. It's the ultimate variable rate everything.* - Andrew Watson

Real world examples with context specific information could help Andrew assess the likelihood of something working within his own business. Different approaches to farm management meant that different technologies that Andrew admires, may not be cost effective or useful at this time as they don't fit with the strategy that is being used to conserve resources or inputs.

> *I love what Karin Stark down at Trangie is (doing) with that stuff (solar powered pumping of water). It's brilliant. I know a couple of the guys that are doing it. I've got a significant interest in it. I'm struggling to make it work with our current (water conservation) systems (which are not based around filling a dam in winter with water to use in summer).* - Andrew Watson

The relative advantage for changing water management strategies was not apparent currently and consequently this solar powered technology was not a priority for adoption.

<u>Government incentives</u>

Economic influences in the form of government incentives does influence the value proposition for adoption of ag-tech. In discussing the farm tour in the USA, Andrew noted the subsidies that offset the costs associated with the precision agriculture systems being used that are not offered in the Australian context.

> *And the US have got a whole lot of funded soil sampling stuff, which can tie into that you know, ultra-fine grided soil sampling. There's a healthy degree of skepticism over here about is it worth doing that?* - Andrew Watson

While it was the millennium drought which acted as the catalyst to begin exploring the use of automated irrigation systems, the government Murray-Darling Buyback Scheme helped to overcome economic barriers that can prevent investment in incorporating automated irrigation technology on farm. The integration of automated irrigation solutions would have been realised without this scheme, but the economic incentives can accelerate investment in technology adoption and help growers when a large capital outlay is involved.

What influences workers acceptance of new technology on farm?

On Kilmarnock, the transformational leadership practices Andrew used were a contributing factor to keeping workers engaged while implementing change on farm, including adoption of new technology. Full time and part time team members employed in a range of roles including general farm management, machinery operation and maintenance, and general farm hand duties were interviewed to gain more insights into their experiences of adapting in their roles,

learning to use new equipment, and their attitudes about digital agriculture. Using the technology acceptance model to frame the investigation, perceptions of ease of use and usefulness were discussed.

> *Interviewer: What makes a technology a good technology?*
>
> *Employee 1: Just the way it goes about its tasks, whether it's user friendly and some creature comforts. Ease of use for the operator and whether it's got the right bits and pieces that we need for the job.*

These appraisals can be further understood through the factors of (a) social influence, (b) cognitive appraisals of job relevance, output quality and results demonstrability, (c) general beliefs about useability of computer systems, (d) direct experiences, (e) age, and (f) digital literacy and self-efficacy.

Worker Perceived Ease of Use

The factors of age, computer self-efficacy, digital literacy and technical operation skills all contributed to appraisals of perceived ease of use. Perceived ease of use is then one of the contributors to appraisals of perceived usefulness; the easier a technology is to use, the less obstacles exist that must be overcome and therefore a clearer path to usefulness exists.

> *Interviewer: Do you ever find that any of the technology makes your job more complicated?*
>
> *Employee 2: Not really. At first you think it does, but the more you get to use it, the more you learn about it, the easier it becomes. You realise that it is more help than a hindrance.*

<u>Age</u>

There is a stereotype that older people are less adaptive and less able to adopt new technology but discussions with participants and past research would suggest that the relationship between age and technology adoption is more nuanced than this (Hauk, Huffmeier, & Krumm, 2018). While some older workers on farm may proclaim their lack of adaptability is due to being older, for them acceptance and adoption of technology may be more related to digital literacy and self-efficacy to learn computer-based systems than actual age. Of course, age may be linked to a lack of exposure to technology that leads to digital literacy, (e.g. no computers when school age and therefore less mandatory interaction), but in this instance age is a confounding variable not the cause. Older worker's ability to engage with new technology could be impacted by the degeneration of some physical and cognitive abilities associated with aging that can impact ease of use; particularly the interaction between poorer eyesight with screen and text size, and self-reported attention and memory decline with learning new tasks. People experience ageing differently and while these characteristics may be present for one older worker, they may not be present for

another older worker. Technology designed to allow for diverse user experience could help to overcome these barriers to adoption.

Comments on eyesight:

> *Employee 4: I find with the phone I'm not as proficient at using that. Being able to use it yeah what all the things you've got to do to go into those things. Um*
>
> *Interviewer: Do you think the computer is better than the phone?*
>
> *Employee 4: I think there you could sit there and look at the screen and have a whole great big screen to look at to read up about things. And whereas the phone you've only got it on a small scale. I think that's a bit easier because of the large size of the screens and that helps. My eyesight's not like it used to be. The desktop computer is much easier to read.*

Comments on attention and memory:

> *I suppose it's an older age thing … I'm not as quick as what I used to be. It sort of comes back to memory things and difficulty with concentration and that. But you know, it might be different for different people. I think that's what I'm finding… it's how good I am at remembering and learning.*

<u>Computer Self-efficacy, Digital Literacy and Technical Operation Skills</u>
Workers' computer self-efficacy, digital literacy, and technical operation skills influenced their appraisals of ease-of-use.

> *I'm not computer literate really. It's hard, I'm going to try and steer away from that as much as I can. (My job) is changing, I still do limited things, and it's a challenge. Andrew gives us a bit of a rundown to start off with and then it's just, have a play yourself and try and work it out from there. It's pretty simple the stuff we've got on farm to be honest, it's just like apps and that. It's not too bad…. on this farm, it just seems to be very simple like the moisture probes. And for our day to day running we've got an app called Trello, where we put jobs that need to be done. Yeah. It seems to be pretty simple.* – Employee 1

> *We like things simple. If it looks too hard we'll just say we don't like it. He (Andrew) will make his decision (to purchase new equipment) on that sort of basis. ---decisions are made mutually…. I think the most challenging things are the aspects when Andy decides to upgrade things to more technical things that he's got his head around but we haven't as yet.* – Employee 1

Computer self-efficacy is an individual's belief that they are capable to organise and execute actions required to achieve desired outcomes from operating computer-based systems. It is an influential factor that motivates people to engage in attempting to use new systems and persist in applying effort,

confident that they will succeed. As illustrated above, the less confident, the more workers will 'try and steer away from that as much as I can', whereas this worker then goes on to explain that the computer and digital based tools they have on farm have been used successfully, giving them confidence they can use 'simple' technologies. Ensuring successful experiences occur to build team members self-efficacy is important for adoption of future technology. The more confident an individual, the more they will engage in experiences that develop their digital literacy and the less likely they are to find new on-farm technology 'looks too hard' and 'just say we don't like it'.

Other factors that influence self-efficacy include verbal persuasion (getting encouragement that they could learn and perform the task), and vicarious experience (seeing fellow team members learn and perform tasks). However, these could be discounted if people did not have past performance experiences to draw on (e.g., "that worker can do that because they're 'technology savvy' and I'm not"). Getting people started with simpler technologies closer to their current abilities and working to develop skills and confidence as they master these technologies is important.

Despite some workers proclaiming lower confidence in using digital technologies, all workers interviewed possessed some digital literacy skills. Within Australian agriculture, digital literacy has been defined as "the ability to acquire and maintain a basic awareness and knowledge of current and emerging technologies impacting on the agriculture industry" (KPMG Consulting & Skills Impact, 2019). Farm managers were more likely to be self-initiating in looking up new trends in farming on the internet. For all workers, Andrew was encouraging them to extend their digital literacy by asking them to investigate digital equipment and machinery for potential adoption. People were more engaged if the technology was used in an area of interest and relevancy to them. For example, a machinery operator clearly described his online search strategy to solve problems with equipment.

> *Interviewer: Have you ever had to search for an answer to a problem online? If so, how do you go about it?*
>
> *Employee 1: We just type in what the machine invoice it's got serial numbers and so forth. And we just type in a serial number and have a look see what it is and then we scroll on different things just to get to that site, just to give you a bit of a rundown of what other people have actually discovered.*

On the farm, different equipment can look very different in terms of the screen layout, requiring different keystrokes, or processes to use it effectively. Developing general digital literacy and computer self-efficacy helps navigate and switch between systems and technology from different providers. An absence of digital literacy and computer self-efficacy can mean it looks difficult.

Most of it looks like it's complicated and hard to get your head around to use because we use all different machinery and every different machine takes a very different technique to use. – Employee 3

Having a sufficient baseline of digital capabilities is required for people to independently work on developing their technology operation skills. The following example is a worker whose digital literacy and computer self-efficacy helps him to switch between operating systems, integrate the advice and instruction he is given to reach a new level of skill in his machinery operation.

Instead of the tractor driving in a straight line, I got it to turn corners, come back in another straight line and go again. I knew how to do it on a different GPS but didn't know how to do it on this one. But I talked to one of the gurus in town and he sort of talked me through it and once he got me through it I was like 'yeah that tractor there is pretty similar'. I'm learning more things about the GPS pretty much every day really. – Employee 2

Facilitating Conditions and Self-directed Learners

Andrew's connector manager style, as previously described, also meant every attempt was made for conditions on the farm to facilitate workers acceptance and adoption of the selected technology. Workers felt more favourably about technology when they were able to access support, where clear instructions, advice and help finding answers, was given. Ultimately, the workers bear responsibility for the effort applied to integrate new skills into their existing skillsets. The faster they could do this, the less mistakes and errors made, which can negatively impact the perceived usefulness of technology.

Interviewer: What was the most challenging aspect about bringing that technology into work?

Employee 1: For us to program correctly. We got shown by the person that installed the devices originally and then Andy showed us once after that and then we had to work it out. It's one of those things if you haven't got it right and something happens in the middle of the night and you're still pumping water but they don't open it's going to go somewhere.

Being motivated self-directed learners is an important part of a workforce adapting to an ever-changing farm work environment. Having the skills to keep up with changes to reduce the challenge associated with learning and reducing the perceived complexity of digital technology will mean it is easier to use and accept/adopt.

Worker Perceived Usefulness

Social Influence

Andrew's leadership practices set up social norms for workers to engage in exploring and learning about new technology when this was not necessarily something they were interested in or intrinsically motivated to do.

Employee 1: I don't really, don't pay attention to it until Andy asks us about it…It is more surface stuff (when learning to use it) but yeah we usually don't dig too far sort of things, Andy does, but us workers don't

The new farm manager (less than 2 years with the team) was in a growth stage of his career. At this stage he was interested in learning more about new developments in farming. This meant that within the team there was a potential 'champion' for adopting new tools or approaches to work. Even for him, learning and accepting new approaches to farming was best delivered in a context where ideas could be discussed with respected peers.

I don't like to learn online. I don't think I take enough in. I like to actually talk to people face to face. And to have others in the room, and you get a few farmers, and everyone talks about different things. About how they've done different things. I think that's how you learn the most.

Research has shown social influence is particularly important for technology acceptance in settings where changes are mandatory (Venkatesh and Bala, 2008). Resistance to ideas from other farming contexts from within the team comes from struggling to see the usefulness of new approaches that have not been adequately proven from their viewpoint.

Andy gets on Twitter and Instagram and everybody's doing those things all over in the States. But the States is completely different to here. The farming practices can be the same but what soil types and environmental conditions and so forth are completely different in this part of the world. – Employee 1

Having a person within the team who will support the grower by championing the change and technology adoption has a positive influence on others that are more established and less flexible in changing their approach to work.

Employee 1: Doesn't come easy for me, because I'm set in my ways but eventually, I do come around to change. Andy will tell you that.

Interviewer: What helps bring you around to change?

Employee 1: Say one of the other workmates comes and says yeah that's a good thing, that sort of change was a good thing then I might sit back and take a longer and better look at it in the long run it probably does send a signal that change is probably better, it takes a while longer

<u>Job Relevancy: Does it support important tasks in my job?</u>

Andrew had been selective in the technology introduced to farm. This coupled with his efforts to develop individuals' expertise to use technology in areas of personal interest and strengths, meant that most workers saw the technology on the farm as helpful and relevant to their job.

Everything that we use helps you do your job more than anything else. – Employee 1

One of the farm managers spoke about the usefulness of technology in relation to tasks that were central to his role (a) making decisions about watering, and (b) managing the distribution of work to other team members. He was clear that the technology was not replacing these tasks, but it did provide value by supporting the performance of important tasks in his job.

On soil moisture probes:

> *One of the biggest things is irrigating and getting the water going at the right time so you're not stressing the crop out too much. The use of moisture probes, that's value adding. They're giving us a better understanding of what we need to do with the watering.*

On Trello:

> *When it's there you can just go through it and give people jobs and go and do jobs yourself and tick them off. It is very handy. You still have got to double check it to make sure it's been done right. So, there's still a bit of hands on. I still think there is value in it.*

For the part-time worker, who is employed to do a variety of jobs as needed on the farm, the Trello system was seen as job relevant. It was an easy way for him to stay informed of where he may be needed on farm.

> *Yeah it's good because he puts things on it and when you're looking to do something, I look up this Trello. And if it's something that falls into my category of experience I'll have a go at doing it. That's a good thing because, you're more or less putting on the phone a list of things that have to be done, should be done or got to be done*

Workers did not see the relevance of all the digital capability of machinery. For example, for one worker, even though the machinery they used collected data, it was only engaged with to the extent that it might be of interest in a brief appraisal of a past performance outcome – what did I achieve? This was surface level engagement and was not linked to future performance. It is an example of digital agriculture being used only in ways that are seen as relevant to the individual.

> *Employee 1: Two piece in the tractor collects data. But we don't go into the depths of going back into it and looking at it. The only one do we get back into is yields. Just look back in the computer and see what yields you did the previous time or something like that but yeah.*
>
> *Interviewer: Does that help you in your job or is that just more sort of curiosity?*
>
> *Employee 1: Yeah. It's more curiosity*

Output Quality: Does it do a job to the standard I currently do, or better?

Technology was seen as particularly useful if it helped overcome skills deficits. For example, the GPS in the tractor was accepted by all staff as useful for the precision it bought to machinery operation

> *Interviewer: And what are the parts of your job where using technology really sort of helps you?*
>
> *Employee 2: Lines in tractors. I can't drive in a straight line to save my life.*

It is interesting to note, that for some workers who were highly skilled in manual machinery operation, further application of GPS to tractor operation was seen as unnecessary and not useful for their farm. While the GPS-assisted turning may be performing a job-relevant task, their response reflects the question, 'is it worth the effort to learn a different way to do something they can already proficiently do manually?'

> *The (operator) can actually just sit there and the tractor will turn itself at the end of the row. You don't have to actually turn the tractor. I can't see it being a use for us. I can see a use for those people further west. Big dryland growers especially, who will probably put backpackers or something on their gear and they're just really there to watch.* – Employee 3

To achieve output quality, workers need skills associated with adapting the technology to their environmental context. For example, with the recent transition of some of the land to utilise the Large Pipe Through the Bank irrigation system, the farm manager was still working through exactly what adjustments needed to be made to improve the output quality of this system.

> *I'm pretty happy with the bit that I've done, but then in between each padman stop we've got to improve that. They haven't gone out far enough into the paddock.*

When the output quality of a technology is observed, the relative advantage is apparent, and it is seen as useful. However, challenging environmental conditions can be barriers to the output quality of this technology

> *When the laterals are running well, I'd say, yeah, it gives you a chance to go and do something else….. (The lateral), they do get bogged and they do get out of alignment. So, yeah it can be time consuming just as much as the old way we used to do it, which was siphons.* – Employee 1

With technology, the output quality needs to be achieved as consistently as possible, otherwise it starts to negatively impact appraisals of the relative advantage and obscure the demonstrability of results.

Results Demonstrability and Relative Advantage

The desired result of adopting technology is to make gains in efficiency and effectiveness of work on farm. Therefore, when discussing the demonstrable

results of technology, workers talked about the relative advantage of the new tools they had to perform their jobs compared to the old methods or tools. These were discussed in relation to (a) personal performance improvements, (b) reduced job demands, (c) greater team cohesion, and (d) achieving farm goals.

Personal Performance Improvements

If the technology can improve performance by ensuring tasks are performed with greater accuracy, in less time, and less effort then it delivers an advantage over prior approaches to task performance.

> *I did take on the GPS guided system. I've always been a bit that way with the technology because I could see the efficiencies and precision that they bring about to what you're doing. And therefore, they can ultimately be cost saving. Yes, these technology things are a worthwhile thing for doing a better job.* – Employee 4

> *The tractor GPS. I think that has improved in the way we do farming as in you can do things nice and straight. That sort of thing has made us a bit better.* – Employee 3

> *Instead of going through a worksheet to work out chemical rates and how much water and what speed you work at, this app will do it for you, makes your job just easier and faster than the old school way.* – Employee 1

Reduced Job Demands

Relative advantage may also be related to better recovery time and less physical stress for workers, or less cognitive load in remembering what needs to be done.

> *Siphons are ok, I don't mind them, but these guys have been doing them for 20 years and hate them. (the automated irrigation) will be less physical, it will probably be more time efficient. You don't have to be out half the night, get home at 5am.* – Employee 2

> *(With Trello) it helps you remember, like sometimes you just drive past something and think, oh I'll put that on Trello and that way you know it will get done.* – Employee 1

Team Cohesion

If the technology helps to facilitate a better organised team and effective communication about priority work, then that is useful to the workforce.

> *Yeah, it can be very useful. It's better than writing it down on whiteboard then everyone just does their own thing. Where on Trello, a job can get put on there, and it can get assigned to one worker to fulfill that job… It's helpful in… especially with the ones that have got to be priority jobs.* – Employee 3

Achieving Farm Goals

The technology is useful if it achieves results that benefit the farm. For example, automated irrigation primarily is useful for water-use efficiency and reducing labour. However, assessing the relative advantage may not always be a straightforward appraisal when comparing two systems. For example, balancing the benefits of water saving versus ease of use, may mean that the relative advantage of one system over the other is unclear.

> *Well, if the lateral has a water saving, it's got to be better. But the padman stop, well, I suppose it's pretty easy like, you just got to set your timers on the gates and they open and shut. I reckon, I don't know*
>
> *… having a lateral there instead of having a siphon over the bank you got lateral with another engine on it which is another mouth to feed with diesel. (It costs) a lot of money in infrastructure, in earthworks, for those laterals and the pivot. So I really don't know whether it's a big saving it's all cracked up to be.* – Employee 3

While assessing the economic advantage of technology is not a responsibility of the staff members, understanding if there is an economic advantage that serves the sustainability goals of the farm, and consequently a perceived usefulness of the technology, may still assist with technology acceptance. For some technology, it may not be until the initial effort to integrate it into the system and the results are observed that acceptance occurs.

> *It was actually good once we got it all up and running. No more siphons in those paddocks, yeah just the ease of it.* – Employee 1

Summary and Conclusion

This case study contributes to a greater understanding of factors influencing the future of work, change processes, technology adoption, and workforce acceptance and engagement with new technology. Main findings of this case study include:

- Workforce development and strategic adoption of technology are integrated into a larger strategic vision for the farm business
- Transformational leadership is influential on workforce acceptance of technology, skill development and effective use of new technology on farm
- Psychological safety has positive implications for the learning environment on farm
- A connector manager approach can reduce the demands on the employer to support workforce in technical aspects of their roles by distributing expertise through the team and extending networks of support.
- Factors that impact the workforce strategy on farm include, the presence of production issues that can be solved with technology solutions, a consequent change in skillset from adoption of new technology, location specific factors and increasing demand for on-farm data management.
- Ease-of-use factors associated with technology are important for assessing the value proposition and these considerations include workforce

capability, integration into the existing work structures, and access to support, solutions, and manual alternatives if the technology fails.

- The grower's perceived usefulness appraisals are supported by a clear value proposition associated with solving a production limiting problem and social learning opportunities.
- Workers experiences of ease-of-use were impacted by their computer self-efficacy, digital literacy, and technical skills, as well as the supports offered to them when learning to use the technology.
- Ease-of-use, job relevancy, the quality of the work achieved through technology use, and the relative advantage the technology offered in terms of their performance, reducing job demands and achieving the farm goals contributed to workers perceptions of usefulness for technology

Farm management strategies, workforce structure and capability, and technology adoption interrelate and impact on each other. Transformational leadership, a psychologically safe work environment, and connector manager approaches to building workforce capacity were identified as mechanisms by which growers may encourage their workforce to adapt and remain engaged when change occurs on farm.

Current production issues were the impetus for the application of time and effort to find potential digital agriculture solutions and investigating new technology. Major arguments for adopting irrigation have focused on labour saving costs and have consequently led to some to lament a loss of jobs and negative community impacts. However, the current investigation found that it is the workforce supply demands and production challenges created because of boom/bust weather cycles that is central to the motivation to automate. Automated irrigation offers the opportunity to restructure the workforce to be smaller, but more highly skilled, and with better work conditions than in the past. The challenge is that while systems are not fully automated, workers need to be willing to upskill but to also engage in the traditional manual labour approaches. Even if fully automated, the technology may not be so reliable that backup manual approaches are not still required at times.

Workforce capability, in particular computer self-efficacy, general literacy, digital literacy, and being motivated, self-directed learners influenced the ease with which technology was accepted and adopted and impacted whether the technology would be used proficiently and be deemed useful. Social learning and observing and experiencing the use of technology in contexts that could be easily compared with the individuals' farm work environment, helped to determine the relative advantage of making a change. Having a team mate to persuade those that might otherwise deem it too much effort to proceed (a champion for the new technology) could help workers persist until they overcame the learning curve required to integrate new ways of working into their role on farm. A number of factors, including job relevancy, output quality, and results demonstrability, are central to convincing workers of the value proposition and accepting new technology on farm.

Chapter Four: Sundown Pastoral Company: Entrepreneurs and Intrapreneurs Creating the Future of the Cotton Industry

Introduction

> *I think it's important to keep it clear that we're not just farmers, it's not just about a crop. We're about a whole of supply chain and about technology and different looking/thinking outside the box.* – Danielle Statham

David and Danielle Statham are owners and directors of Sundown Pastoral Company which encompasses two agricultural properties that grow cotton; Keytah located West of Moree and St Ronan's in North Eastern Queensland. Keytah, is 24,625 hectares with 4,996 hectares allocated for cattle and cropping/grass for cattle production, 6,053 hectares allocated to dry land crop production, and 10,980 hectares allocated for irrigated crop production. While cotton is the focal commodity, wheat, faba beans and chickpeas are also grown, and some cattle kept. At the time of our interview, February 2020, this region was in severe drought and in the most recent season only 3,021 hectares of dryland cotton had been grown and harvested. In the previous year, 2019, the company had purchased St Ronan's, a property spanning 44,000 hectares and had developed 4,211 hectares of this for cropping production.

Keytah is well known for hosting research and development activities. Most recently, longitudinal trials of different irrigation systems and their successful adoption of digital agricultural approaches to farm and crop management have featured in the 2020 Australian Cotton Production Manual. The Statham's have a reputation as leading innovators in the cotton industry and this extends beyond the farm gate with the establishment of their Good Earth Cotton™ business and supply chain traceability solution FibreTrace™.

Sundown Pastoral Company is a family business with a corporate-like structure. People are directly employed or contracted by the business. Core staff highlighted on the company website have been associated with the Stathams and their business in various roles for between 12 – 33 years. The exception is a dedicated IT manager who has been with the company for the last 4 years and a special projects manager who has assisted with company diversification over the past 3 years. With the focus of the case study on the future of the cotton industry, David and Danielle, and three key Sundown Pastoral team members were interviewed. Nick Gillingham is the General Manager of Cropping Operation and has worked with the company since 2005, originally starting out as the farm agronomist under his own business NG Agronomic Consultancy. Wil Jackman is the agronomy assistant under NG Agronomic Consultancy and originally started working with Sundown Pastoral Company in 2008 as an irrigation contractor. Nathanial Phillis who now is employed as the Irrigation Operations Manager has

the longest standing association of the three employees interviewed, having originally joined the Sundown Pastoral team in 1997 as a contract irrigator. All three of these people are trusted and valued team members and able to work with considerable autonomy. With this case study, David and Danielle discussed their entrepreneurial approach to business and the culture of innovation they have established. The team members interviewed at Sundown indicated that they work in a way where they can be viewed as intrapreneurs - active players that shape the future of the farm and behave innovatively within the work structures established. Insights offered within this case study include

- How do the entrepreneurs strategically plan and adapt to change in farming?
- How do the entrepreneurs create the innovative work environment, develop the skills and workforce capability, and the structures required to be at the cutting edge of industry?
- What strategic decisions have been made recently that have changed the business and what does this mean for the workforce?
- How do the entrepreneurs view the future of the cotton industry and what is needed?

How do the entrepreneurs strategically plan and adapt to change in farming?

The adaption process within the farming business is influenced by the growers approach to personal development, and their evolving strategic vision for the business.

Personal Development

When discussing their personal development, both David and Danielle gave examples of formal education and training but particularly emphasised the learning opportunities they had in (a) past business endeavours, (b) investigative experiences and (c) the sharing of knowledge through reciprocal relationships that formed their extensive networks.

Past Business Endeavours

The transferable lessons from direct experience outside of agriculture have developed different skillsets and knowledge that can be then applied to a farming business. Simultaneously learning about farming from the ground up has meant that they have the expertise to discern what new skills will work within the agricultural context.

> *Learning about sales, it's a completely different business outside agriculture but all the concepts are the same. The importance of people, the importance of the sale, the importance of the supply chain, the importance of technology and systems. I took all of what I learnt about that to the farm. The same time I was working within Ranbuild, another part of our business at the time, I was on farm developing and learning from people, I knew nothing about farming in the beginning. I surrounded myself with really*

good people in earthmoving, in agronomy, in marketing…my history is working in a family business, in the steel business, as well as being in the farming business at the start of developing irrigation. – David Statham

Investigative Experiences

Investigative experiences may mean that initial ideas that the entrepreneurs had may be found to be not viable. However, the learning that takes place while exploring these ideas means knowledge develops and new ideas are revealed.

I think by hopping on a plane and going to Switzerland and saying to ourselves we're going to build our own spinning mill. Well that was a quick no, that didn't work out. But that led us to meeting the right people, that led us to buying FibreTrace™…the people who we've met on our journey are some of the best people in the world. So that stimulates our learning. Our learning process is our joint ventures…. we're getting our enthusiasm and our training and our learning from people we're associating with further downstream – David Statham

Building Relationships and a Collaborative Knowledge Network

The importance of relationships is possibly the most important thing that I have ever learnt. I studied fashion, and I was a milliner for 25 years. I always kept my hand in fashion. I had my own wholesale distribution fashion agency. I had my own denim label for a short time which gave me a massive insight to be able to take our business to the next level, understanding where the cotton ends up. So textiles, fashion, and the importance of relationships were the most important facets of my business life. – Danielle Statham

David and Danielle both valued stepping outside of their agriculture 'bubble' and finding the transferable approaches and different skillsets that could assist their entrepreneurial endeavours. This becomes an act of knowledge sharing and development for all parties involved.

We're slowly gathering people along the way with that journey. We still have the original inventor of the traceability technique with us. And we've been able to commercialise that from this tiny little seed into a full-blown tree for him. And in return that's actually educated both of us. Our business partner, we've been able to educate him on the farming, he's been able to educate us on the manufacturing side at an intricate level. There are people who have magnetised together, who all think the same, that have been able to work (collaboratively). – Danielle Statham

Discussing personal development with David and Danielle is a reminder that education credentials are an imperfect measure for the meaningful development of knowledge and skills. With the cotton industry's recent focus on identifying targets and ways to measure social sustainability of the industry, the implications are that accurately capturing a snapshot of skills may involve more than education and training metrics. The people development aspect of social

sustainability within the cotton industry may be additionally measured by an individual's proactivity, conscientiousness, openness to experience, relationship building skills and other factors that underpin one's engagement in lifelong learning, and their ability to adapt and to find opportunity. Developing these skills are what is required for individuals involved in the cotton industry to shape the future, drive it forward and generate new approaches to what is the business of the cotton industry.

Strategic Direction of the Business

Like John Deere adapting and redefining themselves from a machinery company to a technology company, the Statham's approach to business has been to flexibly adapt and grow in strategic ways that expand and refine their ability to influence their market impact and consequently often involves redefining their business. This has involved pivoting away from their initial involvement in cattle and red meat towards cotton, where there were fewer immovable obstructions to disrupting the supply chain.

Establishing Good Earth Cotton™ redefines and expands their business from cotton farming to a producer and supplier of sustainably produced, traceable fibre for the ethical fashion industry. Under the umbrella of Good Earth Cotton™ are their farming and ginning operations, and supply chain traceability solution business, FibreTrace™. In addition to this, the Statham's and their team have formed a number of informal/in-kind partnerships (collaboration with researchers, machinery/technology companies to develop better precision agriculture tools) and formal/business partnerships (partnering with ethical fashion manufacturers) to realise their "seed to shelf" vision for their business.

It must be noted to set this vision relies on David and Danielle's strategic foresight abilities. These abilities were made very clear in Danielle's description of how they connected several concepts to decide on the direction in which they needed to steer their business.

> *We had so much data, and we are good at collecting it… in terms of cotton, we were driven by transparency and without data there's no use talking about sustainability, there's no use talking about environmental and economic sustainability if you haven't got data to benchmark against. I recognised that early in our business and I could see that from the other angle, the downstream supply chain, that everything was heading that way. I knew what David was doing and I knew that everything that was happening out on the farm was directing back to that data. So, for every fibre to tell a story it was just imperative, we just had to do it. Because economically, environmentally, and sustainably that is the future of fashion and the future of the cotton industry if they want to remain relevant with market value in the fashion supply chain.* – Danielle Statham

The strategic vision for the business has come from an extension of the strengths that exist within the business, and consideration of the risks/opportunities that exist beyond the farm gate and into the future. These, along with some strategy

aligned recent changes within the business, and the impacts these hold for workforce are explored more in depth in the following sections.

How do the entrepreneurs create the innovative work environment, develop the skills and workforce capability and the structure required to be at the cutting edge of industry?

Understanding the ways in which innovation happens at Sundown Pastoral Company requires understanding (a) the orientation to work that the Statham's and their key team members possess, (b) the work conditions that facilitate innovation, (c) the prioritisation of data driven approaches to agriculture and (d) approaches to attracting, managing, and retaining people.

An Innovative Orientation to Work

> *The whole story began by being inquisitive, I was always inquisitive. From the day I stepped onto that cotton farm, I loved that whole industry. I understood textiles, and I understood the purpose or use for cotton. For me, it was fascinating and intriguing that this whole supply chain could be connected one day. I saw that there was little or no connection between the fashion industry and the cotton industry or the raw fibre industry. And it was a big passion of mine to bring them close together.* – Danielle Statham

An innovative orientation, as described by David and Danielle, could be defined as a mastery orientation, openness to experience, curiosity, humility, persistent determination, and a dissatisfaction with the status quo. These orientations and traits underpin the openness that people on the farm have for new ideas and the activity, processes and projects that they engage in as part of the way the farm and broader business is managed and developed. As David explains, when asked about the motivation to engage in research and development activities on Keytah:

> *We've always wanted to be the best. Always wanted to be understanding what is coming through, to be the best. So I've always engaged with people that want to try things and that's where that comes from.* – David Statham

And on the motivation to develop Good Earth Cotton™

> *that's what drove me…The merchant system around the world is over 200 years old, and there's the potential to make some slight modifications to the way this works that could improve the grower's position in the supply chain.* – David Statham

They described recent developments, such as expanding the operations into North Queensland as "*there's so much excitement pioneering something in that area*". – Danielle Statham

The Statham's have sought out some key staff (particularly in leadership or management roles) that share their orientation to work. People who also are prepared to work with other innovators, develop their own mastery within their

roles, bring ideas into the business, and be a part of bringing the strategic vision to life.

> *Definitely the people that you employ have got to have a passion for it as well and that's certainly the case with Nick, and Nathaniel, and Wil. Our guys that are out on the farm, they enjoy it as well.* – David Statham

Wil (agronomist) describes his involvement in the innovation system within Sundown Pastoral:

> *There's plenty of cotton farms, but I just love that we are (Sundown Pastoral) always trying to do something different, you know, with the fibre trace, with the way they're growing it and they're not complacent on how they've done it in the past. They're dynamic and evolving with the time or at least try to be. A lot of people are these days. That's what I personally like about it. You're part of a good company….that's why it's great working for someone like Nick, he just thinks outside the box. – Wil Jackman*

Creativity is not a word often used within on-farm professions, but within the agricultural context it appears that the phenomenon is present but often described as generating new solutions to existing problems. When interviewing on-farm workforce participants about their career development, it was discovered that two of the three had initially pursued tertiary education in creative areas seemingly unrelated to farming (Art Design and Teaching, Bachelor of Design/Town Planning). Transferable skills from these initial interests, that were abandoned for an interest in agriculture, serve these people well within an innovative workplace like Keytah.

> *I've got a combination of practical and creative….I much prefer to build something that I created than to build something someone else created*.– Nathaniel Phillis

The dissatisfaction with the status quo that can drive continuous improvement also requires individuals to be willing to adapt and change within this dynamic environment. Wil describes:

> *I think anyone that likes a job or is good at it should be adaptable anyway. You should never think you know everything. If you don't approach the job, willing to change and adapt in certain environments, you're probably doomed to failure.*

<u>Facilitating Conditions</u>

People who have an innovative orientation to work, also need the conditions to enact entrepreneurial or intrapreneurial behaviours. The abilities and skills that make individuals valuable contributors to an innovative workplace need to be encouraged and reinforced by the environment and systems in place. Conditions that facilitate innovation on Keytah include an acceptance of the learning curve costs, investment in the tools required (in particular, good connectivity for digital innovation), a collaborative culture where expertise is shared to the mutual

benefit of all parties, and an emphasis on experiential and continuous learning in the workplace through vicarious or direct experiences.

Working for an organisation that is willing and able to accept there are costs to the learning curve means workers stay open to considering possibilities and investigating new ideas that otherwise they may not explore. This level of risk-tolerance contributes to an innovative culture on Keytah.

> *Again, it comes back to the people that you've got around you and your psyche….I'm lucky that I've been involved with a farm that is happy to be the first people to do it. To our own detriment at times of course, but big enough to cover those losses if there are losses involved in that process.* – Nathaniel Phillis

> *There's definitely a cost …you don't get a good result all the time, but if you do get a result that improves the business or improves productivity or whatever we're aiming for, it outweighs it 10 to 1, the cost of doing the trial.* – Nick Gillingham

Removing barriers that otherwise may frustrate efforts to explore the use of technology has been important. Getting the core infrastructure in place, in this case internet and telecommunications connectivity, and ensuring it is reliable has been essential to moving forward with digital agriculture approaches that are required to progress the business towards the strategic vision.

> *…all the systems we're deploying require remote monitoring. It's no good having remote telemetry in your pump stations if you've got no mobile connection at home. There's no benefit whatsoever. So the most critical thing is on-farm infrastructure for telecommunications. Because every single part and piece of technology requires a mobile service or a telecommunications service to make them reliable.* – Nick Gillingham

> *So (collecting the amount of data) has been a bit painful and time consuming but we've tried to streamline it so it's not too bad. And with good connectivity we can access it all on a server base system that makes it a little easier.* - Nathaniel Phillis

Under education and training, the Statham's had identified how collaboration was essential for growth. This approach does not stop at the owner/director level of the business but is a culture that runs through it with others describing collaborations that had shaped work on Keytah. A collaborative culture becomes essential as the problems that encourage innovation are challenging, complex, and solutions can require multidisciplinary expertise. Building these sorts of relationships within the team or with those outside the farm business is essential to bring people along the innovation journey and to achieve results that extend on what was previously possible. The practical knowledge that the on-farm team bring to the technology providers makes them a valuable part of the innovation system.

> *…having the right people around us that are quite often reasonably innovative. You're evolving as you go. When we first started looking into siphonless irrigation, we looked at people that had already tried it. We looked at so many variations of it. Then we went to designers and said, "Look this is what's out there. Can you make one of these models fit our country?" Nick and I, we'd hit dead ends all the time, because (the designers) had limited practical understanding. They were looking at it purely from a design standpoint. And we were going, "No, it's got to work". So in the end, we went, "We've looked at everyone's (system/design) we're just going to go, this is what we want*." – Nathaniel Phillis

> *I started making some clunky designs and then of course, I'm meant to be doing other things, not inventing stuff. So we got (the technology provider) to look at their structures and said, "This is what I've done. This is what we want it to do. This is how we want it to function." They took that back and they had an engineering department, they had a research and development department and they just brainstormed what we had and developed the product. That's a commercial product now, but it came out of what we wanted. While we like to make things specific to Keytah, we'll normally get someone on board that we know can develop a product that they can develop for the rest of the industry…. we're big enough to be able to drive something, get it moving, and then we can get someone else involved*. – Nathaniel Phillis

The reputation that Keytah has as someone who others can work with to develop innovative ideas means that they are sought out and stay connected with others seeking to change the way things are done in the cotton industry – they are part of a bigger system of innovation.

> *A lot of people come to us with new ideas. Because (a) we've got scale, and (b) we're known as people that will try new things…once you start you end up attracting people.* – David Statham

A systematic process of discovery and learning through direct or vicarious experience is central to knowledge development on Keytah. Experimentation, trials, and trying to find ways to continuously improve is encouraged. As David describes:

> *The R&D can be done at a farm in Narrabri or Wee Waa, or it can be done in Emerald. But there is no better data having R&D done in front of you, experiencing it, in your own valley, on your own farm.*

Nick, the farm manager, has made this a part of the way decisions are made when it comes to adapting farm management strategies to achieve better outcomes.

> *I used to do a lot of trial work before I was here so I'm used to doing heaps of different trials. So we really pushed it from a farm level… To get answers on new things, is why we do it from the management level*

Other staff describe their learning as directly influenced by what happens within their work environment. Nathanial describes it well when he discusses that, for him, it's not so much about staying up to date on trends but getting a good understanding of the problem on farm, checking what solutions are available and if they are not fit for purpose, finding a way to improve or do something new to improve on the current situation on farm.

> *Interviewer: How do you stay up to date on different trends in agriculture and what changes might be coming?*
>
> *Nathaniel: Good question. So bit of word of mouth and, physically driving to an innovator's to look at their system. And never closing your mind when you think, developing being innovative in thinking about things. It's just happening on the farm constantly, so it's through experience (that I learn). It's more driven by "Well, we've got to be able to do this better, this is just mad, why are we doing it this way." I mean, we're lucky and I'm lucky enough to be working with a company that has always spent money trying to be better.*

Wil explains:

> *It's easy (to stay up to date with new technology) at Keytah when they're the ones pushing for half of it…. I'll probably have to research our own stuff more than other stuff*.

<u>Data and Digital Technologies</u>

Collecting objective data to drive decision making on farm has long been a part of the way the Statham's have done business. More data has been able to be collected through the different digital technologies that have been adopted over the years. Ultimately these digital technologies help to manage assets, make better decisions that improve the environmental and economic sustainability of the business, and improve the efficiency and effectiveness of farm management practices. (Table 4.1)

The extensive history of data that has been collected has allowed the Stathams to objectively demonstrate how their best practice management approaches are environmentally sustainable and carbon positive.

> *The previous steel business that I grew up in was Ranbuild. And everything was data driven and data collection. That same logic applied into farming, databases, good management systems, and the guys that I employed were all agronomists that were highly intelligent people, very good at what they did and they believed in data capture as well. So by default we've captured data for a long period of time. I didn't know the power of this carbon story 20 years ago, but because we've captured the data, we've been able to capitalise on it. A lot of people we're talking to now can't capitalise on it, they have to start today because they haven't got the data.* – David Statham

> *Consultants try and keep a fair bit of data. We're probably at the extreme end. The one thing it does provide you is a great history and go back and analyse what you have done and what you can improve. And an example of where it has been extremely useful is for trying to work our carbon footprint. Because we've got 15 years of data; every single paddock, every single operation, everything that has happened to that paddock captured in a database. Which made it relatively easy for them to go back and measure our carbon footprint historically. Which if you didn't have that data, you'd be guessing a bit about what's gone on.* – Nick Gillingham

> *What our guys also saw was the fact that that data enables you to benchmark yourself against the previous crop, where you have to go with your soil. Therefore, that benchmarking data is economically sustainable. So it was all about economics, and how we get better yields, how to improve your soil, how to actually manage what you're doing and really take it to the next level, and what technology you can bring back in to take it to the next level. By default it's morphed into an environmental sustainability story.* – Danielle Statham

At the farm level the value of digital technologies is about continually improving the precision of activities that impact the crop, removing subjective judgements or variability in performance standards and making incremental gains that lead to significant improvements.

Irrigation manager, Nathaniel describes:

> *We're trying to get all the little one percenters right. So we get our yields to go up and up, and our costs go down. What we're looking for is precision irrigation systems, that's what we're chasing. So whatever can be precise. If you take out the human side of things, and you've got reliable technology, then you can get precision.*

Furthermore, specific digital technologies that were discussed reduced labour requirements in both administrative tasks and physical labour. Some technologies served to improve information sharing between different levels of workforce (Microsoft Navision) and between teams working across physically distant locations (Trello). Some technology allowed greater transparency of workers' actions which improved accountability (Deputy system), or facilitated ownership of decision making in a way that balanced management control with staff autonomy (accessible purchase order system with pre-set spending limits).

Table 4.1. Types of Technology on Keytah

Type of Technology	Brand/Company	Description of Performance	Benefits	Impact on Workforce
Purchase order system and accounting system	Microsoft Navision	Mobile app means staff in the field can raise a purchase order, code that purchase order to a particular asset, and purchase orders can be remotely approved for staff by management	Managers can have control of purchases up to pre-set limits Electronic invoice system streamlines paperwork and matches data to track assets maintenance and repairs	Efficient way to give employees autonomy but also to stay informed of purchases without requiring in-person exchange of information/request Informs objective decision making around asset management
Workflow management	Trello	Mobile app that creates job lists and allocates work to be completed be individuals	Co-ordinating the team, communicating priorities, and having a record of actions that have been completed is particularly useful for work taking place across physical distances	Employees have clearly identified list of jobs and understand each team members responsibilities.
Online Time Sheet System	Deputy	Mobile system where staff record their start and finish times on an iPad. This also records GPS co-ordinates to verify location when work is started and completed Timesheets are verified and approved by managers	System communicates directly with payroll. Allows transparency within teams working across different locations with regards to punctuality	Reduced labour requirements on administrative tasks Objective evidence can be used to manage performance issues in teams such as lateness etc.

Table 4.1. Types of Technology on Keytah (continued)

Type of Technology	Brand/Company	Description of Performance	Benefits	Impact on Workforce
Vehicle tracking system	Live Tracking	GPS tracking system that can demonstrate where all cars are at any given time	Transparency of where vehicles and people are at anytime	Safety benefits to knowing where people are
Telemetry System	Goanna Telemetry	Monitoring pump stations, water levels in our storages and supply channels, and our tail water returns, channel heights, fuel tanks, water tanks. Weather stations	Precision agriculture Manage variability in the system Data informed decision making	Prioritising action required based on crop needs
Bankless Channel automation	Sierra technologies and Goanna telemetry	In-field sensors trigger automated irrigation	Precision agriculture Reduced labour requirements Machinery efficiency 18-20% Reduction of tail water by 30-35%	Eliminates human error and reduces stress of sourcing unskilled labour for task that impacts crop yields. Moving towards full automation and cutting unskilled labour from the workforce

Getting the Right People in the Business: Attracting, managing, developing and retaining people

The Statham's approach to business is highly relational as was previously touched on in describing how they developed their knowledge to inform their roles as founders of Good Earth Cotton™ . Along the way, they have identified talented individuals with the skillsets required to bring Good Earth Cotton™ to the market. For example, David describes how his business development and special projects manager has come to be involved in their business.

> *He was my best customer, he then became my best employee, he then became the manager of the business when I left, and I knew one day I'd employ that guy. He's too good. And he's now working with us on special projects like FibreTrace™ …He's very good at business, marketing, people skills…*– David Statham

As Danielle described: *We bring on the greatest minds to be able to forge it forward. I know we keep circling back to this, but relationships are key.*

With regards to hiring their on-farm staff, the Statham's described how for them, attitude is the essential base on which staff skills and capabilities can be built.

> *Attitude is number one, because I truly believe with the right attitude you can teach someone anything.* – David Statham

When asked to describe what the target attitude looks like in an ideal employee, David and Danielle described a recent gap year student they had employed due to her passion and polite persistence in trying to secure work experience.

> Danielle: *We had a young girl who had nothing to do with agriculture, her family had nothing to do with agriculture. She knew nothing about it but she just knew that was where she wanted to be…And she pestered David..*
>
> David: *Nicely, in a passionate way. And she used to watch the weather maps. She'd text me the BOM and it was just constant over a period of time.*
>
> Danielle: *She wanted to irrigate out at the farm. And she knew that we always took out a heap of young kids. It's hot weather, they get great money and to have a good crew of young kids out there is imperative. And she knew she wanted to be a part of that and that was her way to understand agriculture. And we said to her*
>
> David: *There's no water…*
>
> Danielle: *There's nothing to irrigate, there'll be no cotton*
>
> David: *But she kept persisting and I've never had that. I've never seen that. When you see something like that, not once, not twice, not three*

times…five, six, and seven times she just kept asking. I sat in my desk one day, I said, I'm giving this girl a job, she deserves a job. So I created a job for her in the middle of the drought. That's what I look for.

Danielle: *And now she's at ANU and she is studying agriculture and business.*

This young person's willingness to learn from the ground up, to take on a hard laborious job, to communicate in a way that sought to connect and empathise with her employers with regards to lack of rain, and to keep finding ways to learn more even when experiencing knock backs demonstrates a resilience and commitment that is desirable in an employee. This attitude powers skill and knowledge development and gives a base on which a farm business can build in order to more easily shape a new recruit into a valuable team member.

When bringing in skilled on-farm staff, prior understanding of how data driven decision making fits within a farming business is also essential, and not necessarily something that graduates are coming prepared with.

I had an ag graduate come out to Sundown Valley.. we were looking for someone and she had just finished 4 years of university. She came out and we went through about four or five things we do on Sundown, in the beef industry, and they had not learnt one of them. And my recommendation was for her to go work in Dairy in NZ for a couple of years and then come back. Because those people measure everything, every day. They know their inputs, they know their outputs, they know their time management. Everything is down to the minute. It's amazing, some of those good operations over there. That's what I told her to do. I don't know whether she did or not, but she was a very well educated and she was the best of the best and it was just scary to know how little they knew about farming. – David Statham

The approach of "measuring so you can manage" is a central principle to how work happens within Sundown Pastoral company and the right person needs to have some knowledge with regards to this. Valuing the skills people develop through experience underpins perceptions of the 'right person' for their business.

It is clear from reading the bios of the Sundown Pastoral team that once the Statham's have found the right people for their business, they are effective at retaining them. The people-centric approach taken to form their management and leadership team, is also reflected in the way they value the rest of their workforce.

<u>People Management</u>

Digital systems are not a substitute for people management practices. They may even require a more thoughtful approach to people management to effectively integrate and balance the human and digital systems on farm. As irrigation manager, Nathaniel describes:

The biggest thing I have against Trello is in the wrong hands or used incorrectly it can create a sterile environment where people feel like they're robots and they aren't actual people. And so that's the balance I'm trying to strike.

Other than Trello, some of the digital systems used on the farm allow greater oversight of employees, including their start times and location. This information can provide objective evidence of performance issues if team members are not meeting the work expectations on farm. Integrating this data into performance management was done with an empathetic approach, allowing employees take accountability for their actions and being provided support for corrective actions, if required. This approach to using data to support managing the staff builds trust within the team as transparency does not mean being micromanaged nor that errors will automatically result in punitive action. Instead, it becomes understood that this data will be used in a way that results in a fair work environment.

People working at Keytah have been on the forefront of change in the cotton industry. As Nick describes, this change is a continuous process and effectively managing people through this requires transformational leadership (see Kilmarnock case study for more detail about Transformation Leadership):

Change has been happening in farming forever and a day. It's not like it's anything new. It's just a slow pivoting, it's always slowly changing. You're trying to bring them (staff members) along for the ride and making sure they understand why we're changing and what the benefits are. You let them voice their issues around it and try and resolve those issues to get them on board. Because if they're not on board it can get quite difficult to have the change run smoothly and to get it to work properly. – Nick Gillingham

Both Nick and Nathaniel are responsible for leading teams and highlighted the importance of understanding the individual differences of their employees to offer tailored support or facilitate different approaches to get everyone to accept and adopt the change. This is important when the change may not have direct benefits or impacts on their team members work but creates an additional demand for the staff to handle. The example given was Trello. For some workers, it suits their approach to work, they have good attention to detail and working with a checklist to complete gives them a sense of accomplishment. Others see the checklist as an added burden and micromanaging their work.

Nathaniel explains:

It's got nothing to do with skill levels or with literacy, it's purely personality based. So those people that want to be clean and tidy are clean and tidy with it, they want it done. They're organised. Those that don't like authority so much are more likely to buck the system and just don't want to give you

the information. They've got all the skill in the world. They know exactly what they should tell you, but they don't want to be micromanaged. And then my response to them is - You take the reins and I'm happy for you to create your own job list so I can see them. So that's a conversation I can have. You have got to do it in a democratic way rather than a dictatorship way. As soon as it becomes, that "you only do it in that way" you'll exclude people.

Nathaniel as a manager has tried to adapt the task to work with the different strengths of his team and to make sure they feel included in the process of adopting workflow organisation technology. Some like clear direction and others want more autonomy in managing their workload. Nick also echoed this sentiment of trying to meet staff needs in encouraging them through the change. Regular communication, clearly set expectations, and support is required. Sometimes this may involve tough conversations.

You just get involved and talk to them constantly. Coach them through it. Sometimes it doesn't work smoothly, and you've got to make sure that you don't be their mate all the time. You're in the leadership position. (There can be issues if you're) trying to be mates with them instead of being the leader they need you to be. And that depends a lot on personality types. You've still got to have some empathy and not be a dictator either. At the same time, we don't get too much staff turnover so we're doing a reasonable job. – Nick Gillingham

Continuing to check in with staff and being an active and present manager helps to keep the team working towards the farm goals. Technology like Trello is a good record keeping tool but it is only as good as the accuracy of the data that is entered, and similar to other digital systems, workforce data also needs ground truthing.

that's where you can get caught out with technology. Just because the box has been ticked doesn't mean it's been done. – Nathaniel Phillis

Being diligent and dedicated in managing people, connecting with them, ensuring they have what they need to give their best at work and recognising their contributions was a priority for the leadership team on farm. There was an awareness that when digital systems might offer short cuts to overseeing a team, that this could be counterproductive to ensuring the employees were engaged and satisfied at work.

…one of the biggest things I learnt in management training was the most important thing to a person is not how much money they're making, but it's their status. So how important they feel in their role and valued in the company….as long as we don't lose that, we'll be good. – Nathaniel Phillis

<u>Retention: Development opportunities and valuing diversity</u>

There was a recognition of the value that existing employees bring with their skills. It is also their organisational knowledge that is important for efficiency and

productivity on farm. Retaining staff members with this organisational knowledge was a priority.. An example was the recruitment of Wil Jackman into the agronomy role. His was a less traditional career path (i.e. not a straight agricultural science tertiary pathway), but one where different educational experiences, work experiences, and organisational knowledge of Keytah made him a good candidate for Nick Gillingham to hire and train.

> *I'd never considered myself an agronomist, well because I wasn't at that time, and for someone like Nick to give you an opportunity like that. I think that's probably half the reason Nick even approached me… Just from being there (on Keytah), I understand how they do things and why… I don't know if it's ever been explained to me….I didn't really have to ask… I know how Keytah rolls and you can kind of just fit into that….I'm just trying to be part of the structure and system that is already in place and help the company do a good job of what we already do.* – Wil Jackman

As well as access to development opportunities in the form of career growth within the business, staff are given access to education and training opportunities. These could be from formal education providers or industry-based training (at the time of the interview Wil was undertaking the UNE cotton production unit and has recently been accepted into the Future Cotton Leaders program) to short courses or on-the-job training run through vocational training providers or machinery dealerships.

> *I don't have any formal strategy but definitely as courses come up we offer them to staff. And sometimes they take them up, sometimes they don't. We've done everything from little welding courses to some leadership training. We've done a whole range of different courses, when they come up and they're available.* – Nick Gillingham

As people become more experienced and knowledgeable within their work, that expertise was valued and the space given for those who were motivated to explore these ideas within their jobs.

> *I think that's why I'm still here (at Keytah) because there's been enough freedom to use our own brains a little bit. We're a family-owned business that's big enough to have the benefits of some of the corporates but we're not bound and restricted by red tape.* - Nathaniel Phillis

While it is desirable for the next generation coming into the farm to be more digitally literate than in the past, the importance of retaining older team members and the influence they could have on the workplace culture was valued. Not every staff member needed to be intrapreneurial. Diversity within the workforce was valued.

> *David: I've got a couple of old guys where the value of what they bring, the experience of the farm and the basics – turning up on time, long hours, loyal – you can't replace those sorts of things. We're just training up one or*

two specific people in specific areas and when those technologies are required inside the tractors, we have just one guy set up to start it. You know what I mean? So I'm continuing to work with the older generation because I never want to lose those old values, they're too hard to replace. And the loyalty that those old fellows have got – that's priceless.

Danielle: The (younger workers) need role models. And those role models are those older guys on the farm.

David: There is definite value in the diversity of the workforce for sure.

What strategic decisions have been made recently that have changed the business and what does this mean for the workforce?

Two recent developments within the business that have workforce implications are the expansion of automated irrigation on Keytah and the expansion of production locations to include a property in North Queensland. Both the Northern expansion and the increasing adoption of automation align with strategically attempting to retain a core, highly skilled workforce within the Sundown Pastoral company. In farming this is a consistent challenge with not just in-season variation in workflow requirements but also predicted increasing climate variability affecting demand for workforce.

The hardest thing is we don't have a consistent workflow. It's not consistent because it's a lot of seasonal type work and then to make it even harder, we have droughts and we shut down. Which is always going to make it extremely difficult to keeping any skilled permanent staff full time. Somehow, we've got to become less affected by droughts and water, and I don't really know what the answer is for that. – Nick Gillingham

<u>Expansion of Automated Irrigation</u>

Bankless channel automation could be the biggest change, I believe, in cotton farming. We've developed over 1250 hectares of bankless channel irrigation. We're working with Goanna and Sierra Technologies to deploy in-field sensors… it's a fully automated irrigation system which will deliver higher yields, better water use efficiency, and less labour….It eliminates human error is the first thing it does…. The utopia is to have the in-field telemetry sensors trigger the water to start and then that would be fully automated. – David Statham

….the biggest stress of running a cotton farm is irrigating. All the damage can be done by being too early, too late or too much water. It's all around Christmas time, it's stressful, you need all of the labour and with labour comes stress. – David Statham

The expansion of the automated bankless irrigation system (or siphon-less irrigation, as Nathaniel refers to it), reflects the positive results that have been demonstrated through irrigation trials over the last decade. The benefits of reducing reliance on an unskilled itinerant workforce for a vital task on farm is to

get greater accuracy and efficiency in watering and reduce the number of people working in the business who are employed for survival reasons (employees who are solely motivated to seek work on farm for a pay check or visa requirements) as opposed to self-determination reasons (employees who are motivated to seek work on farm because it aligns with their interests, abilities, and goals).

Reducing this type of seasonal labour reduces a job demand on managers who are responsible for ensuring job performance standards are at a level that has a positive impact on yields. Many of these workers will not be around to see the longer-term impacts of their work on the crop and may only work one season meaning they are not learning from past performance experience in the same way a permanent farm-hand does. Replacing these roles with automation may reduce stress on managers and make it possible to retain a smaller higher skilled workforce through challenging seasons leading to improvements in the social sustainability of work on farm.

> *Technology has a big role (in the future of work at Keytah). We'll one day have automated tractors and irrigation systems that could be fully autonomous. Therefore keeping higher skilled permanents on farm, even when things aren't happening (like in dryer seasons) won't be so much of a drag. You know they won't be doing much but maybe you could afford to pay a few higher skilled guys rather than a larger workforce doing not much. So that could be a solution. I don't know whether it will be but we're trying to head down that road. I don't know whether it's going to work*. – Nick Gillingham

While the rise of automation has led some to lament a loss of jobs in the industry, the people interviewed on Keytah were optimistic and positive about the continual progress away from partial automation to fully automate tasks on farm and what this would mean for the people who work in agriculture.

> *When I started, the workforce in general was made up of a lot of people with like-minded agricultural backgrounds. The danger of some of this partially automated machinery like tractors that steer themselves, you have taken away the old skill levels that came from people with agricultural and machinery backgrounds, you've replaced it with someone who could be anyone off the street and throw them on there….(in the past) even (entry level) workers were involved in the industry because they were passionate about it. But you'll find passion is more at the manager level now and for the workers 'it's just a job'*. – Nathaniel Phillis

With regards to the rise in automation:

> *I guess you could probably take that two ways. If you're a worker you're thinking, 'Well, look, technologies going to take my job. So what's the point of caring" but the other side of that is saying, "Well, if we really care, we can be the people looking after this technology"…I feel (with more digital agriculture) there's a swing back to where we need people that want to be involved in farming…The way I see it, technology is not a way of replacing*

people so much as replacing the people you don't want, and then we can afford to pay a higher skill set. – Nathaniel Phillis

Raising the skill level of on-farm professions will change the type of employee that is required on farm. Getting more motivated people for whom farming is their ideal choice of work means getting a team that are cohesive in the alignment of their personal and professional goals. It also means getting people who are likely to build lives where they can access fulfilling work opportunities. This will have a positive effect on the connections that can be formed between team members, and consequently improve the organisational culture.

when you're dealing with someone with a decent skill set, you're dealing with a type of person that you can relate with a lot better. Quite often seasonal workers are not someone you can connect to that well, that might be because they're a backpacker, they're not going to be back next year. If you can replace that sort of labour with people with families and good skill sets, and you can connect on more than one level, I think that makes it better for everyone. – Nathaniel Phillis

Northern Australia Expansion

From a personal angle, there's so much excitement pioneering something in that area. That's been a massive driving force…to be able to pioneer that up north and take your team into something like that is great for morale and it's great for our family – Danielle Statham

While operations on Keytah were scaled back during drought, Sundown Pastoral had diversified the geographical locations of the farming business with the purchase of St Ronan's. The timing of this expansion was essential to retain skilled staff during drought and was also necessary as the development of Good Earth Cotton™ relies on a stable supply of sustainably produced cotton.

We'll be planting and harvesting at different times of the year. It will help our supply of cotton over a 12-month period…. There's so much utilisation of the same people, in two different parts of the country at different times of the year. The utilisation of staff was probably the biggest thing. And the supply of cotton through to the supply chain was the second thing. – David Statham

Nick Gillingham was involved in assessing the suitability of a location which involved considering both climate diversity and whether the logistics of co-ordinating operations between the two locations was possible.

Generally, when the Murray Darling Basin gets a drought, everyone gets affected. The Northern property is totally out of that area. In theory, we're that far away it's not affected (by Southern droughts) but it's on the limit though of being too far away. You don't want to get to NT/WA and then logistically it's a real nightmare for moving trucks and machinery. – Nick Gillingham

The Statham's had noted the new endeavours had boosted staff morale during a time when working in agriculture in NSW was bleak. When the new farm was purchased, staff from Keytah began work on a fly in – fly out (FIFO) basis. The importance of retaining skilled staff in a drought so that production can quickly expand when water becomes available again was emphasised by farm manager, Nick Gillingham.

> *…we did it FIFO because we shut Keytah down. It was either shut it down and do this (expand into the North) or make some staff redundant. I've been in that position 10 years ago (where a significant number of staff were made redundant), and it was a bit of a nightmare when we geared up again… We had a few disasters after that first initial rainfall back in 2010/11…you can't just turn the key and everything just starts up again….I worked really hard (this time around) to try and keep all those staff and didn't make anyone redundant during the drought. So hopefully we don't have too much of an issue when this water turns over and we're back in full production*– Nick Gillingham

When Keytah comes through the drought and production begins again, the plan is to transition away from fly in-fly out and hire a mixture of permanent staff with cotton experience and new locally based recruits who are settled in the area. Discussion on the cotton industry workforce in Northern Australia is expanded in Chapter Six.

How do the entrepreneurs view the future of the cotton industry?

Three areas vital for the future of the cotton industry that were discussed in the interviews was (a) connectivity, (b) traceability, transparency, and trust, and (c) the next generation.

<u>Connectivity</u>

> *The biggest thing that's facing cotton growers is your connectivity and your telecommunications because if you haven't got that you can't employ technology, it's not reliable enough and you are going to end up going around in circles. – David Statham*

Connectivity has already been discussed in terms of being a facilitating condition of innovation occurring on Keytah. As the potential for digital agriculture grows, it is important that growers invest in adequate connectivity and telecommunications to have appropriate infrastructure in place when they are ready to adopt these technologies. The next generation of workers will be expected to perform their tasks in the most effective ways, and this will depend on reliable internet. Frustration around reliable connection could become a pain point in their career.

> *Interviewer: When did you make the decision you weren't going to wait around for Telstra to solve the problem and you were going to take it into your own hands?*

Nick: It got to the point, basically, when we were going to have to move an office into town to operate at any sort of capacity using service. And it would have cost, well it was one of the contributing factors to losing a good agronomist. He was getting so frustrated with it and he couldn't cope with it anymore.

Interviewer: Is that because that connectivity underlies the data capture you need to do, to do your agronomy work properly?

Nick: Yeah, correct.

Connectivity is not only vital for working in ways to maximise farm productivity, but also essential to attract the younger generation, because it is central to their lifestyle.

the thing is the workforce is getting younger, you need their skills, and all these technologies we're using you need a younger brain. Most people won't survive without their mobile phones and connectivity. – David Statham

Social norms for the younger generation require immediate access to information, communication and relational needs fulfilment, entertainment and cultural touchpoints, and engagement in education and training occurring through internet-based services and smart phones. A failure to meet societies expectations for adequate connectivity where they work and live will mean reducing the talent pool that cotton farm businesses can draw on for their workforce.

Traceability, Transparency and Trust

There are people that want the data, that want the real story, they want to connect back to the farm and they're prepared to pay. – David Statham

Good Earth Cotton™ is responding to shifting consumer demands for sustainable and ethical fashion. Due to the complexity of the supply chain, traceability has not been possible in the past. Instead initiatives like the Better Cotton Initiative (BCI) rely on the mass balance system. While BCI is transparent about how this system works and has updated labelling to disclose it, the consumers' desire to physically purchase garments that are guaranteed to consist of sustainably grown cotton is not being met. This is not to say that BCI does not have an important place in improving global cotton production environmental sustainability – it does, particularly in encouraging companies who manufacture clothing that is at an accessible price point for many consumers to enhance their commitment to sustainably produced cotton. However, the validation of product origin and the FibreTrace™ technology validating Good Earth Cotton™ meets a specific demographic of consumers' desire for transparency in order to trust environmental claims.

…. I would be very wary of telling a story that says that it's actually my cotton used to create a fabric if I couldn't 100% guarantee or authenticate it, let alone make statements of environmental or ethical compliance. – Danielle Statham

When discussing their aspiration for Good Earth Cotton™ , Danielle touched on the phenomenon of green washing, a term that refers to the process of misleading consumers about how a company's products are more environmentally sound. With the FibreTrace™ technology, on-farm data capture, and the independent audits on their soil carbon levels, Good Earth Cotton™ can effectively combat green washing and build trust in cotton production on their farm, and by extension, trust in best management practice in the Australian cotton industry.

Expanding their farming business to encompass a vision for an integrated supply chain has led to different skills needs for the Statham's workforce. One example is Danielle's skilful communication in explaining farming practices in a way that bridges knowledge gaps and connects with a broader consumer-based audience. Telling this story, supported with data, will enhance and maintain Sundown Pastoral's social licence.

The Next Generation

The Statham's have built a business that has a range of roles requiring different skillsets that would allow the next generation to see a number of different ways they could use their talents in agriculture. The technology component of the business sets them on a trajectory to compete with other digitally based industries to attract STEM skilled people into a farming-centred agricultural business.

> *A lot of young people leave the farm to go to boarding school or to go to the city, they don't want to come back to the farm because it's mundane and it can be boring. Some farming techniques can be old school. They want to be involved in technology, they can see there is a wider world out there and it's exciting. The future is exciting on another level which they understand. To have technology on your farm and to have the full supply chain that we're creating actually excites the youth and they want to be a part of something new. The kids who are potentially not interested in agriculture become interested in agriculture. Or those kids that were from agriculture find a rekindled love for it because there's more excitement back on the farm. They can take new ideas and implement technology back there. – Danielle Statham*

There is an interest from the next generation about where their work fits into the supply chain and the broader world of work.

As Danielle notes,

> *we've got a young agronomist that is working under Nick. He's so excited about the whole Good Earth Cotton™ , FibreTrace™ story. They're really proud that the fibre they grow could be going to certain brands. The boys know the brands we're talking to and they're blown away, they're absolutely thrilled that what they're producing on the ground could be promoted in stores worldwide.*

This enthusiasm for this aspect of the business was confirmed by Wil as of interest to his generation, with other older workers being more focused on the farm and what they do rather than how this work fits into the bigger supply chain picture.

> *It'd be quite rewarding for everyone to see it be successful, so I'm excited about it. Some people that are on the farm maybe not. Not that they're not excited, it's probably a generational thing. I can see that that's where everything's going to go. People demand to know where their food comes from and where their fibre comes from. I can really see the importance in being able to tell that story at a consumer level.* – Wil Jackman

The Statham's were also interested in better connecting the education system to the real world of innovative digital agriculture.

> *I think that we need to be educating the education system. Even right back to primary school level. I think that our ag programs should be better connected…engaging the youth in agriculture in exciting technologies.* – Danielle Statham

Education, extension and connecting the next generation into the business is part of Sundown Pastoral's social sustainability plan for the future. Investment in infrastructure on Keytah included plans for a lecture theatre that makes it possible to host quality educational experiences that could impact on attraction of the next generation to the industry.

> *There's a passion there to be able to bring the fashion industry, the agriculture industry and education industry all together, collaborating together and to be able to have that available at any given time through Sundown Pastoral Company. To be able to use our facilities, to be able to have time with our key staff members, other people in the industry, to bring all those thread lines together to take it forward and learn new skills. To have that as part of their curriculum – where they come out every 6 months. But that has to start at high school level, in their ag programs, for the kids to be interested and to understand that there are different techniques out there to what Mum & Dad or what Gran & Grandad used.* – Danielle Statham

Another way that Keytah was contributing to getting a work-ready next generation and trying to attract the next generation into the cotton industry was by participating in the Cotton Australia Gap Year program. General Manager, Nick Gillingham noted this was a worthwhile investment for them and an effective strategy to get young people switched onto the cotton industry, thinking practically prior to their university experience.

> *We have found that the cotton gap year program that's been available is very good. It would be good to keep that running because I think a lot of those people that do that gap year do tend to float back into the cotton industry once they finish uni because they have a bit of a background in it*

before they went to uni. You know, we've picked one guy up who was from Canberra, never really seen a farm before and he was interested in cotton. Now he's working back on cotton farms. Hopefully he'll come back here at some point too in his holidays. I think getting some people who aren't from ag into ag is good. – Nick Gillingham

It was discussed that issues with the relevance of agricultural education extended beyond high school to the university system. Encouraging work integrated learning experiences within agriculture businesses that are data-driven is essential to give university students the skills and abilities to be ready to embrace a digital agriculture approach to farming. The lack of practical knowledge of how these systems work and how to work within these systems impacts on the employability of otherwise well-educated graduates.

Our education system is nowhere near up to speed in either the universities or the high schools in regard to actually what happens on the farms today. It's too far behind. And that's a challenge. – Danielle Statham

When I left there was definitely a huge gap there. If its science and business and they can get the basic understanding, then they'll pick it up pretty quick on the job, the practicality of it all. There's always been a little bit of a disconnect in Australia, the actual farms to the universities. I think in the USA they do a better job of connecting the universities to the farm. They do a lot more of the trial work through their university whereas we sort of have the trial work done in a separate department in the university, but they have been getting a bit better lately at working with industry. – Nick Gillingham

Linking the farm with the education system will provide meaningful experiences that can inspire the next generation to aspire to a career in the cotton industry. It will also improve understanding of current practices and standards on cotton farms and demonstrate the sustainability of the industry to future consumers which can be expected to have a positive impact on social licence.

Summary and Conclusion

This case study has examined the personal and work environment factors that intersect to create an innovative business built around cotton production. The workforce impacts of recent changes, including automated irrigation and expansion of cotton production to the North of Australia, have been discussed. The main findings include:

- A collaborative network that draws on diverse experiences strengthens endeavours to innovate in the industry.
- Mastery orientation, openness to experience, curiosity, humility, persistent determination, and a dissatisfaction with the status quo are associated with entrepreneurship and intrapreneurship on farm.

- Acceptance of the learning curve costs, investing in the infrastructure required for digital agriculture, and encouraging collaborative partnerships facilitates intrapreneurial behaviour on farm.
- Data is valued for improved decision making, asset and resource management, and to improve transparency by validating best practice management on farm.
- Implementing digital systems on farm and increased transparency with workforce requires skilled people management and transformational leadership.
- Automation is viewed as positively influencing work conditions and workplace culture, and increasing the skillset required of the workforce.
- Data and effective communication help to build trust and maintain social licence
- Technology and digital agriculture have the potential to inspire the next generation to seek out a dynamic career in the cotton industry.

The positive impacts that digital technology can have on workplace attraction, retention, and culture, and the management practices required to manage any potential negative impacts from the use of these technologies in current roles, show an optimistic way forward for increasing adoption and the benefits that this can bring to the industry. Furthermore, ensuring the digital revolution in the cotton industry is visible and connected to the learning experiences of the next generation is vital to compete with other industries that aim to attract the STEM talent pool.

At the centre of the digital agriculture future for the cotton industry is the collection, management, and use of data. Cotton businesses that have not already begun collecting the data required to validate their sustainable practices need to consider the future impacts on their business. To postpone this, leaves businesses unable to objectively demonstrate their environmental credentials. The ethical and sustainable production of commodities and the origin stories of the goods they become is increasingly important to consumers at a time when the cotton industry faces challenges to its social licence. Transparency and traceability to build trust cannot happen without data to validate sustainability claims.

Chapter Five: Summit Ag Agronomists: Diversity and Connection to Build a Stronger Future

Introduction

Summit Ag Agronomists was founded by two agronomists, Emma Ayliffe and Heath McWhirter, who have extensive experience in the Australian Cotton Industry. Over the course of the case study interview, two themes came through in terms of how these people are actively shaping the future for themselves, their business and the industry. The first, *diversity*, was discussed in terms of the *diverse* skill sets of an agronomist, the *diverse* revenue streams that could be developed from these skills, and a desire to expand into a *diverse* network of supported independent agronomists across *diverse* geographical locations. The second, *connection*, was discussed in terms of the ways agronomists act as a valuable *connector* between various players in agriculture, *connecting* growers to new ideas and innovation, a new business venture, Yacker, that sought to *connect* people's knowledge networks, and identifying the opportunity to become more active *connecting* university graduates to relevant learning experiences to develop the next generation of agronomists. Industry improvement and a sustainable, ever-evolving career comes through these two themes.

In addition to these two overarching themes, insight was offered into two main research questions:

- What is the changing role of an agronomist, including opportunities and threats shaping the future of industry?
- What factors are associated with technology adoption by agronomists and their clients, and the innovative behaviours of growers?

In prior literature, the potential for AI analytics to disrupt and remove the need for an agronomist was proposed. In discussing this, these participants felt that while tasks may be facilitated by technology there is still a need for skilled human-centred approaches to advise on how industry farms now and influence change as to how industry farms into the future.

What is the changing role of an agronomist, including opportunities and threats shaping the future of industry?

An agronomist can be a multi-faceted role, as described by Emma Ayliffe:

> *As an agronomist, you play a role as a business manager, as a counselor, as a marketing manager, as a conduit between researchers, networks, suppliers. You play a role in managing things like chemical demand with resellers. Yes, we're an agronomist, and we put that hat on and we go and bash around a paddock and count the bugs and work out when you should irrigate.*

> *But we play so many roles in the wider industry. You know, we're the conduit between the researchers and the growers in the local community. We get called in when things go pear-shaped, and the EPA get pulled in. We're the ones that have to go and stand as the conduit between the grower and the government. We quite often will put our hand up to take those positions in community roles to be the voice for our producers because producers don't want to.*
>
> *So I think that while people look at agronomy and they think of "Yeah, a sweep net and a muddy paddock". I think the realities of the job are so much more. And I think people underestimate the amount of different skill sets that we need to have to be bloody good at what we do.*

To understand more about the development of an agronomist, the education and training that Emma and Heath engage in is discussed. Factors that are influencing the changing the role of agronomist identified within each aspect of the Summit Ag business are examined. These business activities include: (a) consulting, (b) farm management services, (c) research and development, and (d) an ag-tech startup.

Education and Training

The agronomist profession is one of continual learning due to the changing conditions (weather, insects, and diseases) from year to year. Emma and Heath had developed their current skillsets through a mixture of:

(a) University education, (undergraduate degrees in science (agronomy major), post graduate degrees in agriculture and agriculture economics, UNE cotton production course,

(b) Industry-led development programs (corporate farm cadetship, Future Cotton Leaders program, Picture You in Agriculture's Young Farming Champions program),

(c) Vocational training courses (precision agriculture, fertiliser, corporate governance, communication and building relationships with clients, IPM), and

(d) Experiential learning in the workplace and community (past on-the-job experiences such as working as an on-farm agronomist, conducting research trials, members of executive committees for agricultural organisations).

With regards to their skills to work in the cotton industry, they particularly noted the value of the UNE Cotton Production Course.

> *I think that cotton production course at UNE is the backbone of what most people in the cotton industry do or should do, particularly consultants and advisors or people in agribusiness. I think it's a really good grounding* – Heath McWhirter

A combination of short courses and on-the-job training was important for new entrants to industry. Revisiting short courses, such as integrated pest management (IPM), as a more experienced agronomist was also useful for

refreshing individual's knowledge of best practice and refocusing their attention on different elements of their job. It was noted there was a gap between courses targeting entry level foundational skills development, and those covering the higher-level knowledge that comes from current research. Emma and Heath noted a potential training gap that could be addressed with the introduction of mid-level courses to scaffold a clearer learning journey for those in the workforce to develop their careers.

Both agronomists have a growth mindset with regards to diversifying their business and a thorough understanding of the transferability of their skills. These career self-management skills allows them to be actively engaged in identifying opportunities for work linked to current industry challenges, and developing value-add areas for industry that build off their existing knowledge and skillsets. A future-focused orientation also means they are seeking to strategically upskill themselves in order to effectively craft their careers in response to industry needs and ensure their grower clients are adapting with the times.

Building a Multi-revenue Business

When we started, we understood that had to be a fundamental thing of our business that we only wanted a smaller proportion of our revenue directly associated to that consulting. - Heath McWhirter

While the core of the Summit Ag business is consulting, they also have diversified income streams through farm management, research and development, and entrepreneurial activity (an ag-tech start-up). This is done to balance risk when factors impact production and consequent demand for consulting services reduces. For example, in the second/third year of operation, while water allocation meant cotton agronomy consulting slowed, expanding their expertise in other crops/horticulture commodities and successful tender for research projects relevant for one of their production valleys meant this part of the business expanded. Through quieter years, the business partners developed an ag-tech start-up that aims to improve communication efficiency and knowledge sharing amongst people within the industry. The idea for this business was formed when the agronomists identified that their clients and the wider community could benefit from obtaining information from a range of direct sources with different experiences. Each element of the business compliments the others and works to ensure an economically sustainable business. The variety of tasks involved in the different aspects of the business create opportunity for further on-the-job skills development.

Consulting

Factors influencing the changing direction of the role of a consulting agronomist include: (a) location specific trends, (b) farm business structures, and (c) the use of data and technology. Additionally, potential risk factors to the ongoing

sustainability of a consulting agronomist's work and strategies used to manage these risk factors were identified.

Location Specific Factors

Different threats and opportunities for industry influence the direction needed to be taken with regards to continuous learning for agronomists. For example, in the production valleys where Summit Ag currently operates, the almond industry is expanding, and as a permanent planting, it is a possibility this commodity will dominate water allocations and negatively impact row crop irrigators, including cotton growers.

> *So for us as a business, it means that we need to be working with our growers in an innovative way to set their business up to either capitalize on the boom in the boom-bust cycle, or diversify to allow consistency of income. But then also us as individuals, we recognize that we have to get into the almond game.* – Emma Ayliffe

Farm Business Structures

Farms and their workforce structures are changing which in turn changes expectations for the role of the agronomist. There is a trend for family farms to expand and take on a more corporate style management system. This means the growers are increasingly busy managing the on-farm logistics, the workers, and the business operations and may not have the real time in-field knowledge they have had in the past. These farms look to bring consultants into the business, to outsource the identification of problems in the crop, develop feasible solutions and make the agronomic decisions for crop management. In such arrangements, the knowledge of the farm in terms of natural resources like soils is more often being established and studied by the agronomist and then transferred back to the grower in the form of the rationale for the agronomist's decisions. Whereas in the past, growers held this knowledge and used it to describe problems to agronomists for additional solutions to be generated for their crop management. This second approach is still favored by some established growers in smaller operations where they still have the time to be the 'boots on the ground' in their daily activities. This subtle shift in expectations, relies on a highly skilled agronomist who has established a good, trusting relationship with the grower.

> *Once upon a time, a lot of the family operators knew everything that was going on in their paddock and they'd ring you to go and look (at a specific spot). They know their farm back to front, inside out and you're very much guided by them. (Now) with the larger scale family operations, they're busy… They want you to come in, drive around, find the problems and tell them what to do to fix it. You'll become part of that management team and there's a lot of freedom and poetic license that you're given by those growers to make the decision and nine times out of ten they're happy to run with it.* – Emma Ayliffe

Technology used in consulting

The agronomist role is one that is being augmented by technology. New tools are aiding the efficiency and effectiveness of the tasks an agronomist performs but they are not replacing their consulting job. The central tasks of a consulting agronomist continue to require evaluating the evidence, drawing on knowledge and weighing up complementary and competing aspects of a system involving environment, economic, and social factors to make the best possible recommendation at that point in time. There is sufficient complexity in the systems and diversity in environments that 'ground truthing' of data by the agronomist is important. Adding to this, there is a human element when it comes to the execution of recommendations that the tech does not factor in, but an agronomist can. People do not always behave as they say they will or in logical, rational ways.

> *Tech doesn't take into account personality types. We've got growers that we'll say (to them) irrigate on Thursday because we know they won't (be able to get organised) until Friday or Saturday. Some you've got to say to irrigate on Saturday because you know they're going to say "I'll just start a day early, just so we get around on time".... none of this stuff takes into account the human factor.* – Emma Ayliffe

Reflecting on the most significant technology changes that have influenced their job performance, the introduction of the iPad and access to NDVI maps were flagged as particularly useful. The introduction of the iPad allowed for digital report writing, in-field data entry (including photos and notes), and access to information systems available in app format. NDVI maps are used to plan the structure of the agronomist's farm visits, with areas identified for inspection prior to arriving on farm. They give an objective bird's eye view, as opposed to trying to only spot problem areas with the naked eye. Both these tools allow daily activities to be more time efficient and for the agronomist to more effectively attend to the crop whether it is recording or accessing information to aid their management strategy.

<u>Farm Management</u>

The farm management aspect of the business came about with an opportunity to help some owners redevelop a property to sell. Since then, Summit Ag have taken on farm management of another property and this activity reduces their economic reliance on the number of cotton hectares planted by their clients. Strategically, this work activity has allowed them to diversify the on-the-job training experiences they can utilise for a university graduate that has been working with the business throughout his studies. This secondary outcome from the farm management business stream addresses some of the skills gap that is observed for the next generation undergoing the transition from university to work.

> *we've put him on a farm for a season of driving tractors and irrigating and understanding the production side, which is what Heath and I both did,*

which gives us an incredible foundation to be able to relate to growers and understand the production side of the business too. – Emma Ayliffe

Research and Development

Agronomists can play an important role in connecting the research that may happen in controlled environments to the multiple real-world contexts (different farm systems, different production valleys) where it is intended to be used. A connection to research as part of the business also brings benefits in terms of the development of knowledge and skills, as well as being active in influencing the future direction of agriculture. As relationships are established, this influence can be enacted in two directions to improve innovation in the cotton industry. In one way, Summit Ag are connecting researchers and entrepreneurs to real world problems, and allowing them to obtain important feedback about the impacts (intended and unintended) of their products. In the other direction, they are more confidently able to bring new technology and agronomic solutions to growers. As Emma explains:

> *I think that's where the research really fits in well. Because we're getting access to a lot of products and technology and stuff like that before it's commercially available and linking us in with the next step before it is the next step, if that makes sense. So it allows us to be up-skilled and have a really good handle on what's coming through. It also allows us to build good relationships with the people that are going to develop the tech and the chemistry to throw problems at them to help us solve… (we can) test some of these (products) in our environment and offer feedback around what they expect it to do, but also around some things that maybe they weren't expecting it to do, and some added benefits or concerns that we have.*
>
> *A lot of the time, (technology is) being developed by amazing researchers at university that don't understand fully the production side and the impact of what they're trying to do on the production and maybe where there's incompatibilities. So we can, you know, help be at that coalface and identify, like, "that's a really great concept, but it's not going to work because of x, y, and z," then we're not seeing these techs being released and growers looking at it going, "Oh, that's shit and we can't use it" kind of thing. And it's going to enable that rollout to kind of happen with less of a lag.,*

Ag-tech Startup

> *(We've got) our aspirational (revenue stream) when we get Yacker to be fully commercial, because then that's not related to agricultural water or commodity price. And that's our vision of that project that we've been brainstorming for two years and now making it reality in our drought year.* - Heath McWhirter

The wide range of expertise agronomists develop in their jobs, and exposure to the different farms, and people who are involved in agriculture means they are

uniquely placed to clearly identify and develop practical solutions to problems in all aspects of the farming system. In this case they have created a social communication platform solution to develop people capability, collaboration, and community trust. Yacker recognises the power of diverse networks to improve people's access to information, exploration of agricultural challenges, and to provide relational supports, both professional and personal. These connections between people are facilitated in a secure platform that allows users to arrange conversations via phone at convenient down times, such as when driving in the car.

One of the impacts of Yacker, if widely adopted by industry, could be accelerating technology acceptance and adoption. This platform gives a central space for curious growers to ask questions and find experts or more experienced peers to assist in their journey towards adoption of digital agriculture technology. Researchers or ag-tech companies could get feedback on ideas and students could learn more about the real world of agriculture by connecting with available growers.

Building a Sustainable Career

A sustainable career does not only mean earning sufficient revenue in your business or income in your job. Work can mean long hours and requires effective time management and relationship management to set clear expectations with clients around availability and acceptable response times. Being responsive is particularly important for farms where the agronomist has been given greater responsibility for the overall strategy and the farm manager may not have full awareness of the impacts of taking certain actions with the crops. Agronomists need to be easily accessible for these types of operations. When your job productivity is about working with people, weather, and natural resources towards outcomes (getting a good crop) and not hours or outputs (number of hours, number of reports completed), it can be challenging to ensure this is a sustainable workload and for an individual to have sufficient personal and recovery time.

Being highly organized and having good time management skills is one way for Summit Ag to sustain the level of work they do. Use of tools such as Monday.com help track all the moving parts of the business and the team activities to ensure efficiency, for example, getting a team member who has consulting work in a particular area on a specific day to also perform an activity on an R&D trial site in the same area. Likewise, use of other tools, like Zoom for remote team meetings, a WhatsApp group chat for team problem solving (i.e. what is this weed?), and Google photos to capture images and store in a centralized bank for report writing, are used to effectively collaborate and support each other's work.

Successful agronomists who stay in the profession develop a good understanding of their skills, managing risk and uncertainty and what is within their control.

when you first come out of uni, you think, you are expected to know everything and get everything right all the time. But in reality, it's so much more bearable, it's about trying to manage people's risks and what their attitude to their outcome needs to be - Heath McWhirter

When you leave uni, you feel completely inadequate, you're thrown into the deep end and realise how little uni actually teaches you about the job that you're walking in to. And you feel fine to not know much. But you get to that kind of year three to five, and you think that everyone else knows everything, and there's a lot of pressure on yourself to not be wrong and make the right decision. Then you kind of get this lightbulb moment about year five or six, like Heath said, where you just go, no one actually really knows anything except, you know, the basics. All that we know is the experiences that we've had. And what we've seen in the past of working and not working and, and it's about knowing who to ring, and it's about getting to a point where you're comfortable with yourself to acknowledge that you don't actually know and you need to ring someone or talk to someone else and bounce ideas and come up with that 50/50 shot. And I think that's a case of getting comfortable enough in your own skin and in your own role and with your clients to be able to do that and not feel the pressure to be right. Because you're not going to be, whether you like it or not – Emma Ayliffe

The Summit Ag partners had a very clear vision that focused on the value that team members had in their business, and the importance of a good work culture to support team members. As the business grows, they are considering how to sustainably attract and develop the workforce they require. Ensuring the university graduate employed by their business had good supported and diverse work experiences to develop his/her skills was one way of ensuring a new entrant became a confident and capable team member. Identifying that other agronomists currently working in other businesses or resellers may want the opportunity to be their own boss but not have the skills or interest to handle the business side that is required, Summit Ag have identified a potential opportunity to grow by expanding their network of independent agronomists and being the business 'backbone' for other consultants. There is a clear economic proposition, but it also adds to the sustainability of their own and other careers, as a capable, diverse, connected network that adds to the collective knowledge and experiences that can be drawn on. It also would allow an expansion of their research and development endeavours as they seek to support other agronomists in different geographical locations who could conduct trials.

What factors are associated with technology adoption by agronomists and their clients, and the innovative behaviours of growers?

Discussions about technology adopting for both agronomists and their clients, and innovation behaviours focused on several factors. As previously discussed in Chapter Three, perceived usefulness and ease of use were influential on adopting

new technology and practices within the industry. Differing social norms associated with an openness to innovation had been observed for different demographics of clients. Furthermore, the presence or absence of economic constraints could incentivize exploration of new technologies or new revenue streams. At a broader level, the ability to adopt new technology depends on access to innovative scientific developments associated with cotton and this could depend on the general publics' acceptance of these. The agronomists also noted that the strategic direction of farming businesses towards adoption of technology meant requiring access to higher skilled employees that were in demands across the industry.

Farm Data Management: Perceived usefulness and ease of use

Part of the promise of Agriculture 4.0 is the ability to reduce subjectivity and human error in farm management by moving decision making away from intuitive judgement calls to more quantitative data-driven recommendations. However, while it is useful to have access to information to give greater confidence in decision making, the value proposition for improved profits that come from real time data-driven decisions is currently not realised. The perceived usefulness of data is further impacted by the imbalance of time and labour costs associated with effective data capture, entry and management compared to the time and labour costs of an experienced and knowledgeable agronomist inspecting the paddock. As Heath explains:

> *The reality is you can't make all the decisions from the data because it's.... normally when you make a decision to irrigate a field or put a growth regulator on or spray insecticide, it's more than just data points. There's a lot of other considerations it's hard to capture on a platform.*
>
> *You've got to think all these algorithms and models have all come from people. And those people don't necessarily derive that information from Griffith it might have come out of Dubbo or Victoria or different soil types and different climates, so it doesn't exactly fit. For example, moisture probes on irrigation, the probe might be suggesting that we need to irrigate. But we can go and look at the crop. Look at the weather for the next seven days. And we might decide not to irrigate. There could be 40 mils of rain in two days' time. The probes say irrigate. And if we only looked at that piece of information we'd irrigate a crop and water log it.*

When discussing the usefulness of data, the agronomists agreed it was important for tracking of issues, recording of activities, observations and progress, and then reviewing to identify potential cause and effect of decisions and events in the season. In this way, working with data over time improves the agronomists' knowledge and skills to make effective judgement calls in the future.

A majority of growers will have a farm data management platform designed to be used within their farming business but it was observed that few have integrated this activity (data management) into their daily operations or organised a dedicated resource to utilise such a platform to the full extent. For

an agronomist to take on this activity and capture all the data for clients would mean charging a fee and potentially adding a dedicated role in their business to provide this service. The conundrum is the value of data cannot be realised or proven without ready access to sufficient and reliable data, and without a proven value proposition for data that is tied to profit, the incentive to engage in data capture, entry and management activities remains limited. Clear communication of the economic impact of problems that data can solve is needed for buy in. Furthermore, the ease of use of farm data management systems is a key consideration for effective adoption. This could be overcome with better user experience, design of products particularly trying to efficiently capture and store data in centralised platforms in more automated/less manual ways, and skills development for people to integrate a data management strategy into their farm business. An easier user experience was identified as important by the agronomists who lost efficiency submitting recommendations across multiple platforms for different grower clients.

> *My biggest frustration is when you have multiple growers that do the same thing with about 15 different platforms… I have to understand how to utilise so many different platforms for individual growers to achieve the same outcome… that's where the pain point comes in, is getting guys on the same page and consistency.* – Emma Ayliffe

<u>Working With Growers to Facilitate Change: Social norms and maintenance patterns.</u>

Introducing innovation is a two-way street. While it more often flows from the agronomist to the grower, it can move in the other direction if the agronomist is working with a grower who is curious and wanting to try new approaches. Either way, the agronomist frequently acts as a conduit between ag-tech companies and their clients, cotton growers.

When it comes to exploration and acceptance of new technology or approaches to farm management, perceived differences in social norms were observed when comparing growers with different farming systems or producing different commodities. Generally irrigators were seen to be quite open to considering new ideas and tools. Along with these social norms, the experience of economic constraints, (as in those that are operating within tighter margins) may impact innovation behaviours, e.g. irrigation farmers who have been priced out of the water market are motivated to explore other commodities and ways to value add to their business through direct-to-consumer products. Whereas a grower that is running a business that owns the water and has a comfortable profit margin is content to continue with their current systems. An agronomist working across different farming systems and commodities may be able to overcome these objections to innovate that stem from social norms or growers being in a maintenance pattern to cross-pollinate ideas, once proven, with early-adopter clients. Trialling technology with one interested grower is an effective way to test and evaluate new products.

We spoke to an organization this morning and they've got a new system for organizing yield data. And I know from past experience where I've looked at and gone, "Oh, this is awesome, I'll try and implement it for all my growers", and it just consumes all your time. So normally, if there's something new, we'll identify a grower where that would interest them and put it into their operation and then evaluate it over a season. If that's better than what we're currently doing - off we go… it's a time efficient approach because to just go and set up a new platform for data management, you need to put every field's shape file in, all the paddock history, soil tests. If I would have gone set up something it'd take me literally a week to get it to where it needs to be. Yeah, immense, the amount of time that has to go into these platforms. – Heath McWhirter

Social Acceptance of Science and Technologies

One of the potential game changers for the cotton industry was identified as the new genetics coming into cotton that are expected to further reduce reliance on pesticides, improve crop tolerance, and improve yields. Ensuring these improvements can be realised, means ensuring consumers are accepting of GM technology and support their use. Good science communicators need to build this trust beforehand to avoid any potential misinformation that could threaten access to these technologies.

Demands for a Skilled and Engaged Workforce

As farm businesses expand, rather than expanding the workforce, their employees are required to manage larger areas of land and consequently the industry requires a smaller, more highly skilled workforce. Automated irrigation and robotic precision sprayers (e.g. swarm farms weed-it collaboration) are adding to this trend. To improve agronomic outcomes, workers also need to be highly engaged and motivated to put the effort in to do the job correctly, e.g. follow instructions from the agronomist/farm manager.

The job opportunities for students studying agriculture–related degrees at university are often cited as upwards of five jobs for every graduate (Pratley, 2017). When asked whether they saw this demand continuing, the Summit Ag agronomists agreed, with the caveat that these graduates needed to combine good work experience with their academic subjects.

If I went to nearly all of the bigger farms where there's multiple employees and said here's an ag science graduate with experience in irrigation or farm business, they'd take them tomorrow. I know on two farms at the moment, they're looking for new farm managers, guys that can manage their farm and they want more than just someone that can run the machinery. They want someone that can do the business side for them, give them the spreadsheet on the best return per mega litre (of water) on crops and identify where the custom machinery is … and do all that end of it for the owners, which is a big change, I think from what the historical role have

been. You need to be a uni graduate to be able to do all that, nearly, like they're all the things that you learn at Uni. – Heath McWhirter

There are a wide range of jobs where university agriculture students could apply their problem-solving, business, and farm systems knowledge and skills and add value to different organisations.

We're definitely seeing a shift to people running their operations, not as farms but as businesses. And people are starting to understand that they're sitting on, you know, multi-million dollar businesses that need to be managed by skilled people, 100%. And I think that demand for the ag science grads goes well beyond agronomy and farm managers, you know, there's people within reseller businesses, you know, like irrigation businesses, stuff like that, that are demanding people with a good general background in science and in production that can have, you know, good conversations around the wider production system and think about things analytically and from a business sense and not just go in and plug parts together or, you know, do that basic work. – Emma Ayliffe

It is important for graduates to be aware that university studies are only the beginning of their learning journey, and that they be prepared to work on developing their skills to proactively build a rewarding career in the cotton industry.

Summary and Conclusion

This case study has more closely examined the changing roles of agronomists and their observations of change relating to farm businesses within the cotton industry. The main findings include:

- Agronomists are skilled connectors and can play vital roles translating knowledge between different stakeholders within the cotton industry.
- Continual development and training is essential to developing knowledge required to manage and respond to changes in the farming systems. There is a gap in mid-level courses that connect entry level with later career agronomists.
- Career self-management skills may be needed for ag science graduates to craft their roles within the industry/diversifying beyond consulting or farm management.
- Skills associated with managing workload are necessary to ensure a sustainable career.
- Human behaviour means an agronomist will not be replaced, but rather their tasks will be augmented through the use of new technologies.
- The relative advantage for more extensive data capture, management and use is negatively impacted by ease-of-use issues and an unclear value proposition.
- Farm businesses are changing in such a way that the demand for agricultural science graduates will continue into the future.

The skills and knowledge that agronomists develop in their careers can be applied to several different work roles in the cotton industry, including, but not limited to consulting, farm management, product development, research, extension, science communication and advocacy for the industry. This means an agricultural science degree has a wide range of applications within the industry and people with different occupational interests could build a range of rewarding careers from the base level knowledge obtained in this tertiary level qualification. Some of the job opportunities, in particular consulting, that are widely promoted to graduates remains vulnerable to seasonal pressures such as drought and this next generation will need to develop their ability to adapt and transition at times of reduced work availability. To effectively navigate these risks and identify different career opportunities, these graduates need to have strong career self-management skills.

With regards to the future of work, agronomists are vital connectors of the many different players within the industry and central to the agriculture innovation ecosystem. To be effective contributors when positioned as connectors, agronomists need to be continuous learners, skilled communicators and translators of knowledge related to the diverse expertise of the different stakeholders with whom they interact (e.g. growers, researchers, government, the community). While technology is changing the way agronomists may perform their roles, the human experience and the complex systems that need to be considered when encouraging grower practice change and adoption means their roles are unlikely to be completely replaced by any digital disruption.

Chapter Six: Workforce Considerations for the Cotton Industry in Northern Australia

Introduction

Investigations into cotton production in the North of Australia encompasses the areas in Western Australia, and Queensland that are north of the Tropic of Capricorn and north of Larrimah in the Top End of the Northern Territory (CRC for Developing Northern Australia). A range of crops including cotton are being grown to various scales across the different states. Studying the workforce issues faced by a developing cotton industry in the North is challenging as this vast area is diverse in biophysical properties, infrastructure, and culturally.

The CRCNA (2020) has identified a lack of human capacity as a significant constraint impacting development of cropping in the different areas of Northern Australia. This is evident at each level of workforce. Different factors may be applicable in different areas of the North depending on the maturity of the development of cropping production in the region. A breakdown of issues for each sector of the workforce include:

- Owner/grower level: need to build cropping knowledge and capacity in pastoral focused operations,
- Agronomist/Consultant/Farm manager level: need to be able to access agronomy and farm management skills where people have cropping knowledge and local biophysical environment knowledge. In Mckay's (2020) Nuffield report, it is noted that there is no 'recipe' to grow cotton in tropical conditions, and the need for a highly responsive approach to management. Furthermore, a CottonInfo fact sheet for Northern cotton growers notes: "The ability to contextualise advice to match local conditions is essential" (p.3),
- Farm hand level: need access to skilled labour for both farm operations and to support R&D which could be more challenging in the more remote areas of Northern Australia,
- Industry level support: need access to mechanics and technicians for precision cropping equipment maintenance and repairs which is also affected by remoteness of areas,
- Industry grower groups: the absence of collaborative grower groups in some production areas can slow developmental progress, limiting peer-to-peer learning, inhibiting the shared management of risks required across the valley such as adoption of IPM/stopping spray drift, and establishing a unified position to advocate for growers with other stakeholders in the area who may hold different ideological positions.

For this case study, people interviewed were working in the cotton industry in The Ord (WA), The Douglas-Daly catchment area (NT), and across various trial sites in Queensland, the Northern Territory, and Western Australia. They included

a researcher, a grower, an agronomist, and a farm hand. The findings of this investigation raise some discussion points to consider with regards to the future of the cotton industry in Northern Australia and confirm what has been communicated in the reporting of other research presentations and reports (Yeates, Grundy, Goldsmith, and Mckay, 2019; The CRC for Northern Australia's (CRCNA), 2020). As development continues, this region may prove significant for the future Australian cotton industry.

Who is being attracted to the industry?

Yeates, Grundy, Goldsmith & McKay (2019) have identified a typography of 5 categories of people seeking to invest in cotton in the tropics, listed as:

- Committed large farm developers connected to local communities with access to land and irrigation water,
- Existing land holders seeking to diversify their farm businesses,
- Southern cotton growers seeking access to land holdings in geographical locations unaffected by drought and water restrictions, consequently climatically diversifying their operations,
- Opportunists buying land for capital gain when cotton arrives,
- Foreign investors.

The CRCNA (2020) notes that with regards to adapting existing business, "most value is realised when broadacre cropping is integrating with other enterprises, particularly beef production" (p. 7). The Grower interviewed for this case study was working within a predominantly cattle focused business and explained the benefits and reasons behind the addition of cotton cropping to this enterprise:

(a) It is a profitable crop; other crops had been grown in the past for silage, not to the same standards that cotton would require. The enterprise could afford the inputs and effort to grow cotton to a high standard because it is a profitable crop,

(b) In addition to the lint, cotton provided a value-add by-product of cotton seed for the cattle - "*if we could get a cotton gin up and running, and that seed stayed local out of the cotton gin, then it would be available to be sold throughout the region, negating the freight issue of bringing feed supplements up from southern regions*",

(c) Cotton was viable because the current genetics (Bollgard-3) allowed for control of weeds that are abundant in the biophysical conditions of Northern Australia.

Furthermore, he added, with reference to the broader industry, cotton grown closer to the Northern border of Australia could mean cheaper export costs into various parts of South East Asia.

Orientation and Attitude

Discussions with participants indicated that initial entrants who would contribute to the establishment of the industry needed to be entrepreneurial with the

economies of scale to manage the initial capital costs (machinery and equipment) and persist through the learning curve costs (repeat trials and potential failures needed to make incremental gains in knowledge and practice). The challenge for the cotton industry is that these types of people are not only considering cotton but are exploring multiple options to diversify agricultural businesses. Without adequate support to build the knowledge, practices and skills required to experience successes, or a consistent value proposition, these potential growers may turn their attention elsewhere.

> *Cotton is the crop that's working for us. But will it always be? Not necessarily. When we get to a point where the price of cotton is such that (*the value proposition changes*) the next crop might be hemp, or the next crop might be melons, or the next crop might be something else. Then we'll certainly look at how we can grow that most highly valuable crop.* - Grower

For southern growers/managers venturing north, an openness to experience (a willingness to adapt to the difference of tropical cotton) and humility (a low sense of regard for the knowledge they have already attained in the south) are required as many aspects of cotton crop management do not transfer to tropical regions. The same goes for agronomists and consultants.

> *Growing cotton, where we are here is an entirely different experience to growing it down south. So the people with existing skill sets that come up to grow it, they will have to learn.* - Grower

> *The agronomists with a bit of Southern experience is great as long as they can keep an open mind to how the crop is going to grow differently up here,* -Agronomist

For the existing workforce in the North, these orientations and attitudes (openness to experience, humility and willingness to learn) are also important to adapt their skillsets from those required for working with cattle to broadacre cropping. Additionally, a worker's level of conscientiousness and interest ensures they will be engaged and attentive which is necessary for the progress of the crop.

As the Grower described:

> *It's 100% attitude. If somebody wants to do the work, then I can teach them what is involved with cotton. For example, I've got a guy who came to my farming crew earlier this season and he's been part of the crop from pre-crop fertilizer right through to now when we're just about to defoliate. He is falling over himself to learn about the agronomy of the plant, what the mechanics are of getting enough seed in the ground and the plant out and up and getting it ready to harvest. His attitude is fantastic, and I couldn't be happier with him. That's one individual case. Another case is one guy was helping me and did nothing but complain about it. If they're going to complain, they're not going to do the job right.*

The interest in cotton that the first worker is described as having in the above quote is an important part of their motivation to build their own knowledge and increase their skill and autonomy on farm. The farm hand interviewed described how learning from the grower about the tasks associated with different stages of the crop was enough to begin self-directed searching for information about the machinery and approaches associated with these tasks.

> *I heard (the grower) talking about it and he was telling me that's what I'm going to be doing in a couple of months' time. So, I thought I'd start looking up to see what it's like, so I knew what I was expecting* - Farm Hand

Connections to the Knowledge Network and Broader Industry

For the agronomist interviewed, accessing skills development opportunities and developing a peer network has been important for their ability to contribute to working in the growing cotton industry in their local area. Activities included completing the University of New England Cotton Production course, conducting trial work with more experienced researchers, visiting other cotton production valleys, and joining the Crop Consultants Association.

Furthermore, cotton researchers working in tropical cotton played an important role in the agronomist's development by sharing their technical knowledge and their industry knowledge. These researchers helped to facilitate agronomist's connections with the wider established cotton industry. The value of these connections was two-fold; accessing agronomy peers to discuss technical skills development and knowledge of cotton, and gaining an understanding of how these consultants conduct their work and structure their business.

> Interviewer: *What was good about your trip across to Central Queensland and Goondiwindi?*
>
> Agronomist: *Being about to talk to agronomists more about the details of the job rather than the crop necessarily, but obviously, the crops as well. Just discussing how they relate to the clients. What their fee structures are like.*

The importance of this agronomist being connected to the wider industry was also to share their expertise. This will be essential as the industry grows and demand for agronomists in the north increases. The agronomist explains the importance of developing the skills required to effectively communicate and consult with growers:

> *There's that challenge, when you get people that have come from a cotton growing area in the south to come to the north, and they're trying to grow the crop almost the same way. You need to be able to have the knowledge and the confidence to be able to explain why that might not necessarily work.*

The grower interviewed was involved with the Northern Cotton Growers Association which has attracted members from the Douglas Daly and Katherine

regions in the NT, as well as The Ord, in WA. With these groups, growers relocated from the south played an important role in supporting new local entrants.

> *It's the southern skill set that we will need in management roles and advisory roles. The farmers up here are intelligent and innovative. They're struggling with that tyranny of distance, but they're really good operators. And they're all sponges for the information that's around at the moment. So if we get some good advice up here, these guys will take it on and they'll learn it quite quickly. And then I think we'll be right. But initially we need some Southern influence.* - Grower

As previously mentioned, growers from the south will need to learn to grow cotton in the northern environments but they do bring baseline skills from which they can develop expertise as they move through the learning curve of the tropics and a sense of self-efficacy for cotton growing which could help encourage others around them to feel more confident and supported in trialling the crop. These growers also bring their connections to the cotton industry knowledge network and can facilitate introductions to help new entrants develop their skills and find answers to problems encountered when starting out.

> *I take phone calls from other growers, wanting to know, what's the best way to handle something. And if I can't help them I can certainly direct them to the people who do have the answer. The cotton industry is very collaborative…. I don't know if the Cotton Growers Association has been instrumental in getting cotton kicked off. I think all these guys were already looking for that high value crop. But certainly, it hasn't hindered the process. I think it's probably been a good help to some people, we've been able to run some workshops and get some important people up here.* - Grower

Tyranny of Distance: Lifestyle and planning the season

The phrase 'the tyranny of distance' is significant in developing Northern Australia, as farming locations are classified as remote which brings challenges for agricultural production. The implications of this with regards to workforce include the different lifestyle that comes from working in these areas and the challenge this poses for attraction and retention. The implications with regards to workforce knowledge and skills include the constraints that distance places on access to resources required for cotton growing and needing to know how to mitigate the risks associated with this lower ease of accessibility when making planning decisions for crop management.

The Grower describes the remoteness:

> *So, pretty much all of the Northern Territory is a remote area. We are 190 kms from Darwin, we're about 220 kms from Katherine and we're 80 kilometres from the closest pub for example. If you wanted to leave the station on Friday night and go and have a counter meal, well you've got a*

160 km round trip to do it. So, the tyranny of distance is a major factor. Then you have to consider that all the people who are going to come and work will have to live on the station pretty much. So, there'll be accommodation issues. There'll be a certain skill base (we need) and people will need to be able to pay for that skillset. If you want a skillset that's been in cotton, you're going to have to be able to afford to pay them to come up and work up here.

The vastly different lifestyle that comes with the remote location can make it difficult to attract people who are used to residing in the relatively more populated areas of Southern Queensland and New South Wales..

The Agronomist discussed this further:

the way we farm here is more like the irrigation on the east coast. So you can get farming people from down in SW Western Australia coming up but it's a totally different system. But they understand what living in WA is like. And then if you get people from the east coast, they don't really understand what living in WA is like, but they probably have a better knowledge of the ag system that we use here. We're kind of a little island I suppose in some ways.

When discussing attraction of the workforce with the agronomist, they described a skilled position within the consulting business that had to be re-advertised a few times prior to getting a suitable candidate. A perceived lack of services in the community, e.g. suitable schooling for children, can lead people to leave the region. Alternatively, the farm hand interviewed, who had been living relatively locally to the station he worked on, described how services in the local community were good and that locals could be attracted to work in farming over the mining industry due to lifestyle factors.

I come from town and most people here come from town. There's a lot of people there that will do it (come to work in agriculture). Especially here, there is a pretty good school… There is better money in the mines but for me personally the lifestyle here is a lot better than being in the mines. A lot of mates and family love coming out here. – Farm Hand

The grower, agronomist, and farm hand all described the lifestyle they had while working in the North of Australia as personally desirable to them. Enjoying the remoteness, the landscape and the easy to access outdoor activities (camping, fishing, hunting) that were on offer in their backyard. Finding like-minded skilled people that this lifestyle appeals to will be important for growth of the industry.

The tyranny of distance and what this meant for freight costs while a gin had not yet been established has been well examined as a factor that limits the growth of cotton production. But the impact of distance on getting access to resources was also a consideration for those working in cotton.

> *…it's getting the commodities in too. Roads can be cut (by floods) in Central Queensland and stop you from getting fertilizer up to the Northern Territory. The tyranny of distance…. we've got machinery dealerships that can help us okay, but nothing is overnight…It just doesn't happen that quickly up here. The tyranny of distance is going to be a major factor in any development in Northern Territory.* - Grower

This raised the importance of trying to plan for what inputs are needed throughout the cotton growing season or trying to keep spare machinery parts on hand.

> *you've got to get all your fertilizer on board during the dry months…. if it's on the highway during the wet months, and there's a particularly big storm somewhere, it can be held up for one, two or three weeks. And a week in a lot of cases, particularly for cotton, can be far too long and can be the difference between a good yield and a bad yield.*- Grower

Seasonal Differences: Workflow and labour demands

The cotton planting window in the North is such that some seasonal demand for workers is in contrast to times in the Southern areas.

As the Agronomist describes:

> *From about April through to September we need other people to help, but it's only really those few months. But there's enough work to justify having a couple of other crop scouts*

This difference in labour demand could match up with off-peak times in the south and presents the potential for the cotton industry to organise for young people on gap years or recent university graduates to rotate through different production valleys to gain diverse experiences and skills. However, the current COVID-19 pandemic means movement of labour around the country is not straight forward and this may not be possible until vaccinations are accessible to large parts of the community. The opportunity within this restriction is a greater focus on upskilling of locals which could be a positive for the industry.

> *So previously, we've had crop scouts from New South Wales and Queensland. And they've been recruited more so through word of mouth rather than formal recruiting of people. But then this year we put out a recruitment advertisement and we nearly had someone from Queensland but that fell through when COVID happened and we ended up getting a couple of locals*

With cropping taking place over the wet season, it is possible that adaptable seasonal staff who are willing to work with both cattle and cropping could find their seasonal position become permanent. Whether workers would be willing to work these hours year-round needs to be determined and this could be further explored.

The Grower discussed this further:

we're trying to plant different crops during the wet season and that can be challenging in itself. I'm much more permanent staff focused than itinerant workers. In the farming sector, we'll probably want more workers during the wet season than the dry season. We'll have more workers coming in to do our fertilizing and planting during the wet season, and then as the crop grows, we won't need so many. But at this stage, I think, you know, currently my number is two staff or two and a half staff for 300 hectares. That would be the same out to maybe 800 to 1000 hectares.

Lack of Critical Mass: Implications for training

One of the challenges for skills development is that at the time of the interviews there was a lack of critical mass that impacted the feasibility of offering in-person formal training programs to develop workforce skills.

As the Agronomist described:

There's not enough people to get the interest. You'd either have to travel or get someone specifically here, and that does cost a lot. So that can be tricky. But I've done a lot of remote courses at times and the webinars that people put out from time to time have been pretty handy

While the critical mass is not yet there for formal training, the role that an experienced person on farm and their ability to train people on-the-job plays is very important for skill development of the on-farm workforce. Many cotton specific on-farm skills, e.g. round bale picker machinery operation, may not be of interest yet as having that machinery within a business is not yet feasible and tasks are outsourced to contractors. However, the grower interviewed felt that reaching a critical mass was not far off for their production valley.

He discussed it further:

I think (at the moment) it's probably on the job training for individuals. As we move forward, there will be some industry training. For example, we'll have a spraying workshop that all the guys who have the commercial operations up here and the individual farmers themselves can all get into one room and we can all learn how to minimize our spray drift, how to do it better all the time. All those workshops that are used through the southern regions, freighting your cotton, best management practices, integrated pest management, we will get to that we just don't have enough area or numbers to be pushing it terribly hard just yet. Having said that we have all gone through the accreditation process to grow the Bollgard 3 cotton. So the skills training will come. It's just very early days at this stage. That critical mass is probably going to happen sooner rather than later.

As the industry becomes more established and a gin becomes part of the infrastructure in the production area, local people will be able to see the bigger industry that they belong to when they work in cotton. Understanding and seeing

the process whereby their labour on farm becomes a product for export can be an important influencer on interest, attraction, and engagement of workforce.

> *I'd like to see it processed in the gin. I reckon that would be pretty good. I think the harvester is going to come here in the next couple of days. It'll be good to see that machine working. I'd just like to see what they do and how to do it and how they separate the seeds out of the cotton. It would be interesting.* - Farm Hand

Precision Agriculture: Skills demands and trial experience

An adaptable and agile production approach is needed but requires investment in skills, and specialist equipment. In particular, skills around Integrated Pest Management (IPM) was highlighted as very important. The different seasonal conditions mean there is very limited, if any, dormancy period for insects. Failure to control pests has been responsible for past failures to develop a cotton industry in the North of Australia

> *we need to be on our insect pests much more than southern regions*. - Grower

> *being aware of that IPM stuff is really important here, because we've got a history of resistance in heliothis. So it's something we've got to be really mindful of going into the cotton production.* - Agronomist

Having a production area-wide IPM program and dedicated skilled staff to carry out these tasks is essential. In McKay (2020), the issues of pest and disease management associated with ratoon cotton that exists when an operator has not ploughed a headland properly were noted. This could be a lack of knowledge, a lack of skills, or a lack of engagement.

Upskilling farm hands on how to scout for pests and bugs will help respond to any issues as they arise. The skilled agronomist and farm manager/grower both play a role in developing employee knowledge in this area.

As the farm hand described:

> *I can't remember all the names of the bugs that we've got to look out for, we'll take a photo and write a description. And then one of the agronomists will come out here and go through and have a look.*

The Northern context is such that precision agriculture practices are still being explored and trialled. Growers' skills and ability to conduct trial work on their farms, exploring irrigation (if they are in an area that this is required/accessible) and the varied soil types across large properties is needed. When speaking to the grower, it was clear they were embracing the opportunity to develop sustainable approaches suited to their environments and not simply transferring approaches that had been used in the south. Irrigation systems being explored included lateral move irrigators, centre pivot irrigation, and subsurface drip tape.

Grower on soil types:

there's certainly different soil types over the station and we'll be investigating what the best soil types are for the dryland crop and then a rainfed/irrigated crop

On irrigation approaches:

we can grow it here without having to build the big irrigation dams. You'll grow a rain fed crop with less water and you'll get less yield. But the point being that you can still get a substantial yield and you don't have to chase yields at all costs (because the crop is a profitable one). Nobody wants to destroy these natural pristine waterways up here…. we've got a terrific opportunity in the Northern Territory to get our irrigation systems right…. Now we do know better. And as we develop new areas, we've got a great opportunity to get it right.

Digital Agriculture: Adoption challenges

As with other regional and remote areas of Australia, connectivity remains a major hurdle to any adoption of digital agriculture. This may be exacerbated in Northern Australia. When discussing this issue, the agronomist further highlighted the importance of connectivity and GPS for safety reasons when working in isolated environments.

everyone talks about developing the north and, and that's fabulous. But the further you get away from a town site, the less likely Telstra is to put up a tower. So, then you've got to find other ways of connecting via Wi Fi or satellite. And also, it becomes as a safety thing for us too. We're out in the middle of a cotton crop. You know, if we fall down then no one's going to be able to find us. Those sorts of things. So having little GPS trackers or something with us so that, you know people can at least find you in an emergency is important. - Agronomist

A local area network (LAN) was helping the grower to use as much digital technology as was possible within their operation.

we don't (have good connectivity). We have a mobile service in very limited areas over the station. We are using as much technology as connectivity will allow at this stage. We're doing things like yield monitoring and yield mapping with the harvesters. We're monitoring soil moisture, and soil nutrient levels. We have satellite imagery of the crops. We've actually got a local area network on the station that we've paid for jointly with a CRC project to collect all this information digitally so that it all comes back to a dashboard. – Grower

It was also made clear that technology needed to serve a purpose and provide a relative advantage to manual methods.

Digital agriculture definitely has its place, but we shouldn't think that's the only way we can do it. It's just another tool We're employing the use of technology as much as we can, not just for the sake of it, but if it returns a

benefit to us. So that we don't have to drive out to the paddock, you know, at two o'clock in the morning to check an irrigator well, then absolutely we'll employ the use of that technology.

In terms of the skills to utilise digital technology, the Grower reported that digital literacy was not an issue:

Certainly not in my own experience. The team we've got are all up to speed with that. And I include everybody in that, from the most junior jackaroo to the most senior plant operator. Everybody would be right up to speed with the use of touchscreens in machinery or with the technology that we use. Or have no problem learning it.

Social Licence and Stakeholder Engagement

New entrants will need to be able to advocate for cotton to be grown in Northern Australia as there is at times an emotional as opposed to evidence-based discourse within sectors of the community that may challenge this crop choice. People may be opposed to the growing of cotton due to perceptions about genetically modified crops, water and chemical use. The more local people can become involved in the industry, the more opportunity there is to build trust and disseminate accurate information about growing cotton.

people who don't know a lot about it tend to form their views from what has been in the media about cotton - that it's all bad. There are people that you will never change their opinion, but I've had a lot of opportunities to explain to people, even to my friends, the history of cotton in this area and then why this GM technology is good and how it's not that water hungry plant. - Agronomist

Engagement with local communities and presenting a unified message will be needed. The organisation of grower groups such as the North Australia Cotton Growers Association may help represent the industry in discussions with others who hold opposing views.

Summary and Conclusion

The main findings from the case study include:

- People capability is a potential limiting factor for expansion of the Northern cotton industry.
- New entrants need to have an entrepreneurial orientation and accept the learning curve costs.
- The skills that people from the southern valleys bring to the north is valuable in supporting new entrants to the industry. However, these growers and workforce need to be willing to adapt and relearn farming practices for the new context
- Connecting people working in the Northern regions with peers in other cotton growing regions is essential for their professional development

- Seasonal differences provide an opportunity for seasonal workforce to move between Northern and Southern valleys. This could be particularly useful for young graduates seeking diverse experiences in the industry.
- Trial experience skills will be important for establishing cotton in the North
- Structural issues including the tyranny of distance and connectivity issues associated with remoteness are challenges for the industry. Workforce implications include difficulty accessing training and a lack of infrastructure to use digital technology.
- The cotton industry will need to effectively build relationships with diverse stakeholders to establish and maintain social licence.

An opportunity exists to grow the cotton industry with the expansion of broadacre cropping in Northern Australia. New varieties of cotton mean it is a viable choice, economically it is profitable, and it is complimentary to current production systems with cattle. However, workforce capacity could be a constraint to expanding production. A combination of attracting those with previous experience in the cotton industry to northern locations and upskilling local people is needed. Those growers who do venture north need to be open to having their existing knowledge and practices challenged. Developing people's skills to trial different approaches to growing cotton is required as best practices may look different within new contexts. Collaboration between researchers, agronomists, growers/managers and on-farm workforce is required. This serves to generate the knowledge required to advance an industry in the North and to connect new entrants to broader networks and supports. Investment in solutions to telecommunications challenges is needed to ensure these remote operations can access digital technology to assist production. Skilled communication and community engagement will be essential. Presenting a unified industry position that can gain support from diverse stakeholders is required to ensure social license is established and maintained.

Chapter Seven: Dalara Pastoral Case Study: Setting up structures and processes to build a socially sustainable farming business.

Introduction

Rob Davies is the farming manager in his family's mixed-commodity agriculture business, Dalara Pastoral. The business consists of three properties located near Denman in the Upper Hunter Valley, Walcha in the southern part of the New England Tableland and Blackville on the Liverpool plains. Cattle are run across all farms with sheep also being run at Walcha. A cropping operation at Blackville sees the production of durum wheat, chickpeas, sorghum, and cotton across an area of 2,800 hectares. Cotton is grown as a dryland crop and has been in their cropping program since 2014, missing 19/20 growing season due to drought. In addition to farm management, Rob is the acting chair for the strategic development side of the business and is involved in the financial management with his father, Allan Davies.

Rob was sought to offer his perspective for this case study as no previous participants were engaged in dryland cropping and most were majority broadacre cropping businesses. This bias lead to a narrow focus of the future of work involving conversations about workforce development in relation to automated irrigation and teams consisting of 4 people or more. The cropping operation at Blackville requires only one or potentially two workers in addition to Rob acting as the farm manager. He has offered his perspective on workforce development discussing the different approaches taken when expanding the broader Dalara Pastoral business from 2008 onwards, which does include developing workforce involved with the cattle side of the business.

Highlighted in the discussion was the strategic way Rob and his family were taking actions to ensure a sustainable farming business that will endure and grow into the future. This included structures set-up that value diversity of thought in decision making. Approaches to attract, hire, develop and retain workforce and the values that set the workforce culture added to the social sustainability of the business. Sustainability was also clear in the way succession pathways were clearly defined to progress within the family business.

Personal Development

<u>Early Career Work Experiences</u>

Rob first started working in the cotton industry in the mid 1990's in his last summer of high school, working on a family friend's farm in the Moree area. He continued working for the next few years on cotton farms including having had the opportunity to work for Tony May (who was then managing a farm and is now the Head of Customer Marketing, ANZ for Bayer) and for Frank Hadley's

daughter, Alice Cameron (nee Scott). Frank is credited as one of the pioneers of the Australian cotton industry. Working for these knowledgeable and highly respected people, he developed his appreciation for the history of the cotton industry and the culture of continuous improvement that exists, commenting:

> *I still attribute my love for cotton to that time and learning to work to try to get the most out of the plant. I'm pretty passionate about it… It's a really good industry to be involved with.*

These experiences meant that Rob had the confidence, skills, and supportive network to adopt cotton including it in the cropping rotation (rainfall permitting) when later returning to the family farming business in 2008.

Formal Training and Further Career Development

Rob attended Marcus Oldham College completing his associate diploma in farm management. This program has a reputation within the agricultural workforce as being highly relevant for developing the knowledge and skills of farm managers. Graduates are sought after and very employable. While initially aspiring to complete the degree, career opportunities were present, and Rob pursued the opportunity to further develop his skills while working in the USA for Nippon Meat Packers Australia. As Rob explains:

> *I had to choose a career path or getting a uni degree. I just weighed up the pros and cons of where I was going to end up and it just fell in that direction.*

This situation is not uncommon. When career opportunities become available that are not reliant on a qualification, but on the skillset, experience and ability of the individual, and through these career opportunities the individual has opportunities to further develop their skillset, then continuing formal study may not be the viable choice for individuals in agriculture. As has been highlighted in previous case studies, this is one reason that measuring highest qualification is an imperfect metric of skills and abilities for the cotton industry social sustainability report.

Ongoing Development and Training

In addition to education and work experiences, Rob regularly seeks to stay up to date on new farming practices or technologies through field days. He also reflects on skills gaps and identifies areas for development, then seeks out subject matter experts or short courses that can develop these skills. This attitude to personal development of knowledge and skills is extended to the opportunities that are provided to the workforce within the farm business.

> *We are always looking at bettering our knowledge in the arena that we're focusing on. I'm constantly looking at different field days to attend and different technologies in the marketplace. Whether it's about tractor technology, updated trials with cotton, wheat, chickpeas and sorghum, I try and get to as many of those as I can… And then any other courses that I feel are relevant*

An example of industry-based training included undertaking the Rabobank Executive Development Program himself while also upskilling the cattle farm manager by enrolling him in the Rabobank Farm Managers Program. More

recently, he had identified a need to develop inter-generational communication skills for managing younger staff members. For this, he had engaged the expertise of a consultant to come and deliver some training to himself and other farm managers.

Collaboration and the Knowledge Network

Rob highlighted the value that comes from having good, collaborative relationships with other growers in the area, in particular the growers from the neighbouring properties. Dalara Pastoral participates in a benchmarking group with these growers and has collaborated on sourcing training together.

> *We do a lot with those guys in terms of benchmarking, but also, just general open chat about how the business is performing, what issues we're facing. We were talking the other day, and (the issue of intergenerational communication) was one that we identified being an area for improvement. So we contacted a training provider and they're coming down to meet with us in person.*

In terms of farm management, Rob utilizes an agronomist who specialises in dry land cotton and who introduces new science driven ideas to the strategic management of the crop.

> *…it's a dual effort…. The agronomist is cooking up the chemistry and telling you why he's doing a certain thing and what he's up to and what benefits it may have. He's on the scientific side, and you are the eyes and ears in the paddock, seeing different areas and relaying information.*

How does the grower ensure the future of the business?

<u>Orientation to Work: A custodian mindset and engagement at work</u>

Rob described an approach to work that could fit the description of a custodian mindset. He and his family take care of and act in service to the business. This means they are building their business with a larger vision than their own careers, wants and needs in mind. This mindset underpins their approach to farm management and business management.

> *My brother and I see ourselves as caretakers. So, you might have an asset (the farm) worth millions of dollars but we see ourselves as caretakers rather than individual owners of those assets. We essentially have a view that my brother and I are going to be at the helm, working together in a caretaking role for future generations of our family.*

Underpinning the mindset of a custodian, the value of *care* aligns to the way work expectations are set for staff on their farms.

> *From a paddock perspective, we like to have our farms in a very clean and tidy nature. That's of utmost value to us. Because once we get it clean, and tidy around the working areas, paddocks, green areas, even, you know, having short grass around the paddocks or all sorts of different things that this leads into a mindset that "it's well maintained". It gives us easy to access everything. Everything's clean cut. It's very structured. There's no mess lying around. All the rubbish is picked up. There's no clutter around sheds or around silos. All fence lines are sprayed and all that sort of stuff. That's one of our biggest values on our farms is having a*

tidy workspace and a tidy farm. Because it sets a mindset with the fellow employees and guys that you work with that this is how we want this business to be run, in a very clean manner.

This perhaps not only reflects a custodian approach to work in terms of care, but also an expectation for employees to be fully engaged in work and to do the job properly. Rob noted that this approach to work was also important for how he managed to effectively switch focus and engage in his family life.

From my personal perspective, the core values that are strongly held are to do the job properly and efficiently. Don't cut any corners. And I also take this approach with the family side of things... there's a very fine line between work and family and I try and separate the two as much as I can. And spend as much time in the family arena as I do in the workplace, making the quality of that time really effective and efficient. Which is really important because if you don't do that, you keep thinking about different things all the time to do with work and you don't get to rest.

As described above, this is more than time management, it is energy management. It is not simply about where people are (work/home) and what they are doing (tasks and activities), but how they are being present and attentive while in these domains of their life; allowing quality engagement with family and recovery from work, so an individual can then bring their best self to work.

This custodian mindset (as opposed to ownership) also extends to the way the Dalara Pastoral business has been structured in terms of decision-making processes with the implementation of the board. It allows some detachment to place and for more objective decisions to made in the interest of the future growth and survival of the business. Rob explains further:

Although I've got a heavy connection to the land, after living here for 12 years, if Blackville wasn't performing, and it was a real thorn in our side, we'd have to make the decision to move on.

Workforce Structures in the Business

Decision Making Structures: The use of a board

Dalara Pastoral is one of several businesses that Rob and his family own and operate and has a corporate structure with the implementation of a board. Rob's parents are directors, and the board also consists of two external directors. These two external directors bring perspectives shaped from their experiences in other industries outside of agriculture to the business. Rob reports to the board and executes the strategic direction set by the board on farm. Within the farming business, the managers form a committee to co-ordinate activities that align with the business strategic direction, effectively utilise resources from other aspects of the business, and provide information about the daily operations. Regular meetings and reviews are part of the way work is planned and executed, as Rob explains:

Putting these processes in place, into our farming businesses allow us to not only maximise synergies in terms of the other businesses we own but also to cross check what we're up to and put some guidelines around what

we're doing and how we're doing it. Making it formalized, with a process to follow means everything is very clearly laid out.

The use of the board, with the diverse expertise of directors, allows for more objective and ultimately better decision making to occur to ensure the growth and survival of the business. These structures and processes mean threats and opportunities are regularly identified and managed. The willingness to adapt is part of the business and informed by multiple perspectives.

> *It just takes all of emotion out of it… say the operations at one of our farms have a serious downturn, you know they revoke water licenses altogether and we've got no water and it's been a bad performer for five years. There's nothing to say that we don't go 'we're out of there, let's cut ties and move to a different arena'. Yeah, it's, driven by performance…So that, I suppose, ensures our survival going forward to a degree. At least we think that gives us our best chance and so it's a concept (the farm board structure) that we've adopted.*

Succession Planning: A skilled pathway to greater responsibility

The custodian mindset and more formal corporate-like structure also influences the succession planning for the business: a key activity to ensure the future of the farming operations. The Davies family have been proactive in planning this, coming to an agreement that the business exists as a whole and won't be divided upon transitioning to the next generation. The management of the business is done at the board level and a clear skilled pathway for transition of board directors laid out.

> *For my brother and I to step up and my parents to step down, (my brother and I) we have to complete a securities course and do a directorship course and meet other requirements. We have to tick a heap of boxes from our family side as well in terms of executing financial agreements. It's really clear cut where that path is to become a director of our business.*

This approach strengthens the sustainability of the business ensuring adequate skills are developed and experiences gained to take on the greater responsibility that comes with being a director. This structure and plan reduces the risk of negative impacts on the future of the family business that come with a less clear succession plan.

> *Our family has agreed that we want the business to continue into future years. I am a very heavy believer in that structure because it cuts out any family degradation in terms of in-fighting or any interpersonal issues. People know where they stand, they know what job they have got to do. And in time we will hire, whether it be a family member or not, someone to step into a financial role in the business or decide who will fill a certain role in the business. Rather than informally saying I'll handle this and my brother will handle something else, it's a hired position that if we want to go for that position, we have to put in our resume, go through the interview process with the directors and the management board makes a decision. I believe that, in itself, is a fairly strong concept to ensure that this business lasts for generations, not just one generation and then it's carved apart by my kids or my brother's kids, essentially.*

Attraction, Development, and Management of workforce to Retain Knowledge and Skills

The workforce on the property that Rob oversees includes one or two full time staff who may also move between the broad acre cropping and cattle aspects of the business. On-farm tasks include planting, crop management and storage works. Contractors are used for spraying, harvesting, and picking tasks.

Attraction and Hiring of Workforce

Dalara pastoral consists of a number of workers who have been associated with the business from the onset of operations at the different properties. Having good knowledge of the local environmental conditions was strongly valued and workforce with ties to the community brought a greater likelihood of retention as these workers had built relationships and fulfilling lives in this location. Real world experience is essential beyond any formal training at tertiary institutions.

> *you can sit in a classroom for as long as you like, but if you don't have the on-farm training and experience with the seasons and the weather patterns, and you know what the crop's doing and what the cattle are feeling…. that piece of paper doesn't matter to us. Essentially, we're looking for that environment skillset, it was really important to get that right.*

When there have been some shorter-term seasonal demands for labour, they have been able to look to the local community and upskill them on-the-job.

> *We also have given guys a go for menial tasks who have no skillset at all whatsoever. Like a local guy who occasionally during the drought came and worked for us. He had no formal training in the farming arena. He could drive machinery but had no livestock skills or anything like that. So he went straight into some machinery type roles, helping us feed out on loaders. That suited him. We also gave him an opportunity in the trucks I gave him a bit of on-farm training as well.*

Local workers have the benefit of already belonging to the community and this means they will be easier to retain. These workers still need to go through a screening process prior to being hired that involves an assessment testing numeracy, literacy, and behaviours in different scenarios. This assessment is conducted through a consultant.

The skillset for on-farm workforce has also changed as the business adapted and expanded. When a skilled family member was working on a property, they could afford to fill labour requirements with a lower-skilled local worker but this changed when the operation grew and family transitioned away from being on-site. Rob explains:

> *It required a whole new skillset. So we had a contractor that used to work for us who did a lot of contracting farming & hay making for us. We spoke to him at length and his wife, and we ended up buying his contracting business and then put him on as manager. Because he came to us with, again, the environment factor of knowing the land inside and out but also knowing the district and having family support, and relationships within the community.*

Development and Management of Workforce

Management of staff reflected the grower's orientation, values and expectations within the business. For example, similar to Rob's approach to upskilling for himself, staff are also supported to upskill.

> *I think it's very important, you know, for the cotton industry to be offering up plenty of training programs and development opportunities, but the onus is on the farmer to allow his employees to attend this type of training… At a base level all our employees do a chemical course, a first aid course. Any ticket that they want to pursue or further education in the ag sector we will support wholly and solely., And we'll give them time off to do that.*

Staff are managed to complete their work in alignment with the workplace values of caretaking and have clearly communicated high performance standards set for them. The accomplishment that comes with this helps to develop their intrinsic motivation. Supporting them to feel valuable and that their efforts matter adds to this sense of satisfaction. As Rob describes:

> *we think about it, we don't rush too much. We make sure we finish the job that we're working on at that time. We don't leave one thing go onto another, pending weather situations, obviously. But we usually like to get one thing tied up so it's complete and it's all in sync. Yeah it just works. And it gives everyone a good feeling. They can drive around and feel proud that they've been a part to make the place look how it looks, you know, and I believe it makes for a nicer environment.*

The organisational support that is offered within the business extends beyond developing staff competency and valuing their work to also care for their wellbeing.

> *I think health and well-being with our managers is also important. It's offered up to have yearly, comprehensive health checks done in Sydney, so they can keep on top of their game and make sure they're fit and healthy.*

The commitment to have a quality life at work and a quality life at home, as discussed in Rob's approach to managing his own time and energy also extends to ensuring staff can achieve this.

> *Family and working environment is huge for our business and giving guys time off to go and see their kids play sports and all that sort of stuff…That is one of the bigger parts of our business I suppose*

Engagement with the Next Generation

Dalara Pastoral add to the social sustainability of the agriculture industry by investing in a scholarship for a student attending Marcus Oldham to complete work experience within their business. This financial support helps these individuals to complete their studies.

> *Essentially, it gives us a gateway to that next generation… We try and rotate these young kids through and give them experience. We believe that if you don't spend the time with them, well, the future of ag is looking bleak if you can't give these kids good on-farm experiences. We have to*

work with them a little bit in terms of their experience range and we give a lot of on-farm training at the same time

The preference to support this tertiary institution is associated with Rob's alumnus status and the calibre of students admitted entrance to the programs on offer. Marcus Oldham entry requirements stipulate that students have completed at least 12 months in an industry placement and prefer students to have had exposure to two or more farming systems. This means students come prepared with a baseline of skills that make them more employable than agriculture students who have no prior on-farm experience.

> *They are a cut above the rest to be frankly honest with you... Most kids have already had two years off in the workforce out of school, so when they go to Marcus Oldham, they're usually about 21 or 22 years old. They're not green as green….I think due to their past experiences when they're kids growing up on farm or having gone out to do work experience on farm, they come to us knowing even just simple things and already have those practical abilities.*

The most recent mid-year student employed for 2021 at Blackville had grown up farming in Tasmania and had no prior knowledge of the cotton industry. In further comment on her hiring, Rob noted the several employability skills that contributed to her being the successful candidate. These included good communication skills, curiosity and asking the 'right questions' that demonstrated her existing knowledge and the personal goals she had set for what she wanted to learn from the experience.

> *It's their mindset, ...this young girl, she was very proactive, she's only 20 and she was asking the sort of questions that didn't make us go 'oh wow she's probing' but instead say 'Ok well this girl's in tune. She wants to know what's happening. What her employment conditions are going to be like'. She was really honing in on a few key points. 'How big is the operation? What do we do?' You know, she was really finding out enough about it. That makes you confident that she's going to come on to the job and she's going to be asking questions all the time, which is what you want.*

Similar to the impact that Rob's early career experience in the cotton industry has had on his current career, providing an opportunity for a young aspiring farm manager to gain experience on a farm that grows cotton may give the next generation the confidence to implement this crop choice on properties that they manage in the future, or to actively seek out employment on a farm that currently grows cotton. This type of ongoing scholarship program benefits Dalara Pastoral and the wider industry.

Potential Threats or Constraints to the Future of the Business

When discussing potential threats or constraints to the future of the farm business, Rob raised the issue of the costs associated with purchasing dryland country. Land prices being sufficiently high such that the cost of land could stop farming families (who need to see a profit fairly quickly to have an income) from expanding, leaving it only as an option for larger corporates/super funds who are looking at a longer-term investment and can take the risk on returns.

> *We are currently assessing how we incorporate capital gain into the review process when looking at overall farm profitability. We have previously focused on ROI (return on investment) leaving capital gain figures to one side. The increase in current land values are painting a picture that we cannot ignore the introduction of capital gain increases into our profitability picture. How we do this is still up for discussion as we need to home in on ROI to keep costs at a minimum whilst maintaining best achievable yield and price for our grain/lint.*

At the time of our interview Dalara Pastoral was utilising the experience of a business consultant to better understand how to assess potential expansion opportunities that factor in land value and capital gains, and to set some guidelines to identify future opportunities to grow the business. In terms of considering the future of the cotton industry workforce, access to up-to-date business skills or opportunities to upskill in specific business knowledge areas may be of importance for cotton growers to manage the future of their farms.

Summary and Conclusion

The main findings from this case study include:

- A growth mindset and a collaborative knowledge network help growers to identify and engage with professional development opportunities.
- A custodian mindset helps to take a strategic view of the farm business and the value of 'care' extends from the business through to people management and sets expectations for job performance standards.
- Setting clear structures for decision making and career progression in the family business improves the sustainability of the business for future generations.
- Diverse perspectives from within industry and outside of the industry assist with strategic management of the business.
- Supporting staff to upskill and recruiting from the local community contribute to retention of valued workforce.
- Establishing of a partnership with a tertiary education institution means the business is providing the next generation with quality career experiences. This initiative will also have a positive impact for the cotton industry as young people increase their skills and knowledge required to work in the cotton industry.

From the interview with Rob Davies it is clear that the future of farming is not solely centred around the transition to digital farming practices in the cotton industry. Adaptation and sustainability for the industry into the future also means setting in place business practices that help families benefit from diverse expertise beyond their own to inform the strategic direction and development of

their enterprises. Farming faces complex systematic challenges and this requires a range of expertise beyond that of any one individual.

Clear structures and values that facilitate good communication, team functioning, and support of upskilling means people know what is expected of them, how to be a good contributor to the business and have opportunity to progress in their ability to be a valued member of the team. Identification of the skills required to successfully lead within a farming business and moving towards merit-based pathways are one way to bring greater objectivity to the succession transitions those businesses make. A custodian mindset means people can separate the business needs from their emotional attachments.

Dalara Pastoral's strategy to engage directly with a tertiary agricultural institution is one way to provide pathways for the next generation, including those with no prior exposure to the cotton industry. These students have a supported entry point to learn through experience and build relationships with those already in the industry. It is expanding the students' professional network, familiarizing them with the environmental conditions of the farms the Davies family manage, and giving them the experience of living in cotton farming communities. As noted with the attraction strategy for the Dalara Pastoral workforce, this environmental knowledge and sense of community belonging, and familiarity is important in selecting staff who are likely to be committed to working within this business longer term. This financial support through the scholarship removes barriers for interested and enthusiastic young people to develop their confidence and skills on a cotton cropping operation. For those with no prior experience in cotton it may switch them on to the possibilities of including a cotton crop rotation (if climatically suitable) for farms that they manage in the future. Grower-led initiatives such as this, benefit the whole cotton industry.

Chapter Eight: Columboola Cotton Case Study: Approaching the threat to find the opportunity.

Introduction

Ashley and Bec Geldard own and operate Columboola Cotton, with a broadacre cropping property, Cullingral, near Miles on the Darling Downs. This farm has been owned by the Geldard family since 1909, and Ash is a fourth-generation grower. Cullingral was a dryland property until 2013, when an arrangement was made with Origin to use treated water from their coal seam gas operations for irrigation. The property has been developed to now grow up to 660ha of irrigated and 130ha of broadacre crops including cotton, durum, wheat, mung beans. In the 2019-2020 season 160ha of cotton was produced.

The Geldard's have developed the business over the years for Ash to be able to take on a more strategic role, Bec to manage the accounting, and they currently employ a farm manager to oversee day-to-day operations. An agronomist consults with them on crop management and contractors are used for spraying, harvesting and transporting tasks on farm. Ash's perspective was sought for this case study as his experiences give insight into transitioning a smaller farm (less than 1000ha) to incorporate digital technologies and the impacts this has had on the workforce requirements of the business. Furthermore, in this case study, he discusses the experiences that have developed his skills, the attraction, development and management of his on-farm employee, his own transition from being in the day-to-day on-farm operations to a more strategic leadership role and working to manage threats and opportunities within his business.

Personal Development

Ash returned to the farm after completing high school and has worked his way from the role of machinery operator into the business management side when the accounting transitioned to be managed through digital systems in the early 2000's. He and his wife have taken ownership through a gradual succession process from 2003 to 2012. He has developed his skills and abilities in several ways including tertiary education and seeks out short courses to upskill in various areas including personal development around soft skills, people management and leadership skills.

> *I have done some courses on communication and negotiation... That was a really interesting one. And not just for the business side of it, but more improving my own ability to be resilient and levelheaded…getting a clear perspective on how important that can be.*

Experiential learning has been a significant part of Ash's skills-development. In our discussion the following contexts and situations were discussed that have

challenged him and resulted in the growth of his ability as cotton farm business owner:

(a) on-the-job by working within the business as well as setting up and running his own businesses separate to the farm,
(b) adopting a leadership role in negotiations with coal seam gas companies.

When representing the cotton industry such as with the Basin Sustainability Alliance, an organisation that represents stakeholders in coal seam gas development, mentorship from other growers and leaders of industry have been beneficial for his development.

> *that Basin Sustainability Alliance that I was involved… we were the group trying to form that link between the different stakeholders. Some of the people that I was working with on that committee were amazing people to be around and to see how they operated. I got a little bit of mentoring from being involved in that. So that was really instrumental as well…they were very generous in sharing their knowledge and giving me an insight into how a lot of business is done at that level and how governments actually work with business at that scale. That was a great thing to be a part of.*

Similar to innovation orientations described by other growers, in discussions about developing the knowledge and skills required to implement automation on his farm Ash noted that humility and an openness to experience was required to scale the learning curve.

> *I think the biggest thing I had to do is just learn to completely drop my ego and admit that I know nothing about this, say "tell me what I need to know". Just ask questions and not be afraid to look like an idiot and not be worried about what people might think about your lack of knowledge on a subject. You learn a lot more once you can admit what you don't know.*

Setting up the Business for Social Sustainability

<u>Mindset and Transition of Responsibilities: Drop the ego and learn to delegate.</u>

> *I think a strong business is a business that can work without you in it. And when I really looked at our business, it was set up so that without me in it, it was not going to work.*

Ash has worked to change his business and his role within in it so that his work is sustainable. He has redesigned his job to allow him to manage the key aspects of work that require his input and balance work with his commitments to his family, which are a major priority at this stage of his and his children's lives. These changes have been motivated by a need to manage not just his time, but his energy so he can be present and at his best in both main roles in his life, work

and home. Ash describes some of the personal development training he has done that helped him understand and focus on this.

> *…learning about reprioritising and making sure that when you're dedicating time to something, you're in a position to be at your best rather than spending a lot of hours running it at 30 or 40% your capacity.*

Redesigning his role in the business is not a simple change. It requires a shift in mindset to let go of some of the on-farm operations.

> *That was a bit of a challenge…to try to pass on all the knowledge that I've been guarding, thinking how important I was, and be able to upskill other people and remove myself from being such an integral part of that. So that was a decent challenge. Once I could do that, then my time was freer to spend either working on the business and improving aspects that I just didn't have time to do before and hadn't realised were as important as what they actually are, or be able to spend time with my kids and be part of their life as they grow up. Which I was struggling to do as I was always at the beck and call of what was required on a day-to-day basis farming-wise.*

The willingness to let go of responsibilities and trust his farm manager to do the work has allowed Ash to do the strategic work for his businesses, including the farm business, to adapt and succeed into the future, and to balance the other priorities in his life. Learning to delegate was acknowledged as a skill to be developed:

> *One of the biggest skills that I've had to learn as a manager is to let go of that tendency to want to try to micromanage and not hand over some of that responsibility.*

He reflected on the development of this skill and the cognitive process that influences individuals' abilities to make this transition. Banford, Buckley, and Roberts (2014) have described how "delegation in a local context is a function of the global leader's cognitions and perceptions of their subordinates" (p.646). It is influenced by the culture of the workplace, through learned beliefs, social norms, as well as managers' perceptions of themselves and their workforce. Ash describes the process of challenging beliefs about control and one's unique capability in order to change this behaviour.

> *I think there's two aspects to that. I think some of the decisions can be hundreds of thousands of dollars riding on that decision. So sometimes it's hard to trust someone else to make that decision on your behalf. Even though there's really no reason why you shouldn't necessarily, it's just that people like that level of control in their business. But you look at the corporate businesses that can run very efficiently and most of the people working in them don't really have any stake in the game. And yet they're making much, much bigger decisions. I think that's one element.*

I think the other element is it's very easy to fall into a pattern. For example, when you're working, as opposed to being at a family event, it's very easy to justify that by placing a lot more importance on why you are the only one who could do that task, even if that may not be the reality. You end up feeling probably a little bit more special than what you actually are. And when you start breaking that down, it's often not as hard to teach someone to do the things that you thought only you could do.

Automation and the Impact on Workforce

Since Ash and Bec have taken ownership of Cullingral, the farm has been developed such that it is mainly irrigated cotton (as opposed to dryland) and uses a centre pivot irrigation system. The system is automated, and other technologies used on farm include weather stations, moisture probes, diesel level sensors and flow meters, and fertigation level sensors. The motivation to adopt the digital technology was to gain more ability to monitor the crop and farm operations remotely and to get real time information for decision making and then evaluating the outcomes of these decisions. Ash continues to look at new options and technologies entering the market to expand this.

We looked at what was available technology-wise from a remote monitoring point of view and remote starting and stopping things. I implemented that technology so that while you're on a sprayer or a tractor you can be starting and stopping pumps rather than having to stop and actually go there and do it. Also, some of the technology is measurement related so that we can continually monitor, live, exactly how much diesel we're burning while we're irrigating. Which gives you the information to test that if we start managing it differently, for example we switch one pump off, do our litres per hour or litres per hectare become better or worse at any given time. We're continually looking at what can we do better, what are our major drivers for profitability and how can we improve…what's now available that wasn't available a few years ago at a reasonable price point that now it's feasible to implement.

The impact of access to labour as a constraint on the crop outcome was also a major motivator to adopt technology. This shaped perceptions of usefulness as the relative advantage of knowing that the crop would be watered on time versus the risk of relying on manual labour justified the cost to upgrade.

I didn't want to be in a position where if I couldn't get the two or three staff that I'd need to be out pulling siphons that we wouldn't be able to get water on cotton in the time that it was needed. And when you follow through the cost of being a day or two late on a watering, it was very, very easy for me to justify the cost to implement the technology that we have to automate a lot of that so I don't have to rely on people to be doing it…. when you see the risk and look at it almost like an insurance

policy, sometimes you're insuring against the cost of not being able to achieve something if you don't have it (the technology).

The Importance of the Farm Manager and Considering Diversity when Hiring Employees

The introduction of digital technologies has meant that labour requirements on the farm have been reduced from approximately 4 or 5 people required (including Ash) to now one skilled farm manager to oversee and run the operations, supported by contractors for different tasks. With this reduction in on-farm staff and the transition of Ash to be less hands on, the role of the farm manager, and who is employed in this role, is vital for the success of the farm. With the technology involved this person needs to be "IT savvy" in order to trouble shoot any issues that arise. Ash explained the process for recruiting the current staff member into this role, and what was considered at that time.

I thought I needed somebody with a lot of experience and someone with a lot of runs on the board running similar operations to ours. I got a whole raft of applicants that were exactly the same as me, they were middle age and what they were really looking forward to was the opportunity to spend a bit more time with their family…I had this one guy who his answer to "what are you looking for?" was, "I'd love to have some more opportunity and a chance to prove myself."

The life stage someone is at is an influential factor on their career motivations. Even within a small operation the diversity of the team is important in terms of considering the career stage and aspirations of the team. Ash had already described the importance of the next 5 years and the energy he wants to invest into his family and children at critical stages of their development. Hiring someone who is yet to enter that stage of their life gives him a staff member with a different focus and motivation. This young farm manager had attended ag college and had been working for a reputable employer but had reached the limits of available growth for him in this previous job. He did require upskilling but as Ash describes:

It was relatively easy to upskill someone who was so keen to learn and so keen for extra responsibility. Easier than it would have been, I think, had I taken on someone with all the experience, but a bit less motivation.

The importance of hiring an engaged and motivated farm manager and the trust created with that employee, not the remote monitoring technology, is the main factor that assists Ash to be more hands off with the execution of the operations on farm and in his more strategic role within the business.

I can check the irrigation program is running as per what we planned at the beginning of the week, and it gives you that reassurance but at the moment the thing that gives me the most confidence is the person I've got

running it….my confidence in their ability and their loyalty and that he's just actually keen to make things happen.

People Management

A mixture of formal and informal processes are used to manage and develop the workforce within Ash's different businesses.

> *I try to strike a middle ground between what I've seen with how the corporates run their businesses, and a small business where you can be completely flexible in your (conversations on that) , and I think there's some benefits in both. We have a minimum of one formal performance review a year. And then we would have probably a less formal one every three or four months.*

Staff in both the farming and the engineering business are encouraged to develop their skills through short courses, field days, and training facilitated by machinery and technology dealerships. This is often targeted around individuals' interests as well as the business needs.

> *We sit down over a cup of coffee or tea and just identify ways again that we can improve the business and improve personally and any skill deficiencies and any ways that we can look to upskill through training.*

The collaborative approach to identifying skills gaps is important for people to be engaged in the training opportunities provided to them. In terms of the value of training, Ash notes that the return on investment and benefits to the business are clear.

> *When we've invested in upskilling our staff, it's always expensive at the time, but in hindsight it's always looked very cheap.*

The risks of hiring a young person who is looking for career growth, is that eventually the employee may reach a ceiling in terms of the opportunities available within the business. This is managed through open communication where it is safe for the employee to discuss any potential career frustrations or feelings of stagnation with regards to his job with the grower. By creating this kind of dialogue, succession planning for the farm manager's position can occur with a reasonable transition period for any exiting of the business (if that is the current employees' decision) or with enough planning time, where alternative solutions including expanding the business may also be a feasible option to retain this staff member.

> *I'm very conscious of the fact that if I don't keep one step ahead of finding new challenges for him, he will grow stale with the role and want to move*

on to something else. If I was him, I would as well. If we reach that point where he's conquered every challenge I could possibly find and our business is becoming a bit mundane, I support him in moving on to something bigger and better. The only thing we're really open about is, if he can discuss it with me when he's starting to get these feelings and if he can commit to another 12 months then that will give me time to bring someone else in under him and myself to train up. So we'll have that succession.

Threats and Opportunities

Business Development and Finding the Opportunity Within the Threat

In the discussion with Ash, he was forthcoming about the threats he had identified within the business and the consequent opportunities that he has actively pursued that were leveraged from engaging with the threat situation. The threats/opportunities discussed below include: (a) the growing presence of the coal seam gas industry in agricultural communities and access to water, and (b) community liveability, automation, and access to a skilled workforce. The first threat/opportunity discussed includes transferable lessons in terms of strategic management of threats. The second threat/opportunity discussed is a "wicked" problem and will require the co-ordination of multiple stakeholders within and outside of agriculture to find a solution.

Coal Seam Gas Industry, Agriculture, and Access to Water

The opportunity for the farm to negotiate an arrangement whereby they can access the treated wastewater from coal seam gas and the negotiation process involved offers some insights into strategic management of threats and finding an opportunity within a potential threat to agriculture. In contrast to the 'lock the gate' movement, the Basin Sustainability Alliance that Ash was a member of aimed to find workable solutions and a win-win scenario for two competing industries, agriculture and gas. Other than access to water, Ash has also capitalised on this 'threat' by expanding his business interests beyond agriculture with the establishment of an engineering business that works with the coal seam gas industry. This diversification of his business interests has been important to mitigate the risks associated with sole reliance on a farming when climate factors limit production.

I think the biggest (development) has been access to the gas industry. At the time, it was seen as such a negative and a potential threat but that gave me the opportunity to set up the engineering business and bringing in an income stream from an industry that's completely not weather related… you can't say it's all good but look at it on balance, assess the opportunities as well as the threats and the risks and then make a balanced decision based on that…it's been another industry that we've been able to leverage off. And without that other industry, it's incredibly hard.

The conversion of the farm to irrigation and the access to water from the coal seam gas industry has improved the stability of farm production. As a smaller farm, this helps build and maintain relationships with contractors as they can usually be assured of some business with the farm season to season regardless of drought. These good relationships mean Ash can access the contractors during years of production highs when competition for contractors can be challenging for growers in the region.

While this has been a win-win scenario for Ash and some growers on the Darling Downs, farmers who are only starting negotiations with the Coal Seam Gas industry may not be able to reach the same outcome.

As Ash explains:

> *I'd be surprised if it happens again in Queensland because it's been so expensive for these companies to set up their water treatment plants and the ongoing costs. I think they would push back and say, "Well, if you're going to put those conditions on us, we won't go ahead"…. that's the sort of feedback I've gotten from the gas industry. We're pretty lucky that it happened because if they had have known how expensive it was going to be when they went into it, they wouldn't have done it.*

What this illustrates is that there may be opportunity within a potential threat if caught early but if left too late this window of opportunity can close. While the situation Ash has experienced may not be replicable, his strategic management approach of staying open-minded, setting aside the emotional aspect of the issues, being balanced and critically evaluating the evidence in assessing the negatives and looking for potential opportunities, is a process that may be useful for managing future perceived threats to the cotton industry.

<u>Community Liveability, Automation, and Higher Skilled Workforce Requirements</u>
When discussing potential threats to the industry Ash acknowledged that the reduction in labour due to automation could impact the critical mass of people living in communities reliant on agriculture for work. This reduction in population could see a reduction in services such as schools or community recreational activities, such as social sports, that help bring people together. This problem is not completely owned by agriculture or the cotton industry, but these industries are stakeholders in this issue as it will affect the attraction and retention of future workforce.

> *The fabric of our communities is changing and they're not as nice places to live as the populations reduced. I see that as a threat and something that we need to manage. And those two issues (workforce within the local population and community liveability) actually work very closely together in that the less liveable our communities are, the harder it is to attract the staff that aren't currently living there. It's so easy for any one of those community stakeholders from individuals to community groups and*

businesses to government, to handball it and say it is a problem, but it's not really our problem. As a result it's just steadily declining and yeah, it's just a tough one to manage.

As opportunities in agriculture reduce in numbers due to automation, communities need to diversify the industries that provide work opportunities to attract and retain a critical mass of residents. Liveability is not only about population size but about community health and wellbeing. Changing social cultures around alcohol consumption, encouraging physical activity and creating effective awareness and supports for mental health were also discussed as important parts of creating thriving rural communities. The cotton industry is an important stakeholder that will need to proactively work with communities to address these issues around liveability in the regions.

Summary and conclusion

This case study provides an example of relatively smaller cotton growing business (compared to cotton farms in earlier case studies) that has undergone digital transformation. The main findings include:

- Social-emotional skills are important for grower's leadership capabilities
- Supportive mentoring through a leadership experience can provide valuable development for growers.
- Restructuring work roles and learning to delegate ensures job demands are sustainable for growers.
- Automation is valued for precision and reducing the risk that comes with a reliance on sourcing workforce to perform manual tasks.
- Considering the diversity of the workforce in terms of life stage, experience, and motivation is useful for building an effective team
- People management can be a combination of formal and informal processes. It is an ongoing conversation, not a tick and flick checklist.
- Approaching threats looking for opportunities can result in positive outcomes for cotton businesses, but the window of time to seize an opportunity can be finite.
- Community liveability is a factor that is indirectly impacted by adoption of automation through the reduction of workforce, and it could negatively impact cotton farming business' ability to attract the higher skilled workforce required for digital agriculture.

Part of the motivation to adopt automation on farm was to better monitor resources, improve precision of farm management practices and use objective information in business decisions. The workforce impacts of these changes has been that the number of workers employed within the business has reduced, the farm manager must be willing and able to work with these digital systems and the grower has been able to redesign his role to focus more on strategic business development. These changes required the grower to develop their leadership

capabilities, manage and develop their employee to be autonomous, and to identify which tasks could be delegated to others that they would have usually performed in the past. The outcome of these changes are a better work and life balance that reduces the risk of burnout for the grower. Making the time and ensuring that he has sufficient energy to develop his strategic thinking and planning has meant the grower is well placed to identify and manage threats and capitalise on opportunities that will benefit the business. In this way, he is remaining adaptable and willing to make changes for the business to continue to survive and grow into the future.

Chapter Nine: Discussion

The future of work is dynamically shaped by the people of the industry. It is their preparedness to grow and change that moves work forward, improves productivity, sustainability, and creates a positive culture within which people can pursue rewarding and meaningful jobs and decent work. Like the National Agricultural Workforce Strategy, the current research argues that understanding and enabling the adaptability of people, and their willingness and capacity to change the structures and systems they work within, is the mechanism that shapes the future of work.

This research has evolved into an investigation of the process of change within businesses built around multiple visions that are unique to their leader's interests, strengths, and strategic foresight. Owners, leaders, and proactive employees each find their own ways to grow and shape these businesses. The current study provides examples of the different ways change is happening in different contexts within the cotton industry and offers some insights for potential good practice that may be transferred to other cotton businesses.

The findings from the research are now discussed in relation to the overall aims of the research. The implications that come from the evidence are presented, limitations of the research identified, and arguments made for the future directions of research and interventions that focus on getting individuals and workplaces future-ready in the cotton industry.

Research Aims

The aims of the current research included:

- Understand factors influencing technology acceptance and adoption
- Understand experiences of transition that occurs with the introduction of technology
- Understand entrepreneurial behaviours and the mindsets, skills and structures that encourage entrepreneurship or intrapreneurship within cotton businesses
- Understand the function of the knowledge network and consultants work in extension and influencing on-farm change
- Understand influences on attraction, retention, and development of workforce and how this occurs in adaptable businesses
- Identify other factors that may shape the future of work and workforce requirements for the Australian cotton industry

A summary of the findings in response to the research aims are now presented.

Technology Acceptance and Adoption

The current research used the technology acceptance model to inform the quantitative (grower practices survey) and the qualitative (grower practices survey and case studies) studies. The overall findings of the research with regards to growers' technology acceptance and adoption are synthesised in Figure 9.1. This diagram maps factors that are influential in growers' movement along the path to adoption of digital technology on farm.

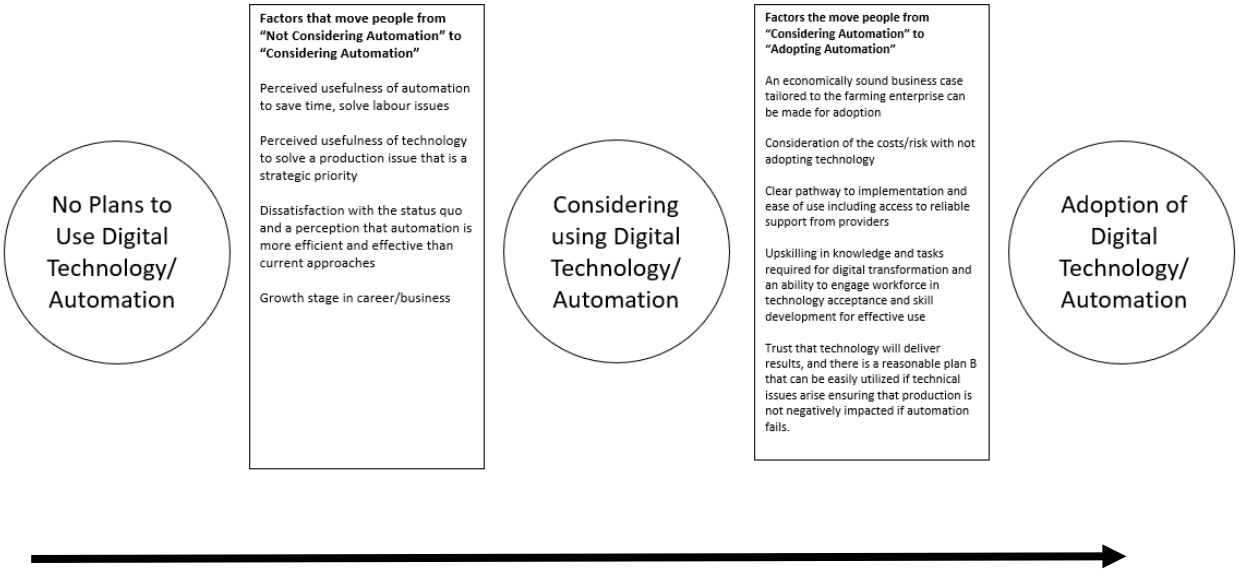

Figure 9.1 The Digital Technology/Automation adoption continuum for Cotton Growers

From the quantitative analysis (Chapter Two), above and beyond other factors (including age, size of broad acre cropping area on farm, and perceived ease of use), growers perceptions that automated technology could (a) be useful in saving them time, (b) reduce labour costs and effort required to manage workers, and (c) be more effective at tasks than current manual approaches, was the main factor that distinguished between growers who had *not implemented automation and had no plans* when compared to those who are *considering technology solutions* for their farms and those who *currently use technology on their farms*. Some preliminary evidence also suggested that different life stages, as indicated by grower age group, could be related to moving through the adoption journey. Those more likely to be further along this adoption journey were younger growers aged 20-34 years old, who are in a growth stage in their career, and growers aged 45-49 years who may be expected to have teenagers or young adult children and could be in a growth stage of their business focused on preparing for the next generation to become involved. Further research to test these inferences is required.

The evidence in the case studies highlights that grower consideration of new technologies is focused on perceptions of usefulness to solve a production issue

that is a strategic priority and perceptions of relative advantage of the technology in terms of being more efficient and effective than current approaches (Chapter Three, Chapter Four). Growers also reported perceptions that technology could alleviate time pressures and help them to redirect their efforts into other aspects of the business (Chapter Two, Chapter Eight), and solve issues with labour, in particular replacing itinerant workers and ensuring production could quickly increase when access to water was available (Chapter Four, Chapter Eight), also contributed to their motivation to increase the use of automated technologies on farm. With regards to these two factors, it is worth noting that not all production issues lend themselves to technological solutions or the technological solutions available may bring their own challenges or a level of uncertainty that contributes to why automation may not be considered by some. Furthermore, those that are sole operators or have their business set up in a way that makes significant use of contractors may not have the labour challenges that some automation addresses and therefore it is of no interest to them at this time.

A dissatisfaction with the status quo (Chapter Three, Chapter Four, Chapter Eight) and an openness to experience (Chapter Four, Chapter Five) was associated with considering new technology, with some growers who were not considering technology reportedly happy with their current manual approaches to growing cotton (Chapter Two). Positioning themselves and their businesses in a stage of growth, with the motivation to adapt and improve their farming enterprise (Chapter Three, Chapter Four), and their roles within the business (Chapter Nine) was also related to grower's exploration of technology solutions.

When it comes to making the shift from consideration of digital technology and automation to adoption, an economically sound business case tailored to the farming enterprise is important (Chapter Three, Chapter Four, Chapter Nine). Not all technologies will easily integrate with legacy systems whether it is existing machinery/technology or farm management approaches, therefore understanding the cost/benefit of these within the specific farm context may mean the same technology is viable for one grower but not another. Some growers factor the cost or risk of not adopting technology into the business case for new technology (Chapter Four, Chapter Eight). Growers need to be confident in their skills and knowledge with regards to navigating the change process, as well as having the resources available to overcome telecommunications infrastructure issues to proceed with integrating digital technologies into their existing farm management systems (Chapter Two, Chapter Four). Access to reliable support from digital technology and automation providers/dealerships, trust that the technology will deliver results, and an actionable plan to ensure production is not impacted if automation fails also contributed to growers' selection and adoption of digital technology (Chapter Three, Chapter Four).

These findings align with concepts identified in the technology acceptance model. The results would seem to demonstrate that moving through the adoption continuum involves initial perceptions of ease-of-use informed by computer self-

efficacy, digital literacy, and personal interests. This ease-of-use factor then influences perceptions of usefulness, in that the grower observes that the technology offers a workable solution to an issue on farm and begins to consider potential automated solutions. Then, when examining the business case for new technology, ease of use in terms of supports, skills to operate and the path to implementation, is again factored in when assessing the relative advantage of making changes to the system through adoption of automation.

There are implications from these findings for growers and agritech companies. For technology providers, a solid understanding of the production issues that matter to growers and the farming systems that surround these issues is needed to find viable solutions. The stronger the value proposition for digital agriculture in terms of demonstrable reliability of automation and reduction of capital cost outlay, the more growers will consider their solutions. A presence of tailored implementation support and ongoing technical support provided by these companies will help growers who are considering solutions to adopt. For growers, identifying the longer-term strategic value of digital agriculture solutions, staying up to date on opportunities and threats associated with digital agriculture and understanding how these technologies fit with other trends impacting their business is an important part of staying open to considering digital agriculture and preparing for when costs reduce, reliability improves and the relative advantage to adopt is apparent. To do this strategic work, growers need to have the resources of time, energy, and capability to focus on the future of their farm, working on their business rather than be consumed by the day-to-day operations. Furthermore, training to upskill growers or the cotton workforce in the process of implementation of automated solutions, data collection, data management and analysis, and in transformational leadership practices to help workers transition in their roles when technology is introduced, would be valuable to help those interested to move from consideration to adoption.

Experiences of Transition Associated with Technology

Case studies in Chapter three, four, five, and eight offered insights into growers, agronomists and on-farm workers' experiences of transition associated with technology.

Growers and workers described an orientation to work characterised by an openness to experience, with a curiosity and willingness to challenge the status quo. Furthermore, the humility to continue to engage in the learning process even when they possess considerable expertise in their roles helped individuals approach change rather than avoid it. These qualities were also present in discussions with growers that are adapting other ways (Chapter Seven) and as such are not specific to transition associated with technology but transition in general. Still, they are highlighted here as important intrapersonal characteristics that underpin the digital transformation of farming businesses.

Transformational leadership practices were effectively used in a way that helped to support workers to adapt within their roles on farm (Chapter Three). Involving

workers in the discussion and investigation of new technology, encouraging them to ask questions and to take ownership in developing a specific skillset aligned with their interests encouraged team members to stay engaged and be a part of implementing changes on farm. A thorough understanding of individual differences, workers strengths and preferences also meant that managers could try and integrate the use of technology in tailored ways to promote use (Chapter Four). Additionally, understanding the job demands of workers and making sure the human aspect of work was not lost in the use of technology is essential. Managing workers in ways that let them know that they are trusted to do their jobs and that their contributions are valued while their jobs were changing, and digital technology was increasing the transparency of their actions, is important. A perceived loss of trust between the leader and employee, or a diminished sense of valued status within the business, and people who otherwise can adapt will become disengaged and resistant to change on farm (Chapter Four).

Entrepreneurship and Intrapreneurship

Like the mindset orientations that keep people flexible to transitions on farm, entrepreneurship and intrapreneurship is also characterised by openness to experience, curiosity, challenging the status quo, and the humility to keep learning. In addition to this, a mastery goal orientation and a passion to be involved in creating solutions moves these people beyond adapting to change to driving change within the industry (Chapter Four and Chapter Eight). Growers may move through phases of entrepreneurial behaviour at times when they can invest the resources (time, energy, and money) that these kinds of activities require, or they may have designed their roles in the business to be in a position where their access to resources allow ongoing entrepreneurial behaviour (Chapter Three, Chapter Four, and Chapter Eight).

The growers who were engaging in entrepreneurial behaviour had the time, ability, and motivation to think strategically and to look outside the business to assess potential threats or problems. Once identified they then looked for opportunity within these threats/problems and took action to develop solutions in attempts to shape the direction of how these forces may play out and to achieve an economically beneficial outcome. On a larger scale this was evident in the Statham's idea formation and pursuit of FibreTrace™(Chapter Four). On a smaller scale this was evident in Ash Geldard's approach to find a win-win outcome from Coal Seam Gas developments in his region (Chapter Eight). Both these examples rely on good business skills and excellent communication skills, in particular the ability to communicate with industries outside of agriculture, and to collaborate in ways that brings together different expertise to develop a solution.

The agronomists interviewed (Chapter Five) were also entrepreneurial in their business, utilising their transferable skills and knowledge to develop multiple income streams . The motivation to do this was to mitigate the risk associated with acting as consultants in an industry where climate variability can severely

impact the supply of steady work. Similarly, in their observations of innovative growers in their region, they noted that it was those experiencing significant constraints impacting the financial viability of their business that were motivated to engage in entrepreneurial behaviour. Those growers that were comfortable with their economic position and satisfied with the current state of their business were less incentivised to explore ways to change it.

In terms of intrapreneurial behaviour, this was observed within the Northern Australia Cotton Industry (Chapter Six) and in discussions with the on-farm team members within Sundown Pastoral Company (Chapter Four). Similar mindsets to entrepreneurs are held by people who, while not farm owners, are shaping the future of the cotton industry from within these businesses. Owners of these businesses provided structures that allowed this behaviour to flourish including sharing knowledge networks, encouraging these workers to build their own knowledge networks and to bring new ideas into the business. Intrapreneurs required the skills to advocate for these ideas and present a business case for the investment of organisational resources. This intrapreneurial behaviour was able to thrive as business owners accepted some level of risk/costs associated with short-term failures that may be experienced while ascending the learning curve as part of the pursuit of innovation.

Knowledge Networks and the Role of Consultants

The networks that people have formed in the cotton industry and outside of the cotton industry were influential sources of information and collaboration that influenced business and personal development activities on farm, and this was evident across all case studies. Social based learning was an influence on the consideration of digital technology. Farmers who were early adopters shared the practical experience of making changes to their farming systems and could discuss the benefits and challenges of doing so with their networks which allowed others to make informed adoption decisions. Growers collaborated with consultants and researchers to conduct trials, opening their farms to host field days (Chapter Three, Chapter Four, Chapter Eight), collaborated on bench marking their businesses or sourcing training and upskilling together (Chapter Seven), or organised with others to take collective action to tackle external threats (Chapter Eight).

When networks and collaboration are influential to how growers shape their businesses, it means the strength and amount of diverse expertise of the network that growers are connected to is influential on innovation. But the more diversity in the network, the more skilful people need to be in communication and working to understand positions that may be different to their own. Growers' abilities to cultivate these relationships, engage with others with different perspectives or expertise, and to find places of convergence and common ground inform their adaptability within themselves, their businesses and ultimately the adaptability of the industry as whole. Similarly, the diverse perspectives and expertise that growers, on-farm workforce, and agronomists possess, is a

valuable resource that can provide an essential contribution to strengthen the efforts of researchers, and machinery and technology developers to find better workable solutions for industry challenges. The knowledge network needs to flow in both directions between participants in the innovation system. Connectedness and collaboration are vital to the future of work for all players in the cotton industry.

The agronomists who were interviewed had identified the value that could be realised if their networks of growers were better able to collaborate with people that they may not have previously formed a connection with, finding new ideas and support in sharing their experiences. This insight was the impetus for the ag-tech startup Yacker, a secure platform that encourages discussion to occur either online or directly connecting to each other via a phone call. This innovation introduces a new way for people in the industry to broaden their networks beyond their own social groups and makes knowledge more accessible for newer entrants who may not possess the social capital to gain the breadth of insights that are easily accessible for those who are more connected through longstanding ties with the industry. Working towards equitable access to the knowledge network is important to increase the diversity of talent that can be attracted, developed, and retained within the industry.

Development and Retention

This discussion chapter deliberately focuses on the development and retention of people to work in the cotton industry before discussing attraction. Workplaces that effectively retain staff have the structures and conditions that create an authentic attraction proposition for new employees. Each employer that participated in the case study research noted the importance of staff retention to the continual development of their business. Cotton growers understand the impact their workforce has within their business and highly value staff, wanting their employees to feel committed to and a part of the business (Chapter Two). Retention is a priority as organizational knowledge, (e.g. knowledge of the farm environment, knowledge of work standards, knowledge of roles within the team) takes time to develop and leads to efficiency gains.

The topic of development and retention is also considered at the grower/business owner level. Growers committed to their own personal development and open to new ideas for their businesses will adapt to survive and thrive into the future. Farms are complex businesses, and the people who work within them can be at risk of having placed an unsustainable number of demands on themselves within their role at work. A socially sustainable business will structure work and design roles in a way that allows leaders to balance their time to work strategically on the business and overseeing work in the business. Preventing work-related burnout by ensuring job demands are balanced with adequate resources is important for growers to persist in their own agricultural careers. Succession of roles within the business whether for family members or employees will be proactively discussed, planned and regularly reviewed.

To ensure their workload was sustainable, several growers had deliberately worked on developing their ability to delegate. This skill and approach to management was successful in large (Chapter Four), medium (Chapter Three), and smaller (Chapter Eight) enterprises. Encouraging and assisting an individual worker to develop expertise in one or more aspects of the farm management system empowered these workers to take ownership in their role (Chapter Three, Chapter, Four, Chapter Eight). This could also reduce the demands on the grower/farm manager to be the main source of upskilling or support for workers to learn on-the-job. These leaders could behave as a connector manager by ensuring team members knew each other's strengths to effectively support each other's learning, and how to access outside expertise to help them in their job performance. Extending connections within the knowledge network as a way to develop employee's skills and competence, encourages autonomous behaviour, collaboration at work and facilitates a culture of improvement.

Developing staff through good people management practices leads to greater employer satisfaction with their workforce (Chapter Two). Creating an environment where workers can contribute ideas and speak openly about issues at work, and can expect to receive tailored guidance, support, and feedback on their performance, contributes to their ability to adapt to changes and to work autonomously on farm (Chapter Two, Chapter Three, Chapter Four). These management practices are consistent with some of the characteristics of transformational leadership. When skilfully employed by those in supervisory or leadership roles, these management practices contribute to a psychologically safe culture. The impacts of this are that workers are (a) more engaged in the learning process, (b) more accepting of implementation of new technology or new approaches to the way they perform their tasks, (c) dedicated in the effort they apply at work, and (c) committed to working for their current employer (Chapter Three, Chapter Four).

There are many reasons why staff may not be retained in cotton farm businesses. Some include reduced availability of work due to drought, or staff may reach a point in their career where they have exhausted the development opportunities available to them and leave to seek new challenges. The businesses studied within the current research were attempting to improve retention and considering the ways that farm productivity solutions may contribute to both issues. Implementation of automation and expansion of businesses across regions with different climatic conditions were two strategies used that could contribute to feasibly retaining a core group of skilled workers. This group of workers could hold the organizational knowledge required to rapidly increase production when water became available and contribute to growing the business. Automation was reducing reliance on seasonal workers and increasing the skill level required of the smaller workforce (Chapter Three, Chapter Four, Chapter Eight). Seasonal or unskilled workers often seek work on farms motivated by extrinsic needs (e.g. money or to satisfy a visa requirement), as opposed to intrinsic needs (e.g. with a genuine interest in farming and

wanting to develop and achieve personal goals through this work). By removing more itinerant workers from the business through increasing automation of manual labour tasks, the expected benefits to those on-farm was an improved workplace culture. It was proposed that a greater proportion of workforce that are unified by shared values, in terms of enjoying the lifestyle of farming and a commitment to their work, would lead to a more enjoyable and satisfying workplace (Chapter Four).

While many of the people interviewed were optimistic about the impacts of automation, there were some concerns raised that need to be proactively addressed. In regions where agriculture was the main employer, a reduction in population as a result of automation replacing jobs could impact the quality of life within the local community. This may negatively impact retention and attraction of the in-demand higher skilled workers required to work with digital farming systems. The shifting demographics in farm businesses due to automation will require rural communities to diversify the industries which economically sustain their regions. This is necessary in order to maintain a critical mass of people to support the provision of essential services (e.g. health, education) and social activities that contribute to a sense of belonging. The lifestyle that comes with working in these communities is important to retain workers.

Another concern is that in the past, agriculture has been an industry that offers people who may have low literacy levels the opportunity to develop a rewarding career. These workers could thrive as their dedication and ability to work with their hands or be mechanically-minded has been an asset to farms regardless of their reading ability. A greater reliance on digital technology and the information that it provides does require a literacy level that may be beyond some of these workers. Older workers with declining vision may struggle to use screens that use smaller fonts. If ag-tech can be designed to support the diverse abilities of people who are attracted to farming then perhaps the industry can still draw on this group of workers that have the attitude and motivation to do good work that benefits cotton farming businesses.

Attraction

Employers interviewed noted the potential challenges with attracting a motivated, skilled next generation worker into the cotton industry. Two of the businesses studied were either invested in or considering partnerships with educational institutions at the tertiary and secondary school level. They argued that this would help to build a pipeline of talent supported into the cotton industry (Chapter Four, Chapter Seven). These business owners paid particular interest to involvement with schools/colleges with whom they had pre-existing relationships. There is a good argument for focusing on these institutions as the values fostered with students through their educational experience likely reflect values that resonate with these business owners. Values congruence aids transition between study and employment in a way that is beneficial for both the

employer and employee and easy transition is important in businesses where leaders are time poor.

However, if the future of work, as discussed in the interviews, will involve a higher level of proficiency of digital skills, soft skills, and technical skills, then it is expected the cotton industry will be competing with other agriculture industries for talent, as well as industries outside of agriculture. Expanding these school-industry partnerships beyond business owners' pre-existing relationships may help to access a more diverse talent pool. Growers/business owners and schools/students that are unfamiliar with each other require support to organize or establish these sorts of partnerships. A successful example of this, discussed by one farm manager in the research (Chapter Four), was the Cotton Australia Gap Year program that saw a student from Canberra with no connection to the industry complete a successful placement on a farm. This led to his enrolment in tertiary study and completion of further work experiences within the cotton industry. External support was provided in the form or organizing the application process and compliance-based training for school leavers, as well as connecting these young people to form a peer network of "Gappies".

Attraction issues were noted with the expansion of cotton to Northern Australia, where farms are remote and local workforce are not skilled in cotton production. Workers are sometimes hesitant to move to unfamiliar environments, although the different seasonal peaks of Northern cotton compared to Southern cotton may offer an opportunity for new entrants to the industry to explore work in different locations. A graduate program could rotate students through different cotton production valleys to gain experience in different environments and different cotton production farming systems. If seeking to encourage these graduates to choose jobs in unfamiliar locations, it is important that they are supported to build social relationships and ties to the community. Work and personal lives are intertwined and satisfaction in both domains is required to remain in a business and in a community. A culture of inclusion that fosters a sense of belonging helps new entrants to build relationships and encourages the development of a professional identity associated with being a part of the cotton industry.

Across cotton production areas, mining was a continued competitor for workers that hold similar interests (working in practical ways, with machinery) to those that work on farm. However, growers and workers noted the benefits of the lifestyle (in terms of the environmental conditions) that work on a farm could offer that mining could not (Chapter Three, Chapter Six). These workers could better combine their work and home life and work in environments that gave easy access to appealing recreational activities. Highlighting this lifestyle factor makes for a distinct value proposition that could attract people away from mining. However, presently the digital technology used in mining is far more widespread than that used on farms. When it comes to the next generation, who have led lives where digital technology has had a greater presence than previous generation, jobs that use cutting edge technology may capture their interest

when selecting a career path (Chapter Four). The importance of having these types of tools on farm could help to demonstrate the dynamic and progressive nature of cotton farming and attract talented young people to the industry. Furthermore, the adequate telecommunications connectivity that is required to implement digital technology on farm, is considered an essential service by many people that is used to facilitate the increasingly digitally connected lives that they lead. To not have internet access where one lives and works is to deprive people of a service that is readily offered in many other industries. Young people expect to stay connected to information, entertainment, and their social networks through internet access. Unreliable access to the internet could be a factor that negatively impacts job and career choices (Chapter Four).

Other Factors of Interest

There were other factors of interest identified within the research that may impact the changing skillsets required for the future workforce and strategic directions of businesses. These were (a) data collection, management, and use, (b) transparency, and (c) social licence.

The rise of digital technology makes it possible to collect extensive amounts of data on farm resources, management practices, and outcomes achieved. This is creating the potential for a role dedicated to data management on farm. At the moment, the economic returns for paying someone to fill this role were not evident. The value of data has often been discussed with regards to improved, objective decision making on farm. Yet, some participants in the current research felt there was little relative advantage when considering the time imposition and effort required to integrate the task of extensive data collection, management, and use on farm when compared to current knowledge and practices.

However, the value of data is also in the validation of good management practice. This is of interest to sectors of society who want greater transparency of the environmental impacts of cotton production. There is recent interest in the potential to diversify grower's income through programs that pay for measurable improvements in biodiversity or carbon gains. While schemes such as the Australian Farm Biodiversity Stewardship Pilot are in trial stages, on Keytah (as discussed in Chapter Four), the Statham's collection of data allowed for an independent audit to verify the carbon footprint of their farm management practices. This is being used to substantiate the environmental claims of their premium brand Good Earth Cotton™. Data collection, management, and use skills are vital to create and demonstrate the value of this brand.

Greater transparency of the industry is something cotton growers who are engaging in best practice can confidently provide. But to ensure this brings benefits, skilled communication needs to accompany this transparency. Discussing the amount of water used per bale of cotton means nothing to people without a frame of reference to comprehend this information. Skilled communication is particularly needed in areas such as the Northern Territory or Western Australia, where those unfamiliar with cotton growers may be concerned

about the introduction of this crop to areas that are being developed for broad acre farming. The skills to build relationships with diverse stakeholders is essential to generating trust for the farm management standards that are accepted and maintained by people in the industry. The combination of data to validate claims, good communicators, and transparency are central to the social licence and future of the cotton industry and the people who work within it.

Limitations of the Research

There are a number of limitations of the present research project. This includes the potential for 'survivor bias' in the findings of the research. By only studying businesses that possess examples of successful adaptability, the research may overlook significant barriers to successful adaptation of businesses that need to be addressed to support transitions associated with the future of work. The survivor bias of the research may also inflate the attributed impact that factors of interest identified in the research have on the success of the businesses studied. Furthermore, the cotton industry consists of an incredibly diverse array of farming businesses. With the limited number of case studies conducted, it is unlikely that saturation has been achieved with regards to comprehensively identifying all future of work and adaptability factors. However, some factors, including the personality factors of openness to experience and humility, and an orientation of continuous learning were repeatedly observed across different businesses.

The strengths-based approach (studying successful cotton farming enterprises) that could contribute to survivor bias in the findings of the research was used for pragmatic reasons. The Australian cotton industry is a small industry. The information required to describe the participating businesses in sufficient detail to allow readers to assess the relevancy of the findings for their owns contexts meant even if names of people or places were removed, it is likely the participants would have been identifiable by those within the industry. Confidentiality could not be assured and ethically it was important that no information shared would be harmful to participants and their reputations. This makes it not practical to study cotton businesses that may be struggling to adapt to the changing future of work context using the case study method that has been employed for this research. Future research that allows the anonymous participation of employers and employees to discuss issues relating to attraction, development, management, and retention to the cotton industry would be valuable.

Future Directions for Research

The current research found that a learning culture within businesses was underpinned by a psychologically safe environment. Psychological safety is defined as the belief that individuals can engage in interpersonal risk-taking at work without negative consequences such as ridicule or rejection (Edmonson, 1999). This factor is associated with improved team learning and performance, and wellbeing in the workplace. Past research has focused on high-risk contexts

such as healthcare where failure by medical professionals to speak up or a fear of asking questions could lead to mistakes that have fatal consequences for patients. To date no research in the Australian agricultural context has explored this construct in relation to on-the-job training and the workplace learning environment.

The literature would suggest psychological safety to be an important focus for developing capable coaches and managers in the workplace, but how this concept works in the farming context needs to be tested before being built into any recommendations or resources for extension. Research is required to understand how psychological safety needs to be framed for growers to adopt these practices, the language that needs to be used, and whether there are any negatives associated with this construct in the farming context. For example, would feeling safe to take interpersonal risks on farm be beneficial for emotional wellbeing (confidence to speak up about issues or mistakes) but create an environment where the team, free from judgement from each other, may feel safe to engage in unethical behaviour?

Given the past research on psychological safety, learning more about the factors that lead to a psychologically safe work environment and understanding ways to improve this, could illuminate what may be a lynch pin to achieving a more socially sustainable work environment in terms of learning and wellbeing. This would be a valuable contribution, generating new knowledge that would place the industry at the cutting edge of positive workplace culture and sustainability at work.

Future Directions for Development and Extension of the Research

The future of work is frequently described as volatile, uncertain, complex and ambiguous and requires a capable workforce to embrace the changes required to adapt to new developments on farm. Best practice people management requires growers to be skilled at leading workers through change processes and to empower employees to take greater responsibility for developing their soft skills to maintain their employability and adaptability. This is central to social sustainability and the 'People' pillar of the cotton industry sustainability framework.

At the moment, current HR&WHS myBMP modules are very much focused on the regulatory compliance aspects of workforce management (minimum acceptable standards). Other areas of myBMP which clearly identify best practice in the technical aspects of farm management and offer growers access to resources that extend their research investment and contribute to environmental sustainability standards of the industry. The current HR & WHS myBMP system does not do this in a similar way that ensures it contributes to social sustainability standards. For example, in the current iteration of myBMP, a checklist item that could allude to best practice is '*A performance management process is in place*' - this is supported by a best practice resource that comes from Dairy Australia. More can be done to give cotton growers an industry

relevant framework and example actions/performance standards for best practice of leading people through a change process and managing/developing workforce.

It is proposed that extension activities from the current research should attempt to integrate best practice transformational and entrepreneurial leadership, people management, and individual development into cotton industry businesses. Further investigation into the development and testing of a pilot program that identifies pathways to delivery and industry-relevant content/activities that create practice change is required.

Conclusion

While the future of work is never certain, several trends are shaping changes in the way people work in the cotton industry including the rise in digital technologies, environmental constraints, and shifting societal demands. An ability to adapt, respond, and capitalise on these trends will determine the ongoing survival of the cotton industry. Like the National Agriculture Workforce Strategy, the current research found that it is the 'human' aspect of cotton businesses that will be a major factor in determining whether the industry is disrupted by the changing economic, environmental, or social landscape or whether it can position itself to be a beneficiary of new developments and thrive into the future.

In the current research different cotton growing enterprises formed the basis of six case studies that explored the personalities, traits, abilities, skills and structures that enabled people in the cotton industry to approach and embrace positive changes that improved the economic, environmental, and social sustainability of their work. The cotton industry values continuous improvement and within these case studies the actions that align with these values were identified. Continuous improvement means continuous learning and then persisting in applying new learning to drive strategic change in workplaces. Managing this change requires great leadership, management and a willingness and ability of the workforce to remain adaptive. Creating the supportive workplaces that enable these adaptive orientations and behaviours is essential to establish the cotton industry as the employer of choice to attract and retain the talented workforce that is required for the future of work.

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Appendix A

Interview Schedule for Growers/Employer

This is a semi-structured interview that will be informed by the data collected from the Principal Grower/Employer/Farm Manager Survey. As a semi-structured interview there is room to respond to participants answers with further questioning. All topics listed will be covered and example questions are provided below.

Strategic Direction

What values are driving your business?

What threats and opportunities do you see that are influencing the direction of your business?

Can you describe your approach to farm management?

What do you think about R&D?

Do you invest in your own development? What do you do?

What digital agriculture technologies do you currently use on your farm?

Changes made

How has working on farm changed over the last 5 years?

What technology are you interested in?

Who has influenced your interest in different technology?

Where do you get information about agtech or digital farming from?

What is the value of technology in terms of how is it useful to you in your business?

What factors influence how easy it is for you adopt new technology in the business?

Workforce implications

How has technology changed the type of workforce you need?

Attitudes?

Skills?

Do you have a strategy for training and development of your workforce? Is it a worthwhile investment?

How do you manage change on your farm? How do you manage the impacts of change on your workforce?

Final Question

Is there anything that we have discussed today that you would like to further reflect on?

Is there anything else you think people need to understand with regards to their workforce when looking to make changes and implement technology into their farming business?

Interview Schedule for Employees

This interview is semi-structured. Not all questions may be asked but all topics will be covered. Depending on answers, additional follow up questions not listed may be asked to further explore topics as they arise.

Background

Tell me about your job? What do you do?

Did you need to study or do any courses to be able to do your job? What have you studied?

Why do you do what you do?

What makes your job a good job? What are challenging aspects about your job?

What kind of person do you need to be to do what you do?

Learning at Work

How have you learnt how to do your job?

Can you tell me if there's ever been a time you've tried to work something out on your own, how you did that?

Can you tell me about a time that you've worked with your co-workers to solve a problem?

Have you ever had a time where you've learnt something from someone outside of agriculture that's been helpful for you in your job?

What you have learned from more experienced colleagues?

What have you learned from less experienced colleagues?

Have you ever participated in any formal training?

What has stuck with you that was good about the training?

Did it change the way you do your job?

Who has taught you the most about how to do your job?

What's important for you to get your job done well?

Technology adoption and acceptance

Tell me about the different technology or tools you use in your job?

What do you think about Agtech/Digital agriculture? Is it hype?

Is there any Agtech that you particularly don't like or don't see a use for?

What are the parts of your job where technology helps you?

Does technology make your job easier? How?

Does technology make your job more complicated? How?

Do you think you can easily pick up and use new technology in your job?

Digital Capability

Digital Literacy

Tell me what you know more broadly about Agtech? Different types? What might be relevant to you?

Technology Operation

How do you work out how to use new technology? Do you look for training?

Do you know how to use the technology to its full capacity or are you just trying to learn what you need to get the job done to the minimum standard required?

How do you stay up to date on different trends in agriculture?

Do you perform updates on your tech?

If something goes wrong, how do you fix it?

Data Monitoring and Analysis

Do you collect data when you use machinery?

How do you use any of the data collected to help you in your job?

Do you ever see a difference between what recommendations come from technology and what you would usually do?

Digital Communication

Do you catch up with other people working in agriculture? Where do you do this? Do you talk about work?

Do you use social networking platforms? What for?

Are you a member of any online groups? Do you participate or just watch and read posts?

Do you own a smartphone, when did you first get one?

Do you ever use email, whatsapp, or other messaging services to maintain communication? Do you think these are good ways to stay in the loop?

Problem Solving

What problems have you experienced with technology and how have you handled these?

Do you ever use your phone or your computer to learn more about something to do with your job?

Can you tell me about a time you've had to search for the answer to a problem online and how you went about it?

Who do you talk to if you're trouble shooting an issue on farm?

Preparation for Change

Can you tell me about the last time your work changed significantly? It could be change in your current job or even change of workplace?

What was the most challenging aspect about that?

What did you have to do to adapt and get up to speed with these changes?

How do you think your job could change in the future?

What would you like to learn to further your career?

Wrap up

Is there any other information you think the research needs to know to better understand your role on farm and how technology is changing the way you work?