GREATER WHITSUNDAY ALLIANCE
MACKAY ▶ ISAAC ▶ WHITSUNDAY

Future Employment Study

September 2020
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Inherent Limitations

This Future Employment Study has been prepared as outlined in KPMG's contract with the Greater Whitsunday Alliance dated 30 April 2020. The services provided in connection with this engagement comprise an advisory engagement, which is not subject to Australian Auditing Standards or Australian Standards on Review or Assurance Engagements, and consequently no opinions or conclusions intended to convey assurance have been expressed. The contents of this report is only indicative in nature.

KPMG have indicated within this Future Employment Study the sources of the information provided as per our methodology. We have not sought to independently verify those sources unless otherwise noted within this Report.

KPMG is under no obligation in any circumstance to update this Future Employment Study, in either oral or written form, for events occurring after the Future Employment Study has been issued in final form.

The findings in this Future Employment Study have been formed on the above basis.

Third Party Reliance

This Future Employment Study is solely for the purpose set out in the contract dated 30 April 2020 and for the Greater Whitsunday Alliance's information, and is not to be used for any other purpose or distributed to any other party without KPMG's prior written consent.

This Future Employment Study has been prepared at the request of the Greater Whitsunday Alliance in accordance with the terms of the Contract dated 30 April 2020. Other than our responsibility to the Greater Whitsunday Alliance, neither KPMG nor any member or employee of KPMG undertakes responsibility arising in any way from reliance placed by a third party on this report. Any reliance placed is that party's sole responsibility.

EXECUTIVE SUMMARY

As the Mackay, Isaac and Whitsunday (Greater Whitsunday) region prepares for the Fourth Industrial Revolution, it is vital that there is an understanding of the future employment environment to best leverage employment and economic development opportunities that will keep the region thriving.

To provide the foundational evidence to support these steps, this Future Employment Study combines both qualitative and quantitative analysis of the expected impact of technology at an occupational level within the Greater Whitsunday region across four key industry sectors:- Agriculture; Health Care and Social Assistance; Mining and Mining Equipment, Technology and Services (METS); and Tourism.

The impacts on future employment are currently subject to a number of changing dynamics which are all interwoven and driving changes to traditional employment models, and the tasks and functions of traditional occupations. These changes include the impact of COVID-19, a greater focus on regional development and investment, and the impact of emerging technologies and the Fourth Industrial Revolution. All of these factors are expected to reshape the labour market, and challenge long-held perceptions about career pathways and opportunities, education and training, moving towards a more dynamic approach to occupations, industries and lifelong learning.

A ten year outlook

The time horizon of this analysis on the Fourth Industrial Revolution has focused on the impacts expected by 2030, in recognition that the adoption of emerging technologies and their impact on the labour market will take time, education and training pathways and pipelines require significant forward planning to support employment, and any reskilling and upskilling of the workforce requires consideration of employment opportunities into occupations requiring similar skills and capabilities and a whole of region approach that looks across industry sectors. It is also acknowledged that jobs growth may be triggered through increasing uplift and competitiveness from the adoption of technologies, the wider supply chain and through employment from the contribution of the region to the Australian economy.

The impact of the Fourth Industrial Revolution is varied across industries and occupations

Importantly, the impact of the Fourth Industrial Revolution varies across each of the four industry sectors that have been examined and the occupations within them. The workforce impacts depend on a range of factors including the size of the workforce across each occupation within the Greater Whitsunday region, and the occupational growth (or decline) which is predicted into the future based on historical data. The significant disruption caused by COVID-19 on some industry sectors and employment trajectories are yet to be fully understood, but based on both initial observations and early data analysis it is clear there will be considerable impacts on key parts of the local economy, such as the Tourism industry.

The Fourth Industrial Revolution is driven by the key technologies that will be implemented at both a whole of workforce or speciality level, and the maturity and pace of technological adoption in organisations. The adoption of these technologies, the incentives to utilise them, and the nuances for each industry and speciality within them ultimately determine the pace and degree of workforce change. For this reason, this Future Employment Study provides detail on these emerging technologies at both an industry and speciality area level.

The impact of emerging technologies on the workforce will occur in two key ways: **automation,** where technology will replace the need for some tasks to be done by humans, will occur at the same time as **augmentation,** where technology will work alongside humans to support traditional roles. Demand for new occupations, including Information and Communications Technology (ICT) related roles, will also occur to support the adoption, implementation, and maintenance of these technologies. These expected impacts need to be considered together, and alongside employment growth, to determine occupations that will be most significantly impacted in the Greater Whitsunday region to determine priority areas for initiatives that will support the workforce into the future.

What is occurring across the four industries?

A summary of the key findings across each of the four industry sectors is provided in Figure 1 and shows that automation is expected to have the greatest impact in terms of Full-Time Equivalent (FTE) staff for the

Mining and METS industry. Overall, the impact of augmentation on occupations will be most felt across the Health Care and Social Assistance occupations, but the opportunity for FTE staff that can be utilised differently as a result of augmentation by 2030 is greatest in the Mining and METS industry. New growth in ICT related occupations is predicted to occur strongly in the Mining and METS and Tourism industries by 2030.

Employment across agricultural occupations, taking into account the impact of emerging technologies and employment growth, suggests the size of the workforce will increase by 37.8 percent over the period to 2030 (or 3.3 percent Compound Annual Growth Rate (CAGR)). While some occupations such as Packers (meat, fruit and vegetable, not elsewhere classified and not further defined) will be impacted by automation, most other occupations will have automation impacts absorbed by employment growth. The impact of augmentation on the workforce is not as significant for agricultural occupations compared with the other industry sectors examined, with only five of the 30 occupations with an impact greater than 10 percent.

The Health Care and Social Assistance industry is expected to hold significant employment opportunity for the region, with predictions that combine both digital disruption and employment growth indicating that the size of the Health Care and Social Assistance workforce will increase by 72.6 percent over the period to 2030 (or 5.6 percent CAGR) in the Greater Whitsunday region. The impact of emerging technologies in Health Care and Social Assistance is more prevalent in augmentation (humans working alongside technology) than automation (where technology will replace the need for some functions), and most automation impacts are absorbed within employment growth. For the small number of occupations where automation impacts will not be absorbed by employment growth, Medical Receptionists are the only role where employment corridors may be required.

Overall, Mining will be more impacted by future of work than the other industry sectors and is the only industry sector where a decline is predicted by 2030 based on 2020 rates (after taking growth in ICT related roles into account). It is expected, based on a combination of future of work predictions and employment growth/ decline, that the size of the workforce will fall by 18.9 percent over the period to 2030 (or -2.1 percent CAGR). It is important to note this does not take into account jobs that may be created through increasing uplift and competitiveness in Australian mining, across the wider supply chain and through employment from the contribution of mining to the Australian economy.

The impact on tourism occupations should be noted with caution, due to the subsequent and substantial impact of COVID-19 on employment in the industry. Overall, based on a combination of future of work predictions and employment growth of occupations, the size of the workforce is predicted to increase by 2.5 percent over the period to 2030 (or 0.25 percent CAGR). Automation is expected to impact on occupations related to Cleaning (domestic and commercial), receptionists, retail and sales and hotel and hospitality management roles. Augmentation will have a varied impact on Tourism occupations, with its greatest impact on Sales Assistant (general), Retail Manager (general), Cook, Chef, Bar Attendant and Waiter.

Employment opportunity and the way forward

Drawing on this evidence base, possible future directions have been developed to support the Greater Whitsunday region with employment opportunities into the future. These are outlined in Chapter 6: The Blueprint and include:

1. Develop targeted workforce transition plans for occupations at most risk of automation

2. Increase the digital foundation skillset for the MIW workforce, including actions to:

- **a. Build digital foundations into all para-professional and professional qualifications**
- **b. Develop micro-credentials to support digital foundations for the existing workforce**

3. Develop local training opportunities that are aligned with future skill needs

4. Job redesign of roles with high levels of predicted augmentation

5. Leadership and change management supporting digital adoption and workforce transition

6. Recognise the importance of and create "bridging" roles that combine industry and ICT knowledge and skills

7. Education and training pathways for emerging occupations

8. Consolidate and build on the innovation and entrepreneurial ecosystem

9. Embrace skilling opportunities to attract and retain young people

Figure 1. Summary of findings across the Agriculture, Health Care and Social Assistance, Mining and METS and Tourism industry sectors.

AGRICULTURE

The Agriculture industry comprises **2.0 percent of employment in the region.** The distribution has 40.0 percent in Mackay LGA, 34.8 percent in Whitsunday LGA and 25.2 percent in Isaac LGA.

Annual average employment growth of 3.0 percent for Agriculture occupations between 2015-2020.

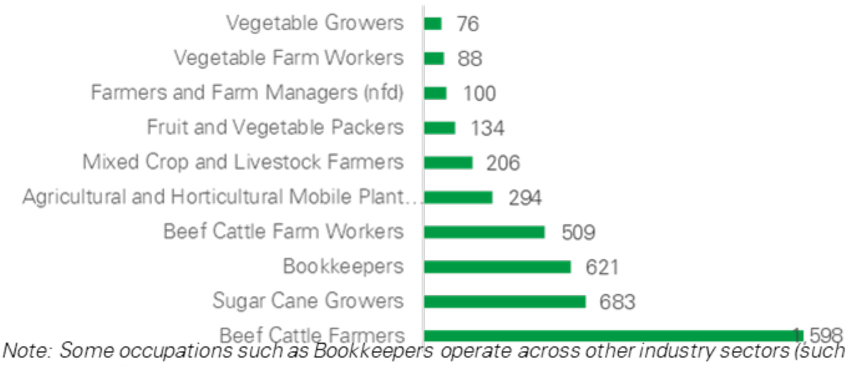
FULL-TIME EMPLOYMENT

Comprises 72.0 percent of all employment in the agriculture industry. Females currently comprise 40.1 percent of the agriculture labour market in the region.

48 percent of agriculture businesses in the region likely to have been **impacted by COVID-19.** Stakeholders report this is due to

- supply chain disruptions,
- rostering arrangements to ensure sufficient social distancing; and
- changes in export market demands.

The ten most prevalent occupations in Agriculture
(by headcount and based on ANZSCO 6 digit occupations as at February 2020):



Note: Some occupations such as Bookkeepers operate across other industry sectors (such as Financial Services), with only a proportion of those included here working in Agriculture.

The occupations with over 40 percent predicted **automation** by 2030 are **Fruit and Vegetable Packer, Packers nec and nfd, Meat Packer, and Bookkeeper.**

Automation is predicted to drive reductions in staffing requirements in the roles of **Bookkeeper, Meat Packer, Fruit and Vegetable Packer, and Packers (nec and nfd).** The impact across these occupations is over 385 FTE in freed capacity by 2030.

The key technologies in the Agriculture industry

- **Automation and Robotics**
- **Novel Farming Techniques**
- **Sensors**
- **Navigation Robotics Technologies**
- **Artificial Intelligence and Data Platforms**
- **Water Management Technologies**
- **Supply Chain, Food and Waste Management**
- **Biosecurity**

The greatest augmentation impact in terms of FTE are the **Sugar Cane Grower, Agricultural and Horticultural Mobile Plant Operator, Beef Cattle Farmer, Farmers and Farm Managers not further defined, Bookkeeper and Beef Cattle Farm Worker.** These occupations represent up to 254 in augmented FTE.

By 2030, **311 FTE in additional ICT jobs** are predicted in the region to support the technology implementation across Agriculture, this grows to **417 FTE by 2035.**

HEALTH CARE AND SOCIAL ASSISTANCE

The Health Care and Social Assistance industry comprises **10.4 percent of employment in the region**, Of those, 78.2 percent are in the Mackay LGA, 15.4 percent in Whitsunday LGA and 6.4 percent in the Isaac LGA.

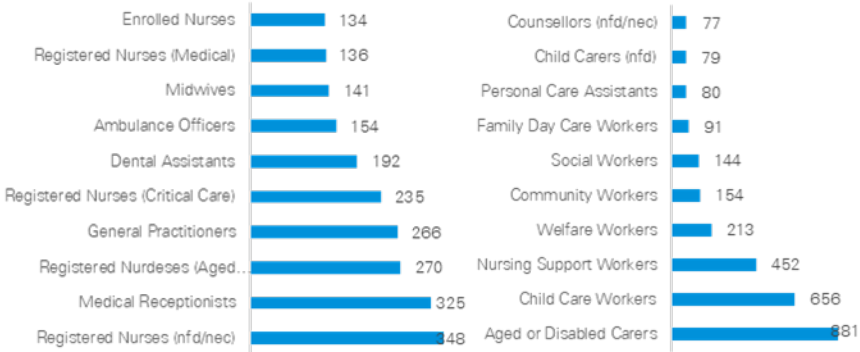
Annual employment growth was 5.2 percent for Health Care and Social Assistance occupations between 2015-2020.

FEMALE EMPLOYEES

Comprise the majority of the workforce (84.9 percent,) and full-time employment is more prevalent 57.1 percent in the region's workforce.

84 percent of Health Care and Social Assistance businesses in the region have been **impacted by COVID-19**. Stakeholders noted they had been able to continue their services, although COVID-19 led to some reduction in hours. Medium and longer term demand is expected to increase.

The ten most prevalent occupations in Health Care and Social Assistance (by headcount and based on ANZSCO 6 digit occupations as at February 2020):



The key technologies in the Health Care and Social Assistance industry

- **Electronic Medical Record**
- **Interoperability**
- **Health Service Command Centres**
- **Precision Medicine**
- **Electronic Medications Management**
- **Prescriptive Analytics**
- **Genomics**
- **Artificial Intelligence**

The occupations with the highest predicted level of **automation** (over 40 percent by 2030) are the **Hospital Orderly, Pharmacy Technician, Medical Receptionist, Admissions Clark, and Pathology Collector.**

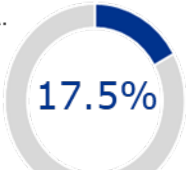
Automation is predicted to reduce workforce in the region for **Admissions Clerks, Medical Receptionists, Pathology Collectors, Pharmacy Technicians, Retail Pharmacists, and Sonographers,** with a small impact for most occupations (under 10 FTE by 2030).

Occupations where over 40 percent of the role is expected to be **augmented** by technology by 2030 include **Registered Nurse (Critical Care and Emergency), Physiotherapists, Registered Medical Officers and Optometrists.**

By 2030, **339 FTE in additional ICT jobs** are predicted to be required to support the technology implementation across health and social services, growing to **458 FTE by 2035**.

MINING AND METS

The Mining and METS industry in the region comprises **17.5 percent of employment in the region.** Of these, 78.6 percent are in the Isaac LGA, 15.8 percent in Mackay LGA and 5.6 percent in Whitsunday LGA.



Annual employment growth was 2.2 percent for Mining and METS occupations between 2015-2020.

FULL-TIME EMPLOYEES

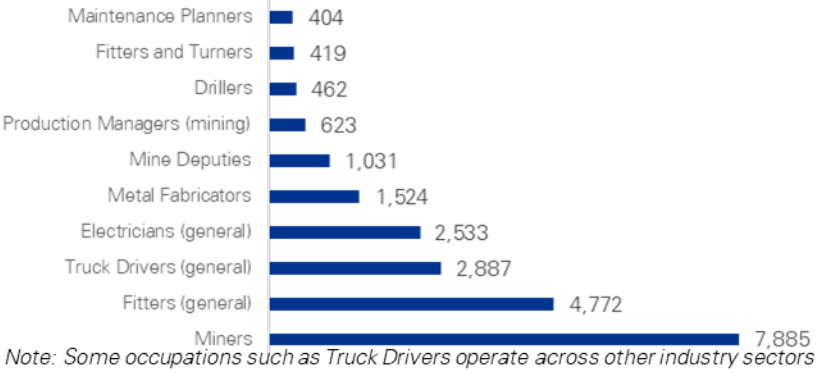
Comprise the majority of the workforce (93.0 percent) and females comprise 21.9 percent of the Mining and METS labour market.

56 percent of Mining and METS businesses in the region likely to have been impacted by COVID. Stakeholders reports this is due to

- supply chain disruptions,
- fly-in fly-out workforce arrangements, and
- rostering arrangements to ensure sufficient social distancing.

The ten most prevalent occupations in Mining and METS

(by headcount and based on ANZSCO 6 digit occupations as at February 2020):



Note: Some occupations such as Truck Drivers operate across other industry sectors (such as Transport and Logistics), with only a proportion of those included here working in Mining and METS..

By 2030, the occupations with the greatest decline are the **Miner** (over 1,800 FTE and the **Fitter** (general) (over 1,700 FTE) from the current 2020 rates due to **automation and occupational decline/ growth projections.**

The automation impact will drive reductions in employment requirements across every mining occupation *with the exception of* the **Mine Deputy, Building and Engineering Technicians (nec), Metallurgical or Materials Technician and Maintenance Planner.**

The key technologies in the MINING and METS industry

Automation and robotics

Data and Analytics

Energy Technologies

Sensors and sources

Geo-Spatial Data and 3D Mapping

Artificial Intelligence and Machine Learning

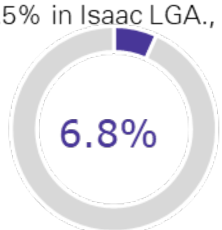
Augmentation will most impact the roles of the **Mine Deputy, Production Manager (both Manufacturing and Mining), Mining Engineer and Building and Engineering Technicians.**

However based on FTE, the **Miner, Fitter, Electrician and Mine Deputy** will be most impacted by augmentation with up to **2,200** in augmented FTE by 2030.

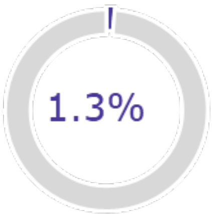
By 2030, **over 1,500 FTE in additional ICT jobs** are predicted to support the technologies across Mining and METS.

TOURISM

The Tourism industry (Accommodation and Food Services) comprises **6.8% of employment in the region.** Of these, 47.5% are in Mackay LGA, 39.9% in Whitsunday LGA and 13.5% in Isaac LGA.,



Annual employment growth was 1.3% for tourism occupations between 2015-2020.



The occupations with over 40% predicted **automation** by 2030 are **Kitchenhand, Fast Food Cook, and Travel Consultant.**

Automation is predicted to drive reductions in staffing requirements in the roles of **Receptionist, Commercial Cleaner, General Clerk, Sales Assistant and Retail Manager.** These five roles result in a predicted employment decline of 2,128 FTE by 2030.

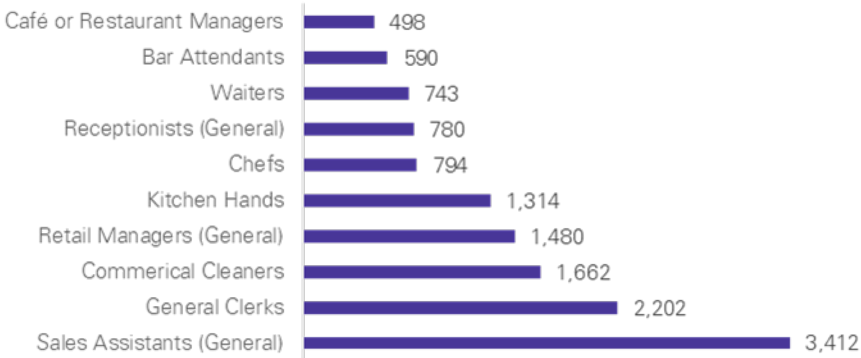
FEMALE EMPLOYEES

Comprise a marginally higher proportion of the workforce (57.7%) and full-time employees represent approximately half of the workforce (49.4%).

100% of tourism businesses in the region have been **impacted by COVID-19**. Stakeholders noted labour force difficulties including:

- replacing staff lost by holiday visas in a COVID-19 context,
- JobKeeper and JobSeeker creating disincentives for people to engage in casual employment.

The ten most prevalent occupations in Tourism
(by headcount and based on ANZSCO 6 digit occupations as at February 2020):



The key technologies in the Tourism industry

Augmented and Virtual Reality

Sharing Economy

Visitor Tracking and Big Data

In-room technologies

Emerging Payment Platforms

Social Media

The greatest augmentation impact in terms of freed capacity are the **Sales Assistant (general), Retail Manager (general), Cook, Chef, Bar Attendant and Waiter.** These six occupational groups account for the opportunity for 1,574 FTE in freed capacity by 2030.

By 2030**, 979 FTE in additional ICT jobs** are predicted in the region to support the implementation of tourism technology adoption, this grows to **1,200 FTE by 2035**.

CONTENTS

ACRONYMS

ACRONYM	FULL NAME
AI	Artificial Intelligence
AR	Augmented Reality
ANZSCO	Australian and New Zealand Standard Classification of Occupations
ABARES	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
CEDA	Committee for Economic Development of Australia
CSCRI	Coral Sea Clinical Research Institute
DCSYW	Department of Child Safety, Youth and Women
DAS	Digital Agriculture Services
EMR	Electronic Medical Record
EMM	Electronic Medications Management
FIFO	Fly-in Fly-out
FTE	Full-Time Equivalent
The Blueprint	Future Employment Blueprint
GPS	Global Positioning System
GW3	Greater Whitsunday Alliance
GDP	Gross Domestic Product
HSCC	Health Service Command Centres
HIMSS	Healthcare Information and Management Systems Society
HHS	Hospital and Health Service
ICT	Information and Communications Technology
ICU	Intensive Care Unit
IoT	Internet of Things
LED	Light Emitting Diode
LAC	Local Area Coordination

ACRONYM	FULL NAME
LGAs	Local Government Areas
Greater Whitsunday region	Mackay, Isaac and Whitsunday regions
MIRI	Mackay Institute of Research and Innovation
MCA	Minerals Council of Australia
METS	Mining Equipment, Technology and Services
NDIS	National Disability Insurance Scheme
nec	Not elsewhere classified (as per ABS classifications)
nfd	Not further defined (as per ABS classifications)
NQPHN	North Queensland Primary Health Network
OECD	Organisation for Economic Co-operation and Development
P2P	Peer-to-Peer
PHR	Personal Health Record
PPE	Personal Protective Equipment
PBS	Pharmaceutical Benefits Scheme
RPAS	Remotely Piloted Aircraft Systems
R&D	Research and Development
STEM	Science, Technology, Engineering and Mathematics
UAS	Unmanned Aerial Systems
UAVs	Unmanned Aerial Vehicles
VET	Vocational Education and Training
VR	Virtual Reality

PROJECT PURPOSE, SCOPE & APPROACH

As the Greater Whitsunday region prepares for the Fourth Industrial Revolution and the changing landscape of workforces in the future, it is vital that there is an understanding of the future employment environment to best leverage employment and economic development opportunities to keep the region thriving.

Project Purpose

In light of the opportunities and challenges associated with the Fourth Industrial Revolution, the anticipated technological transformations in the next few years are expected to significantly reshape the employment and education landscape in the Greater Whitsunday region. With foresight, proactive leadership from across the region and a commitment to act, the Greater Whitsunday region can capture the opportunities offered by automation and digital disruption, manage the transition and ensure the gains are broadly shared.

Preparing the Greater Whitsunday region's workforce for the future lies in collaboration with industry groups and companies across sectors, confirming emerging industries, jobs and workforce needs as well as a digital infrastructure plan to understand the regional infrastructure needs to support jobs of the future.

In April 2020, the Greater Whitsunday Alliance (GW3) engaged KPMG and Faethm to develop the Future Employment Study to explore this opportunity for the Greater Whitsunday region.

Project Benefits

This Future Employment Study provides the opportunity to be proactive in planning a sustainable future for the region's workforce and its economy by:

- Collaborating with industry groups, education intuitions and government to develop a future regional workforce across industries that is skilled and prepared for the jobs of tomorrow;
- Identifying opportunities to support the growth of the Greater Whitsunday region's tertiary and vocational education sector with the aim of equipping the workforce to be ready to take on new and emerging roles;
- Identifying workforce initiatives that encourage innovation, diversification and development of the region's current and emerging industries in agri-business and food production, biotechnology and bio-products, METS, education and tourism;
- Presenting an evidence-based plan of action to advocate for strategic infrastructure which underpins the capacity of business and industry in the Greater Whitsunday region to engage with regional, national and international markets;
- Identifying the means to promote the Greater Whitsunday region to both public and private sector investors with the aim of diversifying the regional economy; and
- Promoting a partnership approach to regional economic development to address key challenges and build on the Greater Whitsunday region's strengths to encourage economic diversity and regional prosperity.

Project Scope

The scope of this Future Employment Study has included:

- Identifying labour market insights based on both traditional approaches and modelling from historical data. This has been based on Australian Bureau of Statistics (ABS) labour market quarterly and census data and supported by other data sources including REMPLAN. Key occupations included in scope are provided in Appendix A;
- Identifying the disrupted labour market picture as modelled through Faethm and specific to the Greater Whitsunday region. These occupations are the same as those used for the traditional labour market insights provided in Appendix A;
- Identifying the emerging technologies globally, across Australia and locally that are expected to impact on four key industry sectors over the short, medium and long term. This was conducted through a literature and desktop review of emerging technologies expected to impact key sectors in the Greater Whitsunday region. Extensive stakeholder engagement also identified the likely adoption of these technologies within the region;
- Examining the workforce and labour market impacts on the Greater Whitsunday region based on the identified technologies, and labour market data, as well as deeper insight into the labour market implications for the future. This involved a desktop review, consultations and validation steps;

- Examining how education and training can support new occupations and capabilities (informed by future directions shared with KPMG by GW3 from previous projects), such as micro-credentialing to build capabilities between current and future state; and
- Collating and analysing the findings from all phases of work to establish a Future Employment Blueprint for the Greater Whitsunday region outlining the current and future employment environment, and recommending approaches to transitioning the local labour market to most benefit the region.

The project scope has been limited to the investigation of four industry sectors: Mining and METS; Health Care and Social Assistance; Agriculture; and Tourism, across the Greater Whitsunday region including the Isaac, Mackay and Whitsunday Local Government Areas (LGAs). These industries have been selected due to their current strategic importance within the region and expected future demand and trend predictions. Future projections are based on a ten year time horizon (to 2030); however, some Faethm predictions have been extended to 2035 where statistically appropriate.

Project Approach

The project has been undertaken across six phases of work, which have built the qualitative and quantitative evidence base for this Future Employment Study. Occupations that have been included in scope for the four industry sectors are included in Appendix A. Further detail regarding Faethm and the disrupted analytics methodology is provided in Appendix B. Data assumptions and limitations are included in Appendix C. Stakeholders consulted through phases 3 and 4 of this project are included in Appendix D.

1 CREATING THE PLAN

Purpose

This phase confirmed the objectives for the project and agreed the approach we took in engaging stakeholders and completing KPMG's analysis.

Key steps

- Development of a Project Plan to guide the project.
- Establishment of a Project Working Group to guide the project.

2 THE DATA: TRADITIONAL AND DISRUPTED

Purpose

This phase identified labour market insights based on both traditional analytics, and the disrupted picture as identified through Faethm.

Key steps

- Labour market analysis of the workforce within the Greater Whitsunday region with a focus on:
  – Industry employment growth sectors (including Agriculture, Health Care and Social Assistance, Mining and METS and Tourism);
  – Labour market demand and supply trends based on longitudinal data;
  – Analysis of the workforce in the region over the next 15 years based on Faethm insights, including occupations most likely to be automated and augmented; and
  – Quantification of expected changes to the future labour market.

3 EMERGING TECHNOLOGIES: INDUSTRY INSIGHT

Purpose

This phase identified the emerging technologies globally, across Australia and locally that are expected to impact on four key industry sectors over the short, medium and long term.

Key steps

- Literature and desktop review of emerging technologies expected to impact on:
  – Agriculture: including precision agriculture, drones, smart farming;
  – Health Care and Social Assistance: including genomics, artificial intelligence (AI), 3D printing, advanced robotics;
  – METS: including autonomous vehicles, autonomous drilling, remote monitoring, control towers; and
  – Tourism: including bots, self-service systems, digital DNA and customisation.
  – Stakeholder engagement identifying the likely adoption of technologies region, including barriers and challenges to adoption.

4 WORKFORCE IMPACTS: THE SO WHAT	5 FUTURE OPPORTUNITIES & CAPABILITIES	6 LABOUR MARKET BLUEPRINT FOR THE REGION
Purpose This phase examined the workforce and labour market impacts on the Greater Whitsunday region based on the identified technologies, and labour market data from phases 2 and 3.	**Purpose** This phase examined the new opportunities within the identified industries that could be used to reshape the workforce and the transition to new capabilities supported by education and training to achieve this.	**Purpose** This phase brought together the findings from the phases of work to establish a workforce blueprint for the Greater Whitsunday region.
Key steps • Identification of emerging roles and occupations that are likely as a result of the identified technologies; • Engagement with the sector on what is currently being undertaken to support and engage the workforce around the Fourth Industrial Revolution; • Examination of Aboriginal and Torres Strait Islander employment impacts, with a particular focus on those occupations with a high Aboriginal and Torres Strait Islander composition; and • Summarise likely employment outcomes and net impact for the region combining global trends and consultation.	**Key steps** • Identification of the new capabilities that would be required to build this workforce in the region; and • Identification of education and training pathways and micro-credentialing needed to build capabilities between current and future state.	**Key steps** • Development of a Future Employment Study and Blueprint outlining the current and future employment environment, and recommended approach to transition the labour market to most benefit the region; • Finalisation of the Future Employment Study and accompanying Blueprint incorporating feedback from key stakeholders.

Structure of this Report

This Future Employment Study has been structured to reflect the changes that are occurring across each of the four industry sectors, in order to support industry stakeholders in understanding implications for them in the Greater Whitsunday region. In addition, the Future Employment Study includes key actions to be undertaken across all industry sectors to support the change required into the future.

This Future Employment Study has been structured into a series of six chapters as per Table 1.1. The Future Employment Study is also supported by a number of Appendices which provide further detail on qualitative and quantitative evidence, consultation sources and data limitations that have been undertaken during the development of this Future Employment Study.

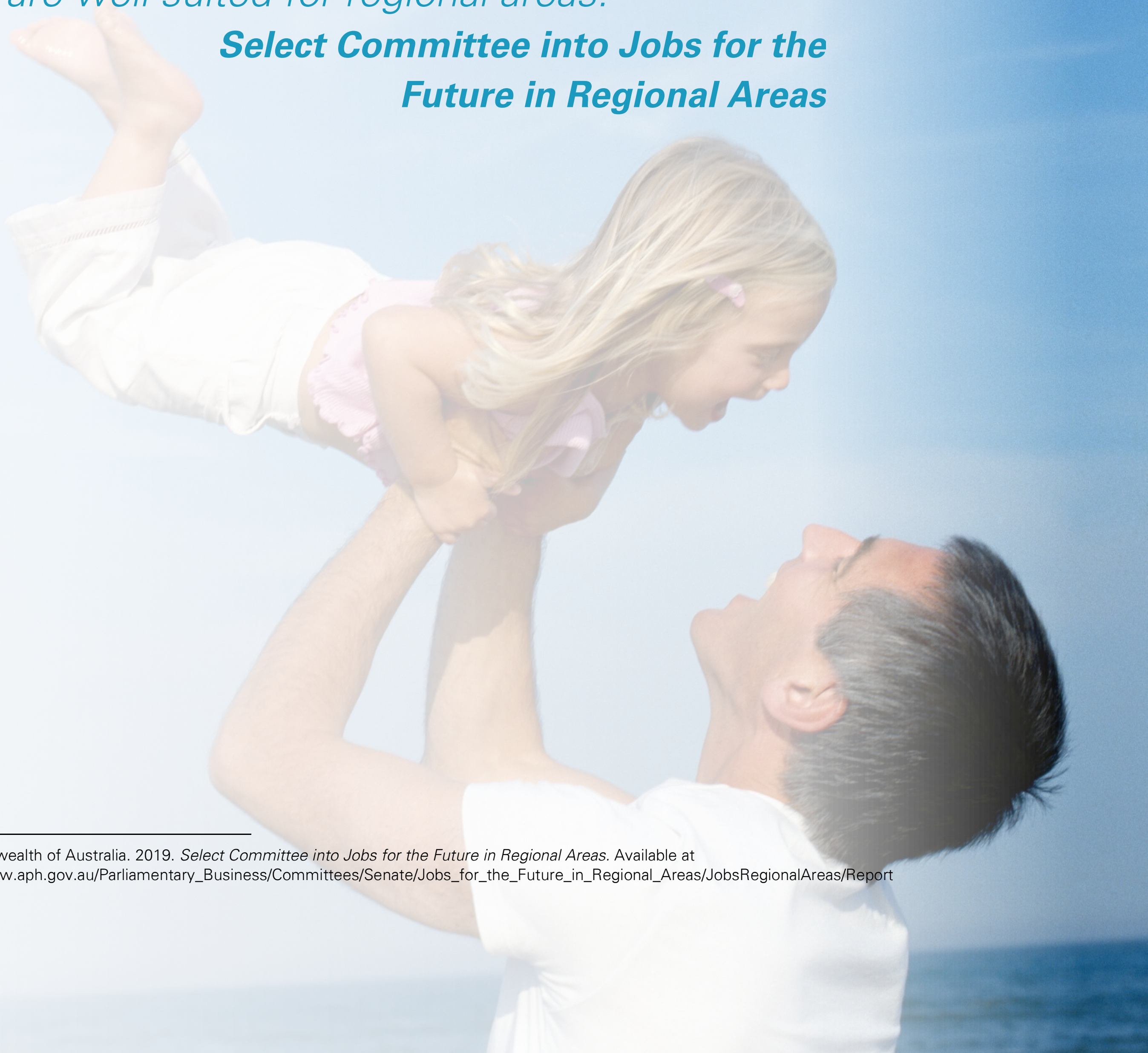
Table 1.1: Report Structure

CHAPTER 1: INTRODUCTION	
PURPOSE	**CONTENTS**
To provide an overview of the Fourth Industrial Revolution and the current state of play for employment across the Greater Whitsunday region, and future projections based on historical trends.	The introductory chapter provides a detailed overview of the importance of the Fourth Industrial Revolution in planning for employment prosperity in the region. This also provides a current state of play of the labour market and employment characteristics of the Greater Whitsunday region, including regional differences, gender composition, age distribution and industry trends.
CHAPTER 2: AGRICULTURE	
CHAPTER 3: HEALTH CARE AND SOCIAL ASSISTANCE	
CHAPTER 4: MINING AND METS	
CHAPTER 5: TOURISM	
PURPOSE	**CONTENTS**
To provide an overview of the opportunity that technology provides for each industry sector within the Greater Whitsunday region and the predicted workforce impacts, with a focus on the 2030 time horizon.	The traditional labour market view provides analysis of current and historical ABS data to highlight key changes and trends that are occurring, and what projections would look like if this continues. The disrupted labour market view is provided through Faethm modelling, which provides a prediction of the key technology adoption rates and workforce impacts of the Fourth Industrial Revolution. The chapter summarises key emerging technologies within the industry that will likely impact the roles, functions and ways of working. Finally, the chapter explores the workforce impacts of emerging technologies across the industry through automation, augmentation and the creation of new roles.
CHAPTER 6: FUTURE EMPLOYMENT BLUEPRINT	
PURPOSE	**CONTENTS**
To provide a summary of the key workforce insights, gaps and recommendations to support the sector.	The research, analysis and evidence outlined in this report has informed the development of a Future Employment Blueprint. The Blueprint outlines the opportunities and challenges in relation to the future of work and industry development within the Greater Whitsunday region.

CHAPTER 1: INTRODUCTION

"The sectors that already sustain regional Australia – such as mining and power generation, agriculture, service industries and manufacturing – hold the key to unlocking new job opportunities. While current skill shortages in regional areas need to be addressed, new technologies and industries may offer the opportunity to create secure and stable local jobs that are well suited for regional areas." [1]

Select Committee into Jobs for the Future in Regional Areas



[1] Commonwealth of Australia. 2019. *Select Committee into Jobs for the Future in Regional Areas.* Available at https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Jobs_for_the_Future_in_Regional_Areas/JobsRegionalAreas/Report

The Global Landscape and the Fourth Industrial Revolution

The global economy and labour market are changing; we are experiencing rapid innovation and evolving technologies. These technologies are fusing the physical, digital and biological worlds, impacting all disciplines, economies and industries, and even challenging ideas about what it means to be human. The resulting shifts and disruptions mean that we live in a time of great promise and also great uncertainty.

Emerging technologies are already being integrated across industry sectors in Australia, with some adapting and changing at a more rapid pace than others. As such, Australian businesses are currently in a state of transition to and within the Fourth Industrial Revolution.

Australian businesses are currently in a state of transition to and within the Fourth Industrial Revolution.

> *Let us together shape a future that works for all by putting people first, empowering them and constantly reminding ourselves that all of these new technologies are first and foremost tools made by people for people."*
>
> ***Klaus Schwab, 2016***[2]

The Fourth Industrial Revolution, first discussed by **Klaus Schwab, Chairman of the World Economic Forum**, suggests we are experiencing a fundamental change in the way we live, work and relate to one another due to the adoption of cyber-physical systems, the Internet of Things (IoT) and the Internet of Systems. [2]This revolution is happening to people across the world, causing disruptions in the way we work, whilst also creating opportunities to use technology for advancements.

> *The world has the potential to connect billions more people to digital networks, dramatically improve the efficiency of organizations and even manage assets in ways that can help regenerate the natural environment, potentially undoing the damage of previous industrial revolutions…*
>
> *….However, organizations might be unable to adapt; governments could fail to employ and regulate new technologies to capture their benefits; shifting power will create important new security concerns; inequality may grow; and societies fragment."*
>
> ***Klaus Schwab, 2016***[2]

Schwab states we are living in a time of both great promise and great peril.

He states:

While technological and digital innovations have been impacting on the Australian workforce and industry profiles for decades, there is a widely held view that the pace and number of technological innovations expected within the next few years will significantly reshape the employment and education landscape across the nation. In light of this, the purpose of this introductory chapter is to highlight the anticipated impacts of the Fourth Industrial Revolution and how these impacts may reshape the workforce across Australia as well as in the Greater Whitsunday region.

[2] Schwab, K. 2016. *The Fourth Industrial Revolution.* World Economic Forum. Available at https://www.weforum.org/about/the-fourth-industrial-revolution-by-klaus-schwab

The Fourth Industrial Revolution and its anticipated opportunities

The Fourth Industrial Revolution has the potential to boost productivity, generate future economic prosperity and improve overall societal wellbeing. In particular, literature and research on the Fourth Industrial Revolution suggests there will be a number of workforce opportunities related to:

- productivity-enhancing technologies which have the potential to result in improved growth in Gross Domestic Product (GDP) and individual incomes; and
- the creation jobs across a range of sectors as well as the expansion of the start-up and small business industry.

These opportunities have the potential to be maximised for the Greater Whitsunday region where technological adoption is accelerated in such a way that ensures inclusive growth for the entire community. Therefore, in order to fully understand the potential impacts of the Fourth Industrial Revolution for the Greater Whitsunday region, it is important to explore each of these opportunities in detail.

Opportunities for productivity and income growth

In recent years, the Australian economy has faced increasing headwinds from slowing productivity and GDP growth. This slowdown has occurred across a diverse range of industries and subsequently has resulted in a sharp slowdown in economic growth as well as real income growth for Australian households. [3]

In light of this economic slowdown, the Fourth Industrial Revolution and the coinciding development and uptake of new technologies holds enormous promise for Australia. Technological and digital innovations to assist humans with their work will become critical to ensuring ongoing productivity and GDP growth over the coming decades.

According to McKinsey Australia, there are a number of ways in which automation and other new technologies will improve national productivity and incomes including:

- improving the efficiency and quality of goods and services;
- increasing international competitiveness in foreign markets and tradeable sectors;
- opening up more jobs to more people, thereby boosting workforce participation; and
- improving the energy, health and safety of those in employment by freeing them from the routine and physical elements of their jobs. [4]

It has been estimated that the adoption of automation and other new technologies could add around $1.2 trillion to the Australian economy by 2030 and give each Australian additional income of $4,000 per year by 2030. Therefore, if embraced, the Fourth Industrial Revolution could have significant positive impacts on the Australian economy over the coming decade. [5]

In order for the Greater Whitsunday region to benefit from the expected productivity and employment growth into the future, there needs to be certain policies and conditions in place for economy-wide diffusion of new products and processes. Policy settings need to focus on ensuring that our education systems support people to gain the skills needed for future industry demand and, in particular, support gaining higher level skills and specialised technical and creative skills and knowledge. It is also important that the region's infrastructure supports businesses and individuals to harness technological change and global opportunities. Business conditions also need to support entrepreneurial activity, and a more technological and global business environment.

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[3] Productivity Commission. 2020. *PC Productivity Insights: Recent Productivity Trends. Available at https://www.pc.gov.au/research/ongoing/productivity-insights/recent-productivity-trends/productivity-insights-2020-productivity-trends.pdf*

[4] *McKinsey Australia. 2019. Australia's automation opportunity: Reigniting productivity and inclusive income growth. Available at https://www.mckinsey.com/featured-insights/future-of-work/australias-automation-opportunity-reigniting-productivity-and-inclusive-income-growth*

[5] *McKinsey Australia. 2019. Australia's automation opportunity: Reigniting productivity and inclusive income growth. Available at https://www.mckinsey.com/featured-insights/future-of-work/australias-automation-opportunity-reigniting-productivity-and-inclusive-income-growth*

Opportunities for job creation and expansion of the start-up industry

Innovation will be a significant industry focus over the coming years, and this will require a skilled technological, digital and scientific workforce. While there have long been calls for an increase in Science, Technology, Engineering and Mathematics (STEM) capabilities, more recent literature notes that digital companies are seeking to fuse technical and creative capabilities to drive innovation.

In an Australian context, Deloitte Access Economics has predicted a growth rate of around two percent per year for the ICT workforce until 2022, as detailed in Table 1.2 below. It should be noted that these occupations are spread across industry sectors, including in the: professional, technical and scientific services industry; public administration and safety industry; financial and insurance services industry; and media and telecommunications industry. This analysis suggests that 'digital disruption' across industry sectors will drive jobs growth in the ICT workforce.

Table 1.2: Expected jobs growth in the ICT workforce (2016-22)

OCCUPATION	2016	2022	AVERAGE ANNUAL GROWTH 2016-2022 (PERCENT)
ICT management and operations	189,503	217,975	2.4
ICT technical and professional	226,856	253,517	1.9
ICT sales	32,461	35,335	1.4
ICT trades	75,368	82,197	1.5
Electronic trades and professional*	3,974	3,774	-0.9
ICT industry admin and logistics support*	112,684	129,087	2.3
Total ICT workers	640,846	721,886	2.0

**Employment in these occupations has only been counted for ICT-related subdivisions, consistent with definitions in Deloitte Access Economics. 2017. Australia's digital pulse.*

Source: Deloitte Access Economics, 2017.

As well as creating jobs, the Fourth Industrial Revolution also has the potential to promote entrepreneurship and expand the start-up and small business communities in Australia. The Office of the Chief Economist notes that Australia is distinct in its high share of small business start-ups (less than 2 years old), with our rate of business entry one of the highest within Organisation for Economic Co-operation and Development (OECD) countries. These start-ups are the largest contributor to job creation in Australia and are spread across all industry sectors.

Start-ups and smaller companies are able to develop flexible organisational structures and business models that leverage ever advancing technology with complementary changes in human capital. In turn, when start-ups and small businesses are enabled to become more entrepreneurial and innovative, they can facilitate technological progress. This ultimately leads to their preservation, expansion and generation of new jobs in the start-up and small business communities.

The Greater Whitsunday region will be positioned to capture the job creation and start-up benefits associated with the Fourth Industrial Revolution where it promotes a dynamic and entrepreneurial business culture. This will involve stimulating the creation of new jobs and enabling businesses within the region to readily integrate innovation and technology in their workplaces.

The Fourth Industrial Revolution and its anticipated challenges

The Fourth Industrial Revolution will not come without its challenges; some jobs will be displaced, and some workplaces and vulnerable industries and communities will be disrupted. In particular, literature and research on the Fourth Industrial Revolution suggests there will be a number of workforce challenges related to:

- the automation of tasks and jobs and subsequent replacement or obsoleteness of certain occupations;
- the shift in the demand for skills across the economy, requiring retraining and upskilling of the workforce; and
- the potential polarisation of the workforce and widening of inequality.

To fully understand the potential impacts of the Fourth Industrial Revolution for the Greater Whitsunday region, it is important to explore each of these challenges in detail.

Challenges associated with the automation of jobs

Automation technologies, such as advanced robotics, machine learning and Artificial Intelligence (AI), all have the potential to make revolutionary changes to the workplace. These technologies are likely to significantly boost efficiency while at the same time replace many current tasks and jobs.

A number of labour market studies have sought to estimate the extent to which the Fourth Industrial Revolution will lead to the automation of Australia's workforce. Recent research and labour market modelling at a national level includes:

- research undertaken by McKinsey Australia which indicated that between 25 percent and 46 percent of existing workforce activities could be automated by 2030 and that between 1.8 and 5 million people may need to switch occupations in this time period;
- modelling undertaken by the Committee for Economic Development of Australia (CEDA) which suggested that it is highly probable that 39.6 percent of the Australian labour market could be replaced by computers within the next couple of decades; and
- research undertaken by Borland and Coeil which found that only 9 percent of occupations would be replaced by automation due to the impacts of digital disruption and automation being buffered by the long term growth of increased employment in non-routine cognitive and non-routine manual tasks.

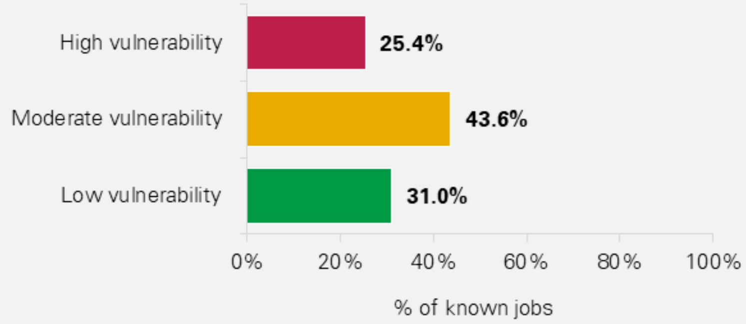
Recent labour force studies have also sought to investigate the regional differences in the future impacts of the Fourth Industrial Revolution. These studies suggest that the level of automation and job displacement will significantly vary between metropolitan and regional areas. Notably, these studies indicate that regional areas have a large proportion of people working in clerical, administrative, technical and trade jobs, as well as jobs in factory processing, all of which are highly susceptible to automation.

In 2018, the Regional Australia Institute (RAI) developed a job vulnerability index to determine the proportion of jobs susceptible to automation in LGAs across Australia. This index was based on internationally recognised studies, such as Frey and Osborne (2013), and assessed how vulnerable regional jobs are to automation (i.e. low vulnerability, moderate vulnerability and high vulnerability). As part of its modelling, the RAI estimated that regional cities have the greatest proportion of jobs that are considered highly vulnerable to automation (28.1 percent), higher than the Australian average (26.5 percent). As highlighted in Figure 1.1, the Mackay and Whitsunday LGAs have a large proportion of jobs that are considered highly vulnerable to automation due to the number of jobs in these LGAs that involve routine and predictable activities (for example, sales assistants and sales persons). In contrast, the Isaac LGA has a large proportion of jobs that are considered moderately vulnerable due to the physical nature of mining activities.[6]

[6] *RAI. 2018. Job vulnerability in Australia: Where are vulnerable jobs locations? Are we ready for the future of work? Available at http://www.regionalaustralia.org.au/home/wp-content/uploads/2018/08/180829_JobVulnerabilityInAustralia_Final.pdf*

Figure 1.1: Job vulnerability for LGAs in the Greater Whitsunday region, based on modelling by the RAI (2018)

WHITSUNDAY



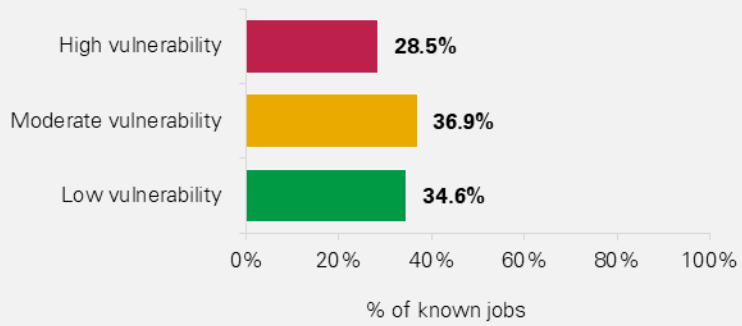
High vulnerability jobs

- Sales assistants and sales persons
- Hospitality workers
- General clerks

Low vulnerability jobs

- School teachers
- Accommodation and hospitality managers
- Retail managers

MACKAY



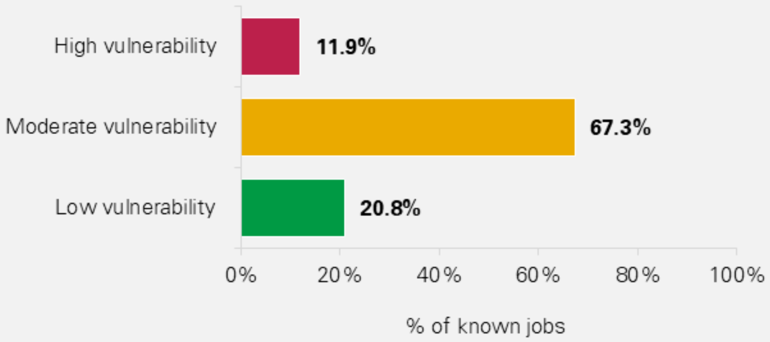
High vulnerability jobs

- Sales assistants and sales persons
- General clerks
- Accounting clerks and bookkeepers

Low vulnerability jobs

- School teachers
- Midwifery and nursing professionals
- Construction, distribution and production managers

ISAAC



High vulnerability jobs

- Mobile plant operators
- Sales assistants and sales persons
- Fabrication engineering trades workers
- **Low vulnerability jobs**
- Electricians
- Construction, distribution and production managers
- Engineering professionals

Source: RAI, 2018.

Challenges associated with retraining and upskilling the workforce

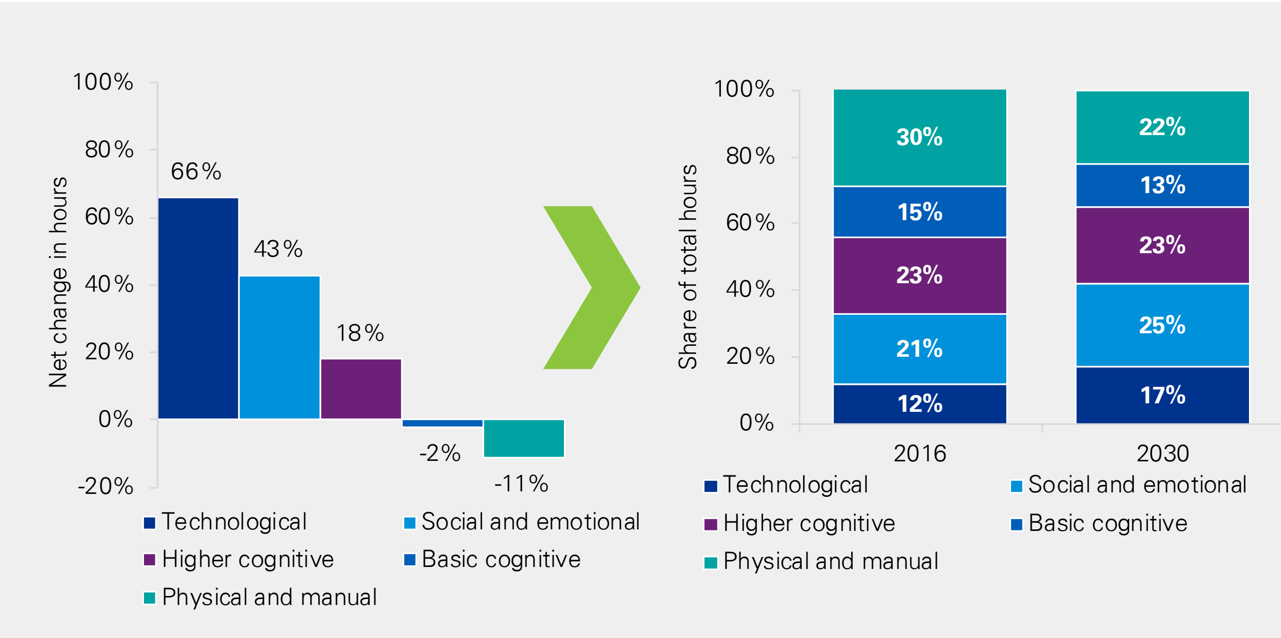
Technological advancements can increasingly lead to the automation of certain skills, which can be offshored or displaced by robots and broader technology. As such, the continual development of workforce skills and capabilities will become key to the sustained competitive advantage of businesses, cities and regions.

The Fourth Industrial Revolution is expected to lead to a shift in the demand for skills across the economy, requiring the workforce to retrain and upskill. As shown in Figure 1.2, recent research has predicted the following three skills and work activities to significantly increase in demand between 2016 and 2030:

- technology skills, which include skills required for working with machines (66 percent increase in hours);
- social and emotional skills, which include skills required for interacting with stakeholders and managing, teaching and developing people (43 percent increase in hours); and
- higher cognitive skills, which include skills required for applying specialised expertise (18 percent increase in hours). [7]

In contrast, the research predicted that demand for people to perform physical and routine tasks will shrink. Overall, this anticipated shift in demand for skills across the Australian economy will lead to an evolution of the future skill mix. The results of the McKinsey Australia's evolution of skills analysis are shown in Figure 1.2 and indicate that digital capabilities, technical skills and social and emotional competencies will become increasingly important in the future. [8]

Figure 1.2: **Net change in hours work and evolution of skills mix (2016-30)**



Source: McKinsey Australia, 2019.

Employers and education and training institutions in the Greater Whitsunday region will ultimately need to work closely together to agilely overcome both the industry challenges and relevant employment and skills development challenges associated with the Fourth Industrial Revolution. This will involve the collaborative and continual development of education and training courses and programs to match the accelerated demand for certain skills in the region.

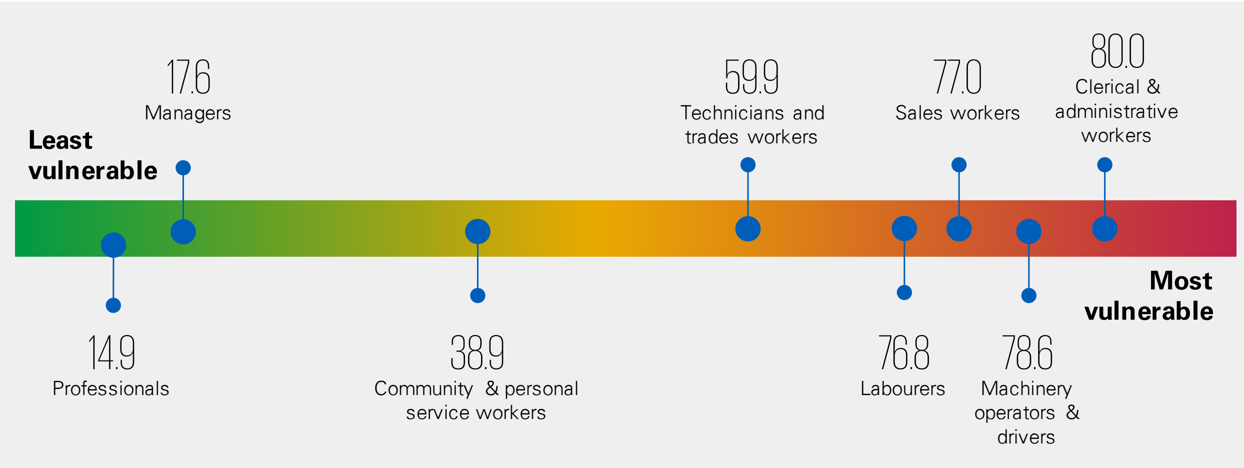
[7] *McKinsey Australia. 2019. Australia's automation opportunity: Reigniting productivity and inclusive income growth. Available at https://www.mckinsey.com/featured-insights/future-of-work/australias-automation-opportunity-reigniting-productivity-and-inclusive-income-growth*
[8] *McKinsey Australia. 2019. Australia's automation opportunity: Reigniting productivity and inclusive income growth. Available at https://www.mckinsey.com/featured-insights/future-of-work/australias-automation-opportunity-reigniting-productivity-and-inclusive-income-growth*

Challenges associated with potential polarisation of the workforce and widening of inequality

Technological change, particularly automation technologies, will enable a reorganisation of the workforce to place greater emphasis on certain skills, particularly technical, interactive and cognitive skills. However, this reordering of skills may also polarise the labour market, with jobs growth occurring in highly skilled workforces but declining in jobs for those in the middle-to-low skilled workforce.

Recent research and labour force modelling indicates that specific occupations – those characterised by performing routine cognitive or manual tasks – will be more vulnerable to automation and obsolescence. Based on the modelling undertaken by the RAI in 2018, Figure 1.3 indicates that these occupations are likely to relate to clerical and administrative workers, machinery operators and drivers, sales workers and labourers. [9]

Figure 1.3: **Occupations (Australian and New Zealand Standard Classification of Occupations (ANZSCO) 1-digit) ranked by average automation score, based on modelling by the RAI (2018)**



Source: RAI, 2018.

As a result of this potential polarisation of the workforce, researchers have expressed concerns that automation may increase levels in income inequality. In particular, these concerns have been expressed in response to the likely increase in demand for high-skilled employment and the coinciding decline in demand for manual or low-skilled labour. Without appropriate policy responses, the inability of many individuals to adjust to the current and expected skill demands of industry will likely result in a number of social consequences including unemployment, financial hardship and marginalisation. [10]

In order to mitigate the income distribution impacts of the Fourth Industrial Revolution, the Greater Whitsunday region will need to be proactive in promoting inclusive growth in the region. This will involve fostering lifelong learning pursuits which will become essential for people to enter the workforce, find and retain jobs, and continue to grow throughout their careers. Education providers can lead these efforts to foster lifelong learning of relevant skills through accessible, modular courses. However, businesses will also need to be proactive in assisting displaced employees and working with government to protect the most vulnerable in the Greater Whitsunday region.

[9] *RAI. 2018. Job vulnerability in Australia: Where are vulnerable jobs locations? Are we ready for the future of work? Available at http://www.regionalaustralia.org.au/home/wp-content/uploads/2018/08/180829_JobVulnerabilityInAustralia_Final.pdf*
[10] *Lewis, P. 2015. Technological and structural change in Australia's labour market. Chapter 2.2. of CEDA's report available at https://www.ceda.com.au/CEDA/media/Research CatalogueDocuments/Research%20and%20Policy/PDF/26792-Futureworkforce_June2015.pdf*

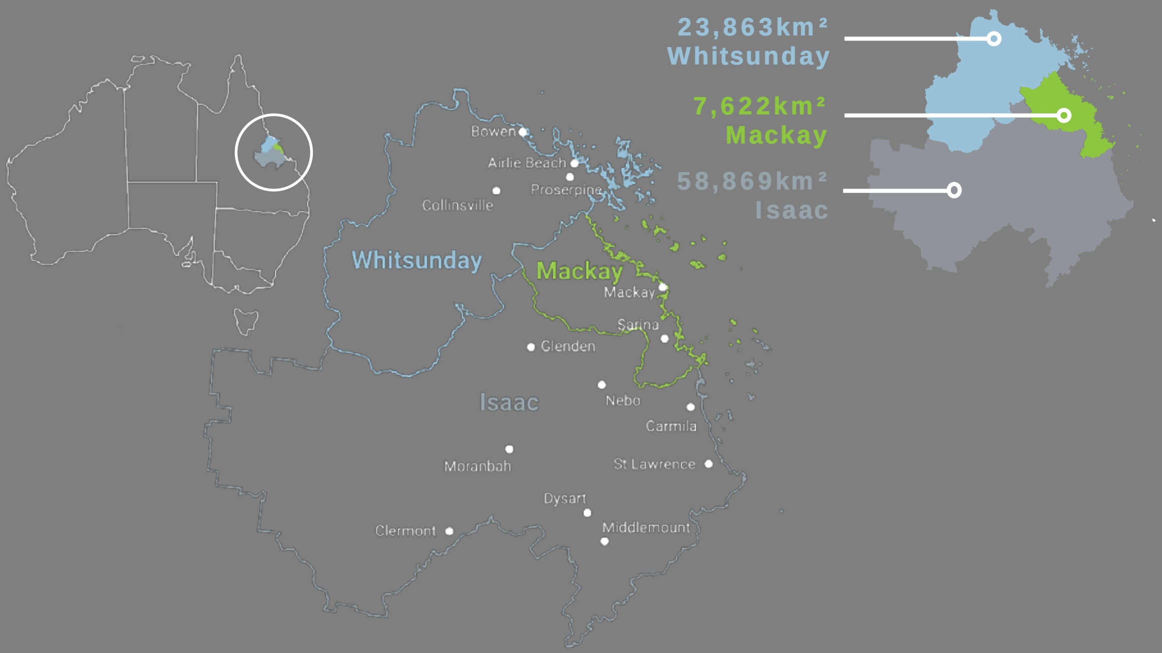
THE GREATER WHITSUNDAY REGION

"According to the Australian Bureau of Statistics, from 2011 to 2036 the population of the Greater Whitsunday region is projected to increase from 171,564 to 249,898 persons. The projected population growth coupled with continued low unemployment rates identifies a need to look at employment opportunities that can be created in the region.

Greater Whitsunday Alliance submission to the Select Committee into Jobs for the Future into Regional Areas, September 2019

THE GREATER WHITSUNDAY LANDSCAPE

The Greater Whitsunday region, including the Mackay, Isaac and Whitsunday LGAs, spans an area of greater 90,000 square kilometres, has a permanent regional population of more than 170,000 people and contributes more than $22 billion to the national economy. [11]



The region's proximity to the Galilee, Bowen and Surat Basins makes it one of Queensland's largest areas of coal, energy and gas production. The region's mining and resource activity includes underground and open cut thermal and metallurgical coal particularly in the Bowen Basin region, minerals and coal seam gas. [12]

The region is serviced by the Mackay Hospital and Health Service (HHS), which is responsible for the delivery of public health services in the region. Additionally, the Greater Whitsunday region has approximately 122 early childhood education and care services, 1,087 aged care places and 2,524 National Disability Insurance Scheme (NDIS) participants. [13]

Agricultural land comprises the significant majority of land in the Greater Whitsunday region, accounting for approximately 79,800 square kilometres or 89 percent of total land within the region. [14] The most common land use is for grazing native vegetation, occupying 42,500 square kilometres or 47 percent.

The region is also renowned for its tourist attractions. In particular, the Whitsunday region is described by local residents as a beautiful beach paradise that is characterised by its iconic islands, tourism market and peaceful setting. [15] The Isaac region forms part of the broader Mackay tourism region area and features a diverse landscape. The Mackay tourism region is characterised by local residents as a beautiful, tropical region with a quiet, peaceful, friendly community and prominent mining industry. [16]

Figure 1.4 overleaf provides a snapshot of the Greater Whitsunday region and its key industries and geographic differences.

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[11] *Greater Whitsunday Alliance. 2019. Regional Economic Profile. Available at https://www.greaterwhitsundayalliance.com.au/reports*
[12] *Greater Whitsunday Alliance. 2019. Regional Economic Profile. Available at https://www.greaterwhitsundayalliance.com.au/reports*
[13] *Queensland Government Statisticians Office. 2020. Queensland Regional Profiles. Available at https://statistics.qgso.qld.gov.au/qld-regional-profiles*
[14] *Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES). 2020. About my region – Mackay - Isaac - Whitsunday Queensland. Available at https://www.agriculture.gov.au/abares/research-topics/aboutmyregion/qld-mackay#regional-overview*
[15] *Tourism and Events Queensland. Social Indicators 2019 Whitsundays. Available at https://cdn1-teq.queensland.com/~/media/8d642698de954924af7d3df164dde8a0.ashx?vs=1&d=20191024T122353*
[16] *Tourism and Events Queensland. Social Indicators 2019 Mackay. Available at https://cdn1-teq.queensland.com/~/media/ad55ff7f8d974e9da58e02136c42551e.ashx?vs=1&d=20191024T121820*

Figure 1.4: The Greater Whitsunday region snapshot

THE GREATER WHITSUNDAY REGION

All LGA data captured from the REMPLAN economy profile and ABS statistics

Whitsunday

Population **35,000** | Employment **16,060** | Gross Regional Product **$2.866 Billion**

Mining, tourism and agriculture are the three pillars of the Whitsunday regional economy. Tourism employs the largest share of the Whitsunday region's labour market and is the second-largest contributor to the region's industry value-added behind Mining. Mining is the largest contributor to the Whitsunday Region's economic output, with coal mining accounting for the largest share of industry output.

Tourism
Output $793 million | **Employment** 2,361 jobs

Mining and METS
Output $996 million | **Employment** 870 jobs

Mackay

Population **116,539** | Employment **52,575** | Gross Regional Product **$9.132 Billion**

The Mackay regional economy is driven by a number of key industry sectors such as mining services, education, health, aviation, tourism and agriculture. The region has a strong agriculture history, as the region was settled as sugar farming areas and is now one of the most recognised and innovative sugar cane growing and milling areas in Australia. Mackay is a world leader in the mining equipment, technology and services sector, and is currently focused on expanding the service industry hubs of the Bowen and Galilee Basins. Mackay also hosts a number of tourist attractions such as the Eungela National Park, Finch Hatton Gorge, beaches and is in close proximity to the Great Barrier Reef Marine Park.

Agriculture
Output $740 million | **Employment** 608 jobs

Mining and METS
Output $2,810 million | **Employment** 2,478 jobs

Isaac

Population **35,360** | Employment **20,934** | Gross Regional Product **$10.827 Billion**

The Isaac regional economy is driven largely by the resource sector, as the largest mining region in the state with 26 operating coal mines and four other resource operations. A large proportion of the population is resource workers who are fly in-fly out. Agriculture is another key industry for the region, through livestock and crops.

Mining and METS
Output $14,740 million | **Employment** 12,298 jobs

Agriculture
Output $354 million | **Employment** 383 jobs

Current workforce characteristics

Overall employment

Employment growth in the Greater Whitsunday region has been relatively subdued in recent years. This subdued growth has largely been the result of a number of challenges relating to the Greater Whitsunday region's current and future workforce. These trends are occurring across Australia and include:

- The casualisation of the workforce – due to the increased digital capability, future jobs will likely be flexible at balancing home and work, with an increase in people independently contracting, working part time, working later in life and choosing to become a 'digital employee' with the ability to choose when and where they work around the world;
- Risk of transient labour – the fly in-fly out workforce, which could be at risk given the increasing options for flexible working available;
- As we enter the Fourth Industrial Revolution there is an increasing demand for not only digital skills, but more intangible attributes such as entrepreneurialism, creativity and interpersonal skills;
- Reliance on digital connectivity – as digital connectivity becomes part of our day to day lives, regional areas are at risk of poorer outcomes due to limited technological readiness due to access and infrastructure challenges; and
- Ageing workforce – population ageing has reduced growth in the labour force across the Greater Whitsunday region as a result of a large number of employees entering retirement. [17]

As shown in Figure 1.5, these challenges have contributed to employment in the Greater Whitsunday region declining at an annual rate of 1.4 percent from 96,122 people in 2015 to 89,589 people in 2020. In comparison, employment at the national level grew on average by 2.1 percent per annum between 2015 and 2020. [18]

Declining employment in the Greater Whitsunday region is set against the context of a declining population. As at June 2019, the Greater Whitsunday region had an estimated resident population of 173,006. [19] In the five year period between 2014 and 2019, the population declined by an annual average rate of 0.3 percent, due to negative growth in the Isaac LGA (-1.7 percent) and Mackay LGA (-0.4 percent). The Whitsunday LGA experienced marginal population growth (0.6 percent). In comparison, the population in Queensland grew at an average annual rate of 1.5 percent during this period. The population within the Greater Whitsunday region is projected to gradually increase to 2031, by an annual average of 1.3 percent to 202,986 people. The Queensland population is expected to continue to grow annually at 1.7 percent, to 6,206,566 people over this period.

The Greater Whitsunday region has experienced prolonged drought conditions, which continue to be a challenge for many primary producers and detrimentally affect the agriculture industry's performance. This is particularly the case for the Isaac and Whitsunday LGAs, which have been partly drought declared since 2013 and 2015, respectively. [20]

In 2017, North Queensland was significantly impacted by Severe Tropical Cyclone Debbie, causing damage to infrastructure and industry in excess of $1 billion. The Greater Whitsunday region was the most heavily affected region in the State, with the cyclone causing damage to an estimated 33 percent of all urban premises. [21] Additionally, the tourism industry was severely impacted by Cyclone Debbie with an estimated $150 million loss to that sector within Queensland. [22]

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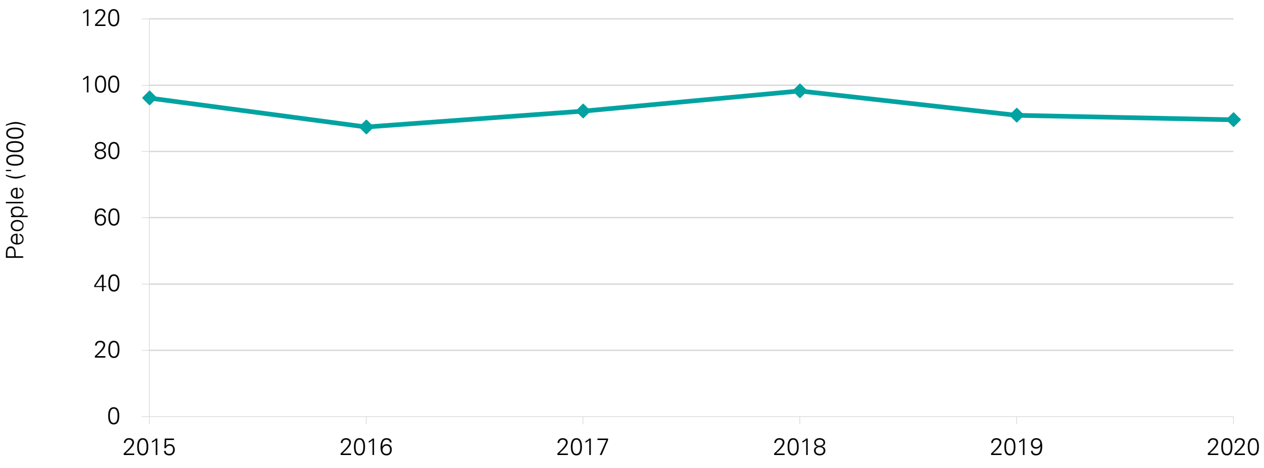
[17] *CEDA. 2015. Australia's future workforce? Available at https://www.ceda.com.au/CEDA/media/Research CatalogueDocuments/Research%20and%20Policy/PDF/26792-Futureworkforce_June2015.pdf*
[18] *ABS, cat. no. 6291.0.55.003, Labour Force, Australia, Detailed, Quarterly, original.*
[19] *ABS, cat. No. 3218.0 - Regional Population Growth, Australia, various editions and Queensland Treasury and Trade estimates.*
[20] *Long Paddock. Drought Declarations. Available at https://www.longpaddock.qld.gov.au/drought/drought-declarations/*
[21] *Inspector-General Emergency Management, 2018. The Cyclone Debbie Review, Report 1: 2017-18.*
[22] *Queensland Reconstruction Authority. 2017. Severe Tropical Cyclone Debbie 8 month progress report. Available at https://www.qra.qld.gov.au/sites/default/files/2018-11/stc_debbie_8_month_progress_report-full-report_0.pdf*

Figure 1.5: Total employment in the Greater Whitsunday region workforce (2015-20)



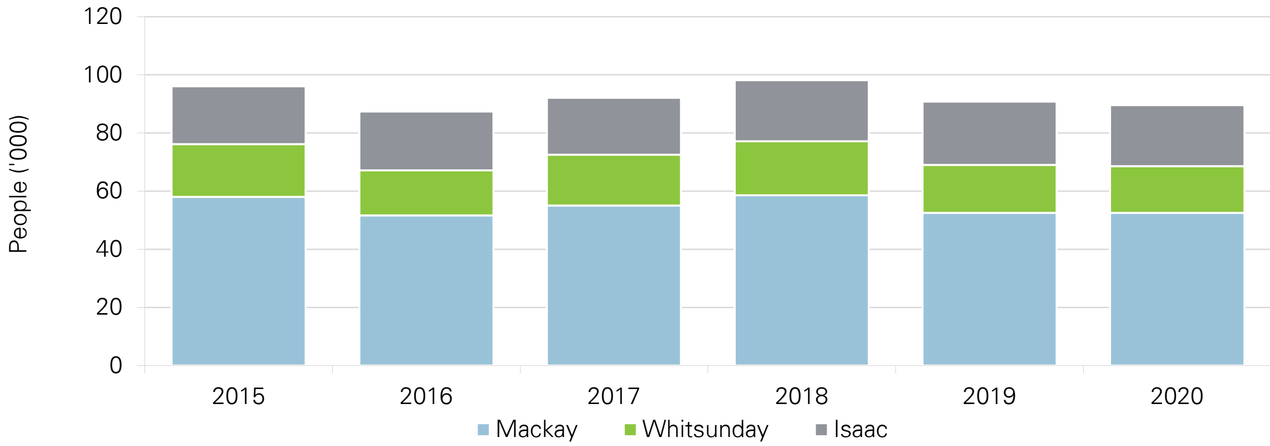
Source: KPMG based on ABS Labour Market Quarterly and Census data.

LGA differences

Within the Greater Whitsunday region there is regional variation in the size of the workforces in the Mackay, Isaac and Whitsunday LGAs. These differences are largely attributable to variations in industry focus, population size, geographic size, and a range of fundamental demographic factors. The Mackay LGA is one of the fastest growing regional areas in Queensland and has a diverse economic focus on the Health Care and Social Assistance, Retail Trade, Construction, Transport, Postal and Warehousing and Manufacturing industries. As the gateway to the Great Barrier Reef, the Whitsunday LGA has a strong focus on delivering tourism and accommodation and food services. In contrast, the Isaac LGA has a significant focus on Mining and METS due to its proximity to resource rich areas of Queensland.

Figure 1.6 illustrates the impacts of these regional employment differences in the Greater Whitsunday region over a five year period between 2015 and 2020. Notably, during this period approximately 59.3 percent of the workforce was employed in the Mackay LGA, 18.5 percent in the Whitsunday LGA and 22.3 percent in the Isaac LGA.

Figure 1.6: Total regional employment variations in the Greater Whitsunday region workforce (2015-20)



Source: KPMG based on ABS Labour Market Quarterly and Census data.

There are some limitations in the ABS data at a regional level. As detailed in Appendix C and summarised in Table 1.3 (overleaf), comparative analysis has been undertaking against the REMPLAN data. This is based on June 2019 data as reported in the Greater Whitsunday Alliance Economic Profile November 2019, whereas the ABS analysis included throughout this report is based on February 2020 data.

A comparison against these labour market datasets shows relatively consistent headcount and percentage employment within the LGA across most industry sectors, however it is acknowledged that there are differences in employment across different datasets, including industry specific data, such as that provided by the Department of Agriculture and Fisheries (DAF). Further discussion about the possible reasons for this difference are outlined in the Agriculture chapter of this Report.

Table 1.3: Employment across selected industry sectors Greater Whitsunday region, based on REMPLAN June 2018 data

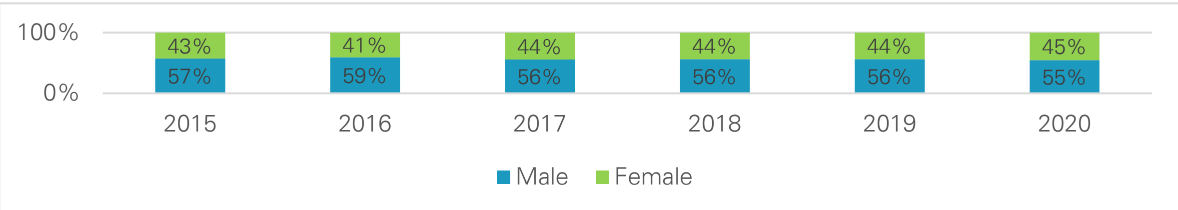
INDUSTRY	ISAAC	MACKAY	WHITSUNDAY
Mining (headcount)	13,080	2,623	924
Mining (% of total employment in the LGA)	60.9%	5.5%	5.8%
Health Care and Social Assistance (headcount)	492	5,948	1,164
Health Care and Social Assistance (% of total employment in the LGA)	2.3%	12.4%	7.4%
Accommodation and Food Services (headcount)	947	3,337	2,727
Accommodation and Food Services (% of total employment in the LGA)	4.4%	7.0%	17.3%
Agriculture, Forestry and Fishing (headcount)	1,160	1,873	1,646
Agriculture, Forestry and Fishing (% of total employment in the LGA)	5.4%	3.9%	10.4%

Source: Greater Whitsunday Alliance, Economic Profile November 2019, p18 [23]

Gender composition

Figure 1.7 shows the gender composition for the Greater Whitsunday workforce over a five year period between 2015 and 2020. During this five year period the number of males and females in the industry declined at an annual average rate of 2.2 percent and 0.3 percent, respectively. As at February 2020, males accounted for 54.8 percent of the workforce, which was slightly higher than the proportion of males employed at the national level (52.7 percent). [24]

Figure 1.7: Gender composition in Greater Whitsunday workforce (2015-20)



Source: KPMG based on ABS Labour Force data.

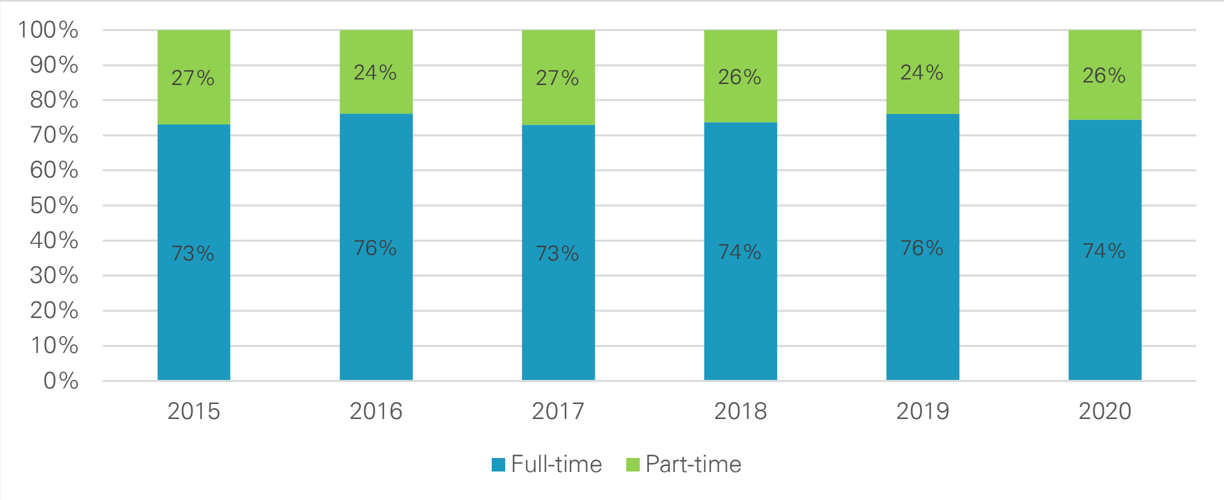
[23] *Greater Whitsunday Alliance. 2019. Economic Profile. Available at https://static1.squarespace.com/static/5e4ce5c91e5a64752b65c169/t/5e7d706214477f68e7ebe96f/1585279145425/GW3+-+Economic+Profile+2019+%5B1184%5D+Final+Digital.pdf*

[24] *ABS, cat. no. 6291.0.55.003, Labour Force, Australia, Detailed, Quarterly, original.*

Employment composition

Figure 1.8 shows the employment type composition (full-time versus part-time) for the Greater Whitsunday region over a five year period between 2015 and 2020. Over the five year period, the industry's profile in employment type has predominantly consisted of full-time employees. This has been the case despite the number of full-time and part-time employees declining at an average annual rate of 1.1 percent and 2.4 percent respectively. As at February 2020, full-time employees accounted for 74.4 percent of the workforce, which was higher than the share of full-time employees at the national level (68.7 percent). [25]

Figure 1.8: Employment type composition in for the Greater Whitsunday workforce (2015-20)



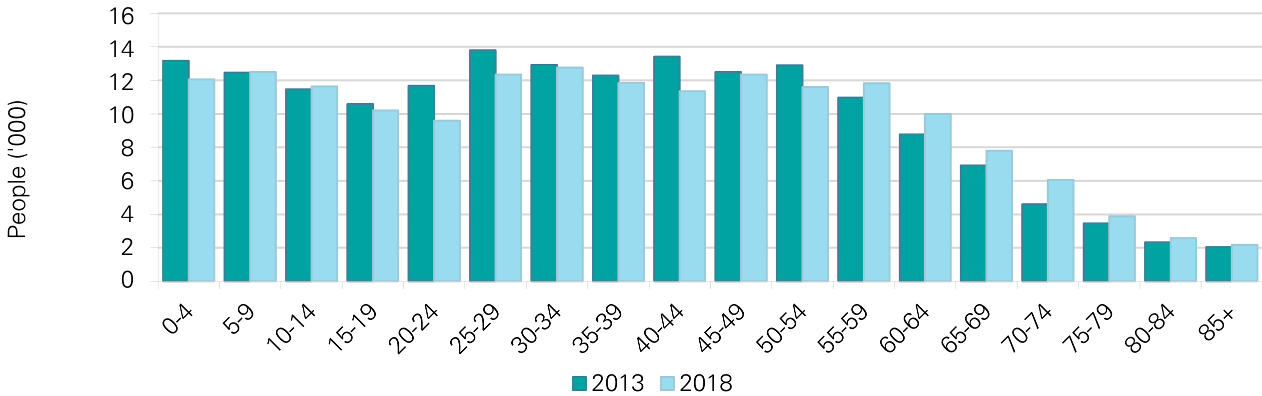
Source: KPMG based on ABS Labour Force data.

Age distribution

As shown in Figure 1.9, the Greater Whitsunday region is characterised by an ageing population. Between 2013 and 2018, the proportion of the population aged 65 years and over increased from 11 percent to 13 percent. This indicates that there will be future downward pressure on aggregate labour supply as older employees retire.

The number of non-working age persons in a community dependent on those working-age persons can be expressed as a 'dependency ratio', being the number of persons aged less than 15 years and 65 years and over divided by the number of persons aged 15 to 64 years. This ratio gives some indication of the burden falling on working-age persons to provide social supports. In the five year period between 2013 and 2020, the region's dependency ratio increased from 47.1 percent to 51.5 percent. At present, over half of the Greater Whitsunday region's population would be classified as being dependent on its current workforce.

Figure 1.9: **Age distribution of the Greater Whitsunday population (2013 and 2018)**



Source: KPMG based on ABS Labour Force data.

[25] *ABS, cat. no. 6291.0.55.003, Labour Force, Australia, Detailed, Quarterly, original.*

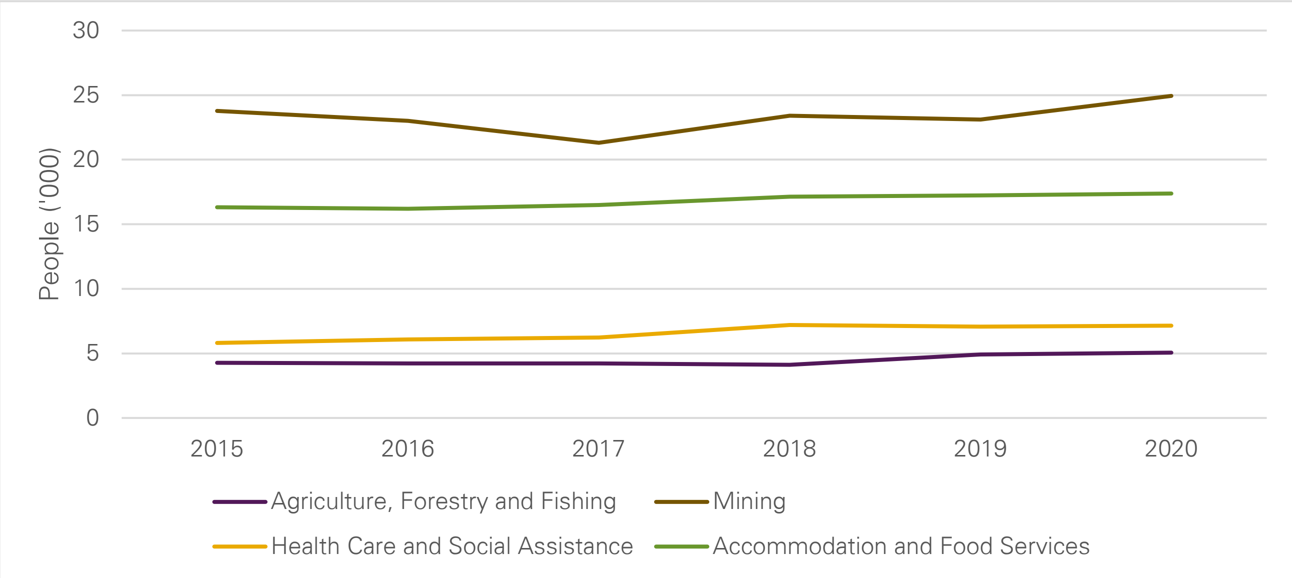
Industry trends

As shown in Figure 1.10, the Greater Whitsunday region has experienced some degree of variability in industry occupation employment during the five year period between 2015 and 2020. Between 2015 and 2020, the Health Care and Social Assistance industry experienced the highest growth in employment in percentage terms, from 5,810 to 7,150 persons (4.2 percent on average per annum). Second to this growth rate, the number of Agriculture, Forestry and Fishing employees grew at an average annual rate of 3 percent from 4,274 people to 5,059 people.

The Mining and METS industry experienced the smallest growth in employment between 2015 and 2020 in percentage terms from 23,789 people to 24,939 people (one percent on average per annum). Second to this, the Accommodation and Food Services (Tourism) industry grew at an average annual rate of 1.3 percent from 16,332 people to 17,380 people.

The current industry employment profile for the Greater Whitsunday region is important to consider for any impacted jobs in terms of future employment opportunity.

***Figure 1.10:* Key industry employment trends in the Greater Whitsunday region (2015-20)**



Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

Small Business Composition

It is acknowledged that the small, medium and large business footprint is very different across industry sectors in the Greater Whitsunday region, and more widely across Queensland and Australia. The size of a business impacts on the agility and responsiveness (generally, smaller businesses are better however this can be dependent upon industry) and also the capital they have available to invest in and implement technology (generally better the larger the business).

Queensland and Greater Whitsunday region data on the small business profile across the four selected industry sectors is shown in Table 1.4 below and shows that across Queensland there are a larger number of small businesses in the Agriculture sector than the other three sectors (40,355 in Agriculture compared with 85,068 across all four industry sectors), and a very low number of small businesses in the Mining and METS industry across Queensland (1,714). The size of the business may impact on technological adoption rates in the industry.

Financial viability remains a key issue for small businesses particularly in the first two years of operation. Small business survival rates over the period from 2015-2018 were highest for Health Care and Social Assistance (65 percent), and lowest for small businesses in the Mining and METS industry (41.1 percent).

Table 1.4: Small business profile of selected industries Queensland and Greater Whitsunday region, 2019

INDUSTRY	NUMBER OF SMALL BUSINESSES	PROPORTION OF ALL SMALL	SMALL BUSINESS (NON EMPLOYING AND <20

	(NON EMPLOYING AND <20 EMPLOYEES) QUEENSLAND	BUSINESSES, QUEENSLAND	EMPLOYEES) AVERAGE SURVIVAL RATE 2015-2019
QUEENSLAND			
Agriculture, Forestry and Fishing	40,355	9.1%	68.7%
Health Care and Social Assistance	26,845	6.0%	69.3%
Mining and METS	1,714	0.4%	61.8%
Accommodation and Food (as a proxy for Tourism)	16,154	3.6%	53.9%
MACKAY			
Agriculture, Forestry and Fishing	1,965	0.4%	-
Health Care and Social Assistance	489	0.1%	-
Mining and METS	98	0.0%	-
Accommodation and Food (as a proxy for Tourism)	267	0.1%	-
ISAAC			
Agriculture, Forestry and Fishing	678	0.2%	-
Health Care and Social Assistance	46	0.0%	-
Mining and METS	22	0.0%	-
Accommodation and Food (as a proxy for Tourism)	55	0.0%	-
WHITSUNDAY			
Agriculture, Forestry and Fishing	655	0.1%	-
Health Care and Social Assistance	115	0.0%	-
Mining and METS	21	0.0%	-
Accommodation and Food (as a proxy for Tourism)	198	0.0%	-

Source: Australian Bureau of Statistics (2019). Counts of Australian Businesses, including Entries and Exits, June 2015 to June 2019. Please note that Small Business Survival Rate is unavailable by LGA.

COVID-19 and "at risk" occupations

The impacts of the COVID-19 pandemic are unfolding in real time. History tells us that pandemics have a material effect on the functioning of the global economy. In broad terms, pandemics cause individuals to change their normal patterns of behaviour; people change how and when they consume goods and services, and how and when they participate in the labour market.

While these impacts have already played out very differently across industry sectors (and are discussed further in each of the industry chapters), Faethm provides analysis of which occupations are at greatest risk based on two dimensions: the degree of remote productivity (or ability to work from home); and the degree of human interactivity (increasing risk of COVID-19 exposure). Table 1.5 provides a summary of the number of occupations Faethm categorise as high, medium and low risk, by industry sector. Of the occupations analysed for this project, the greatest number of occupations at risk to COVID-19 exist in the Health Care and Social Assistance industry (33 total, and 56 percent of all of the occupations in Health Care and Social Assistance), followed by Agriculture, Forestry and Fishing (17 total, and 49 percent of all of the occupations in Agriculture Forestry and Fishing).

Source: KPMG based on the ABS data sources.

Table 1.5: Faethm at risk profiles for job resilience in a pandemic context

INDUSTRY	NUMBER OF HIGH RISK OCCUPATIONS	NUMBER OF MEDIUM RISK OCCUPATIONS	NUMBER OF LOW RISK OCCUPATIONS
Mining and METS	-	22	3
Health Care and Social Assistance	33	21	5
Agriculture, Forestry and Fishing	-	29	1
Accommodation and Food (as a proxy for Tourism)	17	14	4

Source: Faethm (faethm.ai).

CHAPTER 2: AGRICULTURE INDUSTRY

"For Australia's agricultural industries to remain globally competitive, continuous productivity improvements are required. Key to realising these improvements in productivity – and profitability – is the generation and application of new knowledge and technology delivered through research and development.

National Farmers Federation

The opportunity provided by technology in agriculture

Australian context

Australia is a premium global food supplier with a reputation for strong food security and high quality products. Factors such as our geographic isolation and strict quarantine and monitoring standards combined with strategic proximity to Asia, free trade agreements and counter-season production for the northern hemisphere place Australia in a strong competitive position globally. [26]

To capitalise on this strong position and growth opportunities in both domestic and international markets, the agribusiness and food sector within Australia has continued to incorporate innovative approaches utilising technology.

However, the Agricultural industry is predicted to continue to experience rapid change and increasing challenges into the future. By 2050, it is expected that 60 percent more food will be required to feed a growing world population that is estimated reach 9.7 billion people. [27] Additionally, changing consumer preferences, including for organic produce, and increasing environmental impacts from climate change, will disrupt production within the sector and result in the diversification of the traditional agriculture focus. [28]

Australia competes through high quality produce and free trade on the global stage. Increasing uncertainty and tensions in the geopolitical landscape will likely impact significantly on the agricultural products Australia exports into the future. To address these new challenges and continue to capitalise on global demand for Australian agricultural products, an increasing focus and move towards improving the efficiency and productivity of our farming through new agricultural technologies is required.

In addition to the economic increase across the sector, agribusinesses which are able to utilise these emerging technologies will benefit from increasing farm profitability and efficiency, advancing product traceability for consumers and automating global trade compliance. Technology will create a clearer path for industry growth within Australia and a more seamless connection to the ever expanding domestic and global consumer markets. [29]

> *In Australia specifically, support for digital technologies in agriculture is growing, with support from both private and public sector stakeholders increasing. There are currently eleven accelerators, pre-accelerators and incubators supporting agrifood tech start-ups in Australia, as well as a growing number of conferences featuring AgTech content and even start-up pitch competitions. Combined, these programs and events are growing awareness for the industry and its potential.*
>
> ***AgriFutures Australia*** [30]

[26] *Austrade, 2013, Agribusiness – Research, Consulting, Technology and Equipment, p 6.*
[27] *KPMG and Skills Impact, 2019, Agricultural workforce digital capability framework.*
[28] *Grant Hamilton et al., AgriFutures Australia, Horizon Scanning – Opportunities for New Technologies and Industries: Final Report, 2019.*
[29] *E. Perrett et al., Australian Farm Institute, 2017, Accelerating precision agriculture to decision agriculture – analysis of the economic benefit and strategies for delivery of digital agriculture in Australia.*
[30] *AgriFutures Australia. 2018. Emerging agricultural technologies: Consumer perceptions around emerging Agtech.*

A regional lens

Greater Whitsunday region

According to the Australian Bureau of Agricultural and Resource Economics (ABARES), the Mackay, Isaac, Whitsunday region covers approximately 5 percent of Queensland (89,900 square kilometres). Within this region, agricultural land accounts for 89 percent of the region's land use (79,800 square kilometres). Grazing native vegetation is the most common land use within the region, accounting for 47 percent of the regional land use by area (42,500 square kilometres). [31]

In 2018-19, the gross value of agricultural production within the Greater Whitsunday region was $1.28 billion, representing approximately 10 percent of the total value of agricultural production in Queensland. [32]

Livestock, cropping and horticulture

Cattle and calves are the primary agricultural commodity within the Greater Whitsunday region and contribute $623.1 million in gross value. As shown in Figure 2.1, beef production in the region is largely based in the Isaac LGA which has 14 cattle feedlots that intensively produce beef products. [33]

Sugarcane is the second highest value commodity for the region, contributing $361.5 million. As shown in Figure 2.1, the majority of the region's sugar cane is harvested in the Mackay LGA. [34]

Tomatoes ($69.2 million), beans ($40.8 million), capsicum ($32.2 million) and sweet corn ($29.9 million) are all high value commodities that are produced within the Greater Whitsunday region, with all other vegetables comprising $33.8 million.

Aquaculture and fisheries

The Queensland aquaculture industry was valued at $118.4 million in 2018-19, representing a 35 percent increase from the 2012-13 value of $87.6 million. [35] As shown in Figure 2.1, the aquaculture industry is distributed across the Greater Whitsunday region with the Mackay LGA hosting the largest number of aquaculture sites. [36]

Within the Greater Whitsunday region, the total production value of the aquaculture industry in 2018-19 was $13.3 million. [37] Since 2012, the aquaculture industry has on average represented 37 percent of the total fisheries production within Queensland.

The Greater Whitsunday region is expected to experience a significant increase in aquaculture productivity due to the acquisition of prawn farms in both the Whitsunday and Mackay LGAs by Tassal, a Tasmanian based company that has historically specialised in salmon farming and is diversifying its production. Additionally, across Queensland prawn production increased by 7.6 percent in 2018-19 as the industry continues to recover from white spot disease and affected farms restock ponds.

Future focus

Traditionally, the region has relied on the livestock, sugarcane and horticultural sectors to drive the agriculture industry. However, there is an increased regional focus on biofutures. Biofutures broadly refers to the industrial biotechnology and bio products sector that develops and manufactures products from sustainable and organic products and waste resources.

The Queensland Government is focused on biofutures to promote economic development within the region and to stimulate innovation, jobs and economic growth. The Queensland Biofutures 10-year Roadmap and Action Plan identifies the Sarina Wilmar Bioethanol and Mackay Renewable Bio-commodities Pilot Plant as both existing facilities and potential opportunities for biochemical production from succinic acid from sugarcane bagasse. [38]

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[31] *ABARES. 2020. About my region – Mackay – Isaac- Whitsunday Queensland. Available at https://www.agriculture.gov.au/abares/research-topics/aboutmyregion/qld-mackay*

[32] *ABS, cat. no. 7503.0, Value of agricultural commodities produced, Australia 2020*

[33] *Queensland Spatial Catalogue. Agricultural land audit – current cattle feedlots. 10 May 2018.*

[34] *ABS, cat. No. 7128.0, Sugarcane, experimental regional estimates using new data sources and methods, Australia 2019-20.*

[35] *Department of Agriculture and Fisheries, Ross Lobegieger report to farmers – Aquaculture production summary for Queensland 2018-19, 2020.*

[36] *Queensland Spatial Catalogue. Agricultural land audit – current aquaculture. 12 December 2017.*

[37] *Department of Agriculture and Fisheries, Ross Lobegieger report to farmers – Aquaculture production summary for Queensland 2018-19, 2020.*

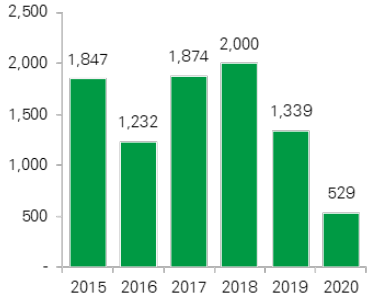
[38] *Department of State Development, Manufacturing, Infrastructure and Planning, Advance Queensland, Queensland Biofutures 10-Year Roadmap and Action Plan, 2016.*

Figure 2.1: Regional differences in the Agriculture Industry

WHITSUNDAY

Whitsunday LGA population
35,000

Agriculture employment
1761



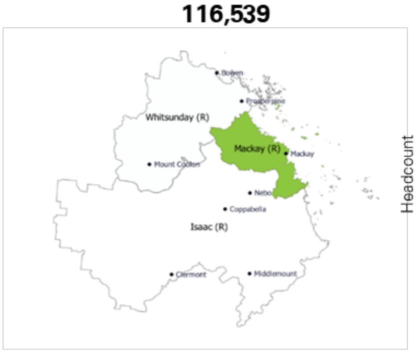
Number of cattle feedlots
0

Tonnes of sugar cane harvested
1,365,800

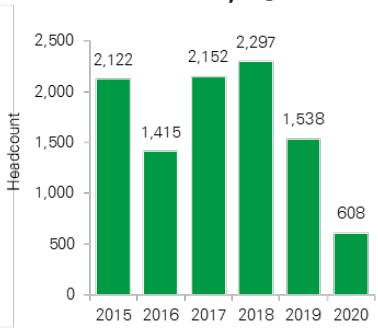
Number of aquaculture sites
6

MACKAY

Mackay LGA population
116,539



Agriculture employment
2,023



Number of cattle feedlots
0

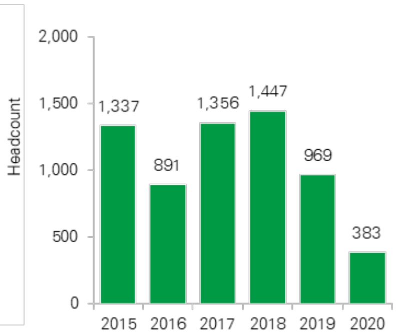
Tonnes of sugar cane harvested
6,007,800

Number of aquaculture sites
14

ISAAC

Isaac LGA population
35,360

Agriculture employment
1,274



Number of cattle feedlots
14

Tonnes of sugar cane harvested
371,000

Number of aquaculture sites
3

COVID-19 EARLY INDICATORS OF IMPACT

Influencing demand for services

The agriculture industry is deemed an essential industry as it is responsible for ensuring food supply and security. As such, the industry has continued to operate during COVID-19 restrictions. While the demand for agriculture services has continued during COVID-19, effects have been felt through the operation of the supply chain and logistics, and surges in consumer demand for some food products.

Labour supply and workforce impacts

Additionally, COVID-19 has impacted the availability of labour for harvesting and production activities within the agriculture industry due to the significant disruption to the seasonal workforce and restrictions on labour movement. According to the Queensland Government, workforce availability issues are expected to arise in:

- working holidaymakers (i.e. backpackers);
- overseas student employees;
- seasonal employee programme;
- Pacific labour mobility scheme;
- local seasonal employees;
- core permanent ongoing staff; and
- other business along the supply chain.

Both the Queensland and Australian Governments have sought to address labour supply issues by promoting the redeployment of employees in industries heavily affected by the COVID-19 pandemic, for example within the tourism industry, to the agriculture sector. The Queensland Jobs Finder and Harvest Trail websites are tools that have been developed to connect seasonal and local job seekers with agricultural work to increase employment opportunities and limit unnecessary interstate or intrastate travel.

Regional impacts for the agriculture industry

Understanding the impact of the spread of COVID-19 on the labour market – both on people and businesses, as well as the responses to government restrictions and government support packages – will be critical to understanding the evolution of the Australian economy.

REMPLAN released data from its COVID-19 Australia Business Economic Impact Survey, measuring the labour market impacts of COVID-19 across Queensland, specifically investigating the business impacts across the Greater Whitsunday region and found:

- 48 percent of businesses and organisations surveyed in the Agriculture, Forestry & Fishing Industry within the region reported to have been affected by COVID-19.
- 22 percent of businesses and organisations surveyed in the Agriculture, Forestry & Fishing Industry within the region reported to be prioritising ensuring the continued supply of the goods and services their business requires to operate over the next three months.
- 38 percent of businesses and organisations surveyed in the Agriculture, Forestry & Fishing Industry within the region reported it would be possible for part of their business to adapt to the new environment (e.g. physical distancing and work from home) but would require major changes.
- 22 percent of businesses and organisations surveyed in the Agriculture, Forestry and Fishing Industry within the region reported to be prioritising the adoption of new systems and practices over the next three months.
- 18 percent of businesses and organisations surveyed in the Agriculture, Forestry & Fishing industry within the region reported that an increased use of local suppliers was an operational benefit to their businesses as a result of the COVID-19 pandemic. [39]

Future opportunities

It is expected that future investment into the agriculture sector will be focused on supporting local supply chains and ensuring food security. Additionally, online services that connect farmers directly to consumers have increased during the COVID-19 pandemic restrictions as consumers have sought to support local businesses, seek alternative online grocery delivery options and avoid supermarkets. [40] It is expected that platforms that increase these connections between suppliers and consumers will represent significant opportunity to the agriculture industry.

[39] REMPLAN, 1st June 2020, COVID-19 Australian Business Economic Impact Survey, Mackay, Isaac and Whitsunday, Available at https://surveys.remplan.com.au/s3/REMPLAN-COVID-19-ABEIS

[40] AgFunder, 2020 Farm Tech Investing Report, Available at https://agfunder.com/research/2020-farm-tech-investment-report/.

Traditional Labour Market View

Traditionally, the agricultural workforce had two distinct components – those who work on-farm and those who work in the value chain off-farm. The number of farm businesses has declined nearly 40 percent in 20 years… In theory, fewer businesses mean fewer farm jobs as economies of scale click in. At the same time, however, there has been increasing demand for university graduates in the services industries reflecting the need for new and sophisticated skills.

Professor Jim Pratley
Charles Sturt Univerity

THE CURRENT STATE OF PLAY

Current workforce characteristics

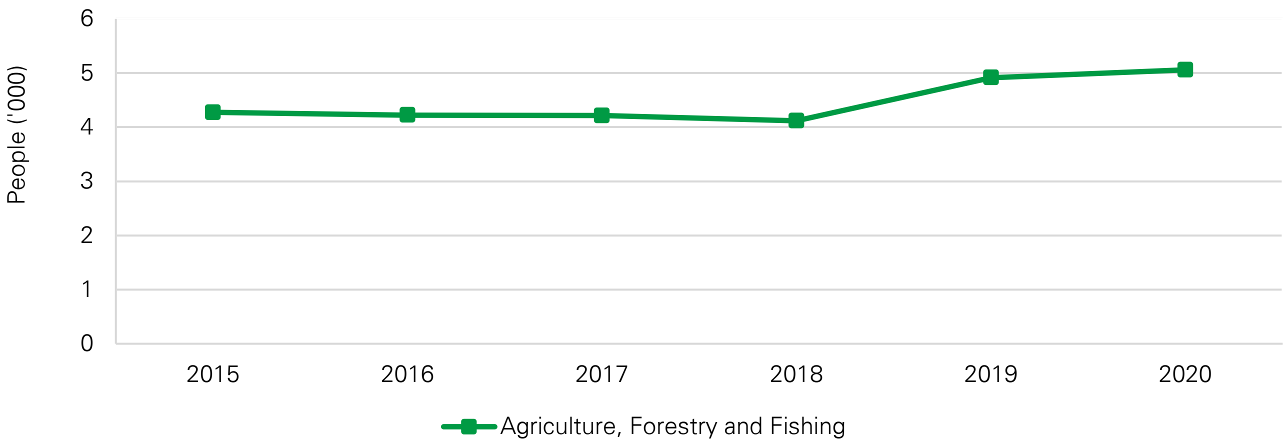
Overall employment

Employment in the Agriculture industry has undergone substantial change over the past decade. These changes have been driven by rapid technological advancements, changing product markets and trade opportunities, new work methods, and demographic, social and economic changes. [41] Despite modest employment growth over the past five years agriculture continues to provide jobs for more than 300,000 people, with the significant majority located in regional Australia. [42]

Across Queensland, approximately 99.6 percent of employees in the Agriculture industry were employed by private sector businesses in 2020. [43] Private sector businesses include generational small family owned and operated farms and large farming enterprises that have sought to optimise economies of scale. Stakeholder feedback indicated that the industry is currently experiencing a gradual transition in farm ownership that is seeking to optimise these economies of scale as farms are selling, and existing farms are getting larger. While public and private divide in employment is not available for the Greater Whitsunday region, it can be assumed that private sector businesses employ the vast majority of Agricultural employees in the region. In the Greater Whitsunday region, the Agriculture, Forestry and Fishing industry accounted for approximately 1 percent of the region's entire workforce in 2020 and was the 14th largest industry in terms of employment. Figure 2.2 represents the Agriculture, Forestry and Fishing occupation employment from 2015 to 2020 (based on the 6 digit occupations identified in Appendix A). As shown in Figure 2.2, employment in the industry has been steady with an annual growth rate of 3 percent between 2015 and 2020. However, it is important to note there has been strong variability in annual employment levels. From 2018 to 2019 the industry within the region experienced a 19 percent increase in employment.

This high volatility in employment levels over the last five years is also reflected in longitudinal data over the last 20 years and is also representative of factors including drought, competition, market demands and export prices. For the period from 2010 to 2015 employment in the industry grew at an annual rate of 2.1 percent. For the period from 2005 to 2010 employment fell at an annual rate of 10 percent compared to a previous period of growth from 2000 to 2005 at 8.1 percent per annum.

Figure 2.2: Total employment in the Agriculture, Forestry and Fishing workforce in the Greater Whitsunday region (2015-20)



Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

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[41] Department of Agriculture. Water and Environment. Agricultural Workforce. Accessed on 2 July 2020: https://www.agriculture.gov.au/ag-farm-food/agricultural-workforce

[42] Labour Market Information Portal. Agriculture, Forestry and Fishing. Accessed 30 June 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/IndustryInformation/AgricultureForestryandFishing

[43] ABS, cat. no. 6150.0.55.003, Labour Force, Australia, Detailed, Quarterly, March 2020.

In comparison, at the national level the Agriculture industry grew on average by 0.2 percent per annum between 2015 and 2020. [44] The volatility in the agriculture labour market was mentioned by stakeholders in the region and is shown in longitudinal historical data. For the period from 2010 to 2015 employment in the industry declined at an annual rate of 1.3 percent. For the period from 2005 to 2010 employment fell at an annual rate of 0.6 percent, compared to a previous period of decline from 2005 to 2010 at 3.7 percent per annum.

Regional stakeholder feedback has indicated that there have been recent increases in employment in the aquaculture sector due to recent investment and expansion in prawn farming in the Greater Whitsunday region.

ABS data at this level of regional granularity is quite volatile (due to small numbers) and it is important to consider these statistics in a broader context, including with regard to labour market conditions at the State and national level. Additionally, the volatility in the agriculture workforce within the region may likely have been influenced by macro-trends including:

- reduction of in the number of Australian farming families and family-owned farms and ageing workforce;
- migration of youth from regional areas to major cities to pursue employment and education;
- increasing severity and duration of drought;
- increasing competition within the regional labour market from industries with high earning capacity (for example Mining and METS); and
- declining enrolments for agricultural education and training programs and closure of agricultural colleges in Queensland (Emerald and Longreach). [45]

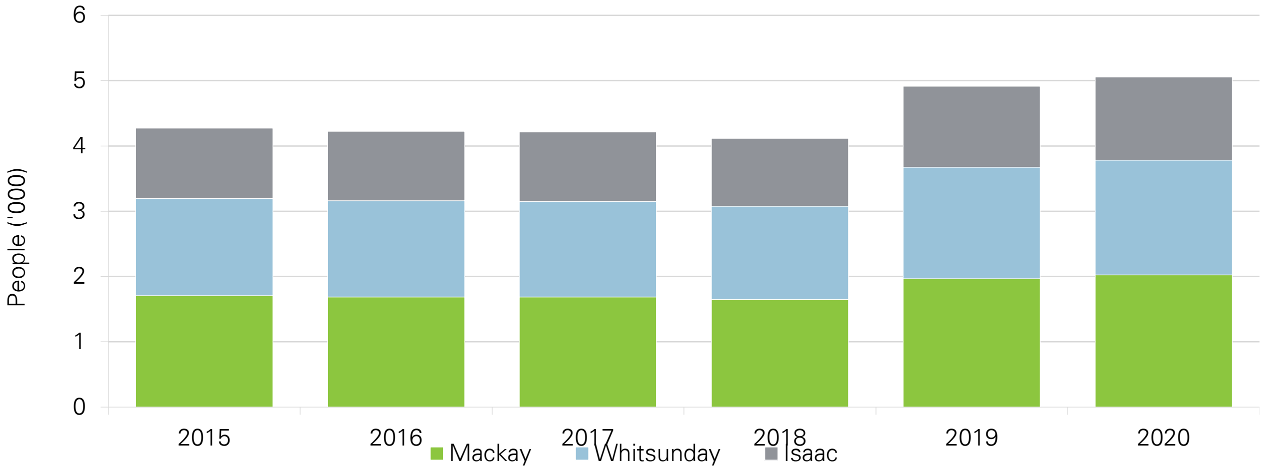
[44] *ABS, cat. no. 6291.0.55.003, Labour Force, Australia, Detailed, Quarterly, trend.*
[45] *Wu W et al. 2019. The future of Australia's agricultural workforce. CSIRO Data61: Canberra, Australia*

Regional differences

Within the Greater Whitsunday region there have been regional differences in the number of people employed in the Agriculture industry. These differences are largely attributable to varying regional focuses on specific crops, livestock or agricultural markets as well as variations in geographic factors such as differences in climate, proximity to water sources and differences in soil quality. As a result, the Mackay and Whitsunday LGAs have a greater focus on sugar cane farming while the Isaac LGA has a strong focus on livestock.

Figure 2.3 illustrates the impacts of these regional employment differences in the agriculture industry over a five year period between 2015 and 2020. Notably, during this period approximately 40 percent of the agriculture industry was employed in the Mackay LGA, 34.8 percent in the Whitsunday LGA and 25.2 percent in the Isaac LGA.

Figure 2.3: Total regional employment variations in the agriculture workforce in the Greater Whitsunday region (2015-20)

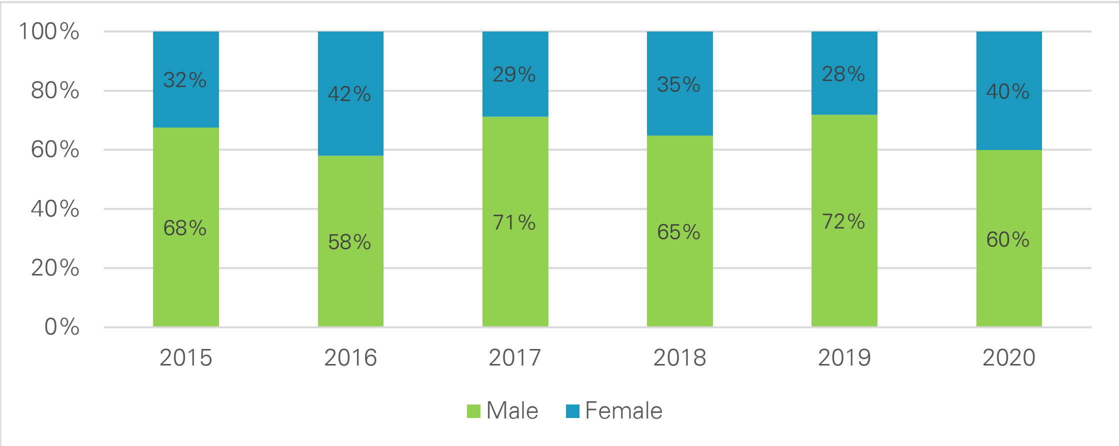


Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

Gender distribution

Figure 2.4 shows the gender distribution for the agriculture industry between 2015 and 2020 in the Greater Whitsunday region. As at February 2020, males accounted for 59.9 percent of the workforce, lower than the male industry share nationally (66.9 percent). [46]

Figure 2.4: Gender distribution in the agriculture workforce in Greater Whitsunday region (2015-20)



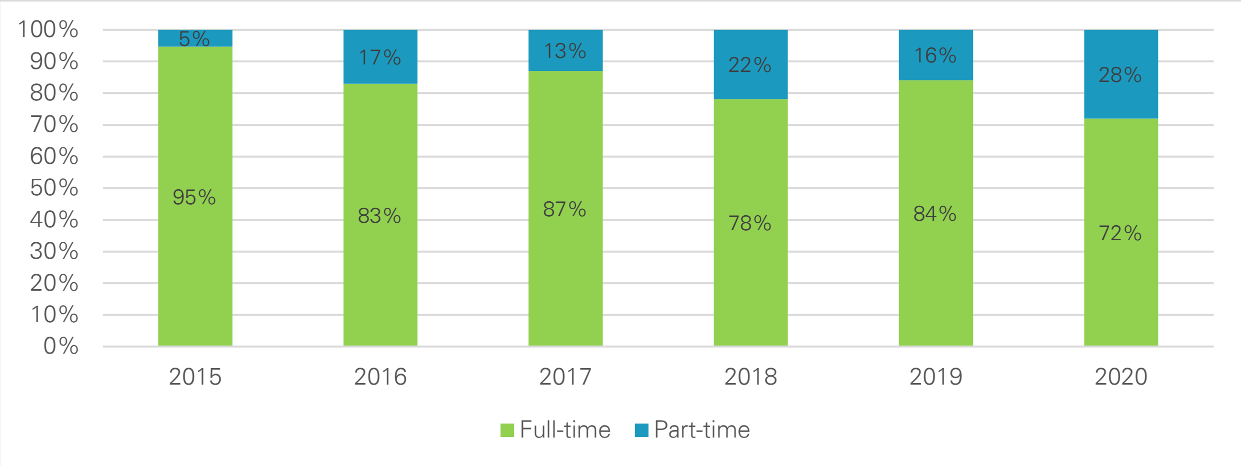
Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

[46] *Labour Market Information Portal. Agriculture, Forestry and Fishing. Accessed 30 June 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/IndustryInformation/AgricultureForestryandFishing*

Employment type distribution

Figure 2.5 shows the employment type distribution (full-time versus part-time) for the agriculture industry over a five year period between 2015 and 2020 in the Greater Whitsunday region. Over this period, the industry's profile in employment type changed from predominantly full-time in 2015, to an increasingly even distribution between full-time and part-time employees in 2020. As at February 2020, full-time employees accounted for 72 percent of the workforce, marginally lower than full-time agriculture employees.

Figure 2.5: Employment type distribution in the agriculture workforce in Greater Whitsunday region (2015-20)

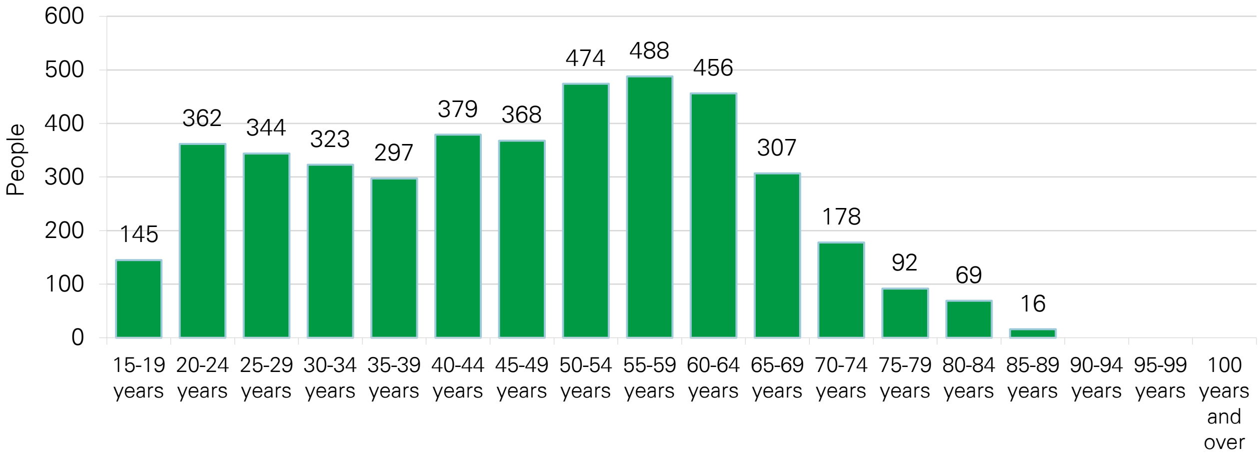


Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

Age distribution

As shown in Figure 2.6, the agriculture industry in the Greater Whitsunday region is characterised by an ageing workforce. In 2016 approximately 65.9 percent of the workforce were aged 40 years or older, with the 55 to 59 age bracket having the highest number of persons in the agriculture industry. By 2030 it is expected that a significant proportion of the workforce in the agriculture industry will be retiring and exiting the industry.

Figure 2.6: Age distribution of the agriculture industry in the Greater Whitsunday region (2016)



Source: KPMG based on ABS Labour Market Quarterly and Census Data

Across Australia, the agriculture industry has the highest proportion of employed persons over 65 years, with almost half of business owners and managers planning to retire within the next five to ten years. [47] According to the CSIRO and Data 61, key factors contributing to the ageing agricultural workforce include:

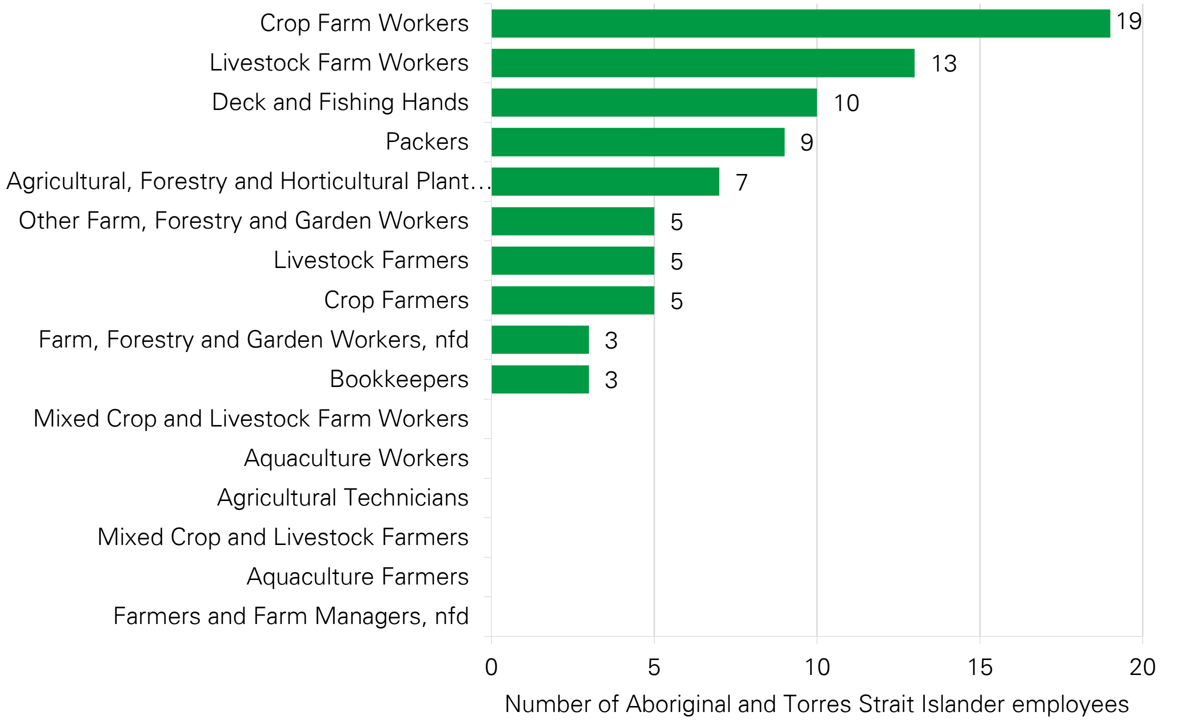
[47] *Adam Hinds and Jodie Gordon, Queensland Farmers' Federation on behalf of the Rural Jobs and Skills Alliance, Rural Industries Jobs and Skills Research Report, 2016, p. 48.*

- intergenerational transfer of farms and transition into retirement is occurring later due to decreasing profits;
- entries into the sector are often tied to exists as part of intergenerational transfers; and
- younger people are entering the farming workforce later due to longer periods spent in education. [48]

Aboriginal and Torres Strait Islander employment

The Agriculture industry is the 13th largest employer of Aboriginal and Torres Strait Islander people in the Greater Whitsunday region. In 2016 approximately 2.5 percent of the Aboriginal and Torres Strait Islander workforce in the Greater Whitsunday region were employed in the agriculture industry. As shown in Figure 2.7, the majority of these Aboriginal and Torres Strait Islander employees were Crop Farm Workers, Livestock Farm Workers and Deck Fishing Hands.

Figure 2.7: Aboriginal and Torres Strait Islander employment in the agriculture industry in the Greater Whitsunday region (2016)



Source: KPMG based on ABS Labour Market Quarterly and Census Data

[48] *Wu W, Dawson D, Fleming-Muñoz D, Schleiger E and Horton J. 2019. The future of Australia's agricultural workforce. CSIRO Data61: Canberra, Australia.*

Projected trends

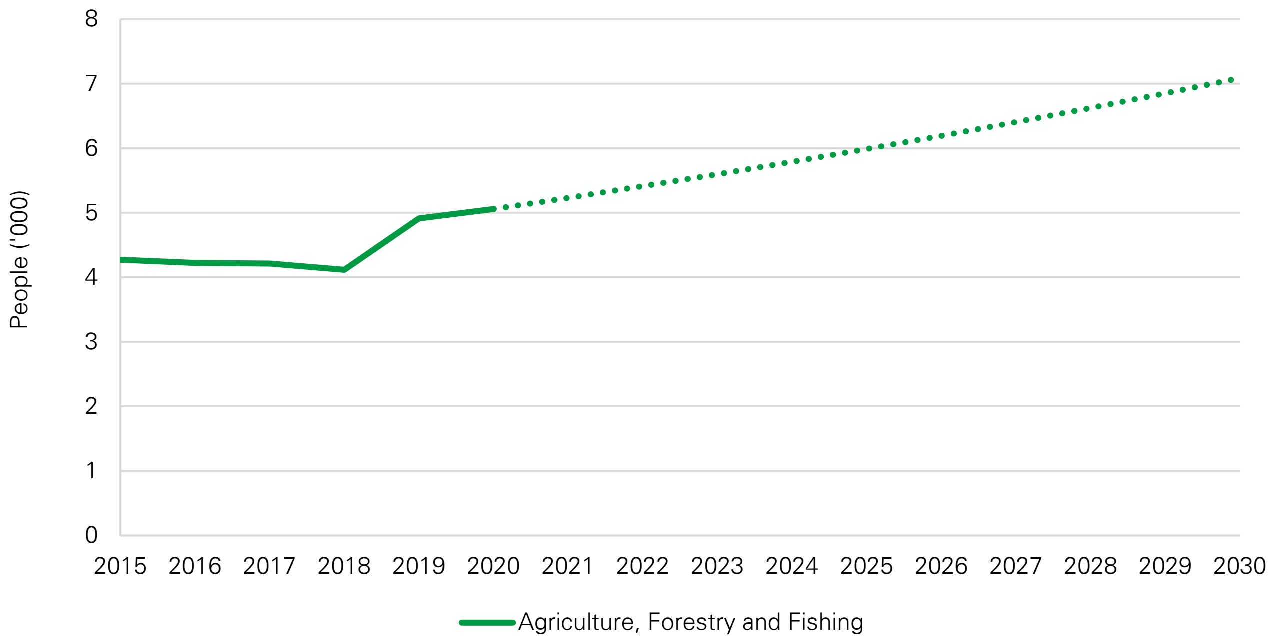
Overall employment

National employment in the Agriculture industry has been projected by the Australian Department of Employment, Skills, Small and Family Business to fall by 3,800 (or -1.2 percent) over the next five years. [49] This projected decline in employment has largely been driven by historical trends and the anticipated impacts of extreme weather events including the extended drought conditions in much of Australia. In particular, employment is projected to decline the most for Sheep, Beef Cattle and Grain Farming (down by 1,500 or 1.1 percent) and Fruit and Tree Nut Growing (400 or 1.5 percent). [50]

Based on historical trends of agricultural occupations, Figure 2.8 shows the projected workforce increase for the agriculture industry in the Greater Whitsunday region for a ten year period from 2020 to 2030. It is important to note that over the past five years there has been a high degree of volatility and variability in the Agriculture industry. Assumptions based on the five year historical trend used throughout this Future Employment Study are therefore, in relative terms, less accurate for the Agriculture sector.

Data from 2015- 2020 indicates an annual growth rate for the Agriculture industry in the Greater Whitsunday region of 3 percent. A projection using this baseline would indicate the Agriculture industry in the Greater Whitsunday region will increase from 5,060 people in 2020 to 7,086 people in 2030.

Figure 2.8: Projected workforce growth for the agriculture industry in the Greater Whitsunday region (2015-30)



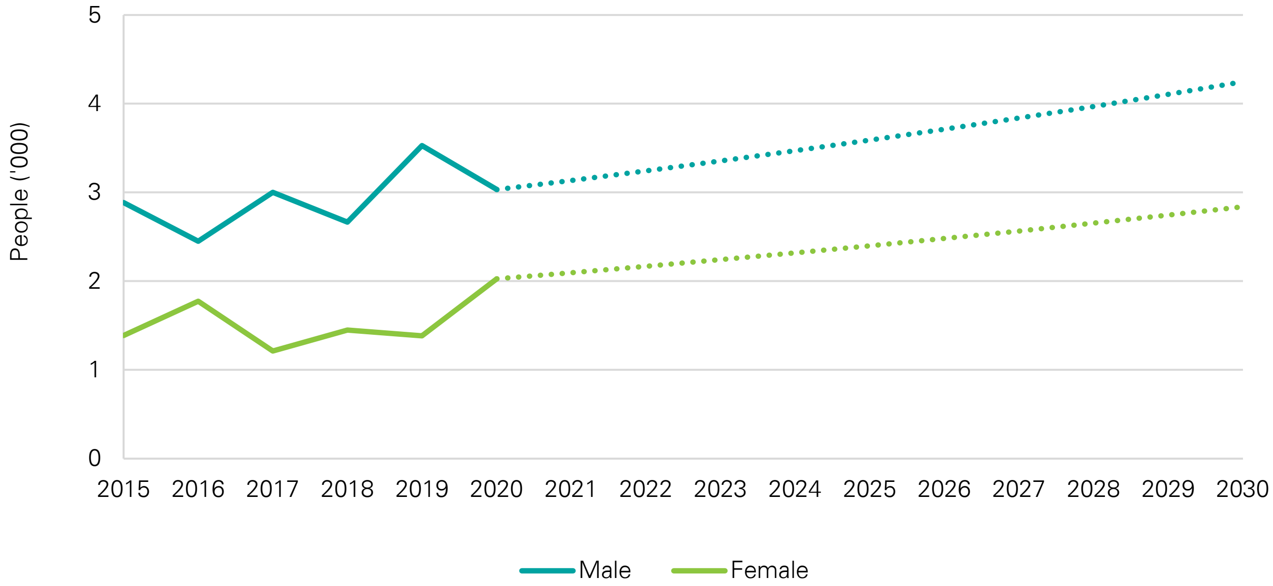
Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

Gender distribution

Based on the historical trends described above, Figure 2.9 shows the projected gender distribution for the Agriculture industry in the Greater Whitsunday region over a ten year period from 2020 to 2030. During this period, the number of males and females employed in the Agriculture industry is projected to increase at an average rate of 6.9 percent. If trends continue, by 2030 males will account for approximately 66.6 percent of the entire agriculture workforce in the Greater Whitsunday region.

[49] *Labour Market Information Portal Employment Projections. Accessed 30 June 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/EmploymentProjections*
[50] *Ibid.*

Figure 2.9: Projected workforce composition by gender for the agriculture industry in the Greater Whitsunday region (2015-30)

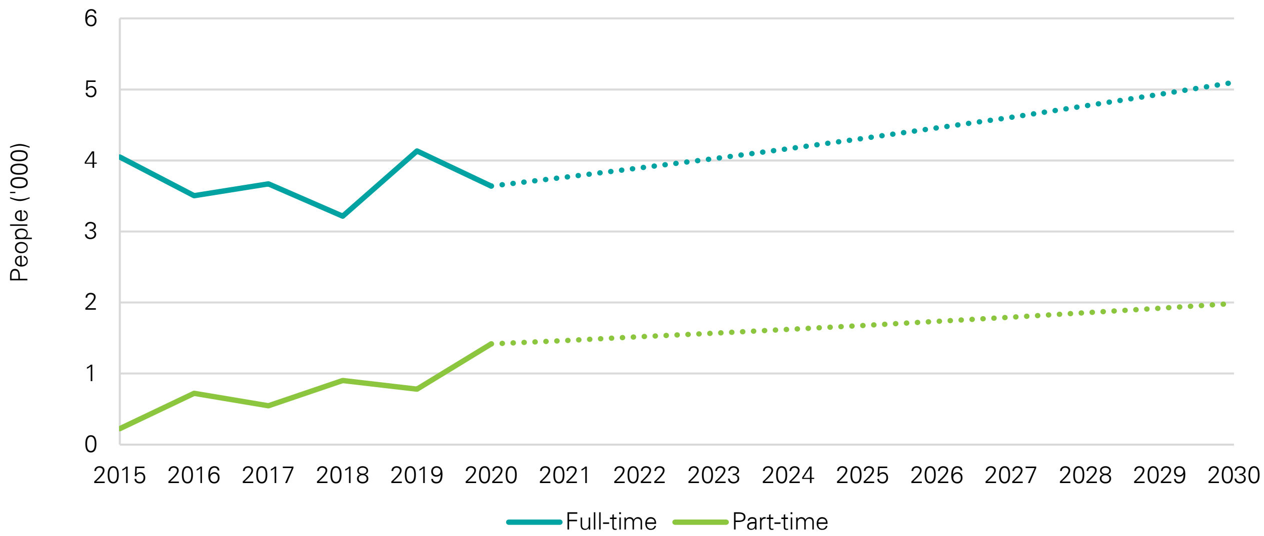


Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

Employment type distribution

Based on historical trends described above, Figure 2.10 shows the projected employment type distribution for the Agriculture industry in the Greater Whitsunday region over a ten year period from 2020 to 2030. By 2030, it has been projected that people working full-time will account for approximately 84.7 percent of the entire agriculture workforce in the Greater Whitsunday region.

Figure 2.10: Projected workforce growth by employment type for the agriculture industry in the Greater Whitsunday region (2015-30)



Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

Occupational growth in the sector

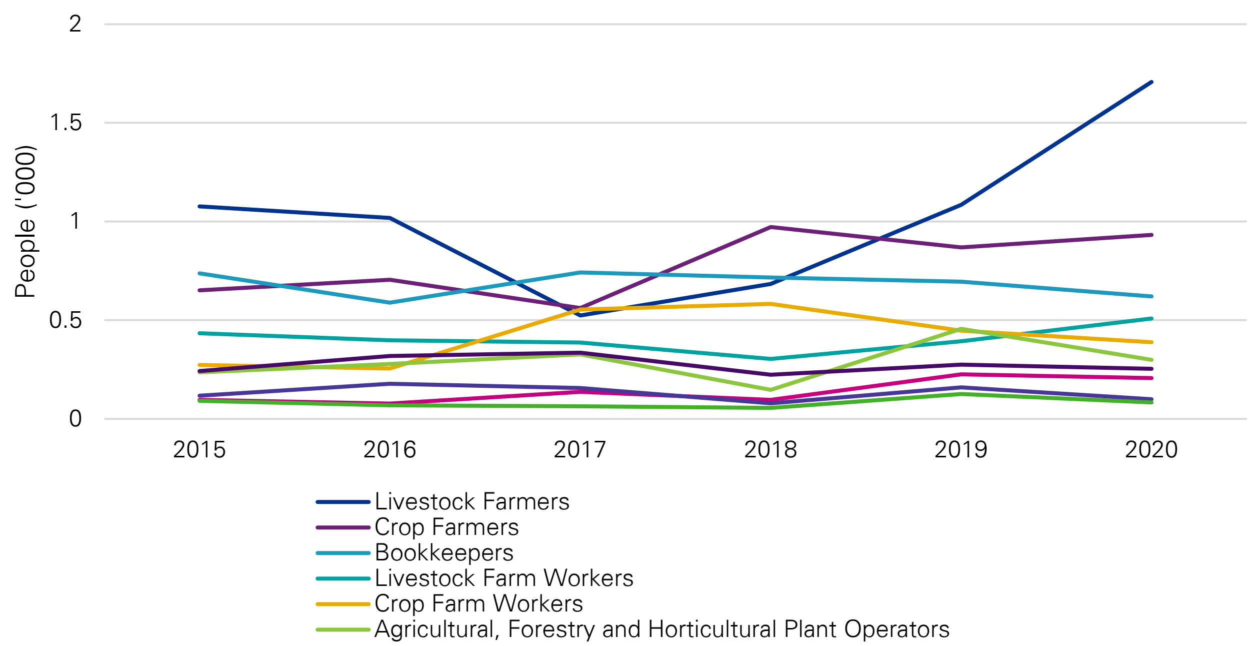
As shown in Figure 2.11, the agriculture industry employs people in a diverse range of occupations as shown by the ANZSCO 4-digit occupational unit groups. Over the past five years there also has been a high degree of volatility and variability in the occupations in the agriculture industry, which may make assumptions based on five year historical trends less accurate.

As at February 2020, the top three employing unit groups in the Greater Whitsunday region included Livestock Farmers, Crop Farmers and Bookkeepers. In contrast, the bottom three employing unit groups in the Greater Whitsunday region included Aquaculture Workers, Aquaculture Farmers and Agricultural Technicians.

Between 2015 and 2020, Agricultural Technicians experienced the highest growth in employment in percentage terms from 12 to 38 persons (25.3 percent on average per annum). Second to this growth rate, the number of Mixed Crop and Livestock Farmers grew at an average annual rate of 16.4 percent per annum from 97 to 206 persons over the same period.

Aquaculture Farmers experienced the largest decline in employment between 2015 and 2020 in percentage terms from 59 to 13 persons (-25.9 percent on average per annum). However, it is important to note that this recorded decline in employment in aquaculture is unlikely to continue into the future with the development of a number of newly acquired prawn farms in the Greater Whitsunday region.

Figure 2.11: Agriculture employment trends by ANZSCO 4-digit unit groups (2015-20)



Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

These ANZSCO 4-digit unit groups have been broken down into ANZSCO 6-digit occupations in Figure 2.12 highlight the top ten occupations in the Greater Whitsunday region for the agriculture industry.

This shows that the average annual occupation growth (between 2015-2020) is highly variable across occupations, with the highest annual growth rates for Meat and Livestock Farmers (16.3 percent), Beef Cattle Farmers (9.7 percent) Vegetable Growers (7.5 percent) and Vegetable Farm Growers (7.2 percent). Two of these top ten occupations are in decline, the Bookkeepers (-3.4 percent) and Farmers and Farm managers (nfd) (-3.2 percent).

Key occupations in Agriculture

Figure 2.12: Agriculture employment trends, top ten employing occupations at ANZSCO 6-digit level

Beef Cattle Farmers

Those who *"plan, organise, control, coordinate and perform farming operations to breed and raise beef cattle for meat and breeding stock"*

9.7% annual growth

Headcount 2015 **1,008**
Headcount 2020 **1,598**

Mackay **341**
Isaac **926**
Whitsunday **331**

4,017 Headcount by 2030

Sugar Cane Growers

Those who *"plan, organise, control, coordinate and perform farming operations to grow sugar cane"*

7.5% annual growth

Headcount 2015 **476**
Headcount 2020 **683**

Mackay **454**
Isaac **49**
Whitsunday **179**

1,401 Headcount by 2030

Bookkeepers

Those who *"maintain and evaluate records of financial transactions in account books and computerised accounting systems for agricultural businesses"*

-3.4% annual growth

Headcount 2015 **738**
Headcount 2020 **621**

Mackay **415**
Isaac **49**
Whitsunday **157**

440 Headcount by 2030

Beef Cattle Farm Workers

Those who *"perform routine tasks on a beef cattle farm such as feeding, mustering and moving cattle, and assisting with animal husbandry"*

3.2% annual growth

Headcount 2015 **434**
Headcount 2020 **509**

Mackay **92**
Isaac **311**
Whitsunday **106**

700 Headcount by 2030

Agricultural & Horticultural Mobile Plant Operators

Those who *"operate agricultural, forestry and horticultural plant to clear and cultivate land, sow and harvest crops, and fell trees and move logs"*

4.9% annual growth

Headcount 2015 **232**
Headcount 2020 **294**

Mackay **182**
Isaac **77**
Whitsunday **35**

472 Headcount by 2030

Mixed Crop and Livestock Farmers

Those who *"plan, organise, control, coordinate and perform farming operations to both grow crops and to breed and raise livestock"*

16.3% annual growth

Headcount 2015 **97**
Headcount 2020 **206**

Mackay **71**
Isaac **117**
Whitsunday **18**

937 Headcount by 2030

Fruit & Vegetable Packers

Those who *"weigh, wrap, seal and label fruit and vegetables"*

0.9% annual growth

Headcount 2015 **128**
Headcount 2020 **134**

Mackay **45**
Isaac **2**
Whitsunday **87**

146 Headcount by 2030

Farmers and Farm Managers (nfd)

Those who *"plan, organise, control, coordinate and perform farming operations in agricultural establishments to grow crops, and breed and raise livestock, and fish and other aquatic life"*

-3.2% annual growth

Headcount 2015 **118**
Headcount 2020 **100**

Mackay **35**
Isaac **14**
Whitsunday **50**

71 Headcount by 2030

Vegetable Farm Workers

Those who *"harvest vegetables and prepare produce for distribution"*

7.2% annual growth

Headcount 2015 **62**
Headcount 2020 **88**

Mackay **21**
Isaac **4**
Whitsunday **63**

176 Headcount by 2030

Vegetable Growers

Those who *"plan, organise, control, coordinate and perform farming, greenhouse and market garden operations to grow vegetables"*

7.5% annual growth

Headcount 2015 **53**
Headcount 2020 **76**

Mackay **51**
Isaac **5**
Whitsunday **20**

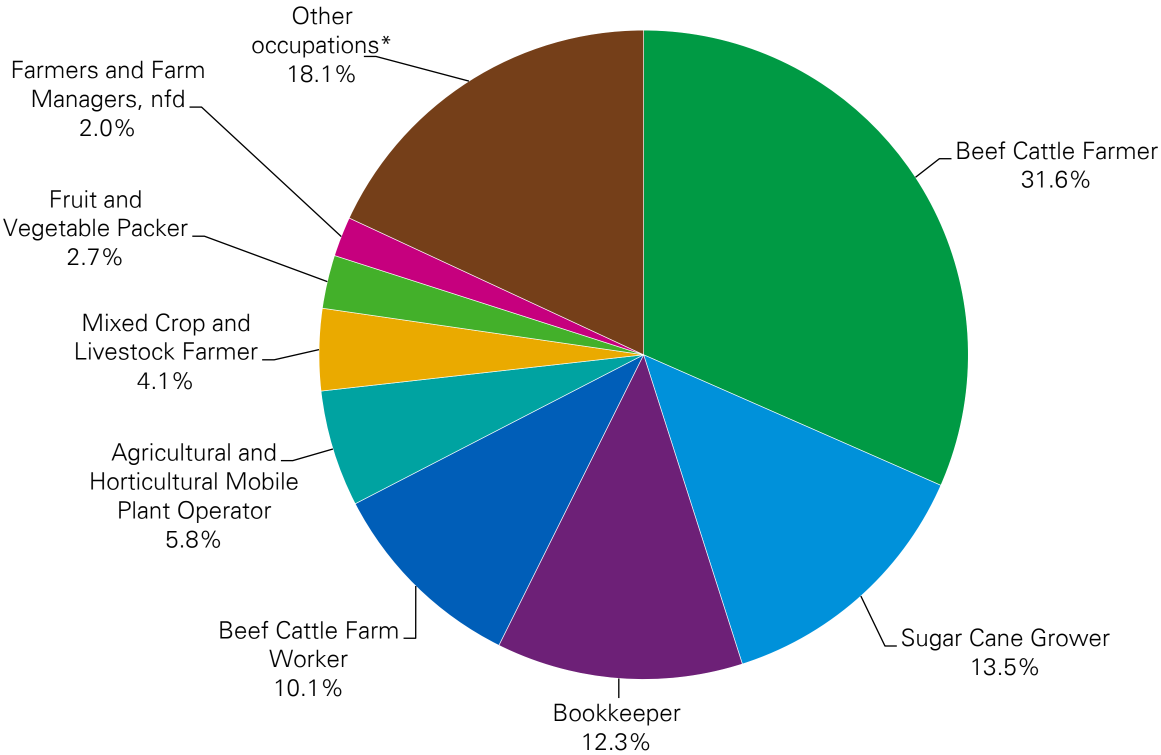
156 Headcount by 2030

Note: Following from stakeholder consultation, the horticulture data from ABS appears to underestimate the vegetable growers and farm workers in the Whitsunday LGA. Estimates are closer to 60 FTE vegetable growers in the Whitsunday LGA and up to 3,000 farm workers during a season in Bowen.

What would the future look like in 2030 if we continued on our current path?

The Agriculture industry employs people in a diverse range of occupations that are classified as ANZSCO 6-digit occupations in the Greater Whitsunday region. Figure 2.13 illustrates the distribution of occupations in agriculture as at February 2020 (with occupations employing less than 2 percent grouped into 'other occupations'). As shown in Figure 2.14, more than 50 percent of the Agriculture industry was employed in the top three occupations of Beef Cattle Farmers, Sugar Cane Growers and Bookkeepers.

Figure 2.13: **Agriculture employment distribution of ANZSCO 6-digit occupations Greater Whitsunday region, agriculture, 2020**



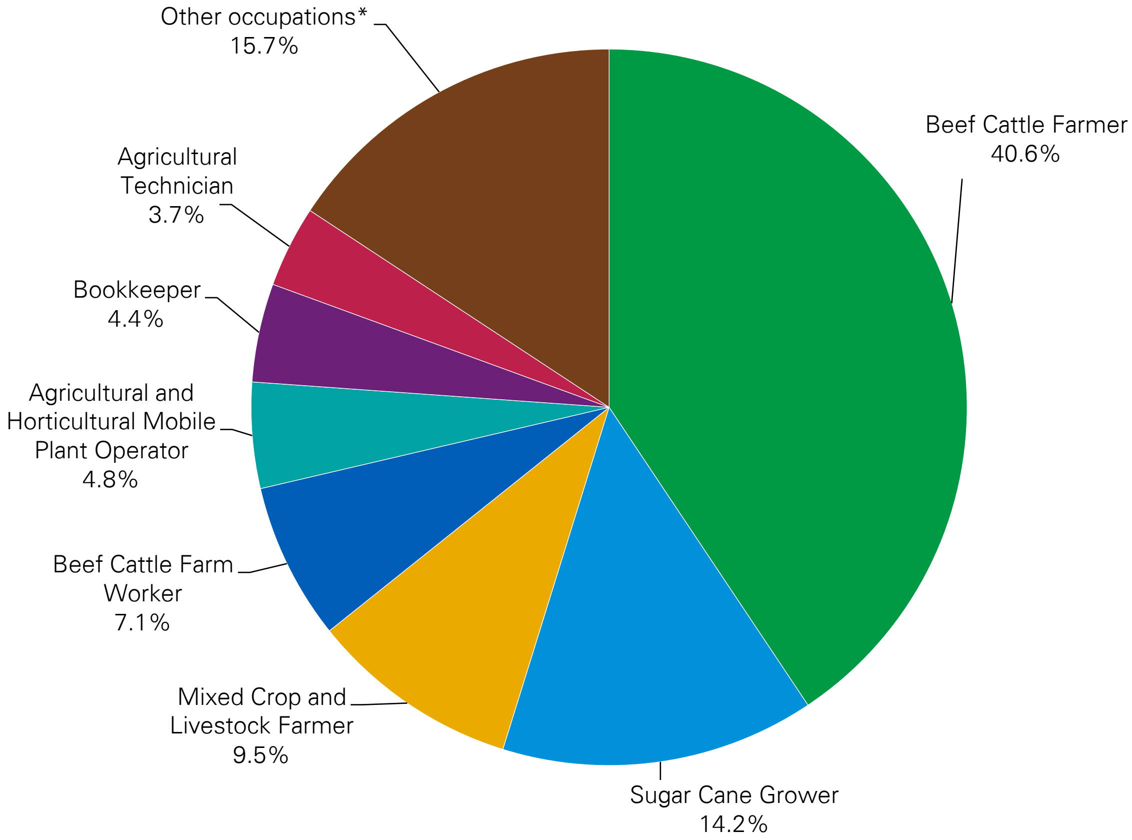
** Other occupations include: Vegetable Farm Worker (1.7%); Vegetable Grower (1.5%); Meat Packer (1.2%); Livestock Farmers nfd (1.2%); Deck Hand (1.1%); Fruit or Nut Picker (1.0%); Mixed Crop or Livestock Farm Worker (1.0%); Crop Farmers nfd (0.9%); Grain, Oilseed or Pasture Grower (0.9%); Farm, Forestry and Garden Workers nfd (0.8%); Vegetable Picker (0.8%); Fruit or Nut Grower (0.8%); Agricultural Technician (0.8%); Fruit or Nut Farm Worker (0.7%); Farm, Forestry and Garden Worker nec (0.6%); Fishing Hand (0.6%); Packers nfd (0.6%); Packers nec (0.5%); Crop Farm Workers nfd (0.5%); Aquaculture Farmer (0.3%); and Aquaculture Worker (0.0%).*

Source: KPMG based on ABS Labour Market Quarterly and Census Data

Based on historical trends in ANZSCO 6-digit occupations in the Greater Whitsunday region, Figure 2.14 shows the distribution of these occupations by 2030 if the current employment trends from the last five years continue (with occupations employing less than 2 percent grouped into 'other occupations'). As shown in Figure 2.13, the employment of Beef Cattle Farmers, Sugar Cane Growers, Mixed Crop and Livestock Farmers is forecast to grow at a considerable rate and account for a large proportion of the agriculture workforce. In addition, the number of Agricultural Technicians is also forecast to grow, increasing from 0.8 percent of the agriculture workforce in 2020 to 3.7 percent in 2030.

In contrast, employment in Beef Cattle Farm Workers (3.2 percent) and Agricultural and Horticultural Mobile Plant Operators (4.9 percent) is forecast to grow at a relatively modest rate. At the same time, employment in Bookkeepers and Farmers and Farm Managers nfd is forecast to decline over the ten year period between 2020 and 2030.

Figure 2.14: **Agriculture employment distribution of ANZSCO 6-digit occupations Greater Whitsunday region, agriculture, 2030**



** Other occupations include: Vegetable Farm Grower (1.8%); Vegetable Grower (1.6%); Livestock Farmer Nfd (1.5%); Fruit And Vegetable Packer (1.5%); Fruit And Nut Picker (1.0%); Crop Farmers nfd (0.9%); Grain, Oilseed Or Pasture Grower (0.9%); Vegetable Picker (0.9%); Fruit Or Nut Grower (0.9%); Farmers And Farm Managers nfd (0.7%); Fruit Or Nut Worker (0.7%); Mixed Crop Farmer (0.7%); Meat Packer (0.7%); Crop Farm Worker nfd (0.5%); Mixed Crop And Livestock Farmer Worker (0.4%); Packer nfd (0.3%); Packer nec (0.3%); Farm, Forestry And Garden Worker (0.0%); Aquaculture Farmer (0.0%); Aquaculture Worker (0.0%).*

Source: KPMG based on ABS Labour Market Quarterly and Census Data

Key employment trends that are occurring in the region

As with the rest of Australia, the Agriculture industry in the Greater Whitsunday region is in the midst of significant transformation. Disruptive and significant weather events, major capital investments and changing farming methods to match evolving community preferences are driving well documented changes in the industry. The impact of these changes on the existing agriculture workforce in the region will be significant.

Regional impacts of drought

The Greater Whitsunday region has a diversity of rainfall and temperature which influences the agricultural product in different parts of the region. The wetter, more coastal regions around Mackay are ideal for cane growing while the more inland and drier climates are more suited to cropping and cattle production. [51]

Across the Greater Whitsunday region, effective management of climate variability continues to be a challenge for many primary producers in the Greater Whitsunday region. This is particularly the case for the Isaac and Whitsunday LGAs which have been partly drought declared since 2013 and 2015, respectively. [52] Over the past few years, drought conditions across the three LGAs have weighed on the agriculture industry's performance.

In response to drought conditions, farmers are increasingly having to adopt risk management strategies to minimise the impact of drought on their enterprise. Farmers are also having to develop innovative farming practices and techniques to improve the capacity of farming businesses and regional communities to become more resilient to the impacts of drought. [53]

The persistence of drought in the region will continue to increase the need to support quality scientific research to improve the industry’s knowledge of projected climate variability in the Greater Whitsunday region. As such, there will be increasing focus on collaborative work with industry, universities and research organisations to expand climate science research and expertise to ensure the continued prosperity of the agriculture industry in the Greater Whitsunday region. [54]

Regional trends in capital investments

The Agriculture industry in the Greater Whitsunday region has experienced a number of capital investments in recent years in order to foster growth in the region. These investments have been cognisant of the region’s natural competitive advantage in a number of agricultural products, including sugar cane and aquaculture.

For example, in July 2019 Mackay Sugar shareholders approved the proposal for Nordzucker AG to acquire a 70 percent controlling interest in the share capital of Mackay Sugar. The Nordzucker investment included a plan to undertake refurbishment work of the sugar mills valued at $13 million. This significant capital investment in Mackay Sugar is expected to enhance productivity and performance of the mills. [55]

Additionally in 2019, Tassal, a large Tasmanian based aquaculture company that specialises in salmon production, acquired prawn farms in both the Whitsunday and Mackay LGAs. [56] This capital investment in aquaculture reflects the growing interest to expand the number of aquaculture facilities in the region. [57]

In turn, investments of this kind in the Agriculture industry will result in increasing workforce demands as production is expanded across the Greater Whitsunday region. Consequently, agriculture businesses will need to develop proactive and creative solutions to attract, develop and retain an adequately sized workforce that will be required to deliver increased services.

51 Regional Development Australia. Mackay-Isaac-Whitsunday Agricultural Overview. 2017.

52 Long Paddock. Drought Declarations. Accessed 13 July 2020 https://www.longpaddock.qld.gov.au/drought/drought-declarations/

53 Long Paddock. Impacts and adaption strategies for a variable and changing climate in the Whitsunday, Hinterland and Mackay Region. Accessed 13 July 2020. https://www.longpaddock.qld.gov.au/qld-future-climate/adapting/impacts/

54 Long Paddock. Impacts and adaption strategies for a variable and changing climate in the Whitsunday, Hinterland and Mackay Region. Accessed 13 July 2020. https://www.longpaddock.qld.gov.au/qld-future-climate/adapting/impacts/

55 Mackay Sugar. Annual Report 2019-20. https://www.mkysugar.com.au/news/Pages/Reports.aspx

56 Regional Development Australia. Tassal tour highlights region’s aquaculture potential. 2019.

57 Regional Development Australia. Mackay-Isaac-Whitsunday Agricultural Overview. 2017.

Regional trends in organic farming

Organic produce has become an increasingly common consumer preference in Australia as well as in international markets. Anticipated increases in disposable income and health consciousness are expected to result in continuing growth in consumer demand for organic produce over the next five years. [58] This will in turn benefit farmers in the Greater Whitsunday region that adapt their farming practices and techniques to produce high quality, organic food.

Organic beef is another area of potential domestic demand growth. While still considered a niche market, organic beef is anticipated to become more popular over the next five years. Organic beef is produced from cattle that have not been treated with antibiotics, growth promoters or other chemicals. Organic beef attracts higher prices and profit margins than beef from traditionally raised cattle. [59] Therefore, increased organic beef consumption presents an opportunity for some industry players in the Greater Whitsunday region to boost revenue and profit margins.

Overall, rising consumer demand in organic farming has the potential to transform the agriculture industry and workforce requirements in the Greater Whitsunday region. As the use of pesticides and herbicides are prohibited in organic farming, the workforce must be highly skilled in order to sustainably farm high quality organic produce.

As well as an increase in organic farming, there is increasing demand for local production and sustainability, including local supply chains. Technologies such as traceability and blockchain are discussed in Appendix E for both the aquaculture and crop farming as being a key technologies that is expected to strengthen and support this trend.

[58] *IBIS World. Specialised Industry Report: Organic Crop Farming Australia. Report OD4191. Accessed 13 July 2020.*

[59] *IBIS World. Beef Cattle Farming in Australia. Report A0142. Accessed 13 July 2020.*

Faethm Insights:

The Disrupted View

"Job requirements are evolving as farms professionalise, automation and technology use becomes endemic, and value chains become shortened so that there is minimal separation between the food and agriculture sectors. This new model of agriculture requires a workforce with skill sets that extend well beyond traditional agricultural skills"

Richard Heath
Australian Farm Institute

PREDICTIONS OF WHEN KEY TECHNOLOGIES WILL IMPACT THE AGRICULTURE SECTOR

There are a range of emerging technologies that are expected to accelerate the rate of technological change and adoption over the coming years and, with this, impact on the workforce. Often, the discussion about the impact of technology on the Future of Work talks about digital disruption in sweeping terms without a clear or nuanced view of what technologies are planned for adoption, the maturity of the industry within the region and its readiness for technology, or the industry-specific technologies which will have a significant workforce impact.

The Faethm modelling provides a prediction of the key technologies that could be implemented at an industry level, specifically for the Greater Whitsunday region. It is important to note this is based on the opportunity that exists, and may not be fully realised. Based on these predictions, Faethm also examines the expected workforce impact of technology adoption. Further information about the Faethm methodology is provided in Appendix B.

What does the technology prediction tell us?

The Faethm technology prediction for the Agricultural industry in the Greater Whitsunday region is summarised in Figure 2.15, Figure 2.16 and Figure 2.17. These figures show the technologies with the greatest predicted impact on the Agriculture workforce measured in terms of $AUD total salary cost savings as a result of a reduction in FTE across the workforce.

This analysis for the Agriculture sector shows:

- By 2035, Navigation Robotics is expected to be the technology that has the greatest impact on the agriculture workforce based on salary savings ($28.5 million in salary savings by 2035), however up until year 10, the technology that will have the greatest impact on the workforce is predicted to be Process Automation ($21.3 million in salary savings by 2035);
- The impact of Navigation Robotics on the workforce in terms of salary savings will triple between years 5 to 10 from $5.1 million in salary savings in 2025 to $15.9 in 2030. Its impact on salary savings doubles again in years 10 to 15 with $28.5 million in salary savings predicted from this technology by 2035;
- This is in contrast to Fixed Robotics which is a technology that will drive significant workforce impact to 2025 ($8.9 million in salary savings), but this impact will plateau out over the following ten years to 2035 ($12 million in salary savings by 2035);
- The impact of Conversation Exchange on salary savings by 2030 is projected to be $5.3 million almost five times that projected in 2025 $1.8 million;
- Predictive Analytics technologies will impact on the salary savings for the agriculture workforce up until 2030 ($2.4 million) and have very little impact after this ($2.5 million by 2035); and
- The impact of Sensory Perception technologies on salary savings across the agriculture workforce will grow steadily over the fifteen year horizon, slowing between years 10-15 in workforce impact ($ 2.7 million in predicted salary savings by 2030 and $3.3 million by 2035).

Figure 2.15: Prediction of emerging technology types with the greatest opportunities to drive automation in the agriculture sector, Greater Whitsunday region, 5 year projection ($AUD salary cost saving)

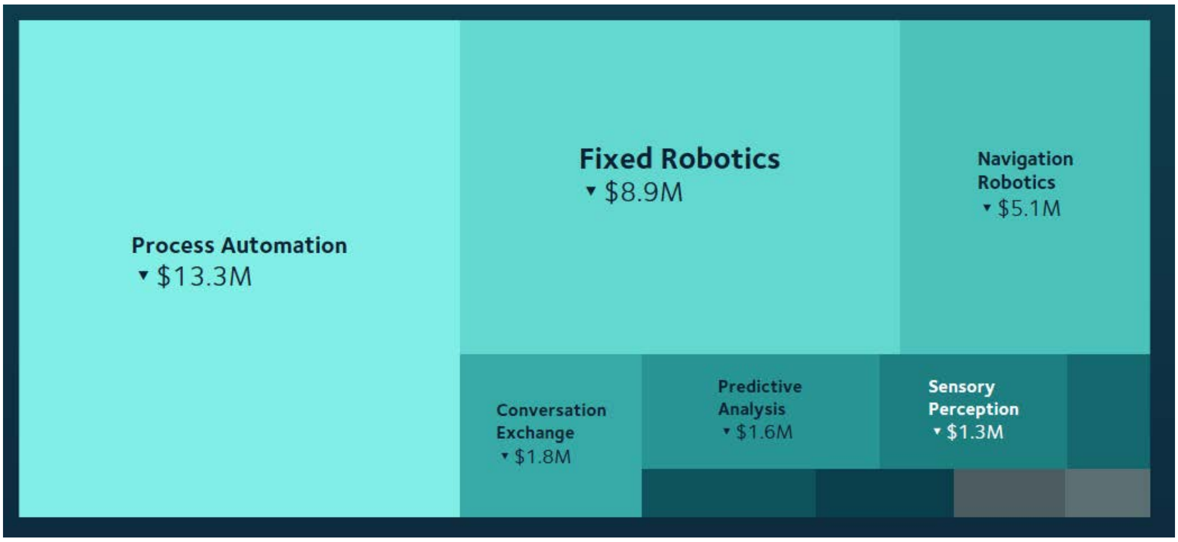


Figure 2.16: Prediction of emerging technology types with the greatest opportunities to drive automation in the agriculture sector, Greater Whitsunday region, 10 year projection ($AUD salary cost saving)

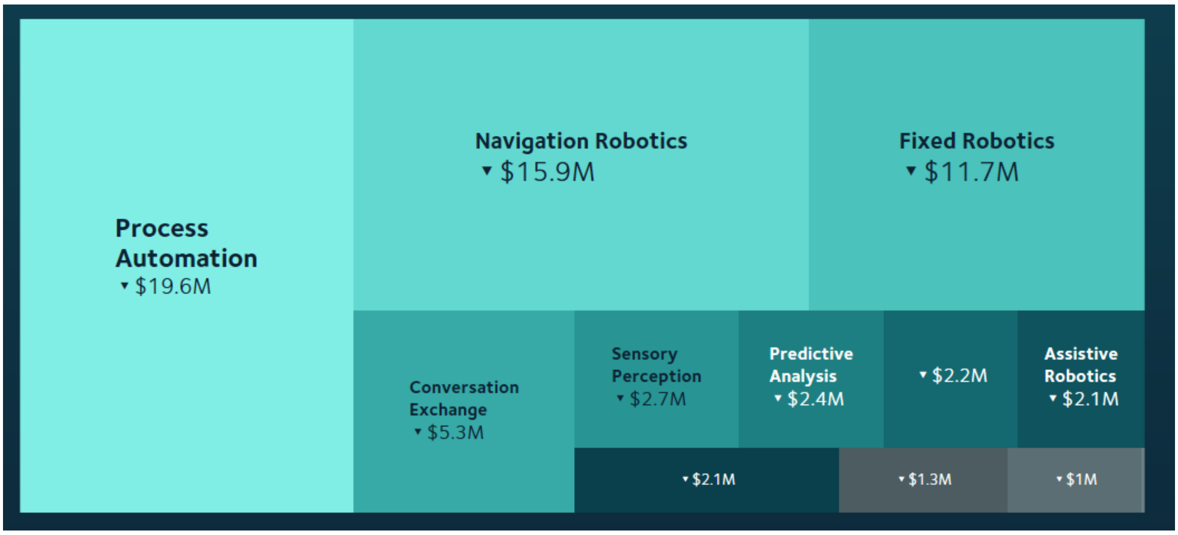
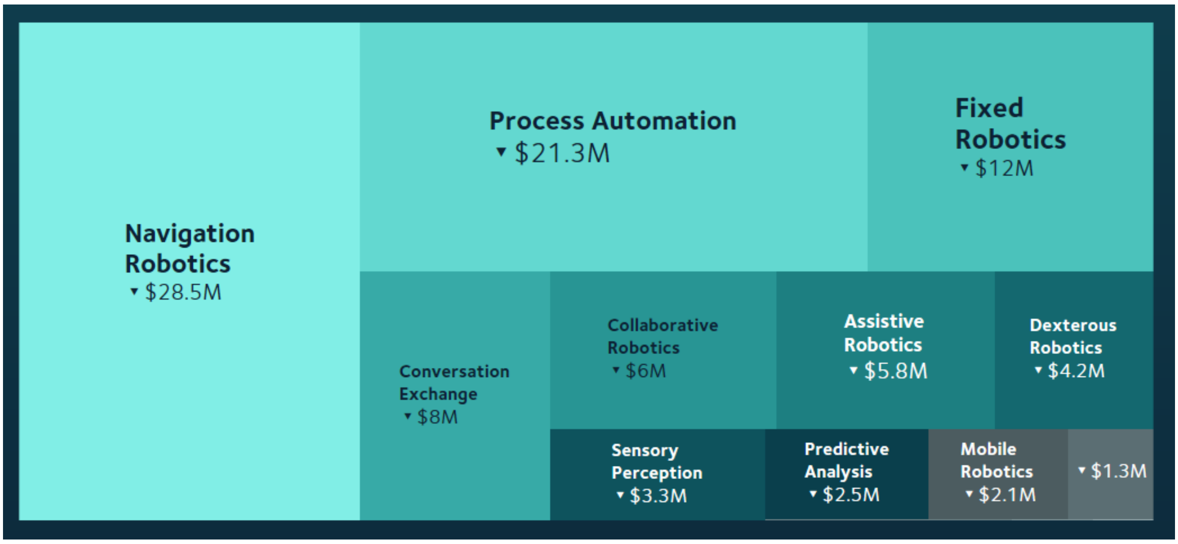


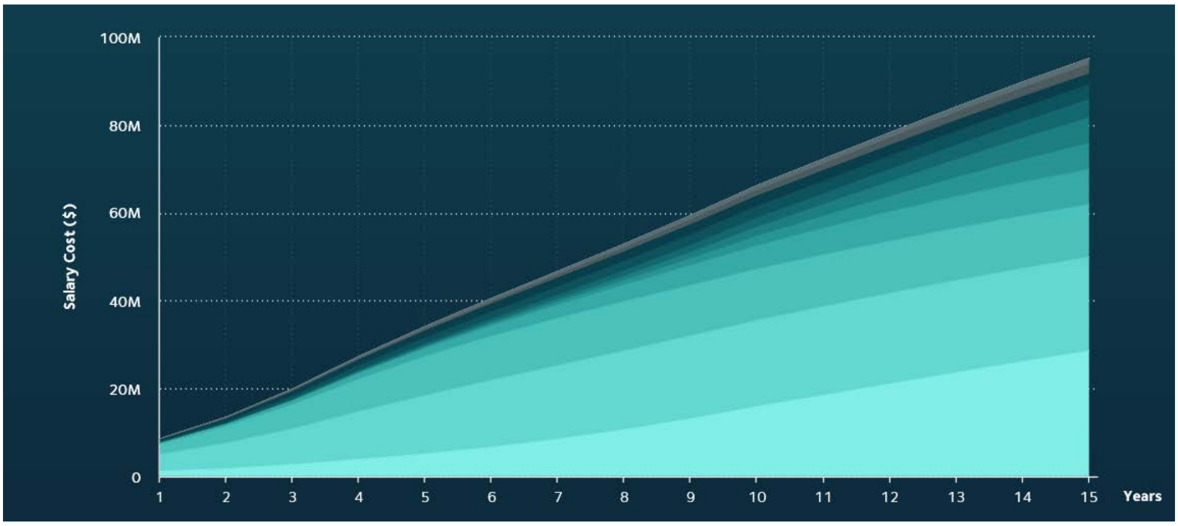
Figure 2.17: Prediction of emerging technology types with the greatest opportunities to drive automation in the agriculture sector, Greater Whitsunday region, 15 year projection ($AUD salary cost saving)



Source: Faethm (platform.faethm.ai)

These impacts are also summarised in the 15 year technology projection curve for the Agriculture industry shown in Figure 2.18.

Figure 2.18: Automation technology adoption curve over the 15 year horizon (2035), agriculture sector Greater Whitsunday region



Key from bottom to top – navigation robotics, process automation, fixed robotics, conversation exchange, collaborative robotics, assistive robotics, dexterous robotics, sensory perception, predictive analysis, mobile robotics, decision generation, solution discovery, generative design, creative origination.

Source: Faethm (platform.faethm.ai)

What is meant by these technology categories in the agriculture context?

Table 2.1 below provides a definition for each of the Faethm technology clusters, and examples of what is meant by this in the agriculture sector context to link the technology discussion later is this chapter with the Faethm nomenclature.

Table 2.1: Technology clusters in Faethm and applicability to the agriculture sector

TECHNOLOGY	DEFINITION (FAETHM)	EXAMPLES IN AN AGRICULTURE CONTEXT
Process Automation	Process Automation technologies use code programmed to complete pre-defined, logical and rule based processing tasks such as quantitative calculations, process onboarding, monitoring and simple robotic jobs and movements. This works by applying rules based logic to take structured inputs and using predefined executable steps, to deliver structured outputs.	This includes the automation of administrative and business functions in areas including billing, expense processing and invoicing, along with end to end processes like procure to pay.
Fixed Robotics	Fixed Robotics technologies are machines that robotically handle and manipulate objects in a predefined way such as by painting or assembling. This works by combining programmed rules based instructions with vision, sensor systems and mechanics.	This includes robotic technologies used in packing and product processing to ensure quality and affordability, by reducing costs of keeping the food fresh and increasing productivity. Robotic machines are improving workplace health and safety by eliminating safety issues for dangerous jobs in the food industry, such as butchers. Robots are used to cut more difficult parts of meats which in turn reduces many work injuries.

TECHNOLOGY	DEFINITION (FAETHM)	EXAMPLES IN AN AGRICULTURE CONTEXT
Navigation Robotics	Navigation Robotics technologies are robots that can navigate autonomously in unstructured environments with specific functions. This works by applying reinforced learning, advanced sensors and mechanics to plan and conduct live movement between environments.	Navigation robotics technologies are commonly used on large properties to assist in water management, stock movement and pest control. They have the potential to assist the agricultural industry through instant data gathering and processing for soil and field analyses, crop spraying and health assessments, livestock monitoring and irrigation.
Conversation Exchange	Conversation Exchange technologies are systems that use machine learning and sensors to interpret and engage in conversation, exchanging ideas and information with humans. This works by applying auditory and speech sensors in combination with Natural Language Processing and speech generation technologies to detect communication and to respond in a social dialogue.	Remote sensors are able to monitor inputs such as water tank levels, animal health and the moisture and nutrient level in soil without requiring human labour and assist in precision agriculture. Precision agriculture is the use of technology aimed at improving farmers' decision-making through data analytics.
Predictive Analytics	Predictive Analytic technologies are tools that use algorithmic based process and prediction software to evaluate narrow data inputs, extracting relevant information and solving specific queries. This works via using machine learning to train and develop algorithms, applying unstructured inputs, unsupervised and supervised learning and adaptation to solve specific parameters.	Predictive analytics utilises AI and machine learning to assist farmers to increase the value of the data collected on farms by analysing and converting it to information to underpin better management decision and directing machinery to undertake tasks based on interpretation of the data. Precision agriculture utilises technology aimed at improving farmers' decision-making through data analytics. It includes emerging software, such as big data solutions and farm management tools, and hardware, such as sensors, drones and satellites.
Sensory Perception	Sensory Perception technologies are systems that use sensors to detect and extract meaning from external stimuli and use this as a prompt to an action. This works by using sensors in combination with machine learning to detect and respond to specific external parameters such as information sources and interactions.	Smart devices and IoT technologies provide a way to monitor the water quality or environmental factors in agriculture and aquaculture environments.
Assistive Robotics	Assistive Robotics technologies are agents with highly flexible and perceptive functions capable of adapting to people, needs and scenarios in a support function. This works by using sensors in combination with machine learning and advanced robotics to proactively communicate and detect and respond to interactions.	In the packing and product processing sector, technological advancements and the use of AI are allowing more complex tasks to be undertaken by robotic machines such as grading, sorting, food safety compliance, packaging and labelling. In Queensland, CQUniversity have built a prototype for an automatic mango harvester that achieved 75 percent accuracy in automatically identifying and picking fruit in view. Internationally, TOMRA is a leading sorting and collection solutions provider in Norway that uses X-ray, near infra-red spectroscopy, laser, cameras and machine learning algorithms to analyse fruit or vegetables for sorting.

Predictions of the impact of these technologies being adopted in the agriculture workforce

Based on the technology adoption rates shown in Figure 2.18, Faethm predicts the opportunity that is created to automate, augment and add to the workforce. The analysis undertaken for the Greater Whitsunday region for the Agriculture industry workforce over a 5, 10 and 15 year horizon is shown in Figure 2.19, Figure 2.20 and Figure 2.21. This predicts that:

- By 2035, 47.7 percent of the total agricultural workforce functions and roles will be automated (or supported) by technology, and 8.6 percent of the current tasks and functions are predicted to be augmented by technology;
- The degree of impact of a change in automation and augmentation is also partially determined by the overall size of occupations in the Greater Whitsunday region;
- The Sugar Cane Grower is the occupation expected to drive the highest overall workforce impact in the region as a result of automation and augmentation of the 5, 10 and 15 year horizon. By 2030, it is predicted that 51.8 percent of this role will be automated as a result of technology, and 7.6 percent of the role will be augmented by technology;
- The top five occupations driving the greatest workforce impact for the region in agriculture over the fifteen year period (and at the five and ten year increments) are predicted to be the Sugar Cane Grower, Beef Cattle Farmer and Beef Cattle Farm Worker (45.3 percent automatable, 8.5 percent augmentable), Bookkeeper (55.6 percent automatable, 4.3 percent augmentable), and Agricultural and Horticultural Worker (40.8 percent automatable, 16.9 percent augmentable);
- The occupations with the highest predicted level of automation (where technology will replace the need for some tasks and functions) are the Fruit and Vegetable Packer (63.0 percent), Packers not further defined (63 percent), Meat Packer (59.7 percent) and Bookkeeper (55.6 percent);
- However there are also a number of agriculture occupations by 2035 that are projected to have over 50 percent of their role automated including Sugar Cane Farmer, Mixed Crop and Livestock Farmer, Vegetable Farm Worker, Vegetable Grower, Fruit or Nut Picker, Vegetable Picker, Crop Farmers not further defined, Grain, Oilseed or Pasture Growers, Fruit or Nut Growers, Fruit or Nut Farm Worker, Mixed Crop and Livestock Farmer, Mixed Crop Farmer and Crop Farm Workers not further defined; and
- For most agriculture occupations by 2035, less than 10 percent of the role is projected to be augmented by technology. Those roles with the highest levels of projected augmentation by 2035 in agriculture in the Greater Whitsunday region are Farmers and Farm Managers (30.2 percent) and Agriculture and Horticulture Workers (16.9 percent), Agricultural Technicians (16.0 percent) and Fishing Hands (13.1 percent).

Figure 2.19: Prediction of tasks within jobs exposed to augmentation and automation in the agriculture sector, Greater Whitsunday region, 5 year projection (top 15 occupations, by FTE)

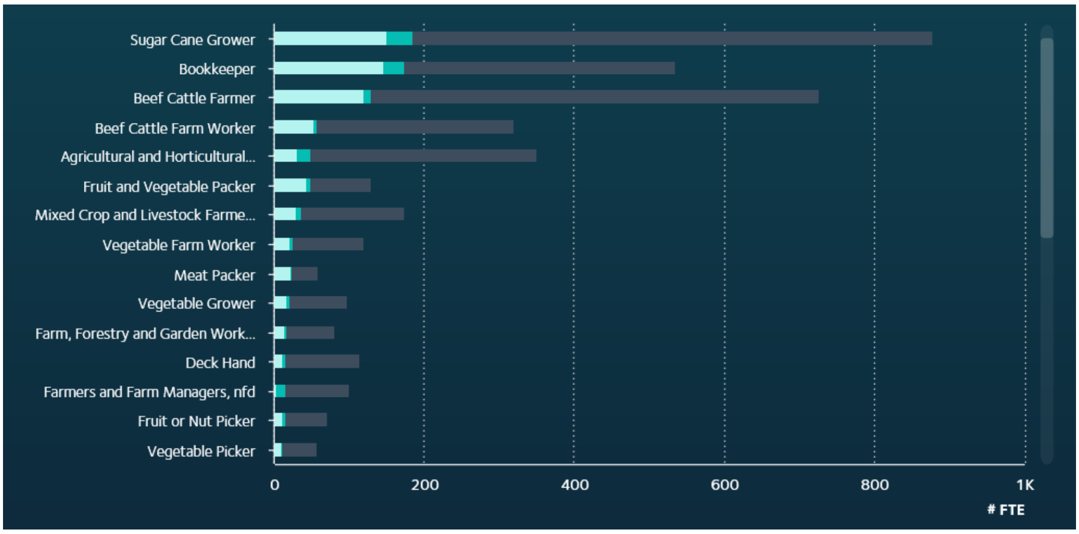


Figure 2.20: Prediction of tasks within jobs exposed to augmentation and automation in the agriculture sector, Greater Whitsunday region, 10 year projection (top 15 occupations, by FTE)

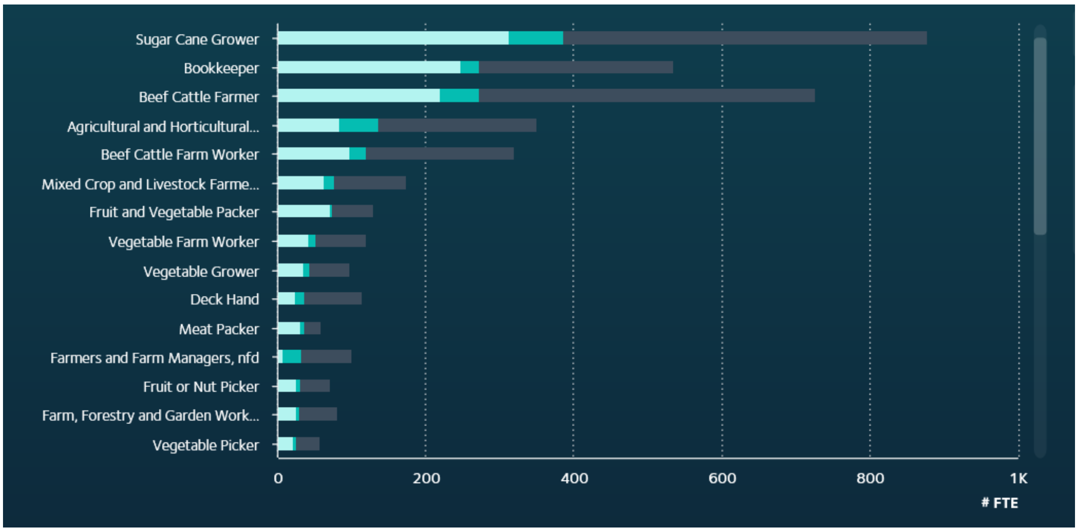
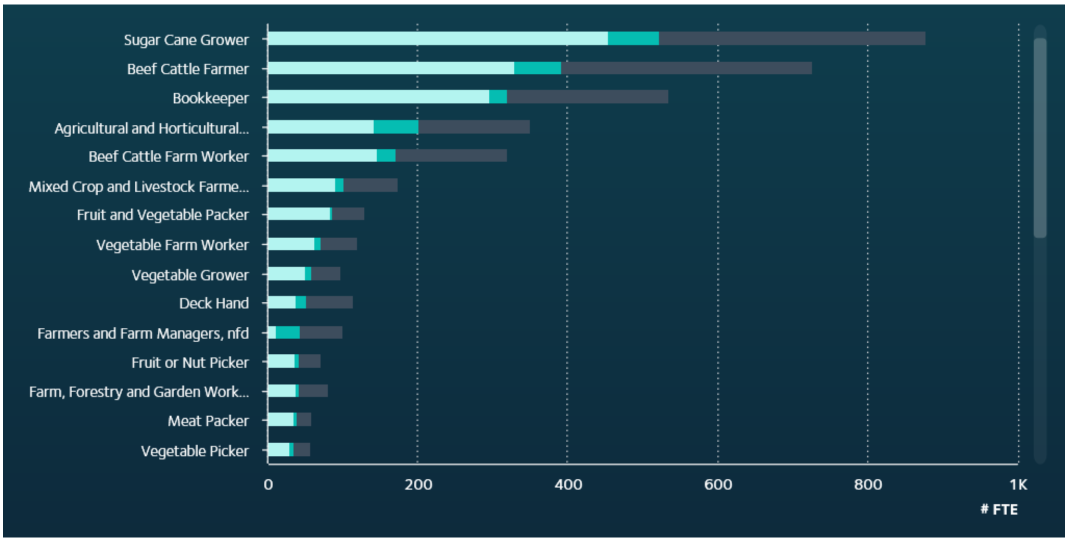


Figure 2.21: Prediction of tasks within jobs exposed to augmentation and automation in the agriculture sector, Greater Whitsunday region, 15 year projection (top 15 occupations, by FTE)



Source: Faethm (platform.faethm.ai)

It is also important to note that there are a number of new occupations that are expected to increase in demand as a result of the adoption of these technologies. Figures 2.22, 2.23 and 2.24 show the key occupations expected to be in demand over the 5, 10 and 15 year horizon based on adoption of new technologies in the agriculture sector. It shows that:

- By 2025, 158 FTE in additional jobs are predicted in the region to support the implementation of agriculture technology adoption, growing to 417 additional FTE jobs by 2035; and
- The top five occupations predicted to grow in demand as a result of technology adoption are Software Developers and Application Developers, Software Developers and Systems Support, Process Improvement Analysts, Data Analysts and Data Engineers.

Figure 2.22: Prediction of additional jobs required to support new technologies adopted in the agriculture sector, Greater Whitsunday region, 5 year projection (top 15 occupations, by FTE)

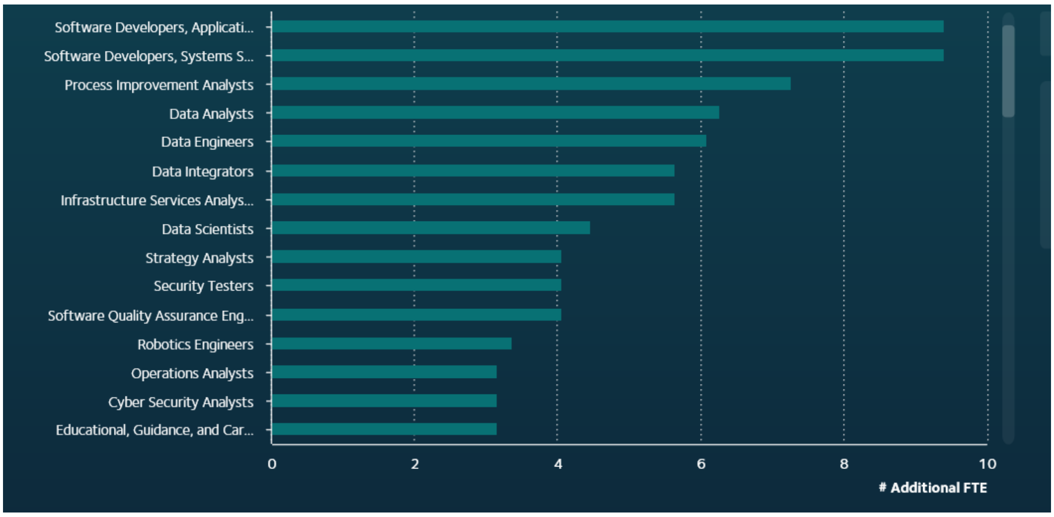


Figure 2.23: Prediction of additional jobs required to support new technologies adopted in the agriculture sector, Greater Whitsunday region, 10 year projection (top 15 occupations, by FTE)

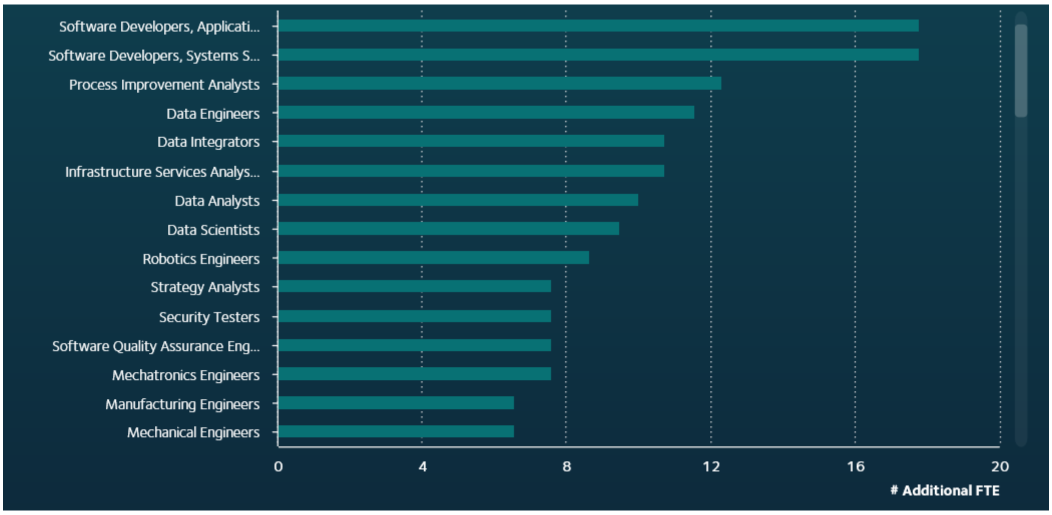
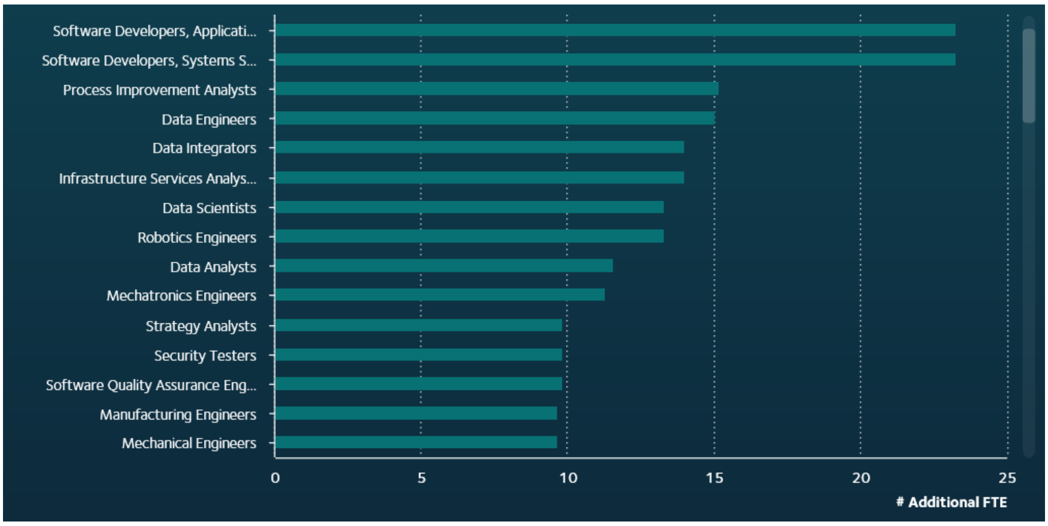


Figure 2.24: Prediction of additional jobs required to support new technologies adopted in the agriculture sector, Greater Whitsunday region, 15 year projection (top 15 occupations, by FTE)



Source: Faethm (platform. faethm.ai)

A deeper dive:

Technologies emerging in agriculture, forestry and fishing

"There is a lot of fascinating work being done with robots and automated machinery for monitoring and managing crops... There are also trials of automated, driverless tractors currently being done. But the important part of these changes is that you will still need people with agricultural expertise to inform those decisions, to determine how crops and livestock should be managed, to tell the technology what to do."

Professor David Kemp
Charles Sturt University

KEY TECHNOLOGIES

The Agriculture industry has experienced various industrial changes, from the introduction of mechanical power which drove productivity to modern agricultural innovations such as GPS positioning. [60] Technology such as automation is increasingly replacing routine operation jobs within the sector as part of the transition to modern agricultural innovations; however, further technology advancement has the potential to transition the traditional workforce into a new digital era of farming. It is predicted that the next ten years could see agricultural technologies continue to progress and have substantial impacts on the size, demographics and skills of the agricultural workforce. [61]

Technological advances have assisted the Australian Agriculture industry to become a global leader in efficiency and productivity and provide a competitive advantage to agribusinesses capable of adopting them. [62] A new era of emerging technologies is enabling farm operators to manage their farms with technology driven solutions. Many of the emerging technologies available within the industry offer complementary benefits and in practice are often utilised in combination to effectively establish a digital agricultural environment. Key emerging technologies and digital enablers that apply across the Agriculture industry include:

Table 2.2: Key technologies expected to impact all, or a significant proportion, of the Agriculture workforce

Automation and robotics: Automation and robotics refers to the process of equipping technologies to complete repetitive tasks and activities that result in process efficiencies. These technologies are expected to increase productivity and reduce labour costs.

Artificial Intelligence and Data Platforms: AI is a broad concept encompassing any machine-based tool that does tasks requiring human intelligence but lacking the ability to apply human logic. Data platforms utilise the collection of 'big data' collected from farm machinery, sensors and digital technologies about the soil, water, crops and animals to inform decision making.

Novel Farming Techniques: Novel farming techniques include vertical farming, high-tech greenhouse facilities and lab-grown agricultural produce, and utilise technologies such as automation, robotics and AI.

Water Management Technologies: Water management technologies includes automated water management systems and sensing equipment that improve decision-making and improve irrigation efficiency.

Sensors: Sensors utilise inputs from the physical environment and internal programming to perform predefined functions upon the detection of specific inputs. Sensors are also able to process this data and pass it on to other applications to support decision-making.

[60] *Perrett, E. et al., Australian Farm Institute, 2017, Accelerating precision agriculture to decision agriculture – analysis of the economic benefit and strategies for delivery of digital agriculture in Australia.*

[61] *Wu W. et al., 2019. The future of Australia's agricultural workforce. CSIRO Data61: Canberra, Australia.*

[62] *AusTrade, Agribusiness – Research, Consulting, Technology and Equipment, p 4.*

Supply Chain, Food and Waste Management: These encompass various technologies including tracking technology to improve food safety and traceability, food processing technology, packaging that enhances shelf life, data driven software to optimise the movement of agricultural supplies, waste management and the circular economy where waste is utilised for packaging or inputs for other farms.

Navigation Robotics Technologies: Navigation robotics technologies are robots that can navigate autonomously in unstructured environments with specific functions. Technologies include auto-steering guidance for tractors, autonomous drones and planning and exploring agents.

Biosecurity: Technology and innovation within biosecurity includes surveillance and monitoring, data and analytics, genetics, sensor technology and smaller, smarter devices, improved risk modelling and cargo scanning.

There are many additional technologies that are expected to impact on subsectors in agriculture areas in specific ways. These are summarised in Figure 2.25 and detailed analysis is included in Appendix G.

As technologies are increasingly used within the industry to promote profitability, efficiency, safety and reduce environmental impacts, digital capabilities will become increasingly important to the employability of the future workforce. [63] The increased adoption of technology such as sensors and GPS machinery and to enable agribusinesses to capitalise on opportunities from data driven solutions, the workforce must acquire and develop the requisite digital and analytical skills. [64] However, industry research indicates that approximately one-third of farmers reported that digital skills were a constraint in utilising new technologies. [65] Ensuring the appropriate reskilling or up-skilling of these segments of the workforce with the appropriate digital skills will be a critical component to the future success of these sectors.

[63] *Austrade – Australia: shaping the future of food and agriculture*

[64] *Jobs Queensland, 2018, Anticipating Future Skills: Jobs growth and alternative futures for Queensland to 2022.*

[65] *ABARES, 2018, Information and communication technology use in Australian agriculture.*

Figure 2.25: Below outlines at a high level the breadth of technologies and how they impact occupations differently.

Farmers, Farm Managers and Workers

- Imaging, drones and UAVs
- Pest management
- Weather and climate monitoring
- Smart irrigation
- Farm management platforms

Aquaculture and Fisheries

- Precision feeding technologies
- Augmented reality
- Water quality sensors
- Traceability technology

Cropping and Horticulture

- Farm management platforms
- Precision technology
- Robotics and automation
- Traceability technology
- Water irrigation technologies

Livestock farming

- Whole of Farm Management
- Online auctions
- Animal and Herd Management
- Supply chain and provenance
- Emissions reduction technology

Packing and product processing

- Automation and robotics
- Novel processing techniques
- Monitors and wearable devices

Automation and Robotics

What is automation and robotics?

Automation and robotic technologies are expected to be able to automate an increasing amount of manual tasks and augment others to increase productivity and reduce labour costs. Automation is the process of equipping technologies to complete repetitive tasks and activities that result in process efficiencies.

How is it being applied within the sector?

Robotics and autonomous systems have the ability to transform the Agriculture industry by replacing elements of human labour for repetitive, highly manual tasks. Robotics is used across a wide variety of sectors within the industry for tasks including harvesting and crop picking, autonomous mowing and pruning, sorting and packing, seeding, spraying and thinning crops and weed and fertilisation management. Navigation robotics allows to autonomously navigate unstructured environments to achieve specific functions or tasks. [67] They are often used for weed management, as they can navigate through a field, detect and classify weeds, and kill weeds mechanically.

In Australia, fruit and vegetable farms face high labour costs and skilled labour shortages during peak harvesting periods, leading to valuable crops remaining unharvested. The opportunity for robotic devices that autonomously sense, analyse and respond to their own surrounds are being developed with the potential to assist in challenges such as the increased demand for fresh products. Robots are being utilised to perform tasks such as assessing fruit ripeness and soil requirements to provide data for a comprehensive model of an entire orchard. Traditionally, this has been performed by a person walking through the orchard and taking samples, and therefore provides significant efficiency and productivity benefits to manual labour. The technology is designed to be able to be applied to standard farm tractors to also perform tasks such as fertilising, watering and mowing.

CASE STUDY – QUEENSLAND UNIVERSITY OF TECHNOLOGY

At the Queensland University of Technology, prototype robotics are being devolved to harvest fruit and vegetables in partnership with the Queensland Government. From 2013 to 2017, a prototype robotic capsicum harvester that combined robotic vision and automation was developed. Research literature in 2017 indicated that harvesting robots tested in similar scenarios to those used to test the prototype had a success rate of 6 percent, and up to 30 percent when the crop is modified with the leaves removed. The testing of the prototype at facilities in both Townsville and Brisbane showed a harvesting success rate of 76.5 percent in modified crop scenarios and an average harvesting time of approximately 30 seconds per fruit. Continued research and development aims to achieve the goal of fully autonomous and reliable crop picking systems that will be able to revolutionise the horticulture industry by reducing labour costs, maximising the quality of produce and improving the sustainability of farming enterprise.

CASE STUDY – C Q UNIVERSITY

CQUniversity have built a prototype for an automatic mango harvester. During field trials at Yeppoon, the prototype achieved 75 percent accuracy in automatically identifying and picking fruit in view. [66] The prototype was developed as part of a Commonwealth funded research project, with the next phase of the project seeking to improve the performance to over 90 percent accuracy before commercialising the product.

[66] *CQUniversity, World-first mango auto-harvester from CQUni, 15 May 2019, Available at https://www.cqu.edu.au/cquninews/stories/general-category/2019/world-first-mango-auto-harvester-from-cquni*

[67] *CQUniversity, World-first mango auto-harvester from CQUni, 15 May 2019, Available a t https://www.cqu.edu.au/cquninews/stories/general-category/2019/world-first-mango-auto-harvester-from-cqunindustry.*

What is the workforce impact?

As access to labour becomes increasingly difficult within the Agriculture industry, particularly in remote and rural areas, automation and robotics provides a solution to ensure demand for products is met. Additionally, human labour is increasingly expensive and often has a lower productivity rate compared to robotic automation for labour intensive tasks.

Automation should not be seen as a significant threat to the future workforce, as new jobs and opportunities are created. It is estimated that unconstrained application of digital technology across the Agricultural industry could potentially see savings of approximately $7 billion from automation on the Australian economy. [68] To ensure the workforce is supported during this transition, there must be investment into supporting low-skilled employees to reskill for higher level positions that will be required with the increased adoption of technology. For example, it is expected that jobs such as robotic engineers, robotic maintenance technicians, technical support officers and data scientists and analysts will be required to service the equipment and analyse the data collected from the systems for future value add inputs. Farm managers in the future will be required to possess a combination of technical farming skills, digital literacy and soft skills.

The realities of widespread adoption of complex automation technology and robotics are highly dependent on costs, with human labour remaining more cost-effective in the short term. The transition to utilising these technologies on a broad scale will likely be slow as there is often a large investment required to establish and implement that technology. As costs and developments in technology adjust to make them increasingly accessible, it is expected that these technologies will be the new normal.

[68] *Heath R. 2018. An analysis of the potential of digital agriculture for the Australian economy. Farm Policy Journal, 15(1): 9-23.*

Sensors

What are sensors?

Sensors utilise inputs from the physical environment and use internal programming to perform predefined functions upon the detection of specific inputs. Sensors are also able to process this data and pass it on to other applications to support decision-making.

Sensors can be utilised in a variety of ways by being mounted on vehicles, Unmanned Aerial Vehicles (UAVs), drones, aircraft and satellites, or placed directly in soil, water and on plants and animals. [70] Sensors can be biological (biosensors) utilising living organisms or biological molecules to monitor the presence of chemicals in a substance, or remote sensors that support precision agriculture.

How is it being applied within the sector?

Remote sensors enable detailed monitoring and efficient management of agricultural resources through the collection of data. Remote sensors are able to monitor inputs such as water tank levels, animal health and the moisture and nutrient level in soil without requiring human labour and assist in precision agriculture. Precision agriculture is the use of technology aimed at improving farmers' decision-making through data analytics. It includes emerging software, such as big data solutions and farm management tools, and hardware, such as sensors, drones and satellites. [71]

Sensors can also be used for logistics once crops have been harvested. For example, horticulture requiring refrigerated trucks with specific transportation temperature requirements to meet strict food safety guidelines are an area of use for sensors that is continuing to emerge and develop within the industry.

While the concept and use of remote sensors is not new, the application in different contexts is still an emerging technology area. A transition to digital agriculture utilising sensors to connect big data captured to inform software, data platforms and the IoT is an area of opportunity to utilise data in farm management. Despite the potential to improve decision making and profitability, the adoption of sensor technology remains low. A 2017 study of 1,000 farmers across Australia found that less than a quarter were using sensor technologies. [72]

CASE STUDY – CROP IRRIGATION

Automated irrigation uses sensors to monitor water levels in channels and in crops, replacing the requirement for water levels to be physically checked. Sensors are able to monitor supply and return channels so that farmers can adjust pumps accordingly. In New South Wales, cotton farmers have implemented sensors to reduce the labour intensity of irrigated agriculture as remote sensing is now used to make farm management decisions.

In California, farmers produce approximately 80 percent of the world's supply of almonds. Almonds require a high input of water to grow – approximately 4.5 litres of water is required to grow one almond. [69] As sustainability is becoming increasingly important to consumers and vital to farmers as water availability is increasingly limited, farmers are using technology to reduce the high quantity of water required to produce almonds.

Moisture sensors are planted throughout almond crops to track data that inputs to the farm's irrigation system. The data inputs are used to pump water mixed with an appropriate dose of fertiliser at scheduled intervals to deliver precise watering to each tree. The utilisation of this system has reduced water consumption by approximately 20 percent and delivered time and cost savings.

What is the workforce impact?

Sensors provide a number of benefits to the industry including reduced labour costs, improved crop performance and water use efficiency. It is predicted that the skills required for the agricultural workforce will change as farmers are informed by objective data rather than physical inspection and observation of crops and livestock. In the short term, farming skills will be supplemented by data that is collected from sensing technology. However, over the medium to long term decisions will increasingly be based on objective data. Farm advisers and agronomists will have to integrate their roles with new technologies to provide advice. As algorithms, AI and autonomous machines continue to advance there is the possibility for the replacement of humans in some farm management roles. However, advancements will be incremental allowing for farm managers to adjust and develop their skills in synergy with technological advancements.

[69] *The Economist, 11 June 2016, Technology Quarterly – The Future of Agriculture, https://www.economist.com/technology-quarterly/2016-06-09/factory-fresh.*

[70] *Rural Industries Research and Development Corporation, 2016, National Rural Issues – Transformative Technologies – Sensors.*

[71] *Ben Van Delden and Piers Hogarth-Scott, KPMG, 2016, The Internet of Things and Smart Agriculture.*

[72] *Rabobank, 2019, AgTech – Does sensor adoption make 'cents'?*

Artificial Intelligence and Data Platforms

What is artificial intelligence and data platforms?

AI is a broad concept that originated in the 1950s, encompassing any machine-based tool that does tasks requiring human intelligence but lacking the ability to apply human logic. The term is frequently used across many industries and applications to describe machines and computers that mimic the cognitive functions of humans such as learning and problem solving.

Machine learning is the ability of algorithms to improve behaviour over time. Algorithms are the driving force behind intelligent technology as they are the processes the software is designed to follow to problem-solve and provide outputs. While algorithms are generally programmed by humans, machine learning adjusts the algorithms to perform more efficiently.

Narrow AI is semi-autonomous and will act to perform structured, repetitive tasks when prompted. Broad AI is proactive technologies that can self-initiate actions and engage with their environment using perception and sensory processing of data. Reinforced AI is self-improving technology that is capable of performing unfamiliar tasks by learning from each experience to then be capable of completing new tasks.

Data platforms utilise the collection of large and complex data sets (commonly referred to as 'big data') that are collected from farm machinery, sensors and digital technologies that generate large volumes of data about the soil, water, crops and animals to transform this into valuable information to guide decision making. Data governance is a critical part of data platforms, as this refers to the management of the availability, integrity and security of data.

How is it being applied within the sector?

Computers can make decisions based on data when AI and machine learning is utilised. Additionally, AI can respond to uncertain and ambiguous scenarios to enable better decision making and to adjust to future needs.

AI will assist farmers to increase the value of the data collected on farms by analysing and converting it to information to underpin better management decisions and directing machinery to undertake tasks based on interpretation of the data. Data has various uses in agriculture and can be used to inform software tools and packages for farming applications, such as paddock management, farm mapping, management of yield and other GPS based data. [73] Additionally, AI combined with farm data is able to provide analysis which directs robotic systems to undertake specific tasks, predict harvest periods, supporting packing needs and facilitate logistics requirements.

CASE STUDY – CSIRO

In 2019, the CSIRO in partnership with rural technology start-up Digital Agriculture Services (DAS) developed an innovative platform combining AI, machine learning and cloud-based geospatial technology to deliver reliable, independent and robust farm data and analytics. The Rural Intelligence Platform comprehensively assesses and monitors rural land in Australia, drawing on information from trusted data sources on productivity, water access, yield, land use, crop type, rainfall and drought impact to inform decision making, investments and management decisions for agricultural businesses.

CASE STUDY – CONNECTERRA

Connecterra is an AI start-up using sensors, data and machine learning to improve core aspects of farm operations to become more efficient, more productive and more sustainable.

Connecterra launched its intelligent dairy farm assistant, Ida, in 2017 that utilises sensors fitted to cows on a collar. Ida uses data analytics and machine learning to translate animal behaviour data into predictive analytics and actionable recommendations for farmers. Connecterra has evolved into a full-stack technology and AI platform that combines proprietary sensor hardware, animal data, third party enterprise data and machine learning algorithms.

What is the workforce impact?

AI is an extension to many farm technologies that underpin the operation and continuous improvement. Without AI to make decisions regarding inputs or to identify the grade of crops many autonomous and robotic technologies will not effectively operate.

As with many technologies within the industry, AI and data platforms provide an opportunity to increase productivity, reduce costs and fill labour shortages. AI may also offer opportunities to support other elements of agribusinesses such as workplace training and WHS.

[73] Wu W, Dawson D, Fleming-Muñoz D, Schleiger E and Horton J. 2019. The future of Australia's agricultural workforce. CSIRO Data61.

Supply chain, food technologies and waste management

What is the technology?

Agriculture supply chain and food technologies encompass various technologies including:

- Technology that can track agricultural products along the supply chain to improve food safety and traceability;
- Food processing technology;
- Shelf life enhancements; and
- Data driven software to optimise the movement of agricultural supplies.

Within the industry there is an increased focus on the whole supply chain, including waste management and the circular economy. Technologies that utilise waste for packaging or inputs for other farms to create systematic approaches to farm management and asset sharing platforms are increasingly important emerging technologies.

How is it being applied within the sector?

The agricultural supply chain is faster, more connected and requires greater amounts of data to operate effectively. Additionally, resilient and sustainable agri-food supply chains are more critical than ever as they face increasing complexity, uncertainty and risks.

Various sources of uncertainty include product (such as shelf-life, deterioration rate, and food quality and safety), process (such as harvest yields, resource needs and production), market (such as demand and market prices) and environment (such as weather, pests and diseases and water supply). Innovative technologies are assisting the agri-food supply chains to manage these sources of uncertainty to ensure future sustainability, food security and to contribute to employability and economic growth.

Blockchain technology serves as the decentralised platform which collects and stores data submitted manually by users and automatically by integrated systems. It is a public ledger available to all parties within a supply chain including producers, retailers, logistics providers and regulators. The security of this data is facilitated by its decentralised and disaggregated functionality which breaks up data which is encrypted.

Tracking and traceability systems involve technology that transmits information about the location of agricultural goods along the logistics chain. Technology such as blockchain and GPS technology can be utilised as supply chain tracking systems that connect and communicate with suppliers and producers. Blockchain provides a platform for food assurance, capturing data that demonstrates where, how and when the food was produced, processed and distributed.

Waste in the supply chain is also being reduced through the collection and analysis of data. Waste is being reduced as goods can be transferred faster through ports to the end consumer, saving the Australian economy approximately $20 billion in food waste costs each year. [76]

CASE STUDY – FOOD SAFETY

Temperature is recognised as the most important environmental factor for food safety, reducing waste and maintaining shelf life. Technology platforms with data logging abilities that automatically upload data to digital platforms to a network hub provide real time data to all within the supply chain, increasing transparency and informing actions to reduce financial impacts and waste associated with poor handling. [74]

CASE STUDY – AGRICONOMIE

Agriconomie is a French digital platform for farmers, an e-commerce enablement software for suppliers, and provides data insights to stakeholders across the agriculture supply chain.

Agriconomie works with incumbent suppliers to offer an agribusiness marketplace for farmers and their suppliers with advanced logistics capabilities and a streamlined value chain that removes some of the mark-up for growers. [75]

[74] *Department of Agriculture and Fisheries, 2019, IoT-driven connectivity will revolutionise real-time temperature monitoring of horticulture supply chains.*
[75] *AgFunder, 2020 European Agri-FoodTech Investment Report, Available at https://agfunder.com/research/2020-european-agri-foodtech-investment-report/.*
[76] *KPMG and National Farmers' Federation, 2018, Talking 2030 – Growing agriculture into a $100 billion industry.*

What is the workforce impact?

Enhanced technologies will be pivotal to strengthening supply chains for Australia, particularly within Queensland, as the demands of both consumers and regulatory bodies increase. Increasingly supply chains will be driven by customer needs and will be less dependent on capital-intensive fixed assets and linear flows.

Through new technologies and digital platforms, supply chain functions can be purchased ‘as-a-service’ from third-party providers and managed through platforms. Collection of data through technologies such as sensors, cameras and AI to detect opportunities to improve actual performance in the supply chain will become increasingly important. [77] A future state supply chain will be able to utilise data to recognise the accumulation of surpluses and scale back production to reduce waste and uncertainty and increase efficiency, sustainability and agility.

To utilise the new digital supply chain, transformation of traditional skill-based agriculture into digital and knowledge-driven agriculture will need to occur. [78]

As such, new skills will be required and new job roles will be created to cater to the new supply chain. Businesses will require a supply chain workforce with specialist skills in AI, blockchain, robotics, cyber and big data analysis. Upskilling, redeploying and attracting new talent will be critical to the implementation and success of emerging technologies within the supply chain.

[77] *KPMG, 2019, The road to everywhere – the future of supply chain.*

[78] *M. Lezoche, et al., 2020, Agri-food 4.0: A survey of the supply chains and technologies for the future agriculture, Computers in Industry.*

Novel farming technique

What is the technology?

Novel farming techniques include vertical farming, high-tech greenhouse facilities and lab-grown agricultural produce.[81] Many of the technologies previously discussed influence novel farming techniques, such as automation, robotics and AI. This section will focus on novel farming techniques that encompass new methods of farming agricultural products that are traditionally grown outdoors.

How is it being applied within the sector?

Although regional Queensland has a low population density and abundant farmland, increasing environmental challenges will affect the future of agriculture in the region. The Greater Whitsunday region is expected to face higher temperatures, hotter and more frequent hot days, more intense downpours, more intense tropical cyclones, rising sea levels and increased sea-level extremes.[82] Climate risks bring associated impacts to the Agriculture industry including changed distribution of pests and diseases, reduced water security, changes to habitat and exacerbation of existing threats to flora and fauna.

Automation is used for seeding through to packaging, reducing the need for seasonal workforces who are typically lower skilled and in Australia commonly on working visas, and limits handling of produce which is important for highly perishable produce.

Indoor farming is likely to become increasingly important in the future to adapt to severe climate and environmental risks, and techniques include hydroponics, hot houses and synthetic foods that are insulated from climate.[83] Light Emitting Diode (LED) lighting solutions, urban farming locations, elimination of pesticides, bringing consumers closer to their food are all impacts of the growth of novel farming techniques. The technologies are mostly utilised for horticulture; however, companies are working to grow fodder and livestock feed.

CASE STUDY – AEROFARMS

AeroFarms has been operating in the United States since 2004 and operates fully controlled indoor vertical farming.[79] They utilise sensing technologies, data science, machine vision and AI to grow crops that reduce water usage and are pesticide free. LED lighting is used to provide specific lighting for each plant that is engineered to provide the spectrum intensity and frequency required for photosynthesis. Plant scientists monitor the data collected to improve growing systems and use predictive analytics to adjust to the requirements of the crops. AeroFarms enables local farming at a commercial scale all-year round, increases product traceability, produces higher yields per square metre and reduces water, pesticide and land usage.

CASE STUDY – STACKED FARM

Stacked Farm is a Gold Coast based agricultural business that provides fresh produce that is grown vertically in stacked rows with a fully autonomous system responsible for planting, harvesting and packaging the produce.[80] The fully autonomous indoor farming system means that crops are not weather dependent, the system uses significantly less water than conventional farming and eliminates the use of pesticides.

What is the workforce impact?

Novel farming techniques utilise many of the technologies discussed above. As such, many of the impacts on the workforce are similar and will require a greater focus on digital skills and technical expertise. Novel farming aims to address many of the challenges expected to be faced by the sector in the future and strengthens the supply chain while contributing to a circular economy that reduces waste and improves sustainability of the industry.

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[79] *AeroFarms, 2020, https://aerofarms.com/.*

[80] *Yolanda Redrup, Australian Financial Review, 2 December 2019, https://www.afr.com/technology/how-an-automated-farm-is-stopping-produce-going-out-of-season-20191115-p53avk.*

[81] *Wu W, Dawson D, Fleming-Muñoz D, Schleiger E and Horton J. 2019. The future of Australia's agricultural workforce. CSIRO Data61.*

[82] *Department of Environment and Science (Qld), 2019, Climate change in the Whitsunday, Hinterland and Mackay Region, https://www.qld.gov.au/__data/assets/pdf_file/0026/68561/mackay-whitsunday-climate-change-impact-summary.pdf.*

[83] *Stefan Hajkowicz and Sandra Eady, Rural Industries Research and Development Corporation and CSIRO, 2015, Rural Industry Futures – megatrends impacting Australian agriculture over the coming twenty years.*

Navigation robotic technologies

What are navigation robotic technologies?

Navigation robotics technologies are robots that can navigate autonomously in unstructured environments with specific functions. [85] Navigation robotics include auto-steering guidance technology for tractors, autonomous drones and planning and exploring agents. Drones are unmanned, radio-controlled aircraft that can operate either remotely or autonomously through software-managed flight plans embedded within their on-board sensors and GPS. The most common types of agricultural use are aerial drones, including fixed wing, rotor and hybrid systems. Terms frequently used interchangeably include UAVs, Unmanned Aerial Systems (UAS) and Remotely Piloted Aircraft Systems (RPAS).

How is it being applied within the sector?

Navigation robotics technologies are commonly used on large properties to assist in water management, stock movement and pest control, however high costs and tight regulations have limited widespread adoption and innovation. With increased adoption it is predicted that these technologies are likely to play a major role in the digitisation of the agriculture workforce in Australia. [86]

Navigation robotics technologies have the potential to assist the agricultural industry through instant data gathering and processing for soil and field analyses, crop spraying and health assessments, livestock monitoring and irrigation. [87] They can be used to provide high resolution imagery for the collection of pest impact imagery on field crops, for fire detection, timber salvage assessment and other forestry managed activities, to undertake crop biomass sensing and to produce precise maps for soil analysis in pre-planting, and further analysis for irrigation application, fertiliser and chemical requirements. [88]

What is the workforce impact?

The widespread adoption of drone use for farmers faces barriers such as high costs, lack of connectivity, value of data collection and operational labour requirements. However, drones are increasingly incorporating technologies such as automation, robotics and AI to assist in reducing barriers to adoption and increasing their value in on-farm use. As the technology around drones evolves, drones will increasingly be used to enable data collection and analysis to assist decision making, farm management and increasing sustainability.

There are regulatory issues surrounding the widespread adoption of drones for farm management, however regulatory changes are allowing expansion of the industry. Despite some Queensland Government amendments to legislation allowing licenced chemical applicators to employ drones for aerial distribution of agricultural chemicals, further regulatory reform is required to allow widespread industry adoption and reduce barriers to implementation.

Concerns of transparency and trust in relation to the use of drones remain areas of concern as drones raise questions and uncertainty over issues such as whether permission is required to pass over private property and potential liability for malfunction or collisions.

CASE STUDY – INSITU PACIFIC

Insitu Pacific is a wholly-owned subsidiary of Boeing and specialises in RPAS and UAVs. It is permitted to conduct commercial RPAS operations beyond visual line of sight and is a recognised leader in the safe and effective operations of RPAS.

Through the Advance Queensland Platform Technology Program, an advanced airspace situational awareness system prototype has been developed with applicability of these unmanned systems to functions such as bushfire monitoring, mining infrastructure inspection, noxious weed detection, and cyclone damage surveys.

Due to the significant agricultural industry within Queensland, Boeing's developmental UAVs are working to apply advanced technology solutions to assist the industry. RPAS equipment is fitted with high-precision and multi-spectral sensors that uses advanced information management to provide practical information to assist farmers to manage crops and other farmland.

The focus is to advance precision agriculture technologies that provide safe, reliable and efficient data collection solutions that are rapidly processed and analysed. This information assists in critical decision-making for crop management by providing information to managers within hours, allowing targeted application of pesticides, fertiliser or irrigation to ensure maximum yield with minimal environmental impact. [84]

[84] *Insitu Pacific, A Boeing Company, Agriculture Services, http://insitupacific.com.au/agriculture/.*
[85] *KPMG and Skills Impact, 2019, Agricultural workforce digital capability framework.*
[86] *KPMG and Skills Impact, 2019, Agricultural workforce digital capability framework.*
[87] *Queensland Government, 2018, Queensland Drones Strategy.*
[88] *Queensland Government, 2018, Queensland Drones Strategy.*

Water management technology

What is water management technology?

The Agricultural industry is highly dependent on access to regular and reliable water supplies. Due to the increasing infrequency of rainfall patterns across Queensland and prolonged droughts, water management is increasingly critical to the management of the agriculture industry. Water management technology includes automated water management systems and sensing equipment that improve decision-making and improve irrigation efficiency.

How is it being applied within the sector?

The agriculture sector is the largest user of water with the vast majority of water used for on-farm irrigation. [89] Water management technology uses automation technologies to control, monitor and measure irrigation systems through wireless networks and data collection tools, including combinations of sensors, automation, robotics and artificial technology. Variable rate technology for irrigation is used to monitor rising temperatures and changes in rainfall, while soil moisture sensors are used to gauge the need for irrigation.

Irrigation technologies will vary based on various factors such as:

- Variations in soil types;
- Varying topography of the land;
- Availability of power sources;
- Availability of water and sources of water;
- The size of the area being irrigated;
- On farm water storage capacity; and
- Availability of labour/financial resources.

CASE STUDY – OBSERVANT

Observant was established in 2003 with a mission to utilise technology to manage agricultural water in drought affected regions of Australia. Observant combines simple, reliable field hardware with online applications to deliver yield improvements, water savings and operational efficiency to growers of all sizes through pump management and irrigation automation solutions.

The irrigation solutions can be used for livestock, crops and pasture, and to use data for asset management and decision making. For livestock management, the technology is used to monitor tank levels to ensure livestock have adequate water levels and automatically control pumps to adjust tank levels. Crop and pasture management solutions can help to achieve optimal growing conditions, manage crop growth and analyse plant water demand.

Observant's platforms including crop manager, irrigation scheduling and analytics dashboards have been designed to utilise data to support decision making to optimise inputs and maximise outputs and monitor operations.

What is the workforce impact?

Water management is a significant challenge for Australian agriculture and restricts the yield and growth of many farms. Decreasing availability of water for agriculture has major impacts on population and regional workforces as people leave regions due to prolonged droughts placing significant strains on the agriculture industry and workforce. Utilising water management technology to drive efficient use of scarce resources to irrigate farms will assist in maintaining regional workforces within the agriculture industry and supporting economic and population growth within these regions.

[89] *ABS, 4618.0 - Water Use on Australian Farms, 2018-19 Quality Declaration.*

Biosecurity technology

What is biosecurity technology?

Biosecurity technology is an emerging area that is designed to enhance Australia's biosecurity system. Technology and innovation includes surveillance and monitoring, data and analytics, genetics, sensor technology and smaller, smarter devices, improved risk modelling and cargo scanning.

How is it being applied within the sector?

In January 2019, the National Biosecurity Committee (NBC) was formally established under the Intergovernmental Agreement on Biosecurity with a goal to implement a national biosecurity system that minimises the impacts of pests and diseases on Australia's economy, environment and the community while effectively managing risk and facilitating trade. The National Biosecurity Research, Development & Extension Priorities were endorsed in 2017 and include data and intelligence, surveillance and diagnostics and improved decision-making tools and risk analysis.

To achieve these goals there will be a necessary increased focus and investment in emerging technologies. Technology is increasingly being used to diagnose invasive species and manage diseases; however, opportunities exist for new technologies to detect diseases that may have always been present, mutation of viruses, and the impact of human activity on wild and domestic animal populations, creating overlaps that allow disease transfer. As many of these diseases are zoonotic diseases that transfer from animals to human, the COVID-19 pandemic has highlighted the critical importance of investment and development of technologies within this field. [92]

There are also opportunities to improve infrastructure to meet growing trade volumes, integrating biosecurity technologies such as sensor and senor networks in the development of cargo and shipping infrastructure. [93] While sensors already play a role across the biosecurity landscape, from monitoring environmental conditions to tracking the movement of animals, plants and diseases, advancements are allowing more specialised monitoring and tracking. Advanced non-invasive infrared thermography sensors are able to assess if an animal is infected prior to time intensive manual inspections or diagnostics.

Other technologies including automation, drones and data analytics are improving long-term decision making capabilities, reducing costs and assisting with global trade.

What is the workforce impact?

Technology, with an emphasis on automation and user updating, has significant opportunities to reduce cost of labour intensive activities that utilise regional agricultural government department staff. Technology also has the ability to

CASE STUDY – RAPIDAIM AND RAPIDFLY

Rapid AIM uses IoT sensor technology to provide real time information of inspect pest detection in orchards and farms. In Queensland, fruit fly detection and monitoring is a significant biosecurity challenge and is estimated to cost growers and governments billions each year in control, monitoring and lost production. RapidFLY uses sensors that attract fruit flies and transmits the information using low-powered radio technology to transmit the information to the cloud and back to the growers' phone to provide detailed pest management information.

CASE STUDY – REMOTE SENSING SURVEILLANCE

Another biosecurity management technology utilised in Queensland is a unique infrared and thermal camera system mounted on a helicopter to detect fire ant nests. This remote sensing technology allows large areas to be searched in a fraction of the time taken by conventional surveillance methods, with minimal disruption to properties. [90] It is estimated that the use of remote-sensing surveillance for detecting fire ants in Queensland will save more than $24 million per year when compared to ground based surveillance approaches. [91] As these systems and approaches mature there is potential for them to be applied to monitoring across a range of ecosystems to capture and communicate information about the arrival or spread of a pest or disease and reduce workforce requirements and costs.

[90] *Sharon Janssen, Biosecurity Queensland, Department of Agriculture and Fisheries, Ten Year Eradication Plan National Red Imported Fire Ant Eradication Program South East Queensland 2017-18 to 2026-27, 2017.*

[91] *Meredith Simpson and Vivek Srinivasan, CSIRO Futures, 2014, Australia's Biosecurity Future – Preparing for future biological challenges.*

[92] *Renate Brooks, Ron Glanville and Tom Kompas, 2015, Queensland Biosecurity Capability Review.*

[93] *Meredith Simpson and Vivek Srinivasan, CSIRO Futures, 2014, Australia's Biosecurity Future – Preparing for future biological challenges.*

enhance integrated systems that promote an holistic approach to biosecurity, connecting on farm biosecurity to surveillance data to create regional summary data and pest and disease identification reports. Additionally, blockchain technology could be utilised to link to the supply chain network to allow track and trace ability across the entire network.

New technology to improve on farm biosecurity will be essential to managing Queensland's increasing and changing risk profile, however Queensland has been slow to implement risk management measures.

There has been a decline in specialist biosecurity workforce, with an independent review into Queensland's biosecurity system highlighting critical gaps in the State's biosecurity system including a need to build capacity and capability. [94] While technology will increasingly replace many of the labour intensive tasks required in biosecurity, a human biosecurity workforce will still be needed to apply these new technologies and interpret the data. Declining biosecurity workforce capabilities will need to be strategically addressed to ensure that new entrants to the workforce with the requisite future skill sets are attracted and retained to the sector to ensure Australia's biosecurity capabilities are maintained and expanded to meet the technological shift. [95]

[94] *Renata Brooks et al. 2015. Queensland Biosecurity Capability Review. Available at https://www.parliament.qld.gov.au/documents/tableOffice/TabledPapers/2016/5516T435.pdf*

[95] *Meredith Simpson and Vivek Srinivasan. CSIRO Futures. 2014. Australia's Biosecurity Future – Preparing for future biological challenges. Available at https://www.csiro.au/en/Research/BF/Areas/Our-impact-strategy/Biosecurity-Future-Report*

Drivers and barriers of industry technology adoption

Digital technologies are already supporting productivity and profitability improvements across the sector, however many farms still struggle with basic connectivity. A strategic approach is needed to position the sector for successful digital transformation, including making sure that connectivity options are in available for farmers across the country… For farmers to invest in and realise the benefits of digital technologies, they need access to quality, affordable and reliable connectivity options –

National Farmers Federation [96]

Drivers of change

Key drivers of innovation and technological change within Agriculture include:

- Responding to climate change including the requirement for drought resistance and an increased focus on and consumer demand for sustainability;
- A growing population requiring increased production and food security pressures; and
- Increasingly complex consumer demands including for foods that cater to specific health needs (allergies, intolerances, diseases) and conscious consumers eating less meat products.

High-tech agriculture presents an opportunity to attract young people to regional Australia after they have completed study in areas of STEM. Within regional Queensland, population declines are accelerated as young people leave rural areas and relocate to urbanised areas to access employment, education and social opportunities. Over the next decade, opportunities to link higher education to advances in agricultural technology to support innovation and entrepreneurship could further assist attracting young skilled people to regional Queensland. [97]

Sustainable agriculture and technologies targeted towards combating the effect of climate change are a key driver of technology innovations within the sector. Australian biotechnology and gene technology is a generally well-established field with technologies utilised to drive results such as improved grain yield and quality, increased pest and virus resistance, protein enhancements and crop tolerance to stress such as drought, alkaline soils or frost. [98] However, as environmental stresses and requirements for crops to be drought and heat tolerant increase, advancements in gene editing may present growing workforce opportunities in biotechnology research, development and sales. [99]

Technology and innovative farming techniques, including automation and robotics, remote sensors, farm management software and land-surveying drones, are critical to addressing key challenges that are driving transformation. [100] Additionally, a modern Agriculture industry is well placed to attract the higher educated and adequately skilled youth required for the sustainability of the workforce into the future.

Barriers

Despite many technologies currently available for the Agriculture industry, barriers such as lack of ICT infrastructure and a workforce lacking the required digital skills to effectively adopt new technologies into work practices are critical barriers that may disrupt the agricultural workforce and sector in the future.

Key barriers include:

- Low digital literacy;
- Prohibitively high costs of technology and lack of a clear value proposition or understanding of associated benefits;
- Minimal investment in research and development;
- Ageing workforce;
- Loss of young skilled workforce to urban areas;
- Lack of economies of scale and market power; and
- Limited internet connectivity across rural areas.

[96] *Get Australia Growing – Ideas for Economic Recovery, June 2020, Available at https://nff.org.au/wp-content/uploads/2020/07/NFF_A4Economic-Recovery_FA_email-3.pdf.*
[97] *Wu W, Dawson D, Fleming-Muñoz D, Schleiger E and Horton J. 2019. The future of Australia's agricultural workforce. CSIRO Data61: Canberra, Australia.*
[98] *ABARES 2012. Agricultural commodity statistics 2012. Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra, December 2012*
[99] *Wu W, Dawson D, Fleming-Muñoz D, Schleiger E and Horton J. 2019. The future of Australia's agricultural workforce. CSIRO Data61: Canberra, Australia.*
[100] *Alexander Whitebrooke, Future Directions International, 2016, Agricultural productivity and the Lack of Young Farmers.*

Australian farm operators have struggled in comparison to international competitors in recent years to continue to utilise technology to optimise outputs. Despite the increased reliance on technology by farm operators, a lack of connectivity has been a key contributor to challenges to innovate and implement technologies within Australian agriculture as quickly and effectively as other leading food producing nations such as the US and the Netherlands. [101] Industry surveys highlighted that approximately one-third of Australian farmers have experienced poor internet connectivity. [102]

Connectivity is critical to enabling increased productivity outcomes and other benefits including improved workplace health and safety, environmental and social benefits and attracting and retaining talent into rural industries. IoT allows for the interconnection of the physical world such as animals, people, and mechanical machines with the digital world. IoT offers broad applications, including for the agriculture sector, to provide a better understanding of our environment to support decision-making and improve system and automation efficiencies. [103] However, on-farm connectivity remains the largest barrier to uptake of IoT technologies which are well established in other global industries.

The COVID-19 pandemic represents significant risks to the sector, as Chinese demand for some Australian agricultural imports has declined since the virus was discovered in January. [104] However, it is estimated that the effect of COVID-19 will be temporary with limited impacts from 2020-21 onward. Additionally, much of the Greater Whitsunday region's agricultural production is largely consumed within domestic markets and has experienced continued strong demand.

[101] *KPMG, Meat & Livestock Australia, and AATLIS. 2019. Agri 4.0 – Connectivity at our fingers.*

[102] *Zhang A et al. 2017. Accelerating precision agriculture to decision agriculture: The needs and drivers for the present and future of digital agriculture in Australia. Commonwealth Scientific and Industrial Research Organisation.*

[103] *KPMG and the National Farmers Federation, 2018, Talking 2030 – Growing agriculture into a $100 billion industry.*

[104] *ABARES 2020, Agricultural commodities: March quarter 2020, Australian Bureau of Agricultural and Resource Economics and Sciences.*

Bringing the story together:

Workforce impacts expected for the Greater Whitsunday region

"The growth potential of the agribusiness industry is creating industry optimism to open new markets, create jobs and develop new technologies. Today's agribusinesses incorporate all types of exciting career paths, and increasingly attract more newcomers and innovators. Engineering, science, IT, commerce and management are all cornerstone skill sets for successful businesses in this growing sector

Tim Burrow
Agribusiness Australia

WORKFORCE IMPACTS

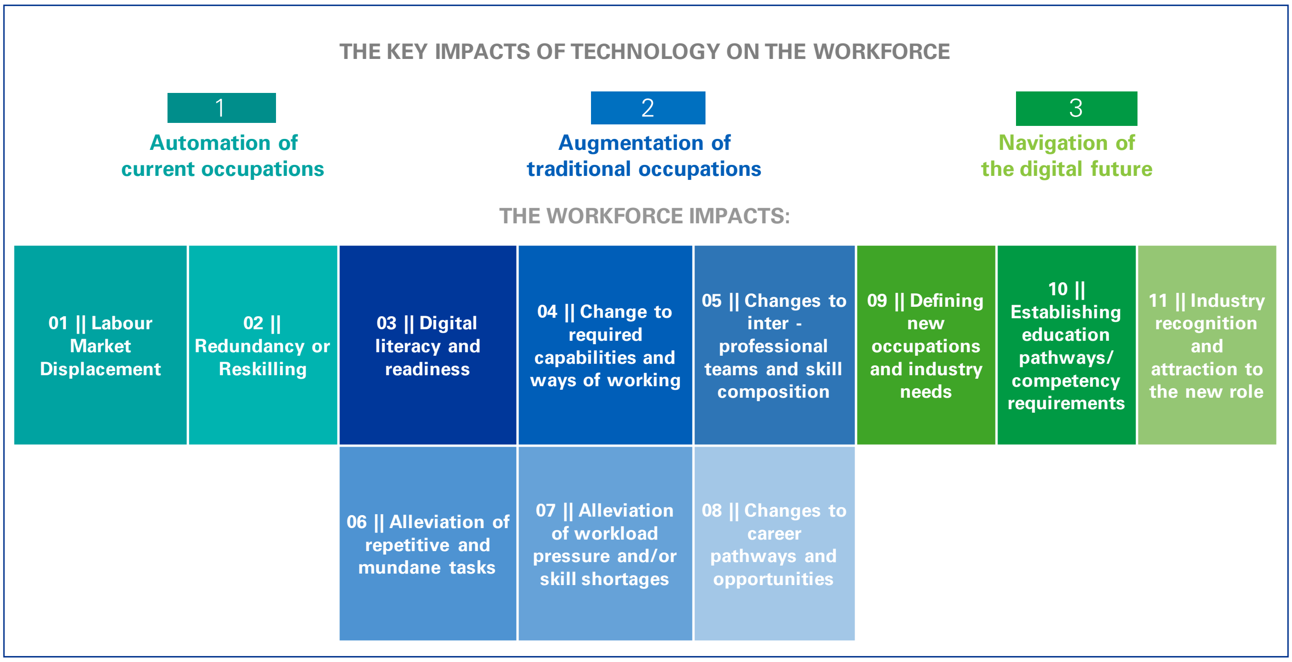
The workforce impacts of emerging technologies across the Agricultural industry are expected to occur primarily through:

- Automation of current occupations (where technology will replace the need for tasks and functions currently undertaken by humans);
- Augmentation of traditional occupations (where technology will work alongside humans and change the way in which tasks and functions are undertaken, making workers more efficient at completing tasks); and
- New roles that are created through the implementation of emerging technologies.

The impact of automation, augmentation and new and emerging job opportunities need to be considered together to determine the net impact on the Agriculture industry. It should also be noted that there may be impacts across other related industry sectors that have been outside of the scope of the Future Employment Study, such as the impact on wider supply chains, related industry sectors and the wider Australian economy.

The detail of the impact of each of these across the Greater Whitsunday region, through combining the Faethm predictions and current growth trajectories for occupations, are detailed below and summarised in Figure 2.26.

Figure 2.26 Summary of the workforce considerations and impacts of technology on the workforce.



Source: KPMG

Automation for Agriculture

Labour Market Displacement

Table 2.3 shows the key agricultural occupations employed within the Greater Whitsunday region and the expected impact of automation on every role (where the impact is predicted to be more than 1 percent). It is important to note that based on the growth trajectories of each of these occupations that some of the automation impact is expected to lower occupational growth into the future rather than lead to a reduction in current workforce levels. This occurs across the occupations of Agricultural Technician; Agricultural and Horticultural Mobile Plant Operator; Crop Farm Workers nfd; Crop Farmers nfd; Fruit or Nut Farm Worker; Fruit or Nut Grower; Fruit or Nut Picker; Grain, Oilseed or Pasture Grower; Mixed Crop and Livestock Farmer; Mixed Crop Farmer; Sugar Cane Grower; Vegetable Farm Worker; Vegetable Grower; Vegetable Picker, Beef Cattle Farmer and Livestock Farmers not further defined.

For other occupations, while there is a reduction predicted from the employment rates in 2020, these occupations are already in decline and automation will slightly increase this predicted reduction. This includes the occupations of Farmers and Farm Managers not further defined, Bookkeeper, Mixed Crop and Livestock Farm Worker, Deck Hand, Fishing Hand, Farm, Forestry and Garden Workers (not elsewhere classified and not further defined) and Aquaculture Farmers. The occupation most impacted of all included in the Agriculture occupations is the Bookkeeper where the impact is predicted to be 385.7 FTE. It is noted that this occupation may not be specific to the Agriculture, Forestry and Fishing industry sector.

Occupations where the automation impact will drive reductions in employment requirements are in the roles of Meat Packer, Fruit and Vegetable Packer, and Packers (not elsewhere classified and not further defined). The impact across these occupation groups is 146.0 FTE over the ten years.

Many of the occupations with an expected decline in headcount over the next 5 and 10 years are in workforce shortage and rather than redundancy or reskilling may instead be areas where workforce supply may need to be boosted. Technology may assist in reducing the demand for these occupations. It is noted that while no agriculture occupations are currently on the national skills shortage lists, the National Farmers Federation report an immediate labour shortfall in excess of 101,000, and propose a range of strategies to boost this supply in their 2030 Roadmap: Australian Agriculture's Plan for a $100 billion industry. [105]

Table 2.3: Automation impacts predictions for the Agriculture occupations within the Greater Whitsunday region

OCCUPATION (6 DIGIT ANZSCO)	PREDICTED AUTOMATION IMPACT 2025 (FAETHM)	PREDICTED AUTOMATION IMPACT 2030 (FAETHM)	ANTICPATED IMPACT FOR GREATER WHITSUNDAY REGION (LABOUR MARKET AND FAETHM)
Agricultural and Horticultural Mobile Plant Operator	9.00%	23.80%	Absorbed within occupation growth.
Agricultural Technician	11.30%	22.90%	Absorbed within occupation growth.
Aquaculture Farmer	16.50%	30.20%	This occupation is in decline, and automation may accelerate this. However, figures become too small to be reliable.
Aquaculture Worker	16.50%	30.20%	The occupation size of this workforce is too small to derive meaningful data.
Beef Cattle Farm Worker	16.50%	30.20%	Automation is predicted to lead to a reduction in required staff from current

[105] *National Farmers Federation. 2020. 2030 Roadmap: Australian Agricultures Plan for a $100 billion industry.*

			levels by 10.8 FTE in 2025 and a further 9.4 FTE by 2030.
Beef Cattle Farmer	16.50%	30.20%	Absorbed within occupation growth.
Bookkeeper	27.40%	46.50%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 241.8 FTE by 2025 and a further 143.9 FTE to 2030.
Crop Farm Workers nfd	17.20%	35.50%	Absorbed within occupation growth.
Crop Farmers nfd	17.20%	35.50%	Absorbed within occupation growth.
Deck Hand	10.10%	21.30%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 35.0 FTE by 2025 and a further 12.2 FTE to 2030.
Farm, Forestry and Garden Workers nec	17.50%	31.20%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 7.6 FTE by 2025 and a further 5.6 FTE to 2030.
Farm, Forestry and Garden Workers nfd	17.50%	31.20%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 34.2 FTE by 2025. At this point figures become too small to be reliable.
Farmers and Farm Managers, nfd	3.10%	7.40%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 18.1 FTE by 2025 and a further 15.7 FTE to 2030.
Fishing Hand	10.10%	21.30%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 19.1 FTE by 2025. At this point figures become too small to be reliable.
Fruit and Vegetable Packer	32.80%	54.3%2	Automation is predicted to lead to a reduction in required staff from current levels by 40.0 FTE in 2025 and a further 27.2 FTE by 2030.
Fruit or Nut Farm Worker	17.20%	35.50%	Absorbed within occupation growth.
Fruit or Nut Grower	17.20%	35.50%	Absorbed within occupation growth.
Fruit or Nut Picker	17.20%	35.50%	Absorbed within occupation growth.
Grain, Oilseed or Pasture Grower	17.20%	35.50%	Absorbed within occupation growth.
Livestock Farmers nfd	16.50%	30.20%	Absorbed within occupation growth.
Meat Packer	36.90%	54.30%	Automation is predicted to lead to a reduction in required staff from current levels by 20.6 FTE in 2025 and a further 9.7 FTE by 2030.
Mixed Crop and Livestock Farm Worker	17.20%	35.50%	This occupation is in decline, and automation may accelerate this. Projected decline is a

			fall of 11.5 FTE by 2025 and a further 10.6 FTE to 2030.
Mixed Crop and Livestock Farmer	17.20%	35.50%	Absorbed within occupation growth.
Mixed Crop Farmer	17.20%	35.50%	Absorbed within occupation growth.
Packers nec	32.80%	54.3%2	Automation is predicted to lead to a reduction in required staff from current levels by 8.3 FTE in 2025 and a further 5.6 FTE by 2030.
Packers nfd	32.80%	54.3%2	Automation is predicted to lead to a reduction in required staff from current levels by 8.6 FTE in 2025 and a further 5.8 FTE by 2030.
Sugar Cane Grower	17.20%	35.50%	Absorbed within occupation growth.
Vegetable Farm Worker	17.20%	35.50%	Absorbed within occupation growth.
Vegetable Grower	17.20%	35.50%	Absorbed within occupation growth.
Vegetable Picker	17.20%	35.50%	Absorbed within occupation growth.

Source: KPMG and Faethm (faethm.ai)

Note: Stakeholders noted that the occupations of Fishing Hand and Deck Hand may not sufficiently capture the aquaculture occupation growth that has occurred in the Greater Whitsunday region, and this may need to be considered in employment opportunity and occupation corridors within the Agriculture sector.

Redundancy or Reskilling

For roles where redundancy or reskilling is required Faethm provides occupational skilling corridors based on the degree to which the current occupation's skills and competencies align with others. Table 2.4 shows the occupations where there is an expected workforce reduction, and the possible employment options that provide a high level of skilling synergy (requiring less reskilling than other occupations).

Table 2.4: Employment corridors for the impacted Agriculture occupations within the Greater Whitsunday region

OCCUPATION/S (6 DIGIT ANZSCO)	IMPACT BASED ON FAETHM AND OCCUPATION GROWTH 2030	EMPLOYMENT CORRIDORS ACROSS ALL OCCUPATIONS (FAETHM)
Bookkeeper	385.7	Concierges, Speech-Language Pathology Assistants, and First Line Supervisors of Personal Service Workers.
Meat Packer	30.3	Cooks (Restaurant).
Fruit and Vegetable Packer	67.2	*It is noted that these occupations do not have a high level of occupational synergy with other occupations in the Faethm modelling, consideration may be given to occupations in the logistics and manufacturing industries.*
Packers (nfd and nec)	28.3	
Beef Cattle Farm Worker	20.2	*Cooks (Restaurant) and Solar Photovoltaic Installers.*

OCCUPATION/S (6 DIGIT ANZSCO)	IMPACT BASED ON FAETHM AND OCCUPATION GROWTH 2030	EMPLOYMENT CORRIDORS ACROSS ALL OCCUPATIONS (FAETHM)
Mixed Crop and Livestock Farm Worker	22.1	*It is noted that these occupations do not have a high level of occupational synergy with other occupations in the Faethm modelling. However it is noted that workforce shortages are being reported by the National Farmers Federation for these roles across the industry, and a reduction in the supply of these occupations may not be desirable.*
Farmers and Farm Managers nfd	23.8	
Farm, Forestry and Garden Workers (nec and nfd)	47.4	
Aquaculture Farmer	Too small for accurate prediction	Cooks (Restaurant) and Solar Photovoltaic Installers. While not identified in the labour market analytics, it is understood that there will be a growing demand for the aquaculture workforce, particularly in prawn farming in line with strategic business plans in the community.
Deck Hand	47.2	
Fishing Hand	19.1	

Source: KPMG based on Faethm (faethm.ai)

Augmentation Prediction

The impact of augmentation on the workforce is difficult given that it is expected to free capacity and change the way in which tasks and functions are completed. It is likely to both mean that the 'released' workforce capacity is used to undertake higher order tasks with a shift away from more repetitive and mundane tasks, and may also mean over time there is a reduction in demand for some of the most impacted occupations. What is also important to note is that the augmented impacts may be felt in addition to the automation impacts.

Table 2.5 provides an overview of the occupations in Agriculture within the Greater Whitsunday region with the highest augmentation rates over the 5 and 10 year projections, along with the expected capacity gain (noting that this may be used for higher order tasks or, over time to reduce labour market supply).

Compared with the other industry sectors included in this analysis, Agriculture has much lower expected impacts of augmentation than other industry sectors. The occupations expected to be most impacted by augmentation are Farmers and Farm Managers nfd, Agricultural and Horticultural Mobile Plant Operator, Agricultural Technician, Deck Hand and Fishing Hand. The occupations with the greatest impact in terms of freed capacity (due to occupation size) are the Sugar Cane Grower, Agricultural and Horticultural Mobile Plant Operator, Beef Cattle Farmer, Farmers and Farm Managers not further defined, Bookkeeper and Beef Cattle Farm Worker. These six occupations represent possible freed workforce capacity of 254 FTE.

Table 2.5: Augmentation impacts predictions for the Agriculture occupations within the Greater Whitsunday region

OCCUPATION (6 DIGIT ANZSCO)	PREDICTED AUGMENTATION IMPACT 2025 (FAETHM)	PREDICTED AUGMENTATION IMPACT 2030 (FAETHM)	AUGMENTED FTE 2030 (FAETHM)
Agricultural and Horticultural Mobile Plant Operator	4.90%	15.20%	53.1
Agricultural Technician	5.60%	13.70%	3.3

Aquaculture Farmer	1.40%	7.30%	2.2
Aquaculture Worker	1.40%	7.30%	0.3
Beef Cattle Farm Worker	1.40%	7.30%	23.2
Beef Cattle Farmer	1.40%	7.30%	52.8
Bookkeeper	4.90%	4.60%	24.5
Crop Farm Workers nfd	4.10%	8.60%	3.1
Crop Farmers nfd	4.10%	8.60%	4.8
Deck Hand	3.90%	10.50%	12
Farm, Forestry and Garden Workers nec	2.80%	4.40%	1.1
Farm, Forestry and Garden Workers nfd	2.80%	4.40%	3.6
Farmers and Farm Managers, nfd	12.10%	24.80%	25.1
Fishing Hand	3.90%	10.50%	6.5
Fruit and Vegetable Packer	3.80%	3.30%	4.3
Fruit or Nut Farm Worker	4.10%	8.60%	4.1
Fruit or Nut Grower	4.10%	8.60%	4.6
Fruit or Nut Picker	4.10%	8.60%	6.1
Grain, Oilseed or Pasture Grower	4.10%	8.60%	4.8
Livestock Farmers nfd	1.40%	7.30%	2
Meat Packer	4.90%	7.10%	4.2
Mixed Crop and Livestock Farm Worker	4.10%	8.60%	3.9
Mixed Crop and Livestock Farmer	4.10%	8.60%	14.9
Mixed Crop Farmer	4.10%	8.60%	3.7
Packers nec	3.80%	3.30%	0.9
Packers nfd	3.80%	3.30%	0.9
Sugar Cane Grower	4.10%	8.60%	75.3
Vegetable Farm Worker	4.10%	8.60%	10.2
Vegetable Grower	4.10%	8.60%	8.4
Vegetable Picker	4.10%	8.60%	5

It is expected that as a result of these augmentation changes:

- There is a need to build digital literacy and readiness around new and emerging technologies, with an increased focus on those expected to be adopted more in the occupation and subsector (as outlined in the Emerging Technologies section of this report);
- There will be alleviation of repetitive and mundane tasks and a freeing of capacity to work on more complex tasks such as business intelligence and interpretation of analytics - while predictions by some in the industry suggest that farmers will increasingly rely on outside expertise for some of this knowledge and skills, it is also predicted that there will be a need for the role of current occupations in agriculture to change dramatically and involve a much better and deeper understanding of managing technological systems and the management of big data, drones, robotics, electronics and agriculture production systems; [106]
- International trends across agriculture and food production (such as in Europe and the United States) are seeing an increase in the qualification requirements in the sector, with agriculture occupations in these countries requiring postgraduate qualifications to be regarded as an agricultural professional;

"The rate of change in agriculture has been spectacular. I don't think even five years ago you could have predicted the sort of jobs that are happening now. In the early part of this century, agriculture was in the doldrums, but now there are roughly four jobs per graduate, and the whole image of agriculture has turned from something quite negative to now very positive. The prospects for agriculture products is probably brighter than it's ever been."

- *-Professor Pratley* [107]

- Over the medium to longer term it is expected that some of the freed capacity will result in changes to tasks and functions of these occupations, and this in turn will change the skill composition and structure of specialist expertise required for farms, including small to medium enterprises; and
- These changes to the Agriculture labour market profile over time will change the career opportunities and pathways available to the workforce.

Education and Training in the region

It is noted that while there is some reliance on international visa holders (particularly for picking related occupations and seasonal work), the majority of the Agriculture workforce are trained domestically, across both the VET and University sectors.

Based on enrolments in 2018 in VET qualifications that relate to Agriculture in Bowen, Mackay and Whitsundays, the most popular qualifications in the Greater Whitsunday region are (further detail is provided in Appendix I):

- Certificate III in Rural Operations with 160 enrolled in 2018. These are expected support career pathways in horticulture, agriculture and conservation land management- which includes all of the occupations included above (noting most agriculture occupations do not have mandatory education and training minimum requirements);
- Certificate III in Horticulture with 81 enrolled in 2018. These are expected to link to occupations that support nurseries, parks and gardens, and may also support the crop and vegetable growing. This may therefore support occupations in Tourism which may include Gardeners, as well as some in Agriculture such as Fruit or Nut Grower and Vegetable Grower.;
- Certificate II in Rural Operations with 105 enrolled in 2018. These are expected support career pathways in horticulture, agriculture and conservation land management- which includes all of the occupations included above (noting most agriculture occupations do not have mandatory education and training minimum requirements);
- Certificate I in Agrifood Operations with 56 enrolled in 2018. These are expected to link to the job roles in agriculture including Fruit and Nut Growers, Vegetable Growers, Fishing Hand, Beef Cattle Farmer.

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[106] *Charles Sturt University. (u.d.). Work Beyond 2020: Agriculture*
[107] *Charles Sturt University. (u.d.). Work Beyond 2020: Agriculture*

It is noted there is not a direct correlation between qualification attainment and specific job roles for these occupations. Better matching of education and training pipelines to in demand occupations could occur to strengthen employability and jobs within the region.

Detailed public data on the university qualification enrolments in Agriculture related qualifications within the CQUniversity is not available, and the future workforce pipeline developed locally is therefore difficult to determine. Enrolments and completions at the undergraduate and postgraduate level are provided in Appendix J.

Navigation of the Digital Future

As was identified in the Disrupted View discussed earlier in this chapter, there are a number of new ICT and engineering related roles expected as a result of the adoption of emerging technologies. These are provided in detail in Table 2.6. In addition, new and emerging roles are expected in areas such as those set out below. This suggests significant opportunities in new occupations in the Greater Whitsunday region over the next decade.

Increased specialisation of the agriculture workforce

It is expected that into the future, the occupations involved in agricultural production will become more specialised and advanced in order to improve yields, profitability and competitiveness of farms. Technology is seen as a necessary adoption, and this is requiring deeper knowledge and skill sets in relation to the business viability and improvements expected from key technologies that may be specific to the produce that is being farmed. While augmentation is predicted across a number of roles, consultation with stakeholders who are participating in technology trials and adoption is suggesting that any increase in capacity is being utilised to build expertise around technology and business analysis and not to reduce labour.

Agricultural research and development roles, and building the evidence around technology adoption

It is expected that there will be increased demand for research and development related roles that support the advancement of technology and food production in the agriculture industry. While this currently occurs through a range of key advocacy and research based organisations and universities, such as CSIRO, Queensland Alliance for Agriculture and Food Innovation (University of Queensland), AgriFutures, Meat and Livestock Australia and the National Farmers' Federation. The demand for research and development related to technology adoption may increase as Australia seeks to maintain and improve its position in agricultural production and exports.

A lesser reliance on holiday visa workforce

There is significant anecdotal evidence that the sector in Queensland and across Australia remains reliant on the working holidays and work and holiday visas for picking and packing of agricultural produce for seasonal work. There is some suggestion that part of this concern with this workforce is that their current labour market utilisation may not be as well known, due to casual, cash in hand arrangements and the seasonal nature of their work which may not be identified in ABS statistics. The Queensland Farmer's Federation state [108]:

"The elephant in the room when it comes to agricultural labour is our sector's reliance on 417 (working holiday) and 462 (work and holiday) visas. …Now is the time to seize this new-found momentum on supporting jobs in regional Australia to address broader barriers like geography, pay and work conditions impacting agriculture's ability to employing 'locals' on our farms. These barriers have and continue to undercut our sector's ability to attract the right talent to maximise growth and opportunities currently available."

Technologies such as robotics may assist in reducing the reliance on this workforce for the seasonal aspects of picking and packing of agricultural produce. In turn this may start to change local perceptions about the opportunities that exist in the agricultural sector, away from entry level and seasonal work to more advanced and complex skills requiring specialisation."

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[108] *Queensland Farmer's Federation. 2017. 457 visas and agriculture's relationship with foreign workers. Available at https://www.qff.org.au/presidents-column/457-visas-agricultures-relationship-foreign-workers/*

Table 2.6: New occupations predicted to be required as a result of technological adoption in the Agriculture industry within the Greater Whitsunday region by 2030

OCCUPATION TITLE (FAETHM)	PREDICTED GROWTH IN DEMAND (HEADCOUNT) (FAETHM)	OCCUPATION TITLE (FAETHM)	PREDICTED GROWTH IN DEMAND (HEADCOUNT) (FAETHM)
Software Developers, Applications	17.8	Computer Systems Engineers/Architects	6.2
Software Developers, Systems Software	17.8	Industrial Engineers	5.7
Process Improvement Analysts	12.3	Industrial Production Managers	4.5
Data Engineers	11.6	Industrial Safety and Health Engineers	4.5
Data Integrators	10.7	Industrial Engineering Technologists	4.5
Infrastructure Services Analysts (IT)	10.7	Change Analysts	4.5
Data Analysts	10.1	Data Architects	4.5
Data Scientists	9.5	IT Governance Analysts	4.5
Robotics Engineers	8.7	Agile Testers	4.5
Strategy Analysts	7.6	Project Analyst	4.1
Security Testers	7.6	Business Intelligence & Analytics Managers	4.1
Software Quality Assurance Engineers and Testers	7.6	AI Research Scientists	3.3
Mechatronics Engineers	7.6	Communications Analysts	3.1
Manufacturing Engineers	6.6	Workforce Planners	3.1
Mechanical Engineers	6.6	Strategy Managers	3.1
Operations Analysts	6.2	Training & Development Analysts	3.1
Cyber Security Analysts	6.2	Human Resources Analyst	3.1
Educational, Guidance, and Career Counselors and Advisors	6.2	Change Manager	3.1
Process Improvement Managers	6.2	Data Warehousing Specialists	3.1
Operations Research Analysts	6.2	Test Automation Engineers	3.1
Tester/Test Analysts	6.2	Project Leader	3.1
		Communications Managers	3.1

OCCUPATION TITLE (FAETHM)	PREDICTED GROWTH IN DEMAND (HEADCOUNT) (FAETHM)
AI Research Scientists, Language Processing	3.0
AI Research Scientists, Image and Videos	3.0
Business Analysts	2.8
Scrum Masters	2.2
Cyber Security Managers	1.6
Industrial-Organizational Psychologists	1.6
Human Resources Managers	1.6
Technical Leads	1.6
Product Development Managers	1.6
Resource Managers	1.6
Agile Coaches	1.6
Test Managers	1.6
Infrastructure Services Managers (IT)	1.6
Human Resources Specialists	1.6
Test Coaches	1.6
IT Governance Managers	1.6
Test Coordinators/Test Leads	1.6
Information Security Managers	1.6
Risk Management Specialists	1.6
Product Owners	0.7

CHAPTER 3: HEALTH CARE AND SOCIAL ASSISTANCE INDUSTRY

The opportunity provided by technology in Health Care and Social Assistance

The Health Care and Social Assistance leaders of today are presented with opportunities and challenges from the adoption of an array of emerging technologies. These technologies are expected to profoundly change the way in which Health Care and Social Assistance is delivered, and in doing so challenge traditional approaches to occupations, tasks and functions. While the impact is not expected to be as significant across the Social Assistance sector (compared with Health Care), there are still future changes expected to roles and ways of working.

Both across Australia and internationally, there is a significant amount of innovation, technology advancement, research and technology adoption trials that are emerging. The expected change to this segment of the sector is significant, with global estimations that by 2025 the digital health market will reach $USD 505.4billion, from $USD 86.4 billion in 2018. [109]

A range of connected care technologies exist in pockets across Australia, such as information management systems, electronic pharmaceutical systems, technology enabled devices and remote patient care. The adoption of these technologies is growing as maturity around digital Health Care and Social Assistance technologies grows. Achieving the benefits of these technology investments depends on a workforce with the requisite digital literacy and educative opportunities.

The benefits of digital Health Care technologies are significant and compelling. In the Health Care context, these include improved access to information to support safer clinical decision making and fewer adverse drug events; improved care coordination and reduced hospital admissions; reduced duplication of diagnostic investigations; and improved health service planning that anticipates demand for Health Care services. In addition, empowering people with access to their own health information helps to enable a more person-centred model of care which is expected to become even more pronounced with the adoption of precision medicine into the future.

In the Social Assistance context, key benefits exist from coordination across different agencies and organisations in providing holistic care for vulnerable children, youth and families. Additionally, there is a complex interplay across service systems that all intersect, such as housing and homelessness, mental health, alcohol and drug addiction, child protection and youth justice. Key benefits in Social Assistance also exist for personalised information and customisation - for example through virtual home assistants and wearable devices for people with a disability.

Used effectively digital Health Care and Social Assistance technologies can save lives, improve the health and wellbeing of Australians and promote a sustainable health and social assistance system at a time of escalating growth in demand.

> *We are at a unique juncture in the history of medicine, with the convergence of genomics, biosensors, the electronic patient record and smartphone apps, all superimposed on a digital infrastructure, with artificial intelligence to make sense of the overwhelming amount of data created.*
>
> *This remarkably powerful set of information technologies provides the capacity to understand, from a medical standpoint, the uniqueness of each individual – and the promise to deliver healthcare on a far more rational, efficient and tailored basis.*
>
> ***Dr Eric Topol*** [110]

[109] *ANDHealth. 2020. Digital Health: The sleeping giant of Australia's Health Technology Industry. Accessed 30 June 2020 https://andhealth.com.au/andhealth-releases-the-first-detailed-report-on-australias-digital-health-industry/*

[110] *NHS. 2019. The Topol Review: Preparing the healthcare workforce to deliver the digital future. Accessed 30 June https://www.hee.nhs.uk/our-work/topol-review*

A regional lens

Delivering regional services

It is important to understand the impact of technology adoption for Health Care and Social Assistance in regional areas, including the Greater Whitsunday region. Nearly 30 percent of Australians live outside of major cities, 18 percent live in regional areas, 8.2 percent in outer-regional, 1.2 percent in remote, and 0.8 percent in very remote areas.

For rural and regional communities there are different priorities (such as basic access to health care) compared to their metropolitan counterparts, which drive the types of technologies which are most likely to address these needs. There are additional barriers to technology adoption (such as technology infrastructure due to geographic isolation) that have a significant influence on the prioritisation, implementation and adoption of emerging technologies. As a consequence of both size and scale, regional and rural health and social care services need to consider differing strategies or models of care to ensure that patients and clinicians can connect efficiently, to deliver high quality health care.

The Greater Whitsunday region

Health Care in the region

As shown in Figure 3.1, the Greater Whitsunday region has sixteen hospitals and community health facilities. In particular, the region is serviced by the Mackay HHS, which is responsible for the delivery of public health and hospital services in the region. Mackay HHS provides an integrated approach to service delivery across acute, primary health and other community based services including aged care assessments and Aboriginal and Torres Strait Islander programs. In 2018-19, the Mackay HHS provided a range of services across the Greater Whitsunday region, including:

- 2,478 emergency surgeries;
- 2,812 elective surgeries;
- 1,659 births; and
- 8,424 telehealth consultations. [111]

The majority of these services were delivered in the Mackay LGA at the Mackay Base Hospital.

The Greater Whitsunday region is also serviced by the North Queensland Primary Health Network (NQPHN), which is responsible for the planning and commission of primary health care services to meet the health needs and priorities of the community. The NQPHN proactively works with health care providers and the broader community to ensure that patients can receive the right care, in the right place, at the right time. [112]

In addition to the provision of public health care, the Mackay LGA is also serviced by private hospitals including:

- The Mackay Rehabilitation Hospital (a rehabilitation and pain management facility);
- Mackay Specialist Day Hospital; and
- the Mater Misericordiae Hospital and Day Unit.

These hospitals deliver a range of inpatient services supported by the latest technology and access to allied health services.

Child care in the region

A range of early childhood education and care services are delivered across the Greater Whitsunday region. These services include:

- 5 family day care services;
- 32 kindergarten services;
- 48 long day care services;
- 34 school aged care services; and
- 1 limited hours care service. [113]

As shown in Figure 3.1, the majority of these services are delivered in the Mackay LGA.

Aged care in the region

Approximately 15.4 percent of the Greater Whitsunday region are aged 65 years or older, with the majority of this population living in the Mackay LGA. [114] Reflecting this, the Greater Whitsunday region experiences high activity in

[111] Mackay Hospital and Health Service. (2019) Annual Report 2018 – 2019. Accessed 30 June 2020:https://www.mackay.health.qld.gov.au/about-us/publications/
[112] NQPHN. (2020). Get to know us. Available at https://www.nqphn.com.au/wp-content/uploads/2013/03/NQPHN-Get-to-know-us-brochure-2018.pdf
[113] Queensland Government Statisticians Office. (2020). Queensland Regional Profiles. Accessed 30 June 2020: https://statistics.qgso.qld.gov.au/qld-regional-profiles
[114] Queensland Government Statisticians Office. (2020). Queensland Regional Profiles. Accessed 30 June 2020: https://statistics.qgso.qld.gov.au/qld-regional-profiles

home support programs and aged care services. There has been growing focus to continue to expand the number and range of aged care services within the region to enable residents to age within their own communities. [115] This growing focus has included:

- the building and refurbishment of aged care facilities in Clermont and Mackay;
- the expansion of telehealth services and virtual consultations to a range of local residential aged care facilities in Mackay, Sarina and Bowen; and
- the trialling of the Frail Project to improve patient flows and outcomes for older patients.

As shown in Figure 3.1, the majority of these services are delivered in the Mackay LGA.

Disability services in the region

Approximately 4.1 percent of people living in the Greater Whitsunday region are in need of assistance for a profound disability or severe disability. [116] Following the rollout of the National Disability Insurance Scheme (NDIS) in 2016, there has been significant activity in the delivery of disability services to assist people living in the region.

In the Greater Whitsunday region, the NDIS has partnered with a number of organisations to deliver Local Area Coordination (LAC) and Early Childhood Early Intervention services to community members with a disability. The largest partner organisations include:

- UnitingCare Queensland, which is experienced in early childhood intervention and provides assistance, advice and access to early intervention and support for children living in Mackay and some parts of the Isaac and Whitsunday LGAs; [117] and
- Feros Care, which is a LAC in Mackay and works with NDIS participants to develop, implement and review NDIS plans. [118]

In addition to these partner organisations, there are also 204 active NDIS service providers operating in the Greater Whitsunday region. [119]

Child and family support services in the region

Across the Greater Whitsunday region, there are a number of child and family support services that are available to ensure that the region's children and young people are cared for, protected, and able to reach their full potential. These services focus on ensuring the safety, belonging and wellbeing of children as well as building the capacity of families to care for and nurture their children.

The Department of Child Safety, Youth and Women (DCSYW) is the Queensland Government's lead agency for child safety and adoption services. The DCSYW has child safety centres in Mackay and Bowen. These centres employ a range of people in the Greater Whitsunday region to assist in providing child safety services, including Child Safety Officers, Cultural Practice Advisors and Senior Practitioners, who have experience in working with children, young people and families. [120]

Across the Greater Whitsunday region there are a range of non-government service providers that collaborate and work in partnership with the DCSYW. These organisations, such as Anglicare North Queensland and The Neighbourhood Hub, provide prevention and intervention services to support families and children if they are experiencing a crisis or difficulties in their life.

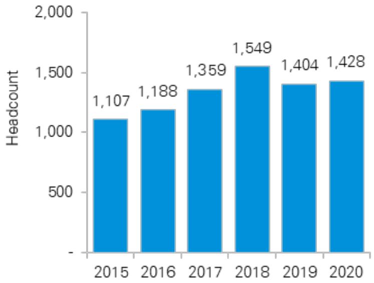
[115] Mackay Hospital and Health Service. (2019) Annual Report 2018 – 2019. Accessed 30 June 2020: https://www.mackay.health.qld.gov.au/about-us/publications/
[116] Queensland Government Statisticians Office. (2020). Queensland Regional Profiles. Accessed 30 June 2020: https://statistics.qgso.qld.gov.au/qld-regional-profiles
[117] Uniting Care. (2020). Early Childhood Early Intervention. Accessed on 15 July 2020 https://www.unitingcareqld.com.au/services-and-support/disability/early-childhood-early-intervention
[118] Feros Care. (2020). NDIS. Accessed on 15 July 2020 https://www.feroscare.com.au/ndis
[119] National Disability Insurance Scheme. Explore data. Accessed 30 June 2020: https://data.ndis.gov.au/explore-data
[120]

Figure 3.1: Regional differences in the Health Care and Social Assistance industry

WHITSUNDAY

Whitsunday LGA population
35,000

Health and Social Services employment
1,100



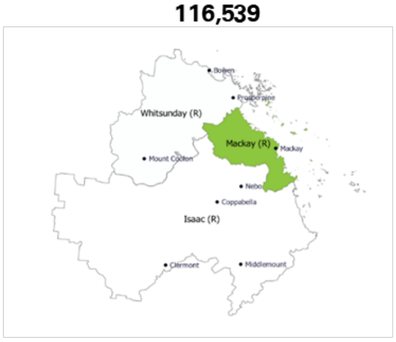
Hospitals and Community Health Facilities
4

Early childhood education and care services
27

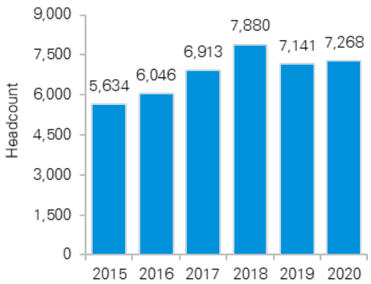
Aged care places
250

MACKAY

Mackay LGA population
116,539



Health and Social Services employment
5,598



Hospitals and Community Health Facilities
7

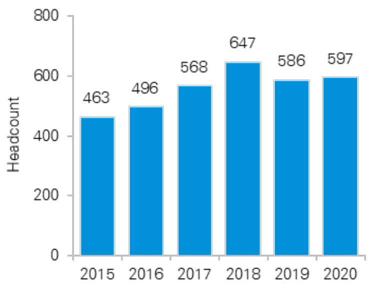
Early childhood education and care services
80

Aged care places
776

ISAAC

Isaac LGA population
35,360

Health and Social Services employment
460



Hospitals and Community Health Facilities
5

Early childhood education and care services
15

Aged care places
61

Traditional Labour Market View

"…rural and remote communities across the country have faced a series of unprecedented natural disasters that have destroyed infrastructure, homes and livelihoods and resulted, in some communities, in a tragic loss of life. As rural communities turn to the urgent task of rebuilding their towns, yet another challenge has emerged – the COVID-19 pandemic. There is no stronger evidence than the potential ramifications of this health emergency to demonstrate how fragile the health workforce is in rural and remote communities and how acute the need is for a more sustainable approach to health service provision."

Professor Paul Worley,
National Rural Health Commissioner[121]

[121] National Rural Health Commissioner. (2020). Improvement of access, quality and distribution of allied health services in regional, rural and remote Australia. Accessed 30 June 2020

THE CURRENT STATE OF PLAY

Current workforce characteristics

Overall employment

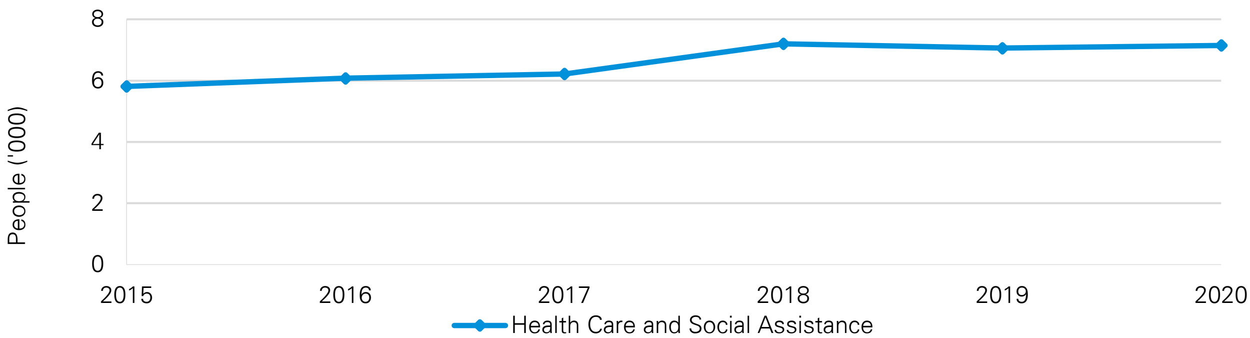
The Health Care and Social Assistance industry is Australia's largest industry sector. Growth across this industry has been accelerated by recent reforms, including the implementation of the NDIS, and demographic changes including Australia's ageing and growing population. [122]

Different reforms continue to shape the required occupations and skilling needs leading to distinct differences in the workforce and skill requirements for the Health Care sector compared with the social assistance sector. Health Care occupations are typically required to conduct tests, diagnose and treat physical and physiological disorders in designated facilities such as hospitals or health care clinics (for example Medical Officers, Registered Nurses and Dental Assistants). In comparison, Social Assistance occupations typically provide a range of holistic care and support services to individuals for the enhancement of their education, health, welfare and comfort (for example Aged or Disabled Carer, Child Care Workers and Nursing Support Workers). Despite these broad distinctions, it is also important to note there is overlap with some occupations across the Health Care and Social Assistance industry (for example Psychologists, Social Workers and Enrolled Nurses).

Across Queensland, approximately 75.1 percent of employees in the Health Care and Social Assistance industry were employed by private sector businesses in 2020. [123] These private sector businesses included small medical practices and social support services as well as large private hospitals and social support providers. It is noted that a public and private breakdown in employment is not specifically available for the Greater Whitsunday region, and regional employment may be more skewed to public sector employment, including in this region, in the Mackay Base Hospital and wider HHS. However there are still expected to be a large number of private sector businesses (including not-for-profit operators) in the region.

In the Greater Whitsunday region, the Health Care and Social Assistance industry accounted for approximately 10.4 percent of the region's entire workforce in 2020 and was the second largest industry in terms of employment. As shown in Figure 3.2, employment in the Health Care and Social Assistance industry has grown at an average annual rate of 4.2 percent. This growth rate for the Health Care and Social Assistance industry was higher than the ten year average growth rate in national health care expenditure (3.9 percent between 2007-08 and 2017-18). [124] This indicates that the Health Care and Social Assistance workforce in the Greater Whitsunday region has been growing at a higher rate than national expenditure across the sector.

Figure 3.2: Total employment in the Health Care and Social Assistance workforce in the Greater Whitsunday region (2015-20)



Source: KPMG based on ABS Labour Market Quarterly and Census Data according to the occupations in scope in Appendix A

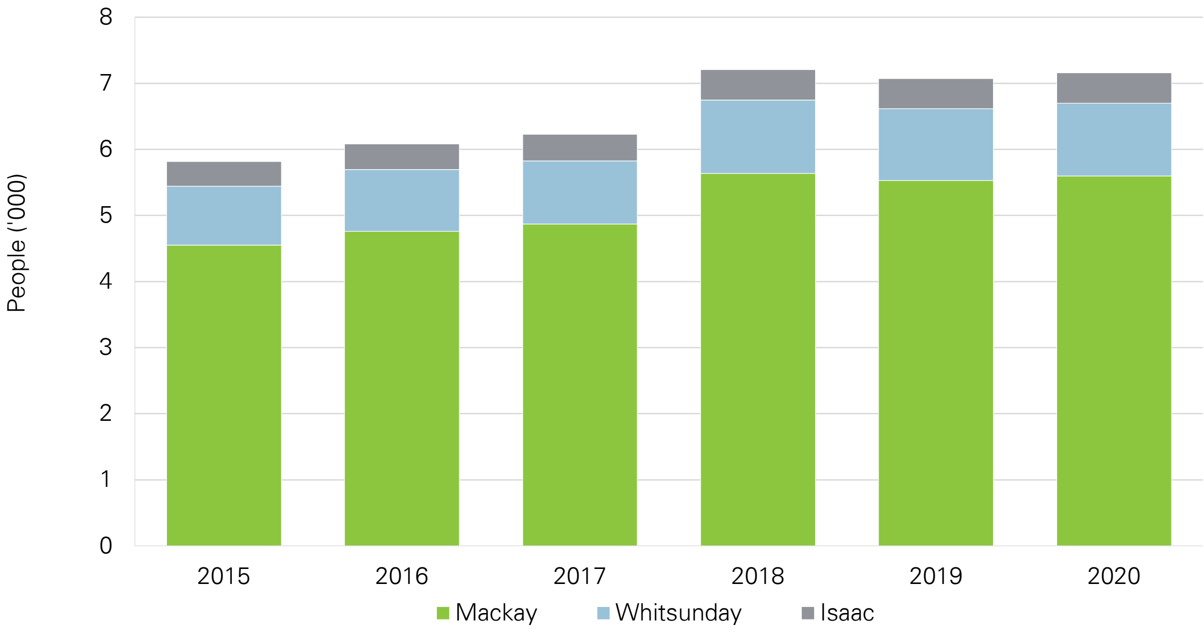
[122] *Labour Market Information Portal Health Care and Social Assistance. Accessed 30 June 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/IndustryInformation/HealthCareandSocialAssistance*
[123] *ABS, cat. no. 6150.0.55.003, Labour Force, Australia, March 2020.*
[124] *Australian Institute of Health and Wellbeing. Health expenditure Australia 2017-18. Accessed 30 June 2020: https://www.aihw.gov.au/reports/health-welfare-expenditure/health-expenditure-australia-2017-18/contents/summary*

Regional differences

Within the Greater Whitsunday region there are employment profile differences across each LGA in the Health Care and Social Assistance industry. These differences are largely attributable to variations in population size and need, as well as alignment to infrastructure and investment in the Health Care and Social Assistance industry. Figure 3.3 illustrates these regional employment differences in the Health Care and Social Assistance industry over a five year period between 2015 and 2020. Notably, during this period approximately 78.2 percent of the Health Care and Social Assistance industry was employed in the Mackay LGA.

Compared with the Whitsunday and Isaac LGAs, the Mackay LGA has the highest number of hospitals, early childhood and education services and aged care places. The Mackay Base Hospital is also the largest hospital across the Greater Whitsunday region and employs a range of clinical staff to deliver specialist services to people living in the region. As at September 2019, the Mackay Base Hospital employed approximately 1,356 doctors, nurses and other allied health and health practitioners. [125]

Figure 3.3: Total regional employment variations in the Health Care and Social Assistance workforce in the Greater Whitsunday region (2015-20)



Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

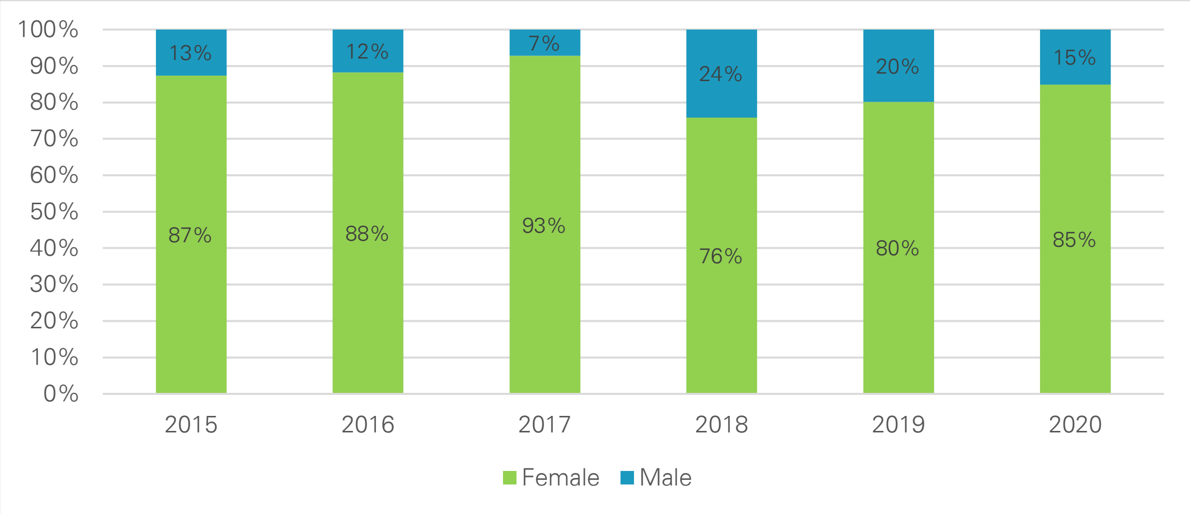
Gender composition

Figure 3.4 shows the gender composition across the Health Care and Social Assistance industry over a five year period between 2015 and 2020 in the Greater Whitsunday region. The number of females in the industry grew at an annual average rate of 3.6 percent during this five year period. As at February 2020, females accounted for 84.9 percent of the workforce, which was higher than the female share of the industry at the national level (78.0 percent). [126] In contrast, the number of males in the Health Care and Social Assistance industry grew at an annual average rate of 8.0 percent. However, this growth rate is largely contributed to be a significant increase in the male workforce in 2018.

[125] *Queensland Health. Performance: Mackay Base Hospital. Accessed 30 June 2020: http://www.performance.health.qld.gov.au/Hospital/Index/172*

[126] *Labour Market Information Portal Health Care and Social Assistance. Accessed 30 June 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/IndustryInformation/HealthCareandSocialAssistance*

Figure 3.4: Gender distribution in the Health Care and Social Assistance workforce in the Greater Whitsunday region (2015-20)

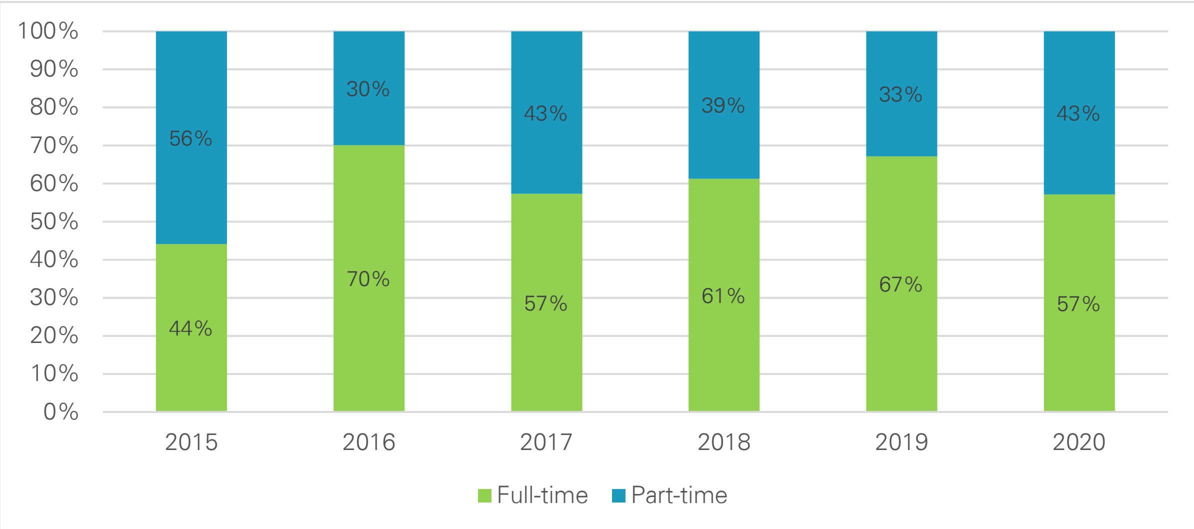


Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

Employment composition

Figure 3.5 shows the employment composition (full-time and part-time) for the Health Care and Social Assistance industry between 2015 and 2020 in the Greater Whitsunday region. Over the five year period, the industry's employment composition has changed from being predominantly part-time in 2015 to being predominantly full-time since 2016. As at February 2020, full-time workers accounted for 57.1 percent of the workforce, which was slightly higher than the share of full-time Health Care and Social Assistance workers at the national level (54.6 percent).[127] It is noted that the ABS data does not provide the composition of casual or contractor employees working in the Health Care and Social Assistance sector and will therefore underestimate the size of the workforce. However, it has been previously estimated that casual employees account for approximately 21 percent of the national Health Care and Social Assistance industry.[128]

Figure 3.5: Employment type composition in the Health Care and Social Assistance workforce in Greater Whitsunday region (2015-20)



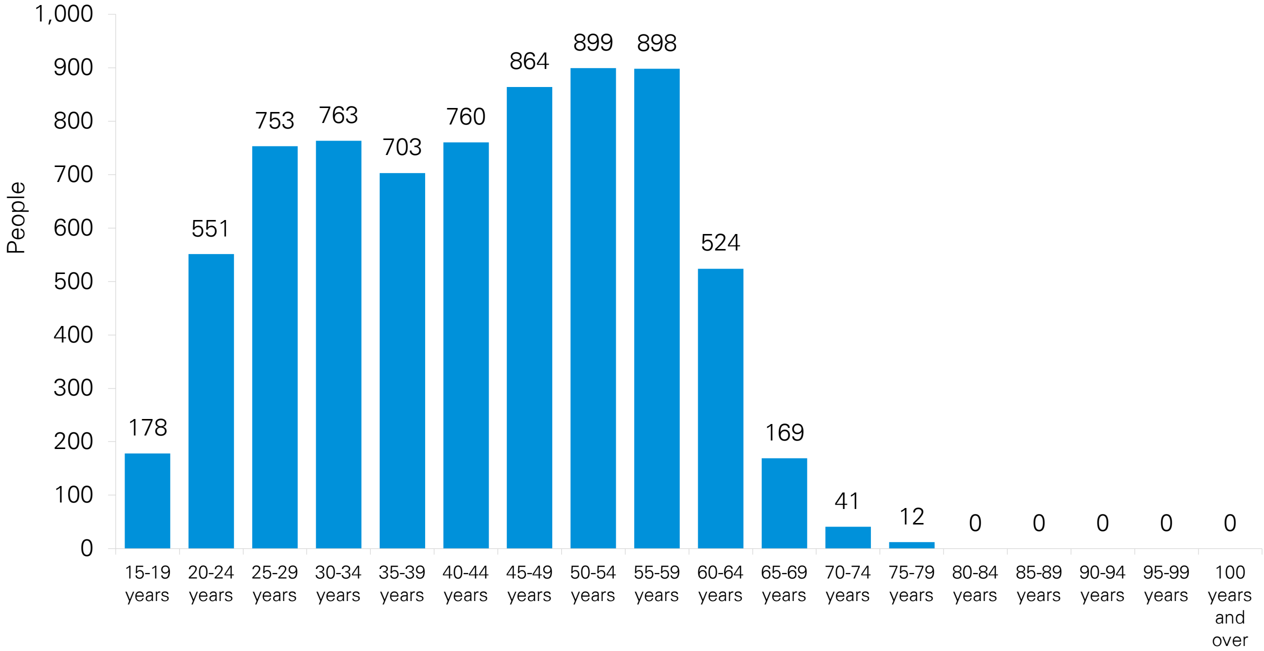
Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

[127] *Labour Market Information Portal Health Care and Social Assistance. Accessed 30 June 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/IndustryInformation/HealthCareandSocialAssistance*
[128] *Parliament of Australia. (2018). Characteristics and use of casual employees in Australia. Accessed 15 July 2020 https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp1718/CasualEmployeesAustralia*

Age distribution

As shown in Figure 3.6, the Health Care and Social Assistance industry has a relatively mature workforce with the most common age clusters being the 45-49, 50-54 years and 55-59 year age groupings. In 2016 approximately 58.5 percent of the workforce were aged 40 years or older, with the 50 to 54 age bracket having the highest number of persons in the Health Care and Social Assistance industry. Therefore, by 2030 it is expected that a significant proportion of the workforce in the Health Care and Social Assistance industry will be entering retirement.

Figure 3.6: Age distribution of the Health Care and Social Assistance industry in the Greater Whitsunday region (2016)

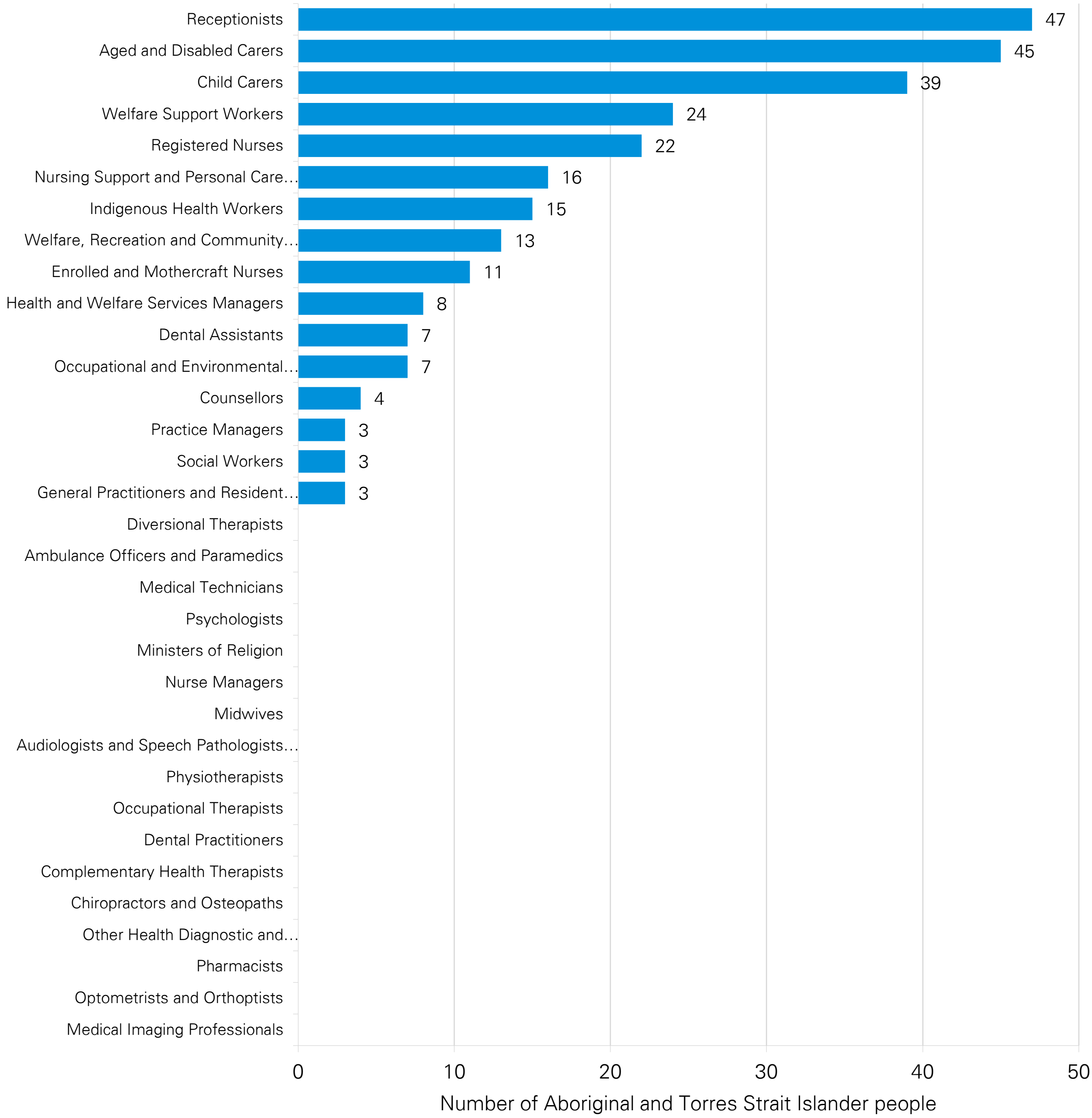


Source: KPMG based on ABS Labour Market Quarterly and Census Data

Aboriginal and Torres Strait Islander employment

The Health Care and Social Assistance industry employs the second largest share of Aboriginal and Torres Strait Islander people in the Greater Whitsunday region. In 2016 approximately 9.9 percent of the Aboriginal and Torres Strait Islander workforce in the Greater Whitsunday region were employed in the Health Care and Social Assistance industry. As shown in Figure 3.7, the majority of these occupations were Receptionists, Aged and Disabled Carers, and Child Carers.

Figure 3.7: Aboriginal and Torres Strait Islander employment, Health Care and Social Assistance industry, Greater Whitsunday region, 2016



Source: KPMG based on ABS Labour Market Quarterly and Census Data

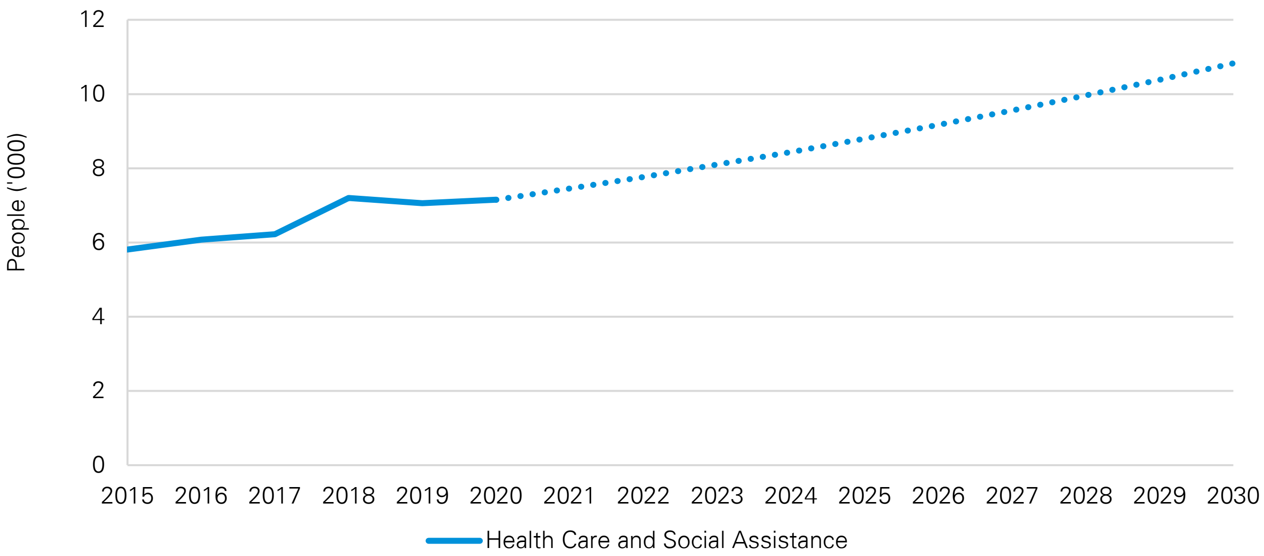
Future workforce projections based on current trends

Overall employment

The Health Care and Social Assistance industry has been the primary provider of new jobs in the Australian labour market over the past decade. This is expected to continue, with national employment in Health Care and Social Assistance industry projected by the Commonwealth Department of Employment, Skills, Small and Family Business to increase by 252,600 (or 15 percent) over the next five years.[129] This workforce growth is expected due to continued service demand generated by demographic changes such as the ageing population, policy reform areas including across disability and aged care and due to trends such as increasing chronic disease and co-morbidities. Large investments in hospitals and increasing demand for childcare and home-based care services have also been anticipated to be significant contributors to this strong projected growth.[130]

Based on historical trends, Figure 3.8 shows the projected workforce growth for the Health Care and Social Assistance industry in the Greater Whitsunday region for a ten year period from 2020 to 2030. With a historical annual growth rate of 4.2 percent, the workforce in the Health Care and Social Assistance industry in the Greater Whitsunday region is expected to increase from 7,150 people in 2020 to 10,827 people in 2030. This projection, however, is based only on historical trends and does not take account any future drivers of change or the recent COVID-19 pandemic. The potential impacts of the COVID-19 pandemic are further explored later in this report.

Figure 3.8: Projected workforce growth for the Health Care and Social Assistance industry in the Greater Whitsunday region (2015-30)



Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

Gender composition

Based on the historical trends described above, Figure 3.9 shows the projected gender composition for the Health Care and Social Assistance industry in the Greater Whitsunday region over a 10 year period from 2020 to 2030. If current trends continue, then by 2030, females will account for approximately 84.9 percent of the entire Health Care and Social Assistance workforce in the Greater Whitsunday region. This will equate to approximately 9,193 females and 1,634 males employed the sector.

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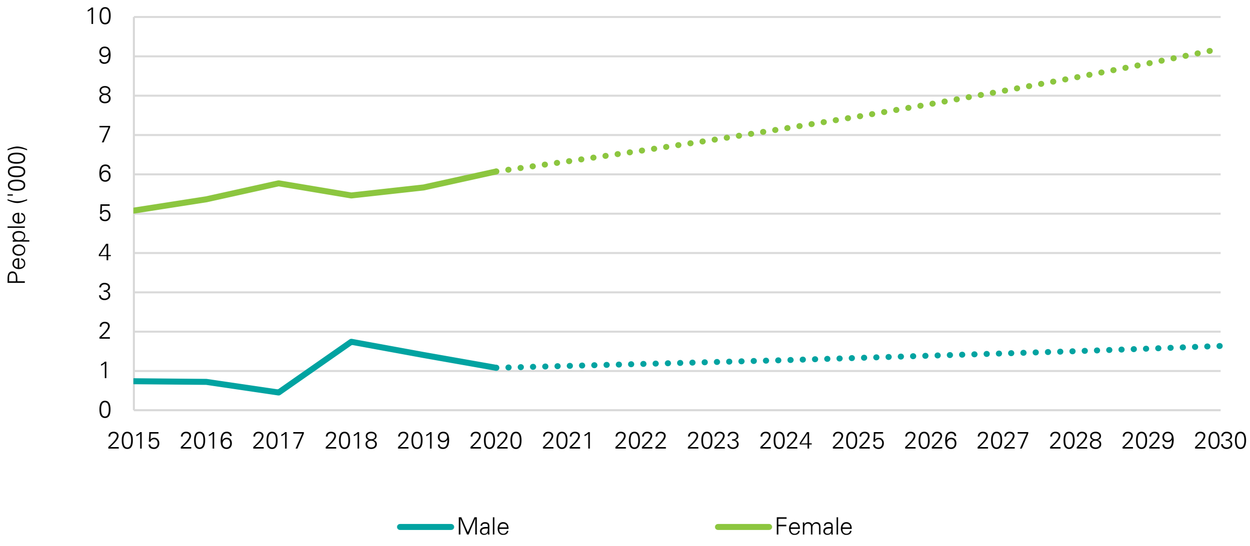
[129] *Labour Market Information Portal Employment Projections. Accessed 30 June 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/EmploymentProjections*
[130] *Ibid.*

Figure 3.9: Projected workforce growth by gender for the Health Care and Social Assistance industry in the Greater Whitsunday region (2015-30)

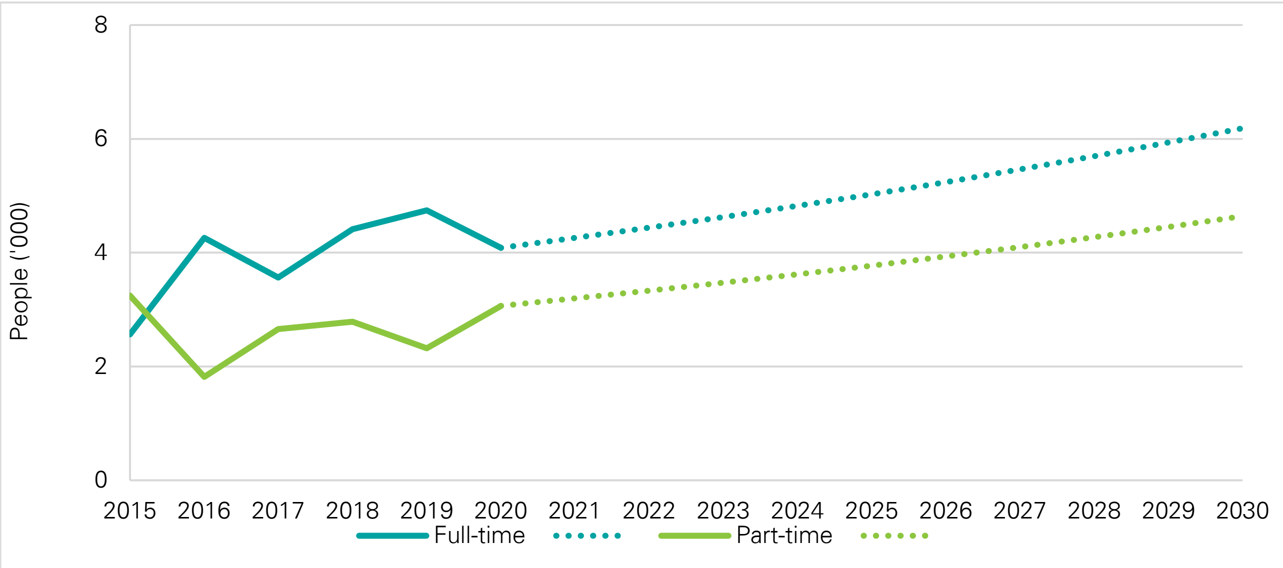


Source: KPMG based on ABS Labour Market Quarterly and Census Data and the 6 digit occupations considered in scope in Appendix A

Employment composition

Based on historical trends described above, Figure 3.10 shows the predicted employment composition for the Health Care and Social Assistance industry in the Greater Whitsunday region over a ten year period from 2020 to 2030. During this period, the number of full-time and part-time persons employed in the Health Care and Social Assistance industry is predicted to grow at an average annual rate of 4.2 percent. If current trends continue, by 2030, people working full-time will account for approximately 57.1 percent of the entire Health Care and Social Assistance workforce in the Greater Whitsunday region. This will equate to approximately 6,285 full-time workers and 4,641 part-time workers.

Figure 3.10: Projected workforce growth by employment type for the Health Care and Social Assistance industry in the Greater Whitsunday region (2015-30)



Source: KPMG based on ABS Labour Market Quarterly and Census Data and based on the 6 digit occupations in scope in Appendix A

Occupational growth in the industry

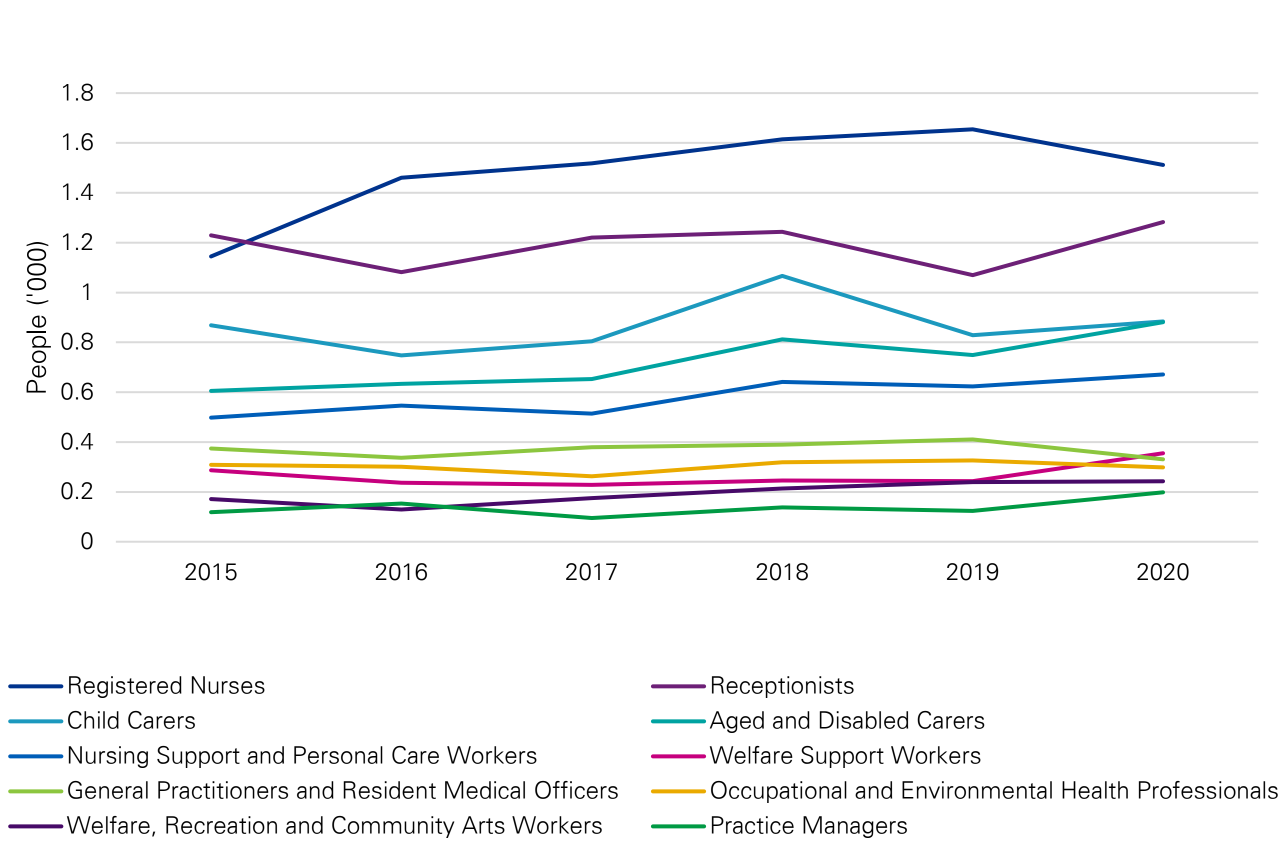
As shown in Figure 3.11, the Health Care and Social Assistance industry comprises a diverse range of occupations (shown across ANZSCO 4-digit unit occupational clusters). Consistent with recent national trends, the top five employing unit groups in the Greater Whitsunday region included Registered Nurses, Receptionists, Child Carers, Aged and Disabled Carers, and Nursing Support and Personal Care Workers. In contrast, the bottom five employing unit groups in the Greater Whitsunday region included Indigenous Health Workers, Chiropractors and Osteopaths, Audiologists and Speech Pathologists, Diversional Therapists, and Complementary Health Therapists.

Between 2015 and 2020, Optometrists and Orthoptist Technicians experienced the highest rate of growth (25.5 percent annually) in employment (however, caution should be used due to the small size of this workforce). Second to this growth rate, the number of Dental Practitioners grew at an average annual rate of 15.6 percent (low workforce size may also distort these growth figures).

Between 2015 and 2020, Registered Nurses experienced the highest growth in real terms and increased by 367 employees during this five year period. Second to this, the number of Aged Care and Disabled Carers grew in real terms by 276 employees between 2015 and 2020.

Ambulance Officers and Paramedics experienced the largest decline in employment between 2015 and 2020 in real terms, decreasing by 44 employees. Second to this, the number of General Practitioners and Resident Medical Officers fell by 43 employees during this same five year period.

Figure 3.11: Health Care and Social Assistance employment trends by ANZSCO 4-digit unit groups (2015-20)



Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A

These ANZSCO 4-digit unit groups have been broken down into ANZSCO 6-digit occupations in Figure 3.12 and Figure 3.13 in order to highlight the top ten occupations in the Greater Whitsunday region across both Health Care and Social Assistance. This highlights the variation in average annual employment growth between 2015-2020, with Midwives, Registered Nurses (nec/nfd), Social Workers and Aged and Disabled Carers showing the highest average annual growth (8.9 percent, 8.1 percent, 8.1 percent and 7.8 percent respectively). Occupations experiencing declining employment rates include Ambulance Officers (-4.9 percent), and General Practitioners (-2.4 percent).

Key occupations in Health Care

Figure 3.12: Health Care employment trends, top ten employing occupations at ANZSCO 6-digit level, 2015-2030 (note that Social Assistance occupations are listed separately below)

Registered Nurses (nfd / nec)

Those who *"provide nursing care to patients in hospitals, aged care and other health care facilities, and in the community"*

8.1% annual growth

Headcount 2015 **189**
Headcount 2020 **348**

Mackay **276**
Isaac **23**
Whitsunday **59**

607 Headcount by 2030

Medical Receptionists

Those who *"greet patients and other clients in a health facility, such as a clinic, practice, centre or surgery, and respond to personal, telephone and written inquiries and requests"*

0.9% annual growth

Headcount 2015 **312**
Headcount 2020 **325**

Mackay **232**
Isaac **26**
Whitsunday **67**

354 Headcount by 2030

Registered Nurses (Aged Care)

Those who *"provide nursing care to the elderly in community settings, residential aged care facilities, retirement villages and health care facilities"*

5.7% annual growth

Headcount 2015 **205**
Headcount 2020 **270**

Mackay **214**
Isaac **20**
Whitsunday **38**

472 Headcount by 2030

General Practitioners

Those who *"diagnose, treat and prevent human physical and mental disorders and injuries"*

-2.4% annual growth

Headcount 2015 **300**
Headcount 2020 **266**

Mackay **221**
Isaac **7**
Whitsunday **37**

208 Headcount by 2030

Registered Nurses (Critical Care)

Those who *"provide nursing care to critically ill patients and patients with unstable health following injury, surgery or during the acute phase of diseases"*

5.7% annual growth

Headcount 2015 **178**
Headcount 2020 **235**

Mackay **186**
Isaac **16**
Whitsunday **33**

409 Headcount by 2030

Dental Assistants

Those who *"prepare patients for dental examination and assist Dental Practitioners, Hygienists and Therapists"*

3.5% annual growth

Headcount 2015 **162**
Headcount 2020 **192**

Mackay **158**
Isaac **5**
Whitsunday **30**

271 Headcount by 2030

Ambulance Officers

Those who *"provide specialised transport services and emergency health care for injured, sick, infirm and aged persons"*

-4.9% annual growth

Headcount 2015 **199**
Headcount 2020 **154**

Mackay **75**
Isaac **49**
Whitsunday **30**

93 Headcount by 2030

Midwives

Those who *"provide care and advice to women during pregnancy, labour and childbirth, and postnatal care for women and babies"*

8.9% annual growth

Headcount 2015 **92**
Headcount 2020 **141**

Mackay **124**
Isaac **-**
Whitsunday **17**

330 Headcount by 2030

Registered Nurses (Medical)

Those who *"provide nursing care to patients with conditions which require medical intervention in a range of health, aged care and community settings"*

5.7% annual growth

Headcount 2015 **103**
Headcount 2020 **136**

Mackay **108**
Isaac **9**
Whitsunday **19**

238 Headcount by 2030

Enrolled Nurses

Those who *"provide nursing care to patients in a variety of health, aged care, welfare and community settings under the supervision of Registered Nurses"*

4.4% annual growth

Headcount 2015 **108**
Headcount 2020 **134**

Mackay **97**
Isaac **10**
Whitsunday **27**

409 Headcount by 2030

Key occupations in Social Assistance

Figure 3.13: Social Assistance employment trends, top ten employing occupations at ANZSCO 6-digit level, 2015-2030 (note that Health Care occupations are listed separately above)

Aged and Disabled Carers

Those who provide *"provide general household assistance, emotional support, care and companionship for aged and disabled persons in their own homes"*

7.8% annual growth

Headcount 2015 **605**
Headcount 2020 **881**

Mackay **662**
Isaac **179**
Whitsunday **40**

1,876 Headcount by 2030

Child Care Workers

Those who *"provide care and supervision for children in programs, such as long day care and occasional care, in childcare centres, hospitals and educational centres"*

0.3% annual growth

Headcount 2015 **645**
Headcount 2020 **656**

Mackay **438**
Isaac **91**
Whitsunday **128**

679 Headcount by 2030

Nursing Support Workers

Those who *"provide limited patient care under the direction of nursing staff"*

6.2% annual growth

Headcount 2015 **335**
Headcount 2020 **452**

Mackay **050**
Isaac **17**
Whitsunday **85**

822 Headcount by 2030

Welfare Workers

Those who *"assist with social, emotional or financial difficulties to improve quality of life, by educating and supporting them and working towards change"*

7.2% annual growth

Headcount 2015 **151**
Headcount 2020 **211**

Mackay **196**
Isaac **-**
Whitsunday **18**

426 Headcount by 2030

Community Workers

Those who *"facilitate community development initiatives and collective solutions within a community to address issues, needs and problems"*

4.4% annual growth

Headcount 2015 **124**
Headcount 2020 **154**

Mackay **115**
Isaac **11**
Whitsunday **28**

236 Headcount by 2030

Social Workers

Those who *"assess the social needs of individuals, families and groups, assists and empowers people to develop and use the skills and resources needed to resolve social and other problems"*

8.1% annual growth

Headcount 2015
98
Headcount 2020
144

Mackay
119
Isaac
9
/hitsunday
16

313 Headcount by 2030

Family Day Care Workers

Those who *"provide care and supervision for babies and children, usually in the carer's own home"*

0.4% annual growth

Headcount 2015
89
Headcount 2020
91

Mackay
60
Isaac
13
/hitsunday
18

94 Headcount by 2030

Personal Care Assistants

Those who *"provide routine personal care services to people in a range of health care facilities or in a person's home"*

6.1% annual growth

Headcount 2015
60
Headcount 2020
80

Mackay
62
Isaac
15
/hitsunday
3

146 Headcount by 2030

Child Carers nfd

Those who *"provide care and supervision for children in residential homes and non-residential childcare centres"*

0.3% annual growth

Headcount 2015
77
Headcount 2020
79

Mackay
52
Isaac
11
/hitsunday
15

81 Headcount by 2030

Counsellors (nfd / nec)

Those who *"provide information on vocational, relationship, social and educational difficulties and issues"*

7.6% annual growth

Headcount 2015
54
Headcount 2020
77

Mackay
61
Isaac
4
/hitsunday
12

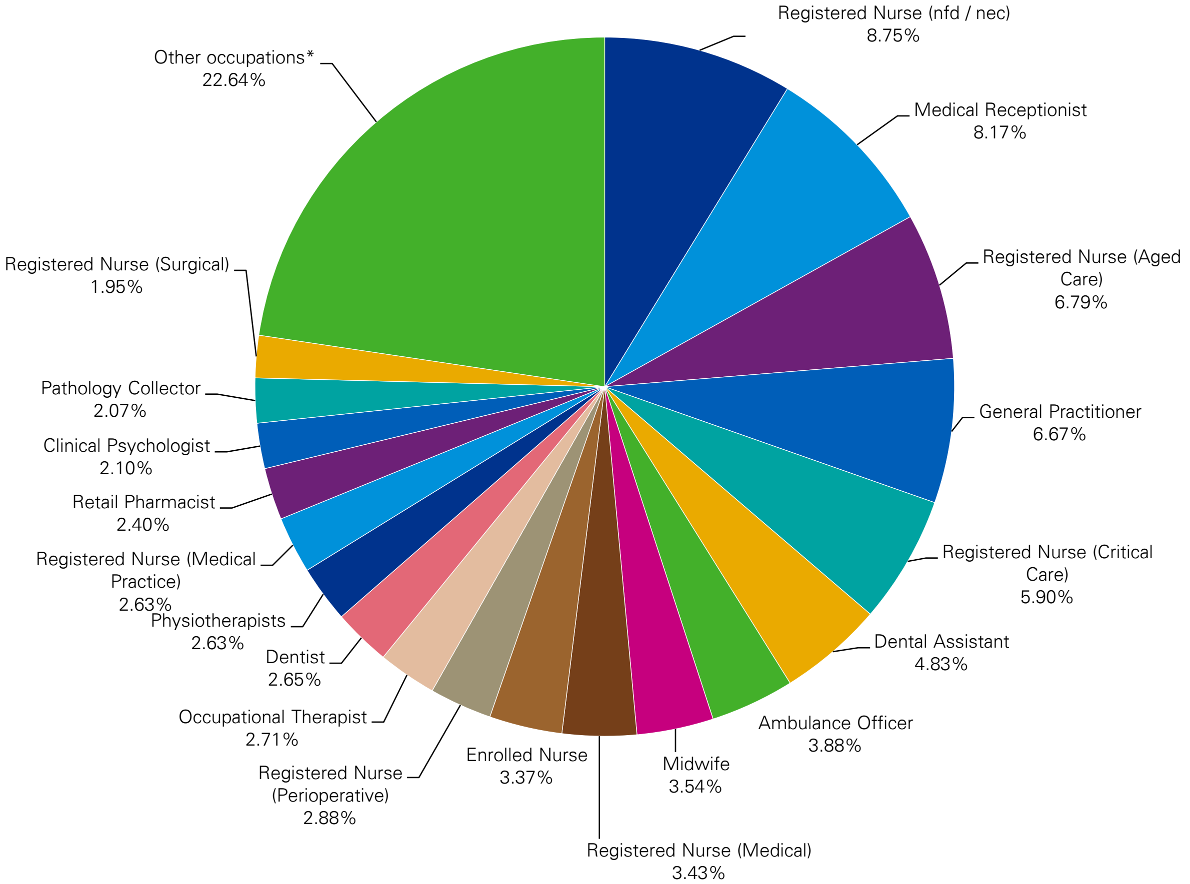
162 Headcount by 2030

What would the future look like in 2030 if we continued on our current path?

Health Care

The Health Care industry employs people in a highly diverse range of occupations that are classified as ANZSCO 6-digit occupations in the Greater Whitsunday region. Figure 3.14 illustrates the distribution of these occupations which employed 2 percent or more of the Health Care industry workforce in 2020. As shown in Figure 3.14, the top five occupations were Registered Nurses (nfd / nec), Medical Receptionists, Registered Nurses (Aged Care), General Practitioners and Registered Nurses (Critical Care).

Figure 3.14: Distribution of ANZSCO 6-digit occupations that account for greater than 2 percent of the Health Care workforce in 2020

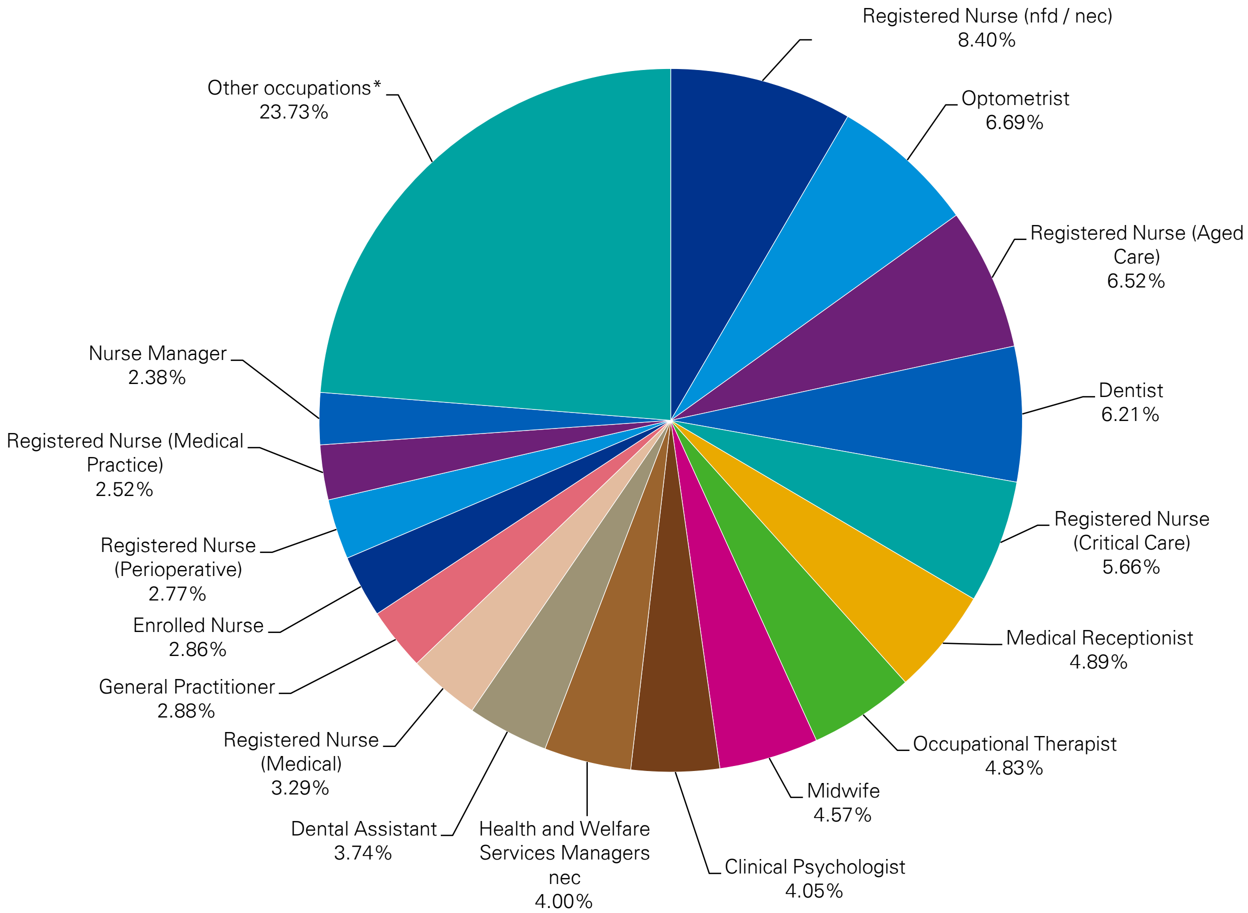


** Other occupations include: Pharmacy Technician (1.9%); Registered Nurse (Community Health) (1.9%); Health and Welfare Services Manager nec (1.8%); Nurse Manager (1.7%); Registered Nurse (Mental Health) (1.7%); Resident Medical Officer (1.6%); Hospital Orderly (1.4%); Optometrist (1.3%); Health Promotion Officer (1.2%); Environment Health Officer (1.0%); Medical Diagnostic Radiographer (0.9%); Naturopath (0.9%); Registered Nurse (Paediatrics) (0.8%); Registered Nurse (Child and Family Health) (0.8%); Admissions Clerk (0.7%); Speech Pathologist (0.7%); Nursing Clinical Director (0.6%); Aboriginal and Torres Strait Islander Health Worker (0.5%); Sonographer (0.5%); Chiropractor (0.4%); Health Practice Manager (0.4%).*

KPMG based on ABS Labour Market Quarterly and Census Data

Based on historical trends in ANZSCO 6-digit occupations in the Greater Whitsunday region, Figure 3.15 shows the distribution of these occupations which have been projected to employ 2 percent or more of the Health Care workforce in 2030. As shown in Figure 3.15, the employment of Optometrists and Dentists is forecast to grow at a considerable rate and move into the top five employing occupations for the Health Care industry. In contrast, employment in Medical Receptionists is forecast to grow at a relatively modest rate. At the same time, employment in General Practitioners and Ambulance Officers is forecast to decline over the ten year period between 2020 and 2030.

Figure 3.15: Distribution of ANZSCO 6-digit occupations that account for greater than 2 percent of the Health Care workforce in 2030



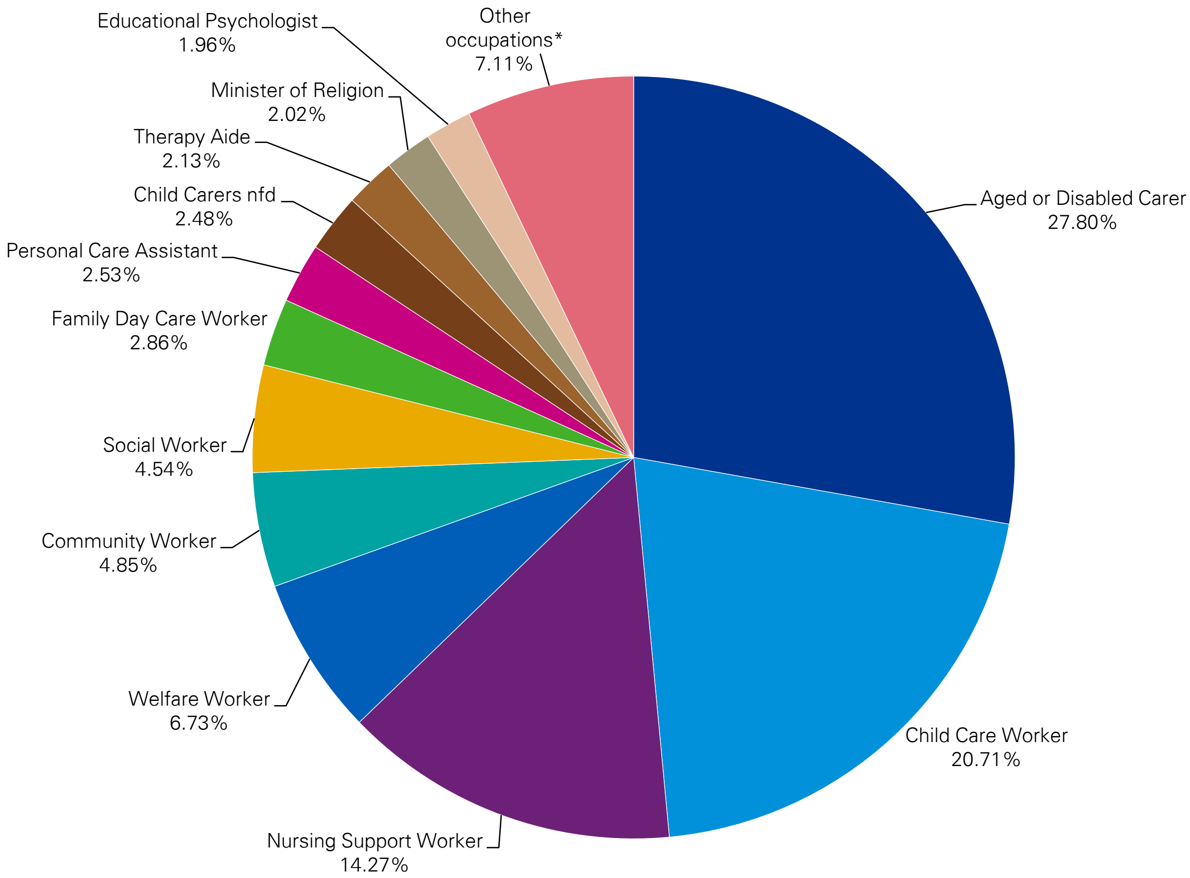
** Other occupations include: Registered Nurse (Surgical) (1.9%); Health Promotion Officer (1.9%); Registered Nurse (Community Health) (1.8%); Naturopath (1.7%); Physiotherapist (1.7%); Registered Nurse (Mental Health) (1.6%); Hospital Orderly (1.4%); Pathology Collected (1.4%); Pharmacy Technician (1.3%); Ambulance Officer (1.3%); Retail Pharmacist (1.3%); Nursing Clinical Director (1.3%); Registered Nurse Paediatrics (0.8%); Registered Nurse (Child and Family) (0.7%); Resident Medical Officer (0.7%); Health Practice Manager (0.7%); Aboriginal and Torres Strait Islander Health Worker (0.6%); Environment Health Officer (0.5%); Admissions Clerk (0.4%); Speech Pathologist (0.3%); Medical Diagnostic Radiographer (0.3%); Chiropractor (0.2%); Sonographer (0.1%).*

KPMG based on ABS Labour Market Quarterly and Census Data

Social assistance

Figure 3.16 illustrates the distribution of social assistance occupations which employed 2 percent or more of the social assistance industry workforce in 2020. As shown in Figure 3.16, over half of the social assistance industry were employed as Aged or Disabled Carers, Child Care Workers and Nursing Support Workers.

Figure 3.16: Distribution of ANZSCO 6-digit occupations that account for greater than 2 per cent of the Social Assistance workforce in 2020

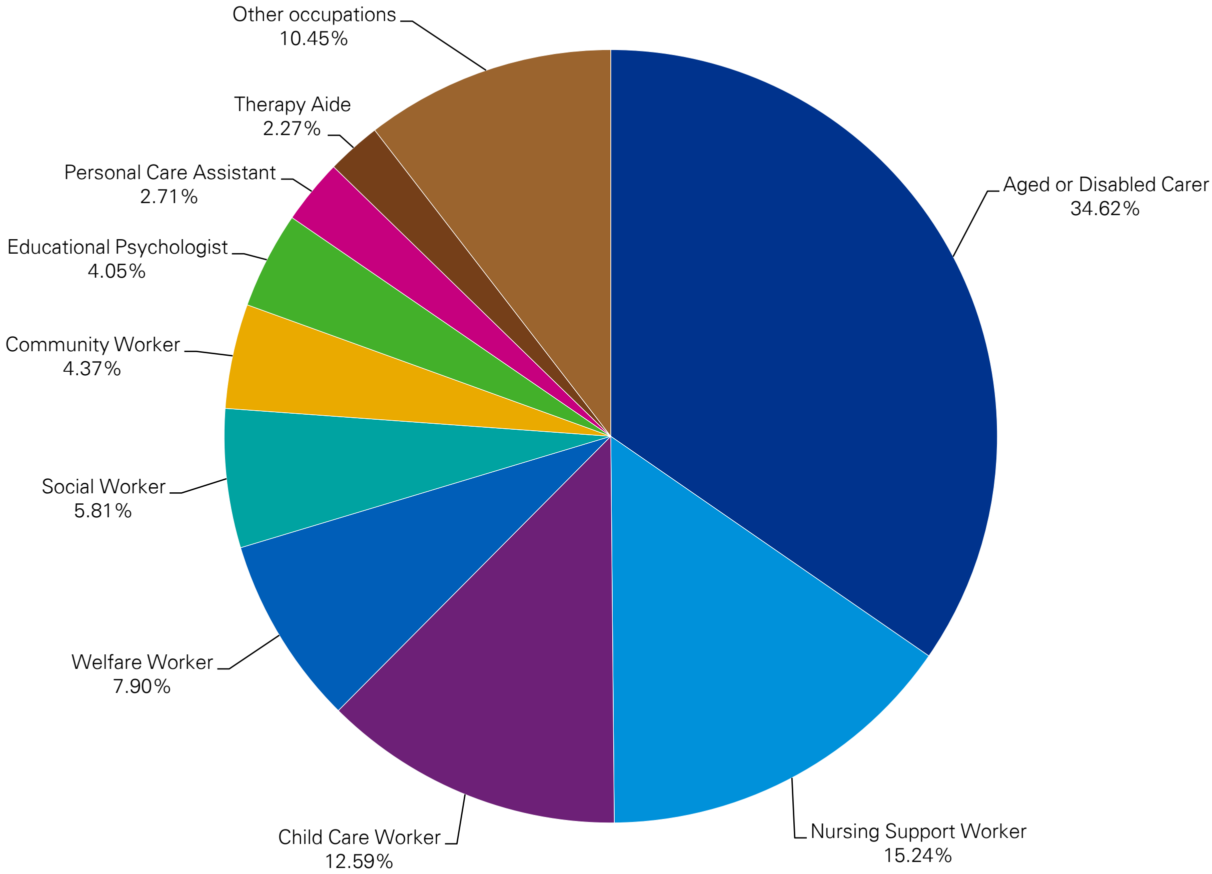


** Other occupations include: Disability Services Officer (1.6%); Counsellor (nfd) (1.2%); Diversional Therapist (1.2%); Counsellor (nec) (1.2%); Nanny (1.1%); Out of School Hours Care Worker (0.8%).*

KPMG based on ABS Labour Market Quarterly and Census Data

Based on historical trends in ANZSCO 6-digit occupations in the Greater Whitsunday region, Figure 3.17 shows the distribution of these occupations which have been projected to employ two percent or more of the social assistance workforce in 2030. As shown in Figure 3.19, the employment of Aged or Disabled Carers, Nursing Support Workers and Welfare Workers is forecast to grow at a considerable rate and account for a large proportion of the social assistance workforce. In contrast, employment in Child Care Workers and Family Day Care Workers is forecast to grow at a relatively modest rate. At the same time, employment in Ministers of Religion is forecast to decline over the ten year period between 2020 and 2030.

Figure 3.17: Distribution of ANZSCO 6-digit occupations that account for greater than 2 per cent of the Social Assistance workforce in 2020



** Other occupations include: Family Day Care Worker (1.7%); Counsellors (nfd) (1.5%); Child Carers (nfd) (1.5%); Counsellors (nec) (1.5%); Disability Services Officer (1.4%); Minister of Religion (0.9%); Diversional Therapist (0.7%); Nanny (0.6%); Out of School Hours Care (0.5%).*

Source: KPMG based on ABS Labour Market Quarterly and Census Data

Key industry trends that are occurring in the region

As with the rest of Australia, the Health Care and Social Assistance industry in the Greater Whitsunday region is in the midst of significant transformation. Rapid digitisation of services, major investments in infrastructure and evolving consumer, community and government preferences are driving well documented changes in the industry.

Regional trends in the delivery of public Health Care

In terms of impacts on the region's Health Care sector, the Mackay Base Hospital has become the first fully digital public hospital in a regional area in Queensland. The Mackay Base Hospital has implemented a range of digital platforms to assist in providing the highest level of care to its community. As part of this transformational journey, the Mackay Base Hospital has recently led a number of initiatives, including:

- the successful transition to a fully integrated Electronic Medical Record (iEMR) site with direct entry into patient records;
- the development of telehealth handover services for patients transferring to rural hospitals which enables video conferenced team-to-team clinical handover;
- the development of a suite of dashboards to give clinical staff more oversight and visibility of patient care; and
- the expansion of telehealth services for aged care residents to save unnecessary trips to the emergency department. [131]

In addition to these initiatives, the Mackay LGA has been selected as one of the Queensland Health's trial sites for eyeConnect© Telehealth System. [132] eyeConnect captures, stores and transmits ophthalmic images and other diagnostic information from a regional centre to ophthalmologists at any site for assessment. The technology will in turn improve patient outcomes for people living in regional areas.

These digital transformations have been occurring in the context of significant investments in the region's public health care infrastructure and services. These investments have been in response to increasing demand for services in the Greater Whitsunday region and have included the following projects which are likely to drive additional employment opportunities in the region:

- the building of a new $6.1 million purpose built Step Up Step Down residential mental health facility; and
- the proposed redevelopment of the Sarina Hospital. [133]

In turn, investments of this kind in the health care industry will be met with increasing workforce demands as service delivery is expanded across the Greater Whitsunday region. Consequently, health care providers will need to develop proactive and creative solutions to attract, develop and retain an adequately sized workforce that will be required to deliver increased services.

Regional trends in the delivery of private Health Care

Medical practices across the Greater Whitsunday region have sought to enhance patient experience with the latest technology. For example, a general practice in Mackay has developed a mobile application to enable patients to schedule appointments and check wait times from their phone. In addition to the appointment scheduling and wait time list, the application offers online patient registration forms, health alerts, health information, health promotions and direct access to doctors after hours. [134]

Across the Greater Whitsunday region, allied health practitioners are also leveraging virtual care solutions to increase access to patients and increase adherence to treatment plans. Notably, a paediatric therapy practice in the Mackay region currently delivers physiotherapy and occupational therapy services to children of all ages and has adopted a suite of virtual care solutions to enhance their services. The practice recently trialled the use of wearable devices to support greater adherence to treatment plans. The wearable technology is a type of gaming controller that can be attached to any part of the

[131] Mackay Hospital and Health Service. Annual Report 2018 – 2019. Accessed 30 June 2020: https://www.mackay.health.qld.gov.au/about-us/publications/
[132] Clinical Excellence Queensland, Queensland Health. eyeConnect© Telehealth System. Accessed on 16 July 2020 https://clinicalexcellence.qld.gov.au/improvement-exchange/eyeconnect
[133] Mackay Hospital and Health Service. Annual Report 2018 – 2019. Accessed 30 June 2020: https://www.mackay.health.qld.gov.au/about-us/publications/
[134] GP Super Clinic. Welcome to Mackay GP Super Clinic. Accessed 16 July 2020 https://www.gpsuperclinics.com.au/

body and then connects to either a mobile device or TV and displays a physical therapy program. [135]

Regional trends in health care research

The three private hospitals in the Greater Whitsunday region deliver a diverse range of inpatient and research services. In particular, the Coral Sea Clinical Research Institute (CSCRI) at the Mater Misericordiae Hospital in Mackay is committed to expanding the therapeutic options for patients in the community. The CSCRI specialises in gastroenterology trials and has a strong focus on education and patient safety. [136]

In partnership with the Mackay HHS, the Mackay Institute of Research and Innovation (MIRI) has also invested in expanding the clinical trial and research capacity of the Greater Whitsunday region. MIRI has collaborated with a range of its partners to optimise the translation of research into clinical practice and health policy. Through its activities, MIRI is expected to improve health service productivity, patient outcomes and the broader health of the Greater Whitsunday region. [137]

These research institutions have the potential to significantly transform the delivery of health care services in the Greater Whitsunday region. As such, health care providers and organisations will need to manage the transition of current employees to potentially new and different ways of working. They will also need to consider the requirements of a future workforce capable of delivering health outcomes in a changing health care landscape.

Regional trends in child care

Between 2012 and 2018 the total fertility rate in the Greater Whitsunday region fell from 2.20 births per woman to 1.96 births per woman. [138] During this five year period, the total number of births fell at an average annual rate of -3.3 percent per annum from 2,734 births to 2,313.

The decline in the region's fertility rate has coincided with a reduction in the number of Child Care Workers and Family Day Care employees in the region. [139] This indicates that the decline in fertility may have significant ramifications for the industry's operating environment in the Greater Whitsunday region. In particular, the region's operators may have to adopt new operating care models with less staff on the basis of reduced child care service usage.

Regional trends in aged care

At the same time of experiencing declining fertility rates, the Greater Whitsunday region's population is also ageing. In response to the region's changing demographics, there has been a strong focus on delivering and improving services for the older population. There has been significant investment in the region's aged care infrastructure and services, including:

- the building of a new $8.1 million aged care facility in Clermont; and
- the building of a new $30 million aged care facility in Mackay. [140]

As such, the Health Care and Social Assistance industry in the Greater Whitsunday region will need to ensure an adequately skilled workforce to respond to changing demographics and health care needs. The workforce will need to be equipped to manage increasingly complex chronic conditions and co-morbidities. As such, the workforce will need to continuously learn, update and adapt skills to future operating environments.

Regional trends in disability services

The delivery of social assistance services in the Greater Whitsunday region has experienced a number of changes in recent years. Most notable was the graduated rollout of the NDIS in November 2016. The NDIS has been one of the most important social reforms in Australian history, delivering choice and control for people with disability.

In the Greater Whitsunday region, there has been significant uptake of the NDIS with:

- 2,524 participants with an average budget of $63,000 in their current plans;
- 66 percent utilisation of plan budgets by participants;
- 204 providers operating in the region; and
- 56 percent of payments going to the top ten providers in the region. [141]

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[135] *Move and Play Paediatric Therapy. Welcome to Move and Play Paediatric Therapy! Accessed on 16 July 2020 https://www.moveplaypaedtherapy.com.au/*
[136] *Coral Sea Research Institute. About us. Accessed on 16 July 2020 https://www.coralseaclinical.com/about-us*
[137] *Mackay Institute of Research and Innovation. MIRI Annual Report 2017 – 2018. Accessed 30 June 2020: https://miri.health.qld.gov.au/about-miri/publications/*
[138] *ABS, cat. no. 3301.0, Births, Australia, December 2019.*
[139] *ABS, cat. no. 6150.0.55.003, Labour Force, Australia, March 2020.*
[140] *Mackay Hospital and Health Service. Annual Report 2018 – 2019. Accessed 30 June 2020: https://www.mackay.health.qld.gov.au/about-us/publications/*
[141] *National Disability Insurance Scheme. Explore data. Accessed 30 June 2020: https://data.ndis.gov.au/explore-data*

The NDIS presents one of the largest job creation opportunities in Australian history. According to the Commonwealth Department of Social Services, it is estimated that the NDIS will be responsible for one in five jobs created in Australia over the next five years.[142]

Given the scale and pace of reforms across the disability support sector, there is a continual need to support business and workforce development while the sector transitions and matures. This means that the Greater Whitsunday region will have to be responsive to the changing needs of the disability sector and be proactive in planning for the requisite disability workforce skillset. This ultimately presents an opportunity for the region to redeploy, up-skill or reskill its workforce.

Regional trends in child and family support services

The child and family support sector has been found to be a limited adopter of technology, with many opportunities for implementing technology yet to be realised. One of the major challenges the sector faces is that there is a lack of interoperability amongst numerous data sets. As part of the community services sector, child and family support services must interact with a diverse range of adjacent sectors such as health, justice, domestic and family violence, education and employment, all of which have their own processes and policies, and more importantly their own information requirements.

In response to these challenges, a Women's Service provider in Mackay is seeking to implement a data integration solution that is able to join records of different agencies key to child and family support including housing and homelessness, child protection, youth justice and police records that support case management of those with complex needs. It also has the potential to promote change in the Greater Whitsunday region and encourage the adoption of similar solutions across a diverse range of child and family support service providers.

[142] *Department of Social Services. Growing the NDIS Market and Workforce. Accessed 30 June 2020: https://www.dss.gov.au/disability-and-carers-programs-services-for-people-with-disability-national-disability-insurance-scheme/growing-the-ndis-market-and-workforce-strategy*

IMPACT OF COVID-19

The COVID-19 pandemic has placed significant pressures on health care systems around the world which has, in turn, created a health care crisis in many countries. While the daily and total reported COVID-19 case numbers in Australia are relatively low in comparison to many other countries, its impact on the Australian health care system was significant.

The impact of COVID-19 continues to be of significant concern for decision makers in Australia's health system. Various models exist regarding the capacity of the country's health care system to respond to increasing caseloads. Another key concern, both in Australia and globally, was the increased demand for Personal Protective Equipment (PPE). Historically, supply chains have relied on international manufacturers whose demand grew rapidly and significantly. Those manufacturers were also impacted by travel and freight restrictions which resulted in variability in the provision of supplies.

Managing demand for services

To manage health system capacity and preserve PPE to ensure the workforce was protected, Australia took proactive steps to manage the pandemic. Key to these were entering various lockdown periods between March and September 2020 (subject to jurisdiction, and noting that these arrangements still exist in a number of locations). As the spread of the virus began to slow in Queensland, restrictions continued to gradually ease from June 2020.

Additionally, most non-urgent health services were reduced or halted to ensure that PPE was conserved until stockpiles were replenished and supply chain surety was ensured.

The Australian Government worked in partnership with State authorities to proactively implement policies that would flatten the curve and mitigate any spike in cases which could put a strain on health system capacity. These measures included suspending or cancelling non-critical health services and elective surgeries. [143]

Private hospitals, including both overnight and day hospitals, partnered and integrated with State and Territory health systems in the COVID-19 response to increase the total capacity of the system.

In Queensland, the easing of restrictions on elective surgeries was planned in a phased approach, with the first phase of reintroduction occurring in late April. This first phase required health administrators to monitor supplies of PPE, Intensive Care Unit (ICU) and bed capacity, while preparing for the next phase of further eased restrictions. [144]

On 22 May the Australian Health Protection Principal Committee agreed that it was safe to increase the level of elective surgery activity in an incremental and cautious way, while maintaining necessary ICU capacity for any localised outbreaks of COVID-19. [145]

These measures were crucial to Australia's response to COVID-19, and enabled the health system to continue delivery of essential services, while managing the increased demand as a result of the pandemic.

Redirection and upskilling of workforce

Many public hospitals also made the decision to put lower priority services and activities on hold whilst more attention was required to manage and treat the pandemic. This resulted in some clinical staff being asked to work outside their usual area of practice. Due to the reduction in non-urgent services, there was also remobilisation of clinical staff to areas of increasing demand. Most State and Territory health systems established application portals to gather expressions of interest and to rapidly build their COVID-19 frontline workforce. [146]

The Australian Health Practitioner Regulation Agency also offered the fast-tracking of re-registration of clinicians after 500 retired doctors in Queensland volunteered to come back into service to support their community. This approach was similar to the one adopted in the United

[143] PWC. (2020). COVID-19: Implications for the Australian healthcare workforce. Retrieved rom https://www.pwc.com.au/important-problems/coronavirus-covid-19/australian-healthcare-workforce.html
[144] Ministers Department of Health. (2020). Elective surgery restrictions eased. Retrieved from https://www.health.gov.au/ministers/the-hon-greg-hunt-mp/media/elective-surgery-restrictions-eased
[145] Department of Health. (2020). AHPPC statement on restoration of elective surgery and hospital activity. Retrieved from https://www.health.gov.au/news/australian-health-protection-principal-committee-ahppc-statement-on-restoration-of-elective-surgery-and-hospital-activity
[146] APHRA. (2020). COVID-19 health workforce. Retrieved from https://www.ahpra.gov.au/News/COVID-19/Workforce-resources/COVID-19-health-workforce.aspx

Kingdom where over 5,000 nurses and 500 doctors came out of retirement. [147]

Despite the increased demand for health care workforce during the pandemic, there have been challenges in this environment to continue clinical placements of medical students. The PPE shortage, coupled with the shift in focus away from training to the delivery of health care during the period of increased demand, and the increased risk of infection during the pandemic meant that a 'business as usual' approach to training could not continue.

However, final year medical students were also leveraged in the response to the pandemic, contributing to their learning. In Italy, a nation that was severely affected by the pandemic, almost 10,000 students were fast-tracked to graduation to increase workforce capacity. [148] Although there was a lower reliance on this cohort in Australia's response, students were engaged to support medical teams across a range of areas from General Practice, to cardiology and neurology, and medical clerical roles. [149] This reduced the workload of more experienced clinicians and enabled them to support COVID-19 activities.

In addition, social assistance organisations were able to advertise casual positions for administrative and clerical roles, due to the increase in demand for their services, and thereby helping to support the many individuals who have been displaced or lost employment as a result of the pandemic. [150] Many State and Territory health systems also rapidly hired temporary non-clinical staff to manage demand during the pandemic.

The impact of COVID-19 on health workers

Health workers are the foundation of the health system, and due to the nature of their work many put their own health at risk when doing their daily work. As at July 2020, more than 14.9 million confirmed cases of COVID-19 and over 615,300 deaths worldwide had been reported by Johns Hopkins University.

The pandemic has highlighted the importance of sustainable investment in the health systems including in the health workforce, and the importance of training and equipment, especially PPE. In countries that have been more heavily impacted, there is now a growing demand for support with vicarious trauma and post-traumatic stress for the health workforce. The WHO has published a policy brief for the need for action on mental health during and after the pandemic. [151] Health care workers on the front lines of the COVID-19 response are a key focus and are considered as a vulnerable cohort. Studies on the health care workforce in China and Italy, and survey responses from a study in Canada, have all found increased likelihood or reported symptoms of Post-Traumatic Stress Disorder, severe depression anxiety, and insomnia. [152, 153, 154]

Rapid adoption of telehealth and virtual care

The concept of virtual care, or telehealth, has been around in Australia for many years but only adopted in small pockets of the health and social assistance sector, often to connect remote and regional communities to services. Since the COVID-19 outbreak there has been a significant and rapid uptake in virtual care solutions with the solution being adopted by General Practitioners, medical specialists, nurse practitioners, midwives and allied health providers. A key driver of this has been the funding rebates which changed to better support telehealth and virtual care.

The use of virtual care services has enabled patients to continue accessing care whilst limiting their exposure, and thereby supporting the population in minimising the risk of community transmission, and transmission to health workers. For example, children's therapy services who provide physiotherapy and occupational therapy services for children were able to use telehealth services to ensure their clients continued to complete their treatment plans, which usually would have been managed face to face, and therefore didn't have any relapse in progression.

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[147] *PWC. (2020). COVID-19: Implications for the Australian healthcare workforce. Retrieved rom https://www.pwc.com.au/important-problems/coronavirus-covid-19/australian-healthcare-workforce.html*
[148] *Wang, J, Tan, S, & Raubenheimer, K. (2020) Rethinking the role of senior medical students in the COVID-19 response. MJA. Retrieved from: https://www.mja.com.au/journal/2020/212/10/rethinking-role-senior-medical-students-covid-19-response-0*
[149] *The Catholic Weekly. (2020) Med students boost the St Vincent's team. Retrieved from https://www.catholicweekly.com.au/med-students-boost-the-st-vincents-team/*
[150] *Rollins, A. (2020) Services Australia scrambles to ass capacity as demand spikes.*
[151] *WHO. (2020) Policy Brief: COVID-19 and the Need for Action on Mental Health. Retrieved from: https://www.un.org/sites/un2.un.org/files/un_policy_brief-covid_and_mental_health_final.pdf.*
[152] *Lai, J, Ma, S, & Wang, YW. (2020) (JAMA) Factors Associated with Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019. Retrieved: https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2763229*
[153] *Rossi, R et al. (2020) (BMJ) Mental health outcomes among front and second line health workers associated with the COVID-19 pandemic in Italy. Retrieved from: https://www.medrxiv.org/content/10.1101/2020.04.16.20067801v1*
[154] *Canadian Public Health Association. (2020). Potloc Study: Canadian health workers share their insights from the front lines of the COVID-19 pandemic. Retrieved from: https://potloc.com/blog/en/potloc-study-canadian-health-workers-insights-front-lines-covid-19-pandemic/*

Future opportunities

The COVID-19 pandemic has tested the Health Care and Social Assistance industry and workforce. The supply of future Health Care and Social Assistance workers has been significantly disrupted with the delay or suspension of education in a sector where a workforce shortage already existed.

Tertiary education providers will have a critical role to play in managing the demand for tertiary education over the short term and in addition the rapid upskilling of newly qualified clinicians.

The sector is also likely to continue with adoption of virtual care, leveraging technology to help manage the ever increasing demand for services and support.

Regional impacts for the Health Care and Social Assistance Industry

Understanding the impact of the spread of COVID-19 on the labour market – both on people and businesses, as well as the responses to government restrictions and government support packages – will be critical to understanding the evolution of the Health Care and Social Assistance industry in the Greater Whitsunday region over the coming months.

REMPLAN has collected and released new data measuring the labour market impacts of COVID-19 across the Greater Whitsunday region. As part of its COVID-19 Australia Business Economic Impact Survey, REMPLAN specifically investigated the business impacts in the Health Care and Social Assistance industry and its results for the Greater Whitsunday region indicated that:

- 84 percent of businesses and organisations surveyed in the Health Care and Social Assistance industry within the region reported to have been affected by COVID-19;
- 17 percent of businesses and organisations surveyed in the Health Care and Social Assistance industry within the region reported to be prioritising the future employment of their staff over the next three months;
- 15 percent of businesses and organisations surveyed in the Health Care and Social Assistance industry within the region reported to be prioritising the adoption of new systems and practices over the next three months; and
- 19 percent of businesses and organisations surveyed in the Health Care and Social Assistance industry within the region reported that they have benefited from the wider acceptance of online / digital delivery of services as a result of COVID-19. [155]

These results indicate that although the Health Care and Social Assistance industry was significantly impacted in the region, a large number of businesses and organisations have readily responded to the pandemic with the adoption of new systems and digital technologies.

[155] *REMPLAN, 1st June 2020, COVID-19 Australian Business Economic Impact Survey, Mackay, Isaac and Whitsunday, Available at https://surveys.remplan.com.au/s3/REMPLAN-COVID-19-ABEIS*

Faethm Insights:

The Disrupted View

While few industries have the potential to be changed so profoundly by digital technology as health care, the challenges facing innovators should not be underestimated.

World Economic Forum, 2016

PREDICTIONS OF WHEN KEY TECHNOLOGIES WILL IMPACT THE HEALTH CARE AND SOCIAL ASSISTANCE INDUSTRY

There are a range of emerging technologies that are expected to accelerate the rate of technological change and adoption over the coming years, and with this, impact on the workforce. Often, the discussion about the impact of technology on the Future of Work talks about digital disruption in sweeping terms without a clear or nuanced view of what technologies are planned for adoption, the maturity of the industry within the region and its readiness for technology, or the industry-specific technologies which will have a significant workforce impact.

The Faethm modelling provides a prediction of the key technologies that could be implemented at an industry level, specifically for the Greater Whitsunday region. It is important to note this is based on the opportunity that exists, and may not be fully realised. Based on these predictions, Faethm also examines the expected workforce impact of technology adoption. Further information on the Faethm methodology is provided in Appendix B.

What does the technology prediction tell us?

The Faethm technology automation prediction for the Health Care and Social Assistance industry in the Greater Whitsunday region is summarised in Figure 3.18, Figure 3.19 and Figure 3.20. It shows the technologies and their predicted impact on the workforce in the Health Care and Social Assistance industry measured in terms of $AUD total salary cost savings as a result of a reduction in FTE across the workforce. These will be the key technologies that would need to be adopted if the workforce automation and augmentation predictions are to be achieved.

This analysis for the Health Care and Social Assistance industry shows:

- Process Automation will be the main driver of workforce change over the next fifteen years, with a more significant impact seen within the first 10 years, plateauing out from years 10-15 ($11.6 million in predicted salary savings);
- Fixed Robotics and Sensory Perception technologies are expected to have the largest salary cost saving impact within the first five years (with salary saving predicted of $1.2 million and 0.8 million respectively), however the impact and growth in adoption slows over the next ten years (with $2.1 million and $1.4 million in projected salary savings respectively by 2035);
- Assistive Robotics is an emerging technology expected to result in salary savings of $0.4million over the next five years, but its impact on the workforce is expected to quadruple in years 5-10 (salary savings of $2.3 million by 2030), and then almost double again between years 10 and 15 (with salary savings projected of $4.4million);
- Collaborative robotics technologies are expected to be a key focus in years 10-15, almost tripling its projected salary savings impact from year 10 to year 15 with $1.4 million in projected salary savings by 2030 and $3.5 million in projected salary savings by 2035; and
- Navigation robotics is also expected to have its greatest impact between years 10-15, doubling in impact from year 10 projections, with $1.3 million in projected salary savings by 2030 and $2.3 million in projected salary savings by 2035.

Figure 3.18: Prediction of emerging technology types with the greatest opportunities to drive automation in Health Care and Social Assistance, Greater Whitsunday region, 5 year projection ($AUD salary cost saving)

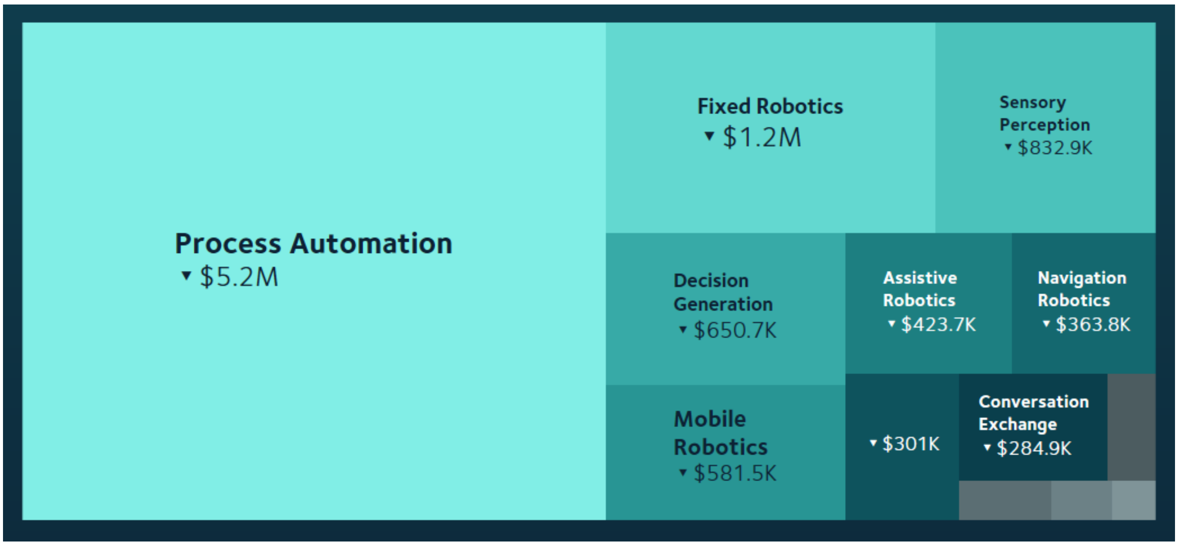


Figure 3.19: Prediction of emerging technology types with the greatest opportunities to drive automation in Health Care and Social Assistance, Greater Whitsunday region, 10 year projection ($AUD salary cost saving)

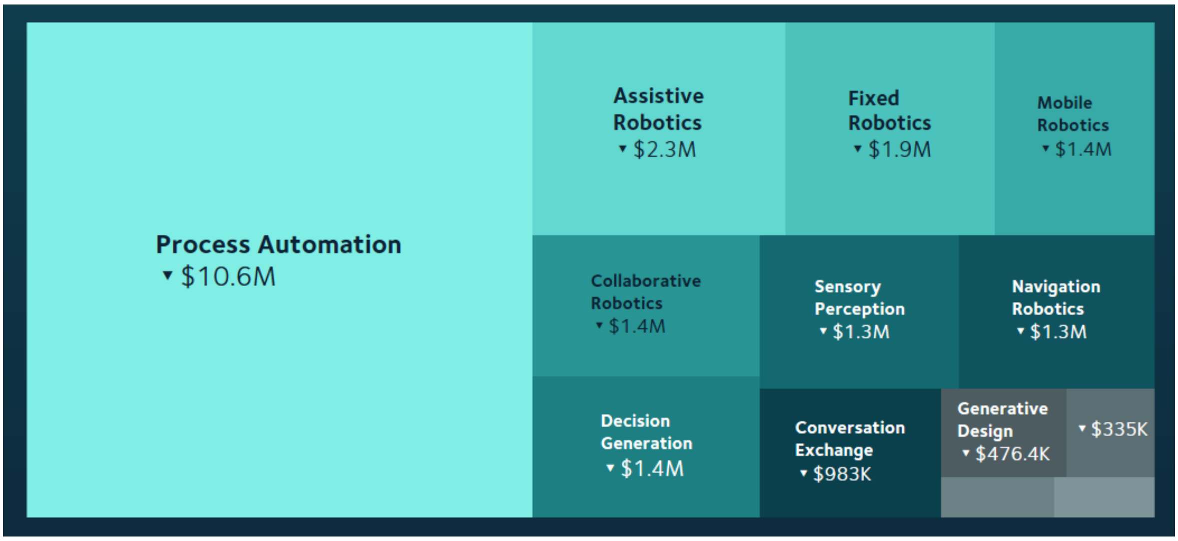
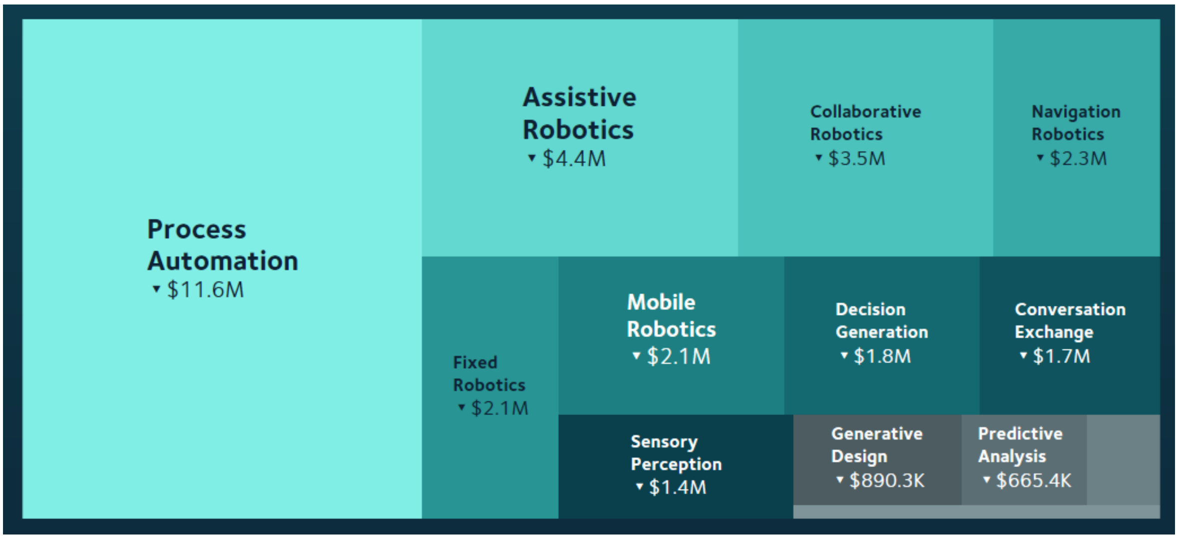


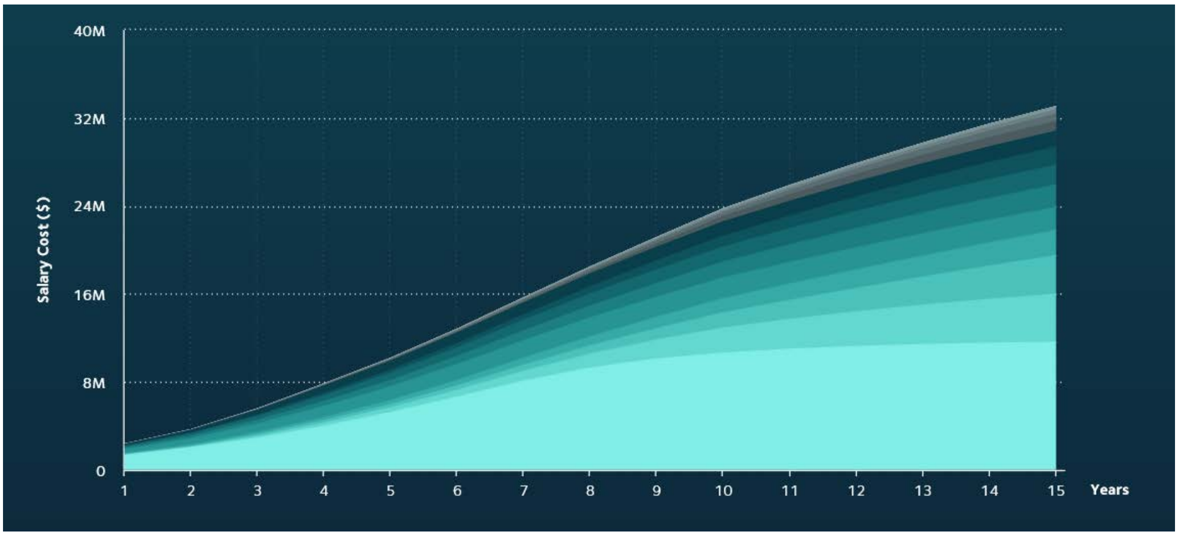
Figure 3.20: Prediction of emerging technology types with the greatest opportunities to drive automation in Health Care and Social Assistance, Greater Whitsunday region, 15 year projection ($AUD salary cost saving)



Source: Faethm (faethm.ai)

These impacts are also summarised in the 2035 year technology projection curve for the Health Care and Social Assistance industry shown in Figure 3.21 below.

Figure 3.21: Automation technology adoption curve over the 15 year horizon (to 2035), Health Care and Social Assistance industry, Greater Whitsunday region



Key from bottom to top – process automation, assistive robotics, collaborative robotics, navigation robotics, fixed robotics, mobile robotics, decision generation, conversation exchange, sensory perception, generative design, predictive analysis, solution discovery, dexterous robotics, creative originations

Source: Faethm

What is meant by these technology categories in the Health Care and Social Assistance context?

Table 3.1 provides a definition for each of the Faethm technology clusters, and examples of what is meant by this in a Health Care and or Social Assistance context. These link together the technologies discussed in the next part of this chapter with the Faethm nomenclature.

Table 3.1: Technology clusters in Faethm and applicability to Health Care and Social Assistance

TECHNOLOGY	DEFINITION (FAETHM)	EXAMPLES IN A HEALTH CARE AND SOCIAL ASSISTANCE CONTEXT
Process Automation	Process Automation technologies use code programmed to complete pre-defined, logical and rule based processing tasks such as quantitative calculations, process onboarding, monitoring and simple robotic jobs and movements. This works by applying rules based logic to take structured inputs and using predefined executable steps, deliver structured outputs.	This includes the automation of administration and business functions through electronic clinical and administrative system and interoperability between these systems. Process improvement may occur in areas including billing, expense processing and invoicing, along with end to end processes like procure to pay.
Fixed Robotics	Fixed Robotics technologies are machines that robotically handle and manipulate objects in a predefined way such as by painting or assembling. This works by combining programmed rules based instructions with vision, sensor systems and mechanics.	In the health context, significant changes to robot-assisted surgery are thought to be imminent with new technologies advancing the development of robotics. New surgical robots will include systems that will record the entire procedure, as well as capturing telemetric data from the robotic arm and instruments. This will enable better evidence-gathering and the refinement of surgical

TECHNOLOGY	DEFINITION (FAETHM)	EXAMPLES IN A HEALTH CARE AND SOCIAL ASSISTANCE CONTEXT
		techniques, leading to better surgical outcomes. [156]
Sensory Perception	Sensory Perception technologies are systems that use sensors to detect and extract meaning from external stimuli and use this as a prompt to an action. This works by using sensors in combination with machine learning to detect and respond to specific external parameters such as information sources and interactions.	Smart devices and wearables provide a way to monitor the individual's different dimensions of health and wellbeing to build a more accurate profile. This allows early identification of risks that can only be detected through long-term monitoring. There are a growing number of examples demonstrating how these technologies can be used, and deliver benefits, in practice.
Decision Generation	Decision Generation technologies are systems that use machine learning to evaluate input data, create options and determine the best course of action or outcome from a number of possibilities. This works by analysing and evaluating inputs, apply algorithmic process and trained logic and past experience to determine outcomes and decide on best course of action.	Key examples emerging in the Health Care and Social Assistance context include predictive analytics, prescriptive analytics and health command centres. These technologies use data-enabled machine learning algorithms to detect useful patterns for prediction of health and wellbeing and other business risks.
Assistive Robotics	Assistive Robotics technologies are agents with highly flexible and perceptive functions capable of adapting to people, needs and scenarios in a support function. This works by using sensors in combination with machine learning and advanced robotics to proactively communicate and detect and respond to interactions.	Key examples of this are bionic exoskeletons which may be used in a rehabilitative, disability support and to support repetitive manual labour in warehousing and distribution. For example bionic exoskeletons are an emerging technology being used in warehousing to support the lifting and rotating movements of humans in an effort to reduce load bearing injuries and improve the health and safety of logistics employees.
Navigation Robotics	Navigation Robotics technologies are robots that can navigate autonomously in unstructured environments with specific functions. This works by applying reinforced learning, advanced sensors and mechanics to plan and conduct live movement between environments.	Examples include autonomous vehicles both within warehouses and hospitals in the form of automated guided vehicles (AGVs) in the delivery of food and linen, and also on the road in the form of driverless trucks to and from distribution centres.
Collaborative Robotics	Collaboration Robotic technologies are agents that contribute to and work jointly with humans to generate shared ideas and work outputs. This works by sensing, supporting and cooperating with humans to complete tasks and assist in designing end solutions.	Examples of this include robotics used to monitor quality of food outputs in aged care or health facilities. Examples of this are Omron and Rethink Robotics which employ vision systems to monitor and verify aspects of products, synthesising data as they go and providing this to humans.
Mobile Robotics	Mobile Robotics technologies are machines that transition between locations and positions, completing robotic handling and object manipulation tasks. This works by combining programmed instructions with moving mechanics to transition between points in a controlled environment.	Key examples are robotics used in warehousing and distribution centres such as Vecna Robotics which offer a combination of collaborative picking and conveyor robots, which can work in warehouses with conventional shelving to pick cartons and boxes, and then move them to pallet-building areas, working alongside humans.

[156] *Royal College of Surgeons. (2018). Future of Surgery.*

TECHNOLOGY	DEFINITION (FAETHM)	EXAMPLES IN A HEALTH CARE AND SOCIAL ASSISTANCE CONTEXT
Conversation Exchange	Conversation Exchange technologies are systems that use machine learning and sensors to interpret and engage in conversation, exchanging ideas and information with humans. This works by applying auditory and speech sensors in combination with Natural Language Processing and speech generation technologies to detect communication and to respond in a social dialogue.	Examples include virtual assistant technologies (such as Amazon's Echo and Google Home) which can provide voice activated virtual assistance, and are increasingly being used to assist people with disabilities.

Predictions of the impact of these technologies being adopted on the Health Care and Social Assistance workforce.

Based on these technology adoption rates, Faethm predicts the opportunity that is created to automate, augment and add to the workforce. The analysis undertaken for the Greater Whitsunday region for the Health Care and Social Assistance workforce over a 5, 10 and 15 year horizon is shown in Figure 3.22, Figure 3.23 and Figure 3.24 overleaf.

Faethm modelling predicts that:

- By 2035, 38.6 percent of the total Health Care and Social Assistance workforce functions and roles will be augmented (or supported) by technology, and 9.5 percent of the current tasks and functions are predicted to be automated (or replaced) by technology;
- The degree of impact of a change in automation and augmentation is also partially determined by the overall size of each occupation within the workforce;
- The Aged and Disabled Carer is the occupation expected to drive the highest overall workforce impact by both automation and augmentation over the 5, 10 and 15 year horizon. By 2030, it is predicted that 11.2 percent of this role will be automated as a result of technology, and 35.8 percent of the role will be augmented by technology;
- The top five occupations driving the greatest workforce impact for the region in Health Care and Social Assistance over the fifteen year period (and at the five and ten year increments) are predicted to be the Aged and Disabled Carer, Medical Receptionist (48.6 percent automatable, 14.3 percent augmentable), Child Care Worker (4.9 percent automatable, 22.3 percent augmentable), Nursing Support Worker (22.0 percent automatable, 29.2 percent augmentable) and General Practitioner (0.9 percent automatable, 50.4 percent augmentable);
- The occupations with the highest predicted level of automation (where technology will replace the need for some tasks and functions) are the Hospital Orderly (59.6 percent), Pharmacy Technician (52.3 percent), Medical Receptionist (48.6 percent), Admissions Clark (48.6 percent) and Pathology Collector (42.2 percent); and
- A number of occupations are predicted to have at least 50 percent of the role augmented by the use of technology by 2035, which means a change to the way in which tasks and functions are performed. This includes all Registered Nursing roles, Midwife, Enrolled Nurse, General Practitioner, Physiotherapist, Resident Medical Officer, Nurse Manager, Optometrist, Naturopath, Occupational Therapist, Chiropractor and Medical Diagnostic Radiographer. This is predicted to occur gradually over the 15 years, with very few roles predicted to have more than 20 percent of the role augmented over the next five years (to 2025).

Figure 3.22: Prediction of tasks within jobs exposed to augmentation and automation in Health Care and Social Assistance, Greater Whitsunday region, 5 year projection (top 15 occupations, by FTE)

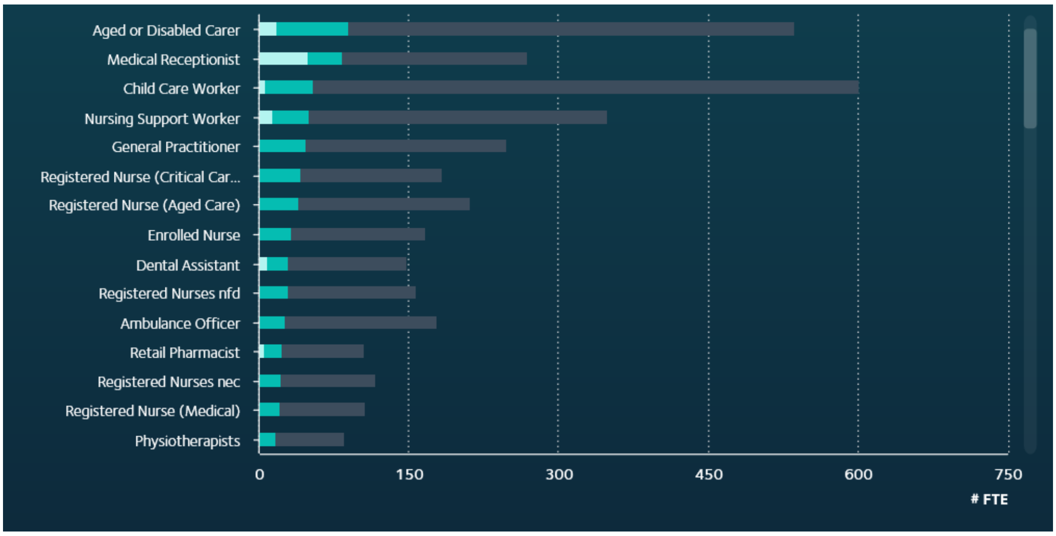


Figure 3.23: Prediction of tasks within jobs exposed to augmentation and automation in Health Care and Social Assistance, Greater Whitsunday region, 10 year projection (top 15 occupations, by FTE)

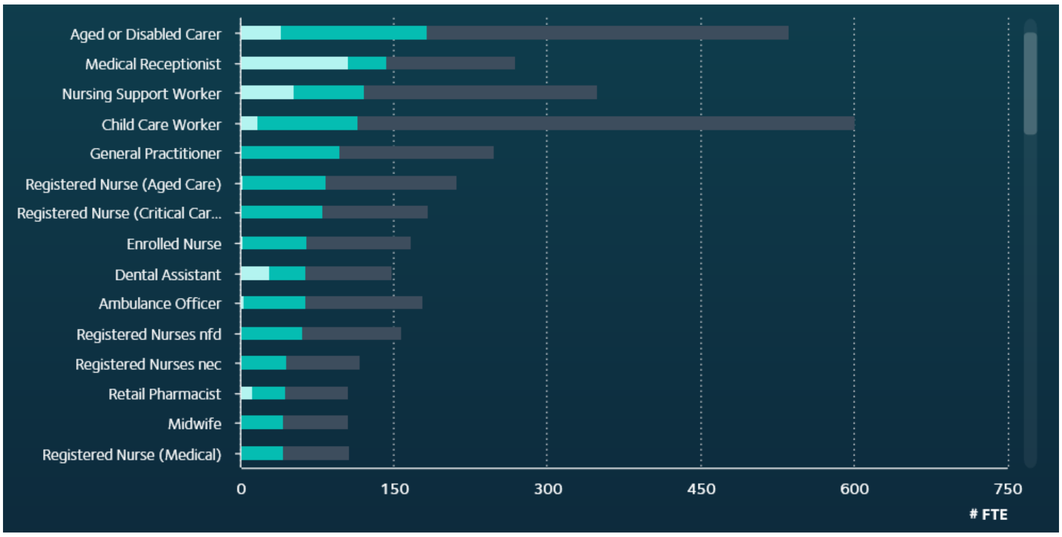
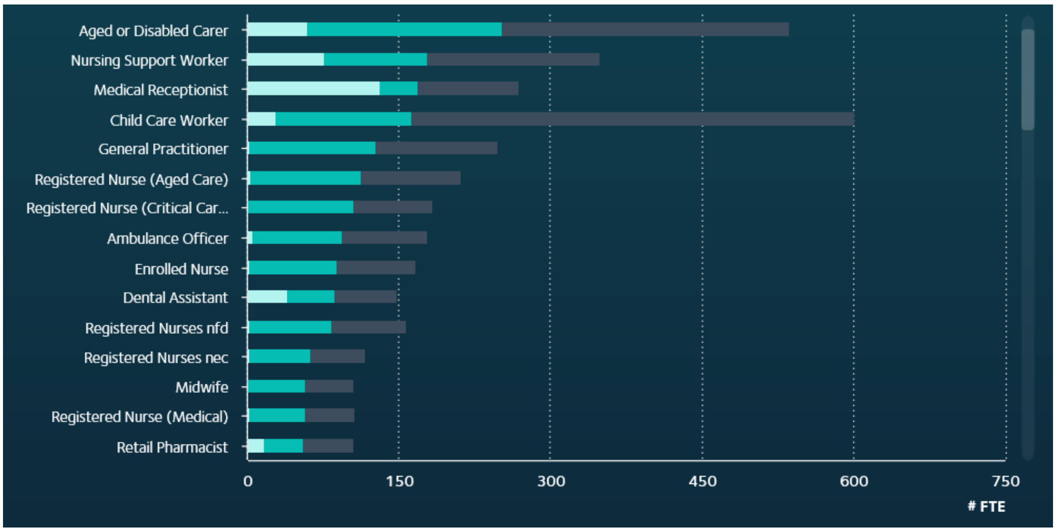


Figure 3.24: Prediction of tasks within jobs exposed to augmentation and automation in Health Care and Social Assistance, Greater Whitsunday region, 15 year projection (top 15 occupations, by FTE)



Source: Faethm (faethm.ai)

It is also important to note that there are a number of new occupations that are expected to increase in demand as a result of the adoption of these technologies.

Figure 3.25, Figure 3.26 and Figure 3.27 show the key occupations expected to be in demand over the 5, 10 and 15 year horizon. These figures show that:

- By 2025, 161 FTE in additional jobs are predicted in the region to support the implementation of Health Care and Social Assistance technology adoption, this grows to 458 FTE by 2035.
- The top five occupations predicted to grow in demand as a result of technology are Software Developers and Application Developers, Software Developers and Systems Support, Process Improvement Analysts, Data Engineers and Data Analysts.
- When viewed against predicted new occupations from the four included industry sectors, the health sector will only increase this workforce by 11.7 percent of the total predicted growth in ICT related roles.

Figure 3.25: Prediction of additional jobs required to support new technologies adopted in Health Care and Social Assistance, Greater Whitsunday region, 5 year projection (top 15 occupations, by FTE)

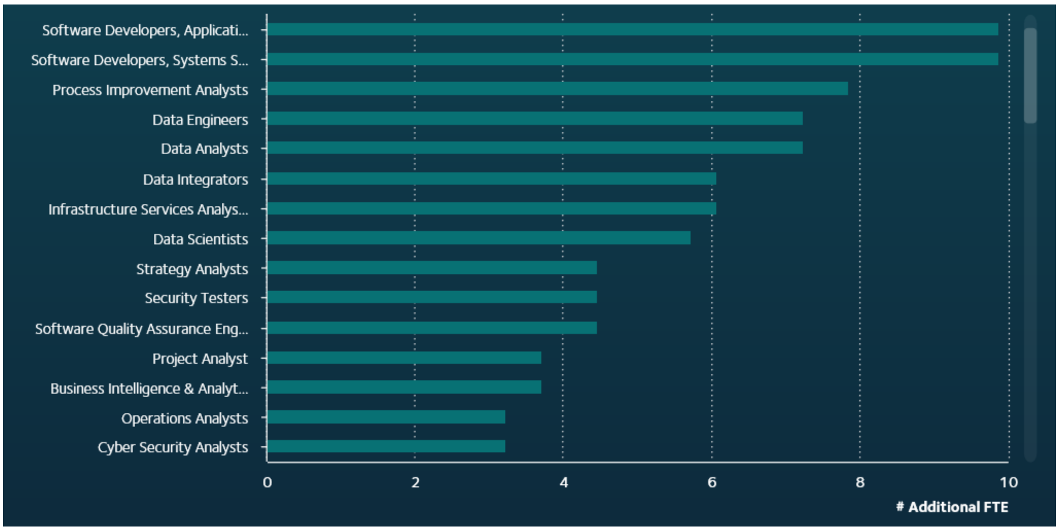


Figure 3.26: Prediction of additional jobs required to support new technologies adopted in Health Care and Social Assistance, Greater Whitsunday region, 10 year projection (top 15 occupations, by FTE)

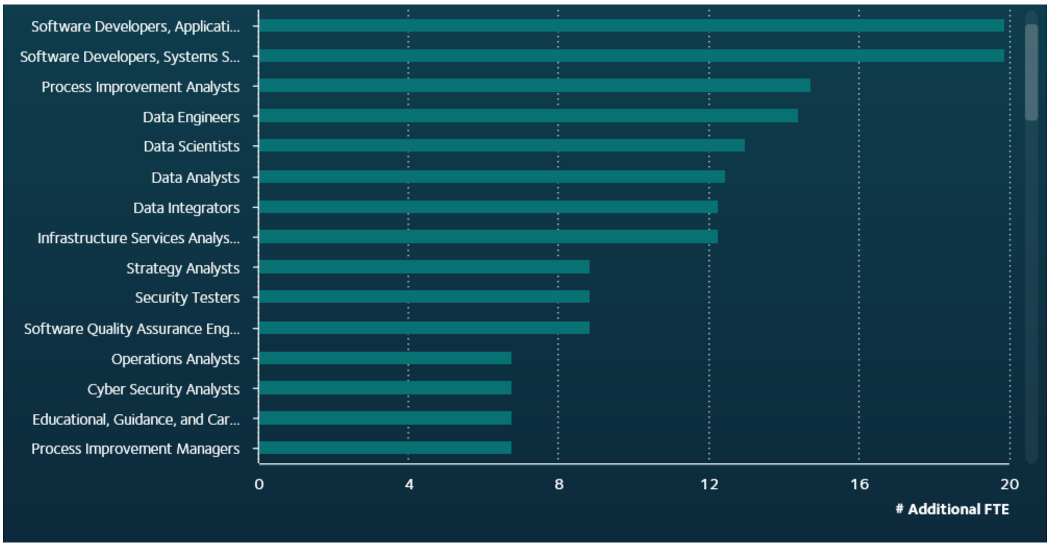
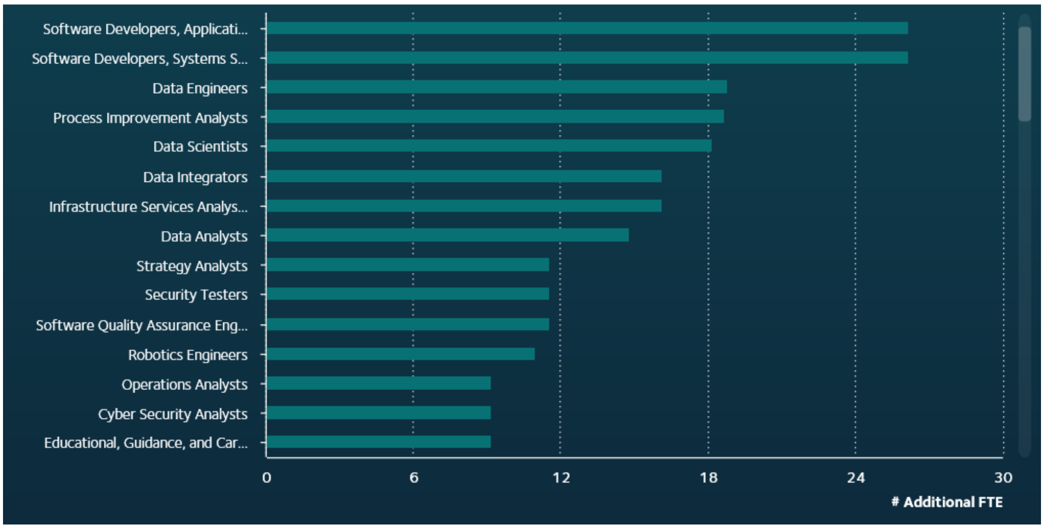


Figure 3.27: Prediction of additional jobs required to support new technologies adopted in Health Care and Social Assistance, Greater Whitsunday region, 5 year projection (top 15 occupations, by FTE)



Source: Faethm (faethm.ai)

A deeper dive:

Technologies emerging in Health Care and Social Assistance

It is important to realise that the roadmap for technological adoption of different "digital disruptors" will be different across every organisation, and depends on the technologies, timeframes, and sequencing chosen by employers and business owners. This means that an organisation's technological roadmap for reform will drive a unique workforce transition process, including the evolution of roles, tasks, processes and workforce design that is associated with that process.

KEY TECHNOLOGIES

The landscape of health care in Australia is changing, over the past two decades Australia has seen digital health technologies transform the way in which healthcare is delivered. These technologies have improved clinical safety, service quality, privacy and confidentiality and are delivering significant efficiencies to the health system as well as clinical benefits.

It is expected that there will be some technologies which will impact the roles, functions and / or ways of working across the whole of the Health Care and Social Assistance industry, while there are other technologies which will impact individual occupation areas differently.

Figure 3.28: The key technologies expected to impact on all of, or a very large proportion of, the Health Care workforce are:

Electronic Medical Record: A repository of clinical information used in patient care, which is captured in a structured computer-readable form that supports interoperability and clinical decision support.

Electronic Medications Management: Software developed to improve patient safety by increasing legibility of prescriptions, implementing decision support and improving access to medical records.

Interoperability: The ability of different information systems, devices or applications to be able to access, exchange, integrate and cooperatively share data in a coordinated matter.

Prescriptive Analytics: The use of modelling, data mining and AI to provide organisations with recommendations around the optimal actions to achieve objectives, they also compare a range of scenarios to determine the impact of choosing one action over another.

Health Service Command Centres: Overcome traditional silos in data and professional practices through co-locating essential expert personnel, automating data collection, defining communication pathways and structuring workflows for a distributed workforce.

Genomics: The analysis of genomes to characterise and map them, allowing for the accurate prediction of how specific sub-types of diseases will progress and how individual patients will respond to different treatments, in turn providing guidance to clinicians regarding the most effective treatment pathway.

Precision Medicine: An emerging approach for disease treatment and prevention, enabled by technological advancements in genomics, AI and data analytics that takes into account individual variability in genes, environment and lifestyle.

AI: A technology that can perform tasks defined by humans without explicit guidance such as planning, learning, reasoning and problem solving.

To be able to effectively respond and adapt to these technologies it is expected that the workforce will require capability development to build foundational digital literacy knowledge. It will also require interventions to drive changes in behaviour that increase the adoption of digital health solutions.

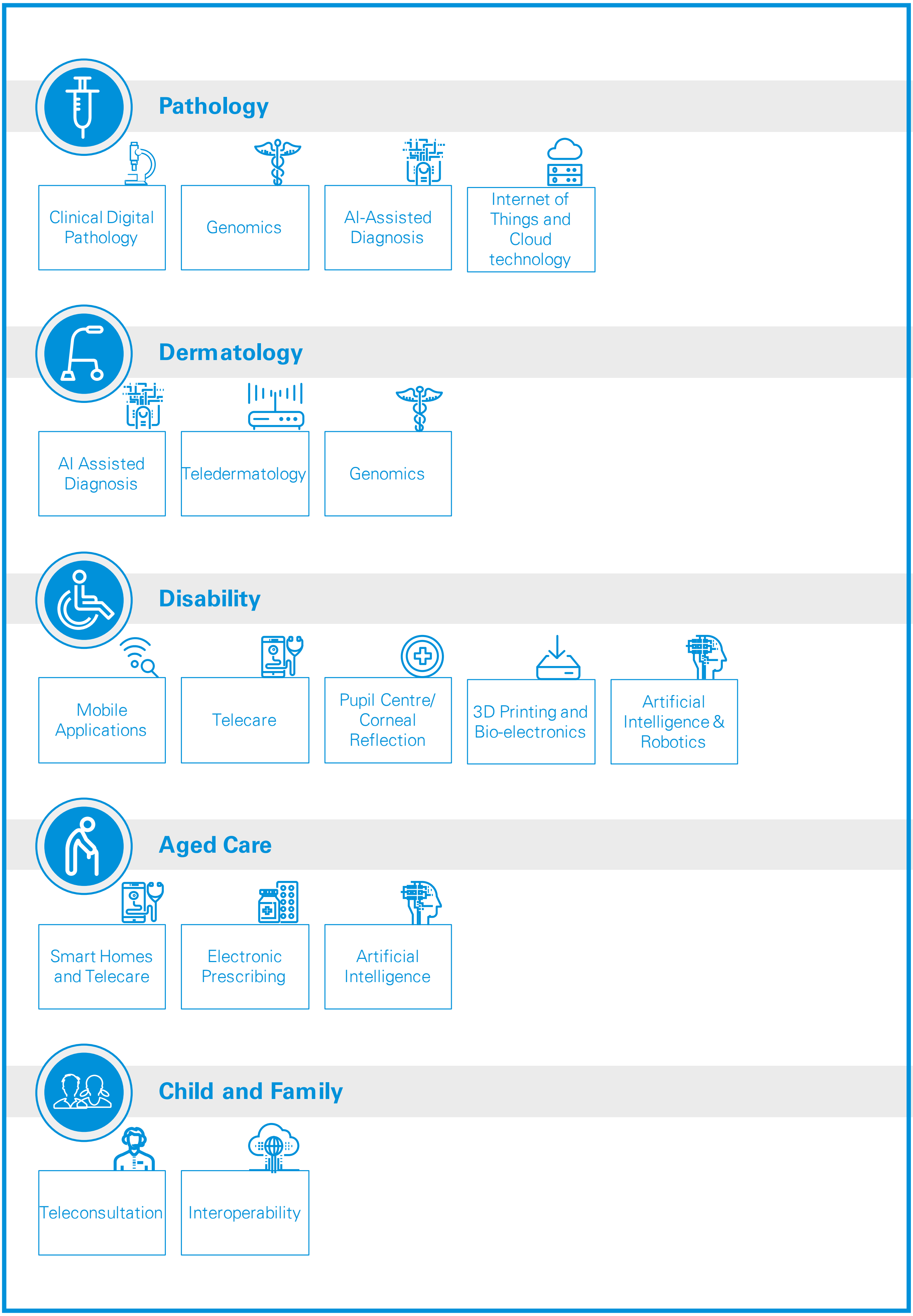
Some of these technologies are in different stages of development, complexity and implementation across the Health Care and Social Assistance industry in Australia (and internationally). In the near term the health sector is expected to focus on embedding foundational technologies (such as Electronic Medical Records, Telehealth, Secure Messaging and ePrescribing / Electronic Medications Management systems), and extending the safe, ethical and effective use of information systems. This immediate focus will see the transition of paper-based practices and systems across health care settings to electronic systems of record.

Other technologies such as AI, Interoperability, Prescriptive Analytics and Genomics are also in the process of being advanced and adopted across Australia and technologies such as Precision Medicine (or Personalised Medicine) and Health Service Command Centres are expected to be more widely adopted over the medium and longer term.

However, there are many additional technologies that are expected to impact on individual occupation areas in specific ways. Figures 3.29 and 3.30 outline at a high level the breadth of technologies and how they impact occupations differently. Further detail on how these technologies impact key segments if the Health Care and Social Assistance industry is provided in Appendix F.

Figure 3.29: High level the breadth of technologies

Figure 3.30: High level the breadth of technologies



Electronic Medical Records

What is an Electronic Medical Record?

An Electronic Medical Record (EMR) is a repository of clinical information used in patient care, which is captured in a structured computer-readable form that supports interoperability and clinical decision support. [160] The term EMR is often used interchangeably with Electronic Health Record or Personal Health Record (PHR), the key differentiator between the three is access to the record. An EMR contains information that is created and retained within a single organisation, whereas an EHR contains information that can be managed across multiple organisations, and a PHR is an electronic application which an individual can manage and share their information with only who they authorise. [161]

How is it being applied within the sector?

Health care providers from across the sector are transitioning into the digital era by adopting and implementing electronic health record systems, largely driven by the ADHA's 2017 National Digital Health Strategy and commitment to connect all Australians to the My Health Record system. The majority of Australians now have a My Health Record (22.75 million records), and approximately 90 per cent of GPs, pharmacies and public hospitals have also registered to use the system. [162]

EMRs enable the effective incorporation and flow of digital information throughout hospitals. These advances not only offer potential quality and safety benefits, but through their implementation, also establish a strong core and critical ICT infrastructure that can be a foundation for further innovation.

Healthcare associations such as the Royal College of Australian General Practitioners, the Pharmacy Guild of Australia and the Australian Health care and Hospital Association believe that adoption of EMR systems will reduce cost and improve safety, quality and efficiency of health care in the country. [163]

CASE STUDY - EMERGING SYSTEMS

Sydney-based information technology company Emerging Systems installed its multi-function clinical information system to support clinical service delivery in a number of major Australian hospitals and healthcare facilities, including St Vincent's Private Hospital, Sydney.

The Clinical Information System in use at St Vincent's Private Hospital tracks, guides and records care delivery from pre-admission to discharge. [157]

CASE STUDY - QUEENSLAND HEALTH

Queensland's integrated electronic medical record system has been progressively rolled out at public hospitals from 2011, with the aim to have 27 Queensland hospitals live with advanced systems by the end of 2020.

Beaudesert Hospital became the first Australian rural digital hospital in 2017, using computers and mobile digital devices instead of paper files to document and access patients' medical information. [158]

CASE STUDY - ROYAL MELBOURNE HOSPITAL

The Royal Melbourne Hospital together with the Peter MacCallum Cancer Centre, Royal Women's Hospital and Royal Children's Hospital created one world-class EMR, which stores information about all patients in one secure location.

The EMR includes a patient portal where patients are able to view and manage upcoming appointments, test results and prescribed medications. [159]

What is the impact?

The transition from paper-based records to electronic records enables both increased efficiencies in workflow, as well as a greater ability to process and transfer data. In areas such as pathology, sample slides can be documented in fully digital systems, eliminating the need for transportation of slides between facilities and enabling greater collaboration between sites. To achieve the potential benefits, the whole medical workforce must have knowledge of the operation of data management systems, as well as the subsequent ethical implications and medico-legal barriers.

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[157] *Australian Unlimited. 2016. Digital Health. Australian Trade Commission.*
[158] *Queensland Government. 2018. Better patient care through digital. Accessed from https://www.forgov.qld.gov.au/better-patient-care-through-digital*
[159] *The Royal Melbourne Hospital. 2019. Electronic Medical Record. Accessed from https://www.thermh.org.au/patients-visitors/coming-hospital/electronic-medical-record*
[160] *Victoria State Government. 2012. Defining an electronic medical record.*
[161] *Australian Digital Health Agency. 2018. Types of digital health records. Accessed from https://www.digitalhealth.gov.au/get-started-with-digital-health/digital-health-evidence-review/types-of-digital-health-records*
[162] *My Health Record. 2020. The Big Picture. Accessed from https://www.myhealthrecord.gov.au/statistics*
[163] *Osman G. 2019. Australia contributes to growing HER market size. Accessed from https://www.healthcareit.com.au/article/australia-contributes-growing-ehr-market-size*

Electronic Medications Management and ePrescribing

What is the case for Electronic Medications Management and ePrescribing?

Medication errors cost an estimated $1.3 billion each year in Australia, increasing the risk to patients, and potential length of stay in hospitals. [167] Electronic Medications Management (EMM) has been developed to improve patient safety by increasing legibility of prescriptions, implementing decision support and improving access to medical records. EMM can be applied to a range of systems such as:

- Prescribing systems, such as GP desktop systems or hospital clinical information systems;
- Decision support systems that are used to check medication interactions or allergy history;
- Dispensing systems such as pharmacy software and automated dispensing systems;
- Ordering and supply solutions, such as electronic transfer of prescriptions; and
- Electronic medical records. [168]

As a patient is discharged from hospital, ePrescribing will then enable them to manage their own health with reduced errors, increased efficiency, and greater choice. ePrescribing is the complete digitisation of prescription management. In Australia, this allows prescribers and their patients to use an electronic Pharmaceutical Benefits Scheme (PBS) prescription. ePrescribing removes the need for handling and storing a physical paper prescription. The key benefits of ePrescribing is that prescriptions are legible, traceable, and accurate, and will reduce dispensing errors. ePrescribing will also integrate with the digital health ICT infrastructure to support electronic medication charts in hospitals and aged care facilities, allowing a complete view of the patient's past medication, ensuring continuity of patient care. [169]

CASE STUDY - HUNTER NEW ENGLAND LOCAL HEALTH DISTRICT

Hunter New England Local Health District has been driving innovation in a range of ways, moving to a more value-based care model and embedding an EMR system across the district, with around 75 per cent of medication management across the district now being digitally delivered. [164]

CASE STUDY – CHILDREN'S HOSPITAL WESTMEAD

The Children's Hospital at Westmead was the first paediatric hospital in Australia to go live with EMM in 2016. The system allows clinicians to prescribe medication at the bedside using laptops and other smart devices, helping to reduce errors in prescribing and administrating medication. Research from Macquarie University shows that medication errors in children's hospitals for high-risk medications have the potential to drop by almost 40 per cent following the rollout of EMM. [165]

CASE STUDY – ANGLESEA MEDICAL

Anglesea Medical is one of the first GP clinics in Australia to use ePrescribing in 2020. The process was reported to be as straightforward as writing a physical prescription. The prescription is sent using a digital token and encrypted channels to the pharmacy. Within the pharmacy, the ePrescription process integrates well with existing platforms and workflows. The patient then presents a QR code which is sent through email or SMS at the time of prescription, which is scanned at the pharmacy and the medication is dispensed. [166]

[164] *Healthcare IT. 2019. Driving disruptive innovation in healthcare. Accessed from https://www.healthcareit.com.au/article/driving-disruptive-innovation-healthcare*
[165] *The Sydney children's Hospitals Network. 2016. Paper-free is child's play for electronic medication management. Accessed from https://www.schn.health.nsw.gov.au/news/articles/2016/04/paper-free-is-childs-play-for-electronic-medication-management*
[166] *Hendrie, D. (2020) (RACGP) Electronic prescribing enters testing phase ahead of rollout.*
[167] *Macquarie University. 2020. Fewer medication mistakes in children's hospitals will save millions. Accessed from https://lighthouse.mq.edu.au/article/march/fewer-medication-mistakes-in-childrens-hospitals-will-save-millions*
[168] *Australian Commission on Safety and Quality in Healthcare. 2019. Electronic medication management. Accessed from https://www.safetyandquality.gov.au/our-work/medication-safety/electronic-medication-management*
[169] *Department of Health. (2020) Electronic prescribing. Retrieved from: https://www.health.gov.au/initiatives-and-programs/electronic-prescribing*

How is it being applied within the sector?

There are a number of EMM systems available, ranging from software for individual practitioners to district wide systems. The technology is often packaged with an EMR to deliver an integrated system that includes both electronic clinical records and EMM functionality.

The Commonwealth Department of Health has recently partnered with the ADHA and Services Australia to ensure electronic prescriptions are available across Australia. There are two models proposed to support electronic prescriptions, which include the Token Model and the Active Script List Model. [170]

ePrescribing has begun its rollout in Australia, led by the Australian Government and ADHA. This has occurred ahead of schedule due to the increased need for virtual service delivery as a result of COVID-19. [171]

Most States and Territories have passed regulatory changes to recognise ePrescriptions as a legal document permitting medicines to be dispensed. On 6 May 2020, Australia completed its first end-to-end electronic prescription in primary care to be dispensed by the pharmacist and claimed through Services Australia. [172]

ADHA and the Department of Health are now evaluating ePrescribing in some GP clinics and pharmacies to address technical and workforce issues prior to a national rollout between October and December 2020. [173]

What is the impact?

By using EMM and ePrescribing, healthcare providers are able to reduce the number of preventable adverse medication events, and medication prescribing and dispensing errors that can occur through human error. The system improves accuracy, visibility and legibility of medical information, ensuring that the communication between professionals and patients is clear.

[170] *ADHA. 2020. Electronic Prescriptions – For Dispensers. Accessed from https://www.digitalhealth.gov.au/get-started-with-digital-health/electronic-prescriptions/for-dispensers*
[171] *Hendrie, D. (2020) (RACGP) Electronic prescribing enters testing phase ahead of rollout.*
[172] *Hendrie, D. (2020) (RACGP) Electronic prescribing enters testing phase ahead of rollout.*
[173] *Hendrie, D. (2020) (RACGP) Electronic prescribing enters testing phase ahead of rollout.*

Interoperability

What is Interoperability?

Interoperability is the ability of different information systems, devices or applications to be able to access, exchange, integrate and cooperatively share data in a coordinated matter. The Health care Information and Management Systems Society (HIMSS) determined there are four levels of interoperability:

- Foundational (Level 1) – establish the inter-connectivity requirements needed for one system or application to securely communicate data to and receive data from another.
- Structural (Level 2) – defines the format, syntax, and organisation of data exchange including at the data field level for interpretation.
- Semantic (Level 3) – provides for common underlying models and codification of the data including the use of data elements with standardised definitions from publicly available value sets and coding vocabularies, providing shared understanding and meaning to the user.
- "New" Organisational (Level 4) – includes governance, policy, social, legal and organisational considerations to facilitate the secure, seamless and timely communication and use of data both within and between organisations, entities and individuals. These components enable shared consent, trust and integrated end-user processes and workflows. [176]

CASE STUDY - ST STEPHEN'S HOSPITAL IN HERVEY BAY

St Stephen's Hospital in Hervey Bay is demonstrating the benefits of improved interoperability after integrating different systems within the hospital to ensure clinicians are able to deliver better care more safety and help patients feel more supported and engaged. St Stephen's was awarded the HIMSS Davies Award of Excellence for its use of connected technology to boost patient safety and improve quality outcomes. [174]

CASE STUDY: DOING IT BETTER INTEROPERABILITY WORKING GROUP

Doing IT Better is a three-year project to build ICT capacity in the Victorian community services sector, and is a social justice initiative of the Centre for Community Networking Research (Faculty of Information Technology), Monash University and the Victorian Council of Social Service. The project focuses on achieving three outcomes: effective governance, content sustainability, and interoperability. [175]

How is it being applied within the sector?

Following the breadth of adoption in digital health technologies across the country, specifically EMRs, interoperability has become an important focus for the ADHA, as stated in the 2017 National Digital Health Strategy. In recognition of the importance of interoperability the ADHA engaged in a co-design approach to develop the National Health Interoperability Roadmap, and in 2019 opened an online consultation for Australians to provide their thoughts and feedback on the roadmap. [177]

Strong health ICT infrastructure is required to advance the integration of high quality EMR and eMeds data that is accessible to relevant staff across public, private, primary, community, and hospital settings. This integration can enable timely information flow and deliver a seamless continuum of care to meet patient needs, regardless of clinical setting. It can also improve the health outcomes of patients, and reduce the time and cost of the patient's journey through the health system.

What is the impact?

Paper-based records and notes are being replaced by EMRs at hospitals, pharmacies and GPs. However, the process of EMR implementation has resulted in a number of silos of patient information across the country. Interoperability is the next step to ensure that both consumers and providers have access to health information from a range of sources to ensure that clear and transparent clinical decisions are being made.

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[174] Millard M. 2019. Australia's St. Stephen's Hospital earns HIMSS Davies Award for device integration, patient safety. Accessed from https://www.healthcareitnews.com/news/australias-st-stephens-hospital-earns-himss-davies-award-device-integration-patient-safety
[175] Doing IT Better Interoperability Working Group. 2008. The Interoperability Challenged. Accessed from http://www.doingitbetter.vcoss.org.au/docs/iwg-positionpaper.pdf
[176] HIMSS. 2018. What is interoperability in healthcare? Accessed from https://www.himss.org/what-interoperability
[177] Australian Digital Health Agency. 2019. Interoperability in 2019: watch this space. Accessed from https://www.digitalhealth.gov.au/about-the-agency/digital-health-space/interoperability-in-2019-watch-this-space

Prescriptive Analytics

What is Prescriptive Analytics?

Prescriptive analytics uses modelling, data mining and AI to provide organisations with recommendations around the optimal actions to achieve objectives. They also compare a range of scenarios to determine the impact of choosing one action over another. Prescriptive analytics differs from predictive analytics in that it demonstrates suggested actions to make healthcare providers more successful, profitable or responsive to patient needs.

How is it being applied within the sector?

The exponential growth in information within the health system as a result of adopting EMR and EMM will be especially useful to advance predictive analytics enabled by large datasets. Rather than the manual compilation of individual patient data to provide a knowledge base for diagnosis, data-enabled machine learning algorithms can detect useful patterns for prediction of health risks. This will not only be beneficial to individual patients, but also for broader population health management.

Individual users are provided with useful information about predicted health risks from assessment of data about their lifestyle, vital data trends, pre-existing conditions, and medications. Users or their physicians can also receive automated information about the most effective preventative measures. This same data can also be used to analyse population health trends, assisting administrators in better allocating resources to at-risk regions or demographics.

CASE STUDY – NPS MEDICINEWISE

Early stages of this technology can be seen within Australia's National Prescribing Service (NPS), which has established the MedicineWise program. The program gathers health information from medical records from over 800 GPs and provides this information to clinical researchers for analysis. The program has yielded numerous quality improvement insights. These include identification of predictors and outcomes associated with inappropriate prescribing of antibiotics in general practices, and the monitoring and evaluation of the Heart Foundation's Risk Reduction Program.

CASE STUDY – DIJON UNIVERSITY HOSPITAL CENTRE (CHU DIJON) FRANCE

Dijon University Hospital Centre (CHU Dijon) in France has hospitals distributed across a wide geographical area which has created challenges in intra-hospital patient transport. The hospital implementation of an optimisation model of their transport data using prescriptive analytics helped them to manage and execute multiple daily transport requests. They improved punctuality by 25 per cent and reduced patient wait times. [178]

Based on decision optimisation technology, prescriptive analytics solutions will be able to detect increased prevalence of comorbidities in certain patient groups. For example, hypothetically, if the technology finds a pattern that there is an increased diagnosis of retinopathy in diabetic populations, the system would alert administrators in order to start an early detection scheme for this population.

Prescriptive analytics has a wide range of applications and is already being used in both acute and primary health care settings across the world.

What is the impact?

The benefit of prescriptive analytics is that it goes a step further than traditional predictive models by helping organisations forecast future outcomes and provide options or recommendations on the best step forward. Prescriptive analytics can assist hospitals with reducing costs, delivering higher quality services and improving operational transparency.

[178] *SD Global. 2020. Prescriptive Analytics in Healthcare – What is it and why companies should care? Accessed from https://www.sdglobaltech.com/blog/prescriptive-analytics-in-healthcare-what-is-it-and-why-companies-should-care*

Health Service Command Centres

What are Health Service Command Centres (HSCC)?

HSCCs overcome traditional silos in data and professional practices through co-locating essential expert personnel, automating data collection, defining communication pathways and structuring workflows for a distributed workforce.

HSCCs are increasingly becoming the 'brains' of the hospital, or even a cluster of hospitals. Similar to command centres of space programs, HSCCs are equipped with large screens, highly skilled workforces, large datasets, and are powered through AI and predictive analytics. It enables a complete view of the status of the hospital or cluster of hospitals, including capacity of beds, locations of ambulances, staff and specialist locations. They can transmit data and messages from each facility, room and patient monitoring devices.

This collection of integrated devices and workforces allows for faster and more accurate decision making for hospital transfers, care logistics, and staffing. HSCCs are also dramatically increasing efficiency and patient outcomes in hospitals around the world. Hospitals are 'unlocking' more beds through rapid transfer of patients, and analytics from received data can detect early signs of harm, ensuring time-sensitive care requirements are addressed on time and early signs of deterioration is immediately notified to nearby clinicians. [181]

How is it being applied within the sector?

Effective management of patient, hospital, and equipment related data and facilitation of capabilities like prescriptive analytics cannot be achieved through fragmented sites. The establishment of real-time command centres has shown to effectively manage and utilise large quantities of data and dramatically improve patient outcomes.

Command centres have existed for many years across some industries such as aerospace and aviation, oil and gas and broadcasting, however they are a more recent addition to the health care sector. Over recent years more hospitals have been adopting the command centre model to break down silos that have emerged from years of traditional functional unit models.

What is the impact?

The transparency and processing of complex information that command centres can provide help improve patient capacity management and other operational processes.

CASE STUDY - JOHNS HOPKINS HOSPITAL

Johns Hopkins Hospital established a command centre powered by prescriptive analytics and high quality EMR data in 2016. Through effective coordination of services and equipment to respond to patient needs, they achieved a 35 percent decrease in emergency department wait times, and a 70 percent decrease in surgery wait times.

CASE STUDY - ST JOHN OF GOD HOSPITAL

In Australia, St John of God's Murdoch and Subiaco hospitals have implemented clinical command centres to ensure a patient's journey through theatres is smooth from start to finish.

Both the St John of God Murdoch and Subiaco Hospitals have implemented clinical command centres to provide an overview of a patient's progress through large digital screens in the command centre and on screens within the theatres.

Through implementing this technology both hospitals have found enhanced patient flow and communication throughout the hospitals. [179]

CASE STUDY - CLEVELAND CLINIC

In 2014 the Cleveland Clinic launched a clinical command centre where a team of physicians, critical-care nurses and technical staff monitored data on a digital wall in real time at the intensive care units. The team used analytical algorithms and multidimensional data to stratify patients based on risk and demographic profiles. The team also used data from EHRs to provide alerts for patients displaying higher risk levels. In the first half of 2015, the command centre reviewed data on more than 37,800 ICU patients. [180]

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[179] *St John of God Health Care. 2018. Clinical Command Centre technology powering theatres. Accessed from https://www.sjog.org.au/news-and-media/news/2018/08/24/06/42/clinical-command-centre-technology-powering-theatres*

[180] *Deloitte. 2018. The hospital of the future: How digital technologies can change hospitals globally. Accessed from https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Life-Sciences-Health-Care/us-lshc-hospital-of-the-future.pdf*

[181] *GE Healthcare. (2019) Ground Control to Major Growth in Hospital Command Centres. Retrieved from: https://www.gehealthcare.com/article/ground-control-to-major-growth-in-hospital-command-centers*

Genomics

What is Genomics?

Genomics is the analysis of genomes to characterise and map them. This allows for the accurate prediction of how specific sub-types of diseases will progress and how individual patients will respond to different treatments, in turn providing guidance to clinicians regarding the most effective treatment pathway. Progress in genomics has seen the cost of a human genome sequence fall from over $100 million in 2001, to $1,000 in 2018, increasing access and opportunity for its application. [184]

How is it being applied within the sector?

Genomics has the potential to reshape clinical practice and fundamentally change the way that clinicians diagnose, treat and monitor illness. However, the practical application of genomics in health care brings with it ethical and social challenges of how health services should use genomic information to improve health care of the population. In recognition of the importance of genomics, in 2018 the Australian Health Ministers' Advisory Council (AHMAC) produced the National Health Genomics Policy Framework. The framework identified five key priorities to support the integration of genomics into health care between 2018 and 2020. The priorities were: a person-centred approach; building a skilled workforce; ensuring sustainable investment; maximising the quality and safety of genomics in health care; and the responsible collection and handling of genomic data. [185]

Genomics research and genomics based care is already impacting the workforce today. The demand for genomics data has seen increased demand for skilled specialists to extract, interpret and deliver patient genetic data for use in specialties such as pathology, radiology and surgery. Recent Medicare Benefits Scheme (MBS) requirements dictate that genomics laboratories must be led by genetic pathologists, driving up their demand, which has in turn led to the creation of accelerated accreditation processes.

CASE STUDY - UNIVERSITY OF NEW SOUTH WALES (UNSW)

A two-year project called PreGen led by UNSW and NSW Health Pathology received $4.9 million in funding from the Australian Government Medical Research Futures Fund (MRFF) to perform genomic tests in families seen at ten of Australia's largest maternity centres. The project will improve knowledge about the conditions causing malformations, improve available testings and promote international collaborations to understand genetic conditions that may occur in babies. [182]

CASE STUDY - SWINBURNE UNIVERSITY OF TECHNOLOGY

The Australian Government's Genomics Health Future Mission awarded Swinburne researchers almost $500,000 for a project to examine the public's concerns about ethical and social issues related to the use of genomics in health care.

The project will provide an evidence base to guide how to best engage with different segments of the public in relation to different forms of industry involvement. [183]

What is the impact?

Genomic medicine has the potential to help the health system in overcoming some of the biggest challenges, such as increasing demand on the health system from our ageing population, increased presentations of complex chronic conditions and the rising cost of health care. Genomics can work to identify individuals at risk of diseases and significantly reduce the incidence of disease, and therefore the number of acute presentations and burden on our health system. Genomics is expected to bring transformative change to the health care sector, moving towards personal health optimisation and personalised medicine. [186] In Queensland, the Queensland Genomics Health Alliance (Queensland Genomics), a $25 million program funded by Queensland Health and led by the University of Queensland, leads the discussion on genomic medicine in the State and fosters collaboration between health care providers, researchers and health consumers. [187]

[182] UNSW Sydney. 2020. Research into the health of unborn babies receives government funding. Accessed from https://newsroom.unsw.edu.au/news/health/research-health-unborn-babies-receives-government-funding
[183] Swinburne University. 2020. Swinburne researchers to examine public trust in genomics in health care. Accessed from http://www.swinburne.edu.au/news/latest-news/2020/05/swinburne-researchers-to-examine-public-trust-in-genomics-in-health-care.php
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[186] Inquiry into Chronic Disease Prevention and Management in Primary Health Care. 2010. The impact of genomics on the future of medicine and health.
[187] Health Consumers Queensland. (2019) Queensland Genomics Health Alliance. Accessed from: http://www.hcq.org.au/apply-to-join-the-queensland-genomics-health-alliance-community-advisory-group/

Precision Medicine

What is Precision Medicine?

Precision medicine is an emerging approach for disease treatment and prevention, enabled by technological advancements in genomics, AI and data analytics, that takes into account individual variability in genes, environment and lifestyle. [190] Precision medicine has the ability to improve diagnosis accuracy and reduce unwarranted variations in diagnosis through understanding the causes and progression of the disease.

How is it being applied within the sector?

Precision medicine has become a funding priority across many countries, with strategies seeking to accelerate the discovery of markers of disease and treatment models that can be applied cost-effectively at scale. In response to the growing interest in precision medicine the Health Informatics Society of Australia has established a Precision Medicine Community of Practice to work with the wider health ecosystem.

Precision Medicine is closely linked to genome technologies and advancements in genomic testing. Treatment approaches based on genetic variations and biomarkers have been increasing as genomic technology has evolved. Genetic variants have also been shown to influence the metabolism of drugs, meaning that a patient's genomic information could be used to rationalise and guide treatment and prescription options.

A recent focus on research into precision treatments has been on genome editing or engineering which offer options to patients with rare conditions that were previously untreatable such as patients with advanced oesophageal cancer and leukaemia and lymphoma. However, due to the early stages of these clinical trials and the current limitations of genomic medicine these treatments are expensive and unlikely to be viable options for the majority of patients.

CASE STUDY - CNSDOSE

An Australian biotech company, CNSdose, has developed and launched a DNA-guided prescription tool to help doctors to personalise treatments.

The tool, Amphis, was created to help doctors assess multiple patient factors, reducing the risk of adverse medical reactions and implementing an appropriate medical treatment plan. The tool was developed from research into blood-brain barrier genetics that aids the selection of optimal antidepressants.

CASE STUDY - THERMOFISHER ONCOMINE ASSAY

Although still in the research phase, when oncologists at the Children's Hospital Los Angeles were presented with a 2-year-old cancer patient with a large, and fast growing mass on her neck which was suffocating her, they were able to use the Oncomine Childhood Cancer Research Assay to run a complete genomic analysis of the child's tumour in a record time of 48 hours. [188] This enabled the oncologists to determine the specific gene contained within the tumour and was able to quickly enrol the patient in an advanced clinical trial that specifically targets the gene to treat the patient. [189]

What is the impact?

Precision medicine has the potential to improve the health of the Australian population whilst creating new opportunities for research and innovation. Once precision medicine is widely adopted it could shift health care spending from management of chronic conditions to a proactive and preventative approach, transforming the way in which we diagnose, treat and monitor health care.

The widespread adoption of precision medicine focused on individualised variations in pathology will challenge the traditional public health policy and funding agreements which are based on safety, efficacy and efficiency. [191]

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[188] ThermoFisher Scientific. (2020) Oncologists identify cancer patient's NTRK gene fusion in unprecedented 48 hours. Accessed from https://www.oncomine.com/outcomes
[189] ThermoFisher Scientific. (2020) Oncologists identify cancer patient's NTRK gene fusion in unprecedented 48 hours. Accessed from https://www.oncomine.com/outcomes
[190] Office of the Chief Scientist. 2018. Precision Medicine. Accessed from https://www.chiefscientist.gov.au/sites/default/files/Precision-medicine-final.pdf
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Artificial Intelligence

What is Artificial Intelligence?

AI is a technology that can perform tasks defined by humans without explicit guidance. AI systems will demonstrate behaviours associated with human intelligence such as planning, learning, reasoning and problem solving. AI is evolving every day, and has the ability to mimic or surpass human cognitive or analytical capabilities to perform tasks. AI also possess the ability to 'learn', where its capabilities are improved by performing its intended action with varied and more complex data.

There are three main categories of AI devices: machine learning; natural language processing; and deep learning. Machine learning analyses structured data like genetic and imaging data, clustering traits of patients and assessing the disease outcome probability. Natural language processing analyses unstructured data like medical literature and clinical notes, aiming to turn text into machine readable structured data that can then be analysed by machine learning. Deep learning is a subset of machine learning and leverages algorithms inspired by the human brain to learn from large amounts of data at a rapid pace. [194]

How is it being applied within the sector?

AI has the potential for a wide range of applications across the Health Care sector. For example, around 80 per cent of health care data is unstructured, and the NLP category of AI devices ensures that the information can be read, understood and translated into machine readable structured information. [195]

Many health executives believe that every human will be directly impacted on a daily basis by an AI-based decision within the next three years, however AI is advancing faster than organisations' pace of adoption. [196]

As AI capabilities in health care continue to evolve, organisations need to utilise AI in a way that appropriately considers ethical concerns that are present for the industry, such as privacy and ensuring a duty of care. Many organisations are developing internal ethical standards relating to the use of AI to ensure their AI systems are designed to act responsibly.

CASE STUDY - ROYAL AUSTRALIAN AND NEW ZEALAND COLLEGE OF RADIOLOGISTS

The Royal Australian And New Zealand College of Radiologists released a paper in 2019 outlining nine ethical principles for artificial intelligence in medicine. The principles aim to guide the:

- development of standards of practice for research in AI tools;
- regulation of market access for machine learning and AI;
- development of standards of practice for deployment of AI tools in medicine;
- upskilling of medical practitioners in machine learning and AI; and
- ethical use of machine learning and AI in medicine. [192]

CASE STUDY – IBM WATSON FOR GENOMICS

For an AI system to be successful it requires both the machine learning component of AI technology to analyse complex information and the natural language processing component to digest the unstructured data. IBM Watson for Genomics uses AI to provide validated, comprehensive variant information enabling molecular pathology laboratories to scale their precision oncology programs. IBM Watson for Genomics leverages AI to extract the unstructured data from literature to continue to learn and grow its knowledge. [193]

What is the impact?

AI is expected to impact through improved diagnostic capability, for example in identifying cancers on scans, and augment and support medical specialists such as radiologists and dermatologists in their care. Specialists can transfer workloads that involve repetitive and high volume tasks and low cognitive skills to supporting AI. In turn this enables them to either reduce workloads, improve delivery of care by giving specialists more time to analyse patient data and/or improve delivery of service by increasing time spent with the patient.

[192] *The Royal Australian and New Zealand College of Radiologists. 2019. Ethical Principles for Artificial Intelligence in Medicine.*
[193] *IBM Watson for Genomics. 2020. Watson for Genomics. Accessed from https://www.ibm.com/au-en/marketplace/watson-for-genomics*
[194] *Sharma, Z., Chauhan, A., Vepanattu, P. 2019. The impact of artificial intelligence on healthcare.*
[195] *IBM Watson Health. 2020. Artificial Intelligence. Accessed from https://www.ibm.com/watson-health/learn/artificial-intelligence-medicine*
[196] *Accenture. 2018. Digital Health Tech Vision 2018 Intelligent Enterprise Unleashed. Accessed from https://www.accenture.com/t20180625T060849Z__w__/us-en/_acnmedia/PDF-78/Accenture-digital-health-tech-vision-2018.pdf*

Bringing the story together:
Workforce impacts expected for the Greater Whitsunday region

Clients pay for our clinical reasoning, our analysis, our support and our expertise. Technology will never be able to replace the role of the therapist but could complement the role, freeing up time for therapists by reducing administrative burdens and increasing adherence of patients to therapy programs through the use of teleconsultations and wearable technologies.

-Stakeholder feedback from the region

WORKFORCE IMPACTS

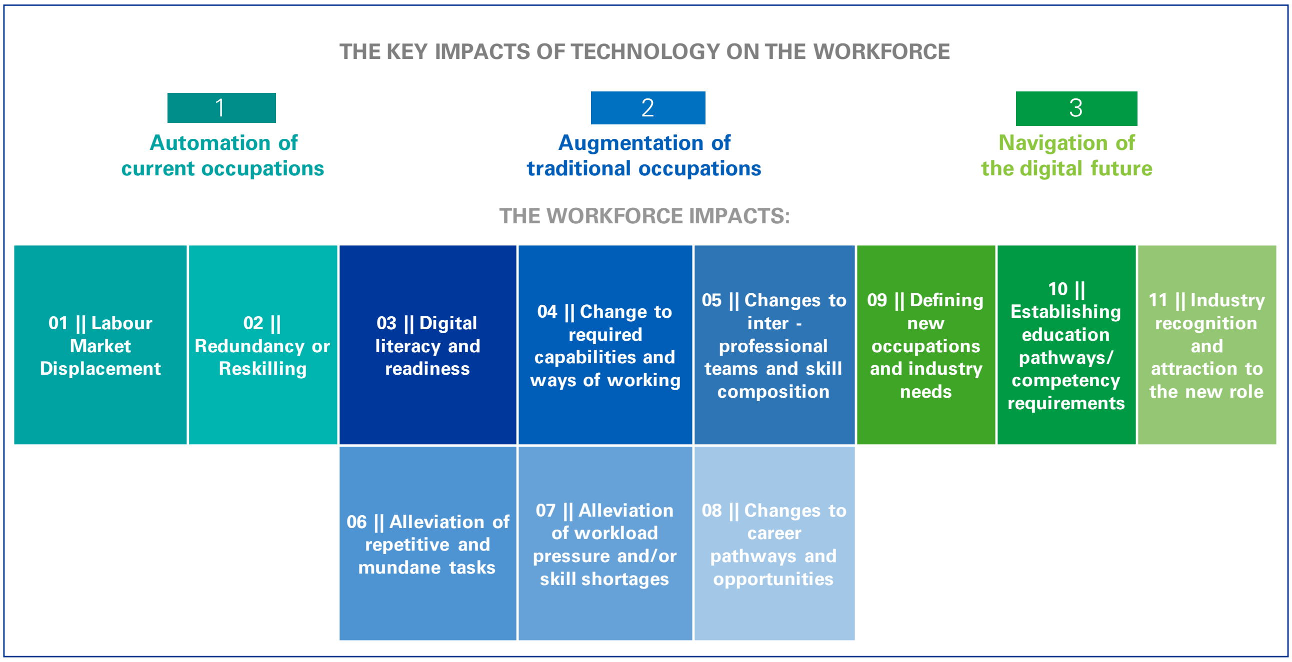
The workforce impacts of emerging technologies across the Health Care and Social Assistance industry are expected to occur primarily through:

- Automation of current occupations (where technology will replace the need for tasks and functions currently undertaken by humans);
- Augmentation of traditional occupations(where technology will work alongside humans and change the way in which tasks and functions are undertaken, making workers more efficient at completing tasks); and
- New roles that are created through the implementation of emerging technologies.

The impact of automation, augmentation and new and emerging job opportunities need to be considered together to determine the net impact on the Health Care and Social Assistance industry. It should also be noted that there may be impacts across other related industry sectors that have been outside of the scope of the Future Employment Study, such as the impact on wider supply chains, related industry sectors and the wider Australian economy.

The detail of the impact of each of these across the Greater Whitsunday region, through combining the Faethm predictions, and current growth trajectories for occupations are detailed below and summarised in Figure 3.31 below.

Figure 3.31 Summary of the workforce considerations and impacts of technology on the workforce.



Source: KPMG

Automation for Health Care and Social Assistance

Labour Market Displacement

Table 3.4 shows the key health occupations employed within the Greater Whitsunday region and the expected impact of automation on every role (where the impact is predicted to be more than 1 percent).

What is important is that based on the growth trajectories of each of these occupations based on the growth over the last five years growth (as discussed under the Current State of Play) for many of the occupations in Health Care and Social Assistance, the automation impact is expected to lower occupational growth rates rather than lead to a reduction in workforce size. This includes the Aged and Disabled Carer, Child Care Workers and Child Carers, Dental Assistant, Dentist, Enrolled Nurse, Family Day Care Worker, Health and Welfare Services Manager, Health Practice Manager, Hospital Orderly, Nanny, Nurse Manager, Nursing Clinical Director, Nursing Support Worker, Optometrist, Out of Schools Hours Care Worker, Personal Care Assistant, Registered Nurse and Therapy Aide.

For some occupations in Health Care and Social Assistance, while there is a reduction predicted from the employment rates in 2020, these occupations are already in decline and automation is predicted to accelerate this predicted reduction. This includes the occupations of Ambulance Officer and Medical Diagnostic Radiographer. There is also a very small FTE reduction predicted over the 10 years for Environmental Health Officers.

Occupations where the automation impact will drive reductions in employment requirements from current levels are the Admissions Clerk, Medical Receptionist, Pathology Collector, Pharmacy Technician, Retail Pharmacist and Sonographer. The impact on the majority of these occupation groups is small, including Admissions Clerk (9.8 FTE over 10 years), Pathology Collector (10.6 FTE over 10 years) and Sonographer (8.9 FTE over 10 years).

It is also worth noting that some occupations are projected to fall in spite of technology adoption including Registered Medical Officers, General Practitioners, Chiropractors and Diversional Therapists.

Many of the occupations with an expected decline in headcount over the next 5 and 10 years are in workforce shortage now. Into the future technology may reduce the demand for these workforces which may assist in addressing future shortages. These roles include Medical Diagnostic Radiographer (shortage in regional Queensland), Sonographer (shortage across Queensland), and Retail Pharmacist (shortage in regional Queensland). [197]

Table 3.4: Automation impacts predictions for the HealthCare and Social Assistance occupations within the Greater Whitsunday region (where the impact is greater than 1 percent)

Occupation (6 digit ANZSCO)	Predicted automation impact 2025 (Faethm)	Predicted automation impact 2030 (Faethm)	ANTICPATED IMPACT FOR GREATER WHITSUNDAY REGION (labour market and Faethm)
Admissions Clerk	18.3%	39.3%	This will lead to a reduction in required staff from current levels by 4.3 FTE in 2025 and a further 5.5 FTE by 2030.
Aged or Disabled Carer	3.3%	7.6%	Absorbed within occupation growth.
Ambulance Officer	0.8%	2.0%	This occupation is in decline (-5.0% CAGR), and automation may accelerate this. Projected decline is a fall of 35.4 FTE by 2025 and a further 27.6 to 2030.
Child Care Worker	1.0%	2.8%	Absorbed within occupation growth.
Child Carers nfd	1.0%	2.8%	Absorbed within occupation growth.
Dental Assistant	6.4%	19.2%	Absorbed within occupation growth.
Dentist	0.7%	2.3%	Absorbed within occupation growth.
Enrolled Nurse	0.4%	1.2%	Absorbed within occupation growth.
Environmental Health Officer	1.4%	3.7%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 1.9 FTE by 2025.
Family Day Care Worker	1.0%	2.8%	Absorbed within occupation growth.

[197] *Department of Education, Skills and Employment. 2020. Occupational skills shortage information. Accessed 30 June 2020.* https://www.employment.gov.au/occupational-skill-shortages-information#engineering-professions-and-technicians

Health and Welfare Services Managers nec	3.4%	7.1%	Absorbed within occupation growth.
Health Practice Manager	3.4%	7.1%	Absorbed within occupation growth.
Hospital Orderly	14.7%	40.3%	Absorbed within occupation growth.
Medical Diagnostic Radiographer	3.1%	7.7%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 10.2 FTE by 2025, and a further 17.6 FTE by 2030.
Medical Receptionist	18.3%	39.3%	This will lead to a reduction in required staff from current levels by 48.2 FTE in 2025 and a further 62.0 FTE by 2030.
Nanny	0.8%	1.7%	Absorbed within occupation growth.
Nurse Manager	0.4%	1.2%	Absorbed within occupation growth.
Nursing Clinical Director	3.4%	7.1%	Absorbed within occupation growth.
Nursing Support Worker	4.2%	14.9%	Absorbed within occupation growth.
Optometrist	0.7%	2.5%	Absorbed within occupation growth.
Out of School Hours Care Worker	1.0%	2.8%	Absorbed within occupation growth.
Pathology Collector	13.1%	29.2%	This will lead to a reduction in required staff from current levels by 3.0 FTE in 2025 and a further 7.6 FTE by 2030.
Personal Care Assistant	3.3%	7.6%	Absorbed within occupation growth.
Pharmacy Technician	28.2%	44.1%	This will lead to a reduction in required staff from current levels by 15.5 FTE in 2025 and a further 8.2 FTE by 2030.
Registered Nurse (all specialities)	0.4%	1.2%	Absorbed within occupation growth.
Resident Medical Officer	0.0%	0.1%	Absorbed within occupation growth.
Retail Pharmacist	4.4%	11.3%	This will lead to a reduction in required staff from current levels by 6.3 FTE in 2025 and a further 8.3 FTE by 2030.
Sonographer	2.4%	7.4%	This will lead to a reduction in required staff from current levels by 5.2 FTE in 2025 and a further 3.69 FTE by 2030.
Therapy Aide	4.2%	14.9%	Absorbed within occupation growth.

Source: KPMG based on Faethm

Redundancy or Reskilling

For roles where redundancy or reskilling is required Faethm provides occupational skilling corridors based on the degree to which the current occupation's skills and competencies align with others and are provided in table 3.5 for occupations with a high correlation.

Table 3.5: Employment corridors for the impacted Health Care and Social Assistance occupations within the Greater Whitsunday region

OCCUPATION/S (6 DIGIT ANZSCO)	IMPACT BASED ON FAETHM AND OCCUPATION GROWTH 2030	EMPLOYMENT CORRIDORS ACROSS ALL OCCUPATIONS (FAETHM)
Medical Receptionist	100.2	Speech-Language Pathology Assistants, Concierges, Physical Therapy Aides, First Line Supervisors of Personal Service Workers, and First Line Supervisors of Customer Service Representatives. *Consideration could also be given to Practice Management roles which require more advanced skillsets around business and practice management (it is noted this role is not included in the Faethm ontology for occupational corridors). Practice Management requires a Diploma in Professional Practice Leadership to be recognised through the Association of Practice Managers.*
Pharmacy Technician	23.7	Physical Therapist Aides, Physical Therapist Assistants, Home Health Aides, Occupational Therapy Aides and Medical Assistants. *Consideration should also be given to Pharmacy Retail Assistants (which are currently in shortage as discussed below).* *An Anaesthetic Technician is also expected to have synergy requiring knowledge of medications (anaesthetics) and assists with the administration of medications.*
Pathology Collector	10.6 *This small reduction may be absorbed through attrition and retirements over a 10 year period.*	Physical Therapist Aides, Physical Therapist Assistants, Home Health Aides, Occupational Therapy Aides and Medical Assistants. *These predictions of automation do not take into account the likely increased demand for this occupation in a COVID-19 environment. This is likely to mean that over the short to medium term there may be a need for more Pathology Collectors across Australia and even within the region, rather than a reduction in demand.*

Source: KPMG based on Faethm (faethm.ai)

As both the Retail Pharmacist and Sonographer are currently in shortage, it is expected that while employment rates are projected to fall this may not be desirable if workforce supply is unable to meet demand. While there is also a significant reduction predicted for Ambulance Officer (most of which is to do with occupation decline and not technology impacts), it is expected to be an occupation which will continue to be in demand and where workforce shortages may exist if current employment decline trends continue.

Augmentation Prediction

The impact of augmentation on the workforce is difficult given that it is expected to free capacity and change the way in which tasks and functions are completed. It is likely to both mean that the freed workforce capacity is used to undertake higher order tasks with a shift away from more repetitive and mundane tasks, and may also mean over time that there is a reduction in demand for some of the most impacted occupations. It is also important to note that the augmented impacts may be felt in addition to the automation impacts.

Table 3.6 below provides an overview of the occupations in Health Care and Social Assistance within the Greater Whitsunday region with the highest augmentation rates over the 5 and ten year projections, along with the expected capacity gain (noting that this may be used for higher order tasks or, over time to reduce supply).

The occupations with the highest predicted augmentation impact on the occupation are Resident Medical Officer, Registered Nurse (Critical Care and Emergency) and Physiotherapists. In terms of the opportunity for freed capacity and due to the workforce size of some occupations, the greatest impact will be provided for Aged or Disabled Carer, Child Care Worker, General Practitioner, Registered Nurse (Aged Care), Registered Nurse (Critical Care and Emergency) Nursing Support Worker.

When comparing Table 3.4 with 3.6, it can be seen that technology is expected to have a much greater augmentation impact on the Health Care and Social Assistance industry than automation.

Table 3.6: Augmentation predictions for the Health Care and Social Assistance occupations within the Greater Whitsunday region

Occupation (6 digit ANZSCO)	Predicted AUGMENTATION impact 2025 (FAETHM)	Predicted AUGMENTATION impact 2030 (FAETHM)	Augmented FTE 2030 (FAETHM)
Aboriginal and Torres Strait Islander Health Worker	12.1%	25.0%	3.5
Admissions Clerk	12.4%6	13.9%	3.3
Aged or Disabled Carer	13.3%	26.4%	141.2
Ambulance Officer	13.5	33.7%1	60.1
Child Care Worker	8.2%	16.2%	97.6
Child Carers nfd	8.2%	16.2%	11.7
Chiropractor	18.3%	39.0%	10.9
Clinical Psychologist	7.2%	2.2%	9.7
Community Worker	12.1%	24.9%	23.9
Counsellors nec	15.3%	35.6%	9.3
Counsellors nfd	15.3%	35.6%	9.3
Dental Assistant	14.0%	23.9%	35.4
Dentist	10.3%	32.3%6	20.3
Disabilities Services Officer	18.3%	40.3%	12.9

Occupation (6 digit ANZSCO)	Predicted AUGMENTATION impact 2025 (FAETHM)	Predicted AUGMENTATION impact 2030 (FAETHM)	Augmented FTE 2030 (FAETHM)
Diversional Therapist	15.9%	36.6%	10.3
Educational Psychologist	9.1%	26.1%	8.6
Enrolled Nurse	18.8%	38.0%	63.44
Environmental Health Officer	17.7%	36.1%	10.8
Family Day Care Worker	8.2%	16.2%	13.5
General Practitioner	18.6%	38.9%	96.9
Health and Welfare Services Managers nec	11.8%	28.3%	18.1
Health Practice Manager	11.8%	28.	30.0
Health Promotion Officer	12.1%	24.9%	6.5
Hospital Orderly	1.2%	2.0%	0.9
Medical Diagnostic Radiographer	18.5%	38.9%	17.9
Medical Receptionist	12.4%	13.9%	37.5
Midwife	16.4%	39.6%	42.0
Minister of Religion	2.5%	14.0%	12.2
Nanny	12.3%	20.1%2	6.2
Naturopath	15.6%	36.6%	5.93
Nurse Manager	18.8%	38.0%	25.1
Nursing Clinical Director	11.8%	28.3%	6.0
Nursing Support Worker	10.4%	19.7%	68.7
Occupational Therapist	15.0%	37.9%	25.8
Optometrist	18.6%	40.4%	9.78
Out of School Hours Care Worker	8.2%	16.2%	3.6
Pathology Collector	10.4%	20.9%	10.9
Personal Care Assistant	13.3%	26.4%	16.3
Pharmacy Technician	7.4%	9.5%	4.6
Physiotherapists	20.4%	42.0%	36.1

Occupation (6 digit ANZSCO)	Predicted AUGMENTATION impact 2025 (FAETHM)	Predicted AUGMENTATION impact 2030 (FAETHM)	Augmented FTE 2030 (FAETHM)
Registered Nurse (Aged Care)	18.8%	38.0%	80.5
Registered Nurse (Child and Family Health)	18.8%	38.0%	9.1
Registered Nurse (Community Health)	18.8%	38.0%	22.0
Registered Nurse (Critical Care and Emergency)	22.6%	43.3%	79.8
Registered Nurse (Medical Practice)	18.8%	38.0%	31.5
Registered Nurse (Medical)	18.8%	38.0%	40.64
Registered Nurse (Mental Health)	18.8%	38.0%	19.7
Registered Nurse (Paediatrics)	18.8%	38.0%	9.9
Registered Nurse (Perioperative)	18.8%	38.0%	34.1
Registered Nurse (Surgical)	18.8%	38.0%	23.1
Registered Nurses nec	18.8%	38.0%	44.4
Registered Nurses nfd	18.8%	38.0%	59.6
Resident Medical Officer	21.7%	44.6%	27.7
Retail Pharmacist	18.0%	31.0%	32.9
Social Worker	13.8%	33.8%	27.7
Sonographer	16.1%	37.0%	8.9
Speech Pathologist	15.4%	35.7%	13.6
Therapy Aide	10.4%	19.7%	10.2
Welfare Worker	13.8%	33.8%	39.5

Source: KPMG based on Faethm (faethm.ai)

It is expected that as a result of these augmentation changes:

- There is a need to build digital literacy and readiness around new and emerging technologies, with an increased focus on those technologies expected to be adopted more in the occupation and subsector (as outlined in the Emerging Technologies section of this report);
- There will be alleviation of repetitive and mundane tasks and a freeing of capacity to work on more complex tasks including clinical diagnosis, treatment and monitoring, and business and practice analytics;

- The adoption of technologies may help to alleviate the demand pressure for occupations in shortage. In Health Care and Social Assistance, this currently includes Audiologists, Dentists, Medical Diagnostic Radiographers (regional shortage), Retail and Hospital Pharmacy Assistants (regional recruitment difficulty), Medical Radiation Therapists (regional shortage), Optometrists, Sonographer, Physiotherapists (recruitment difficulty in private practice), Enrolled Nurse and Midwife (regional recruitment difficulty);
- Due to the significant augmentation impacts it is expected that across health occupations this will require:
  - Incorporation of digital literacy and emerging technologies in Health Care and Social Assistance qualifications and training;
  - Incorporation and recognition of digital training within continuing professional development requirements for both registered and self-regulated professions;
  - Digital change champions (which may also be the frontline workforce) in the workplace to assists with the adoption of emerging technologies);
  - Specific and targeted training in relation to emerging technologies relating to the areas of specialisation of the occupation, (as outlined in the Emerging Technologies section of this report); and
  - Over time, changed scope of practice, capabilities and ways of working for Health Care and Social Assistance professions will require organisations to support a lifelong learning focus, and an organisational investment in skilling (either formal or on the job), change management and leadership support for the adoption of emerging technologies. This is may, over time, change the job descriptions for key occupations.
- Over the medium to longer term it is expected that some of the freed capacity will result in changes to employment growth of some occupations, and this in turn will change the skill composition and structure of teams (noting that this will also likely include new occupations). This may change multi-disciplinary team structures depending on the setting (aged care, hospital, primary and preventative health etc.); and
- These changes to the Health Care and Social Assistance labour market profile over time will change the career opportunities and pathways available to the workforce.

Education and Training in the region

It is noted that while there is some reliance on internationally trained professionals (such as International Medical Graduates), the majority of the Health Care and Social Assistance workforce are trained domestically, across both the VET and University sectors.

Based on enrolments in 2018 in VET qualifications that relate to Health Care and Social Assistance in Bowen, Mackay and the Whitsundays, the most popular qualifications in the Greater Whitsunday region are (further detail is provided in Appendix I):

- Early childhood (Diploma) with 380 enrolled in 2018. These are expected to link to the job roles of Child Carers, Child Care Worker, Family Day Care Worker, Nanny, Out of School Hours Care Worker;
- Certificate III in Early Childhood with 405 enrolled in 2018. These are expected to link to the job roles of Child Carers, Child Care Worker, Family Day Care Worker, Nanny, Out of School Hours Care Worker;
- Certificate III in Individual Support (Ageing, Home and Community). These are expected to link to the job roles of Aged or Disabled Carer and Personal Care Assistant.
- Certificate III in Education Support with 210 enrolled in 2018. These are expected to link to the job roles of Out of School Hours Care Worker and may also link to Integration Aide and Teacher Aide roles in education);
- Certificate III in Ageing Support with 133 enrolled in 2018. These are expected to link to the job roles of Aged or Disabled Carer and Personal Care Assistant.

It is noted there is not a direct correlation between qualification attainment and specific job roles for these occupations, however qualifications are either highly desirable or mandatory in most Health Care and Social

Assistance occupations. Better matching of education and training pipelines to in demand occupations could occur to strengthen employability and jobs within the region.

Detailed public data on the university qualification enrolments in Health Care and Social Assistance related qualifications within the CQUniversity is not available, and the future workforce pipeline developed locally is therefore difficult to determine. Enrolments and completions at the undergraduate and postgraduate level are provided in Appendix J.

Navigation of the Digital Future

As was identified in the Disrupted View section discussed earlier in this chapter, there are a number of new occupations expected as a result of the adoption of emerging technologies. Each of these are provided in detail in Table 3.7. In addition, new and emerging roles are expected in the areas set out below. This suggests significant new opportunities within the Greater Whitsunday region by 2030.

A "bridging role" between clinical practice and technology, and technology as a specialist area for some occupations

Within the Health Care sector there is already the emergence of roles that provide the bridge between clinical practice and ICT related roles, and often involve clinicians who become project leads for the implementation of emerging technologies in the workplace. These roles provide advice during the design and development of new digital technologies and systems, leverage clinical networks for user testing and adoption, become a digital change champion and play a key role in the user testing and quality control of these technologies in local practice. These roles may also start to emerge in the Social Assistance industry as technologies are increasingly adopted.

Human resources, change management and capability development roles

Given the degree of workforce change that is predicted, many suggest the role of the Chief Human Resources Officer will become critically important to organisations. Growth areas predicted include:

- Human resources and organisational development specialists;
- Roles aimed at facilitating talent development, and capability development; and
- Senior management roles aimed at driving significant change across organisations.

Given the size and scale of some health providers (both public and private), the growth in demand for the Health Care and Social Assistance workforce, and the high levels of augmentation impacts on key occupations it is expected that there will be growing demand for these human resource professional roles.

Roles supporting R&D, and translational research

The adoption of digital technologies are playing a key role in shaping innovation and research across the Health Care and Social Assistance sector, with a significant shift towards translational research (the application of research into practice). Pilots and trials of digital technologies are often based around clinical research and evidence of the implications, impacts and health and social outcomes of the adoption of these technologies.

In addition. Medical technology start-ups, entrepreneurs and businesses are increasing around Australia. A recent report by ANDHealth identified over 300 such organisations across Australia. One third of these companies have up to 10 staff and a further 13 percent have up to 40 staff reflecting lean organisations with industry specific skills and expertise. In the ANDHealth recent survey 82 percent of these businesses expect to expand into the future. In outlining the future medical technology opportunity that exists in Australia, ANDHealth state: [198]

[198] *ANDHealth. 2020. Digital Health: The sleeping giant of Australia's health technology industry. Available at https://andhealth.com.au/wp-content/uploads/2020/07/Digital-Health_-Australias-Sleeping-Giant_FINAL.pdf*

"The pipeline of companies and technologies demonstrates the potential to position Australia as a global destination for digital health development, commercialisation, clinical trials and implementation, delivering against the triple aim for post- COVID recovery investment:

1. Economic growth through high value, STEM-based companies headquartered in Australia, delivering globally;

2. A resilient, agile, scalable and personalised health care system, focused on preventing, diagnosing, managing and treating illness using cutting edge technologies; and

3. Expanded high-value manufacturing capabilities, through sensors, wearables, connected devices and regulated software products."

Table 3.7: New occupations predicted to be required as a result of technological adoption in the Health Care and Social Assistance industry within the Greater Whitsunday region by 2030

OCCUPATION TITLE (FAETHM)	PREDICTED GROWTH IN DEMAND (HEADCOUNT) (FAETHM)	OCCUPATION TITLE (FAETHM)	PREDICTED GROWTH IN DEMAND (HEADCOUNT) (FAETHM)
Software Developers, Applications	19.9	Tester/Test Analysts	6.8
Software Developers, Systems Software	19.9	Computer Systems Engineers/Architects	6.8
Process Improvement Analysts	14.7	Robotics Engineers	6.6
Data Engineers	14.4	Project Analyst	6.2
Data Scientists	13.0	Business Intelligence & Analytics Managers	6.2
Data Analysts	12.5	Change Analysts	5.5
Data Integrators	12.2	Data Architects	5.5
Infrastructure Services Analysts (IT)	12.2	IT Governance Analysts	5.5
Strategy Analysts	8.9	Agile Testers	5.5
Security Testers	8.9	AI Research Scientists	4.6
Software Quality Assurance Engineers and Testers	8.9	Industrial Engineers	4.3
Operations Analysts	6.8	Business Analysts	4.2
Cyber Security Analysts	6.8	Mechatronics Engineers	4.0
Educational, Guidance, and Career Counselors and Advisors	6.8	Manufacturing Engineers	3.8
Process Improvement Managers	6.8	Mechanical Engineers	3.8
Operations Research Analysts	6.8	AI Research Scientists, Language Processing	3.7
		AI Research Scientists, Image and Videos	3.7

OCCUPATION TITLE (FAETHM)	PREDICTED GROWTH IN DEMAND (HEADCOUNT) (FAETHM)	OCCUPATION TITLE (FAETHM)	PREDICTED GROWTH IN DEMAND (HEADCOUNT) (FAETHM)
Communications Analysts	3.4	Industrial-Organizational Psychologists	1.7
Workforce Planners	3.4	Human Resources Managers	1.7
Strategy Managers	3.4	Technical Leads	1.7
Training & Development Analysts	3.4	Product Development Managers	1.7
Human Resources Analyst	3.4	Resource Managers	1.7
Change Manager	3.4	Agile Coaches	1.7
Data Warehousing Specialists	3.4	Test Managers	1.7
Test Automation Engineers	3.4	Infrastructure Services Managers (IT)	1.7
Project Leader	3.4	Human Resources Specialists	1.7
Communications Managers	3.4	Test Coaches	1.7
Industrial Production Managers	3.3	IT Governance Managers	1.7
Industrial Safety and Health Engineers	3.3	Test Coordinators/Test Leads	1.7
Industrial Engineering Technologists	3.3	Information Security Managers	1.7
Scrum Masters	2.7	Risk Management Specialists	1.7
Cyber Security Managers	1.7	Product Owners	1.0

CHAPTER 4: MINING AND METS INDUSTRY

"Innovation, people and skills combined with technological advances will deliver a more globally competitive minerals sector. Quality and responsive education, training and workforce development are a crucial mechanism to ensure a supply of skilled workers enter and remain in the industry.

Minerals Council of Australia

The opportunity provided by technology in Mining and METS

Global mining megatrends, such as the dropping rates of discovery of high-quality and accessible ores, concerns about decreasing productivity, and increasing operational costs, have led the industry to move towards an increasingly automated future.[199]

The Mining and METS industry is comprised of mining extraction and refining as well as a broad range of METS industries. Mining includes industries such as iron ore, coal, copper, gold and bauxite, whereas the METS sector includes areas such as mining support services, chemical manufacturing, telecommunication services, computer systems design, equipment manufacturing and transportation services.[200]

Australia has the world's largest economically demonstrated reserves of iron ore and gold, second largest of bauxite and copper and the fifth largest of black coal. These reserves give Australia a significant advantage in mining production.[201] The Greater Whitsunday region is located across one of the key mining regions in Australia, the Bowen Basin, which contains Australia's largest coal reserves.[202]

In addition, Australia is considered a world leader in METS across many different technologies that enable resource companies to operate safely and more efficiently in remote and harsh conditions. Australian mining technology exports account for over $2 billion a year, with 60 percent of mining software solutions used around the world being Australian made.[203] Queensland has a world leading METS sector, employing over 20,000 people across Queensland, with $7 billion in revenue and $2.5 billion in value add to the economy.[204]

The Australian Government's Department of Industry, Science, Energy and Resources established METS Ignited, an industry growth centre initiative with the goal to further grow the Australian METS industry, overcome barriers and grow Australia's share in the global market. METS Ignited works with Australian suppliers to the mining industry, global miners, research organisations and capital providers to improve the global competitiveness and productivity of the Australian METS sector, focusing on strengthening collaboration in the mining innovation system and addressing gaps in the METS-Mining ecosystem.[205]

The focus on technological innovation in mining in recent years has been on cost efficiencies and supply chain optimisation, enhanced by technologies including IoT, cloud based Global Positioning System (GPS), and Radio-Frequency Identification.

Automation also plays a critical role in the evolution of the METS sector, with many mining companies moving from integrating existing technologies, to implementing the next generation of digitally enabled technology. Automated mining comprises a range of new technologies in the fields of computing, signalling and sensing technologies, as well as sophisticated communication systems, and has the potential to add $74 billion in value to the national economy by 2030 and create more than 80,000 new jobs.[206]

For example, BHP Mitsubishi Alliance (BMA) will be introducing 34 autonomous trucks at the Daunia coal mine in central Queensland through a $100 million investment. The first autonomous trucks are expected to begin work in February 2021, with the full fleet expected to be completed by the end of 2021. It is expected

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[199] CSIRO. 2017. Mining Equipment, Technology and Services: A roadmap for unlocking future growth opportunity for Australia. Available at https://www.csiro.au/en/Do-business/Futures/Reports/METS-Roadmap%20

200 Deloitte Access Economics. 2017. Mining and METS: engines of economic growth and prosperity for Australians. Available at https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-mining-mets-economic-growth-prosperity-engines-170317.pdf

[201] Deloitte Access Economics. 2017. Mining and METS: engines of economic growth and prosperity for Australians. Available at https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-mining-mets-economic-growth-prosperity-engines-170317.pdf

[202] Deloitte Access Economics. 2017. Mining and METS: engines of economic growth and prosperity for Australians. Available at https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-mining-mets-economic-growth-prosperity-engines-170317.pdf

[203] SRO Technology. 2016. How is the Australian mining sector leading the world in efficiency innovations? Solution in Measurement. Available at http://www.srotechnology.com/services/how-is-the-australian-mining-sector-leading-the-world-in-efficiency-innovations/

[204] Department of State Development, Tourism and Innovation. (2019). Mining equipment, technology and services (METS). Available at https://www.statedevelopment.qld.gov.au/industry/priority-industries/mets.html

[205] METS Ignited. (2020). About METS Ignited. Retrieved from: https://metsignited.org/about/

[206] METS Ignited. (2020). About METS Ignited. Available at https://metsignited.org/about/; Matysek, A. L., & Fisher, B. S. 2016. Productivity and Innovation in the Mining Industry. BAE Research Report 2016.1. BAEconomics Pty Ltd.

the project will create 150 additional project roles and 56 new permanent site roles.[207] Additionally, BMA is investing $4.2 million at the Goonyella Riverside coal mine to implement autonomous haulage which is expected to improve safety and production while creating new roles and job opportunities.

The future of Australian Mining is likely to be realised through the national adoption of the "digital mine". This refers to a traditional mine adopting digital technologies such as autonomous trucks, trains and drones to enhance the efficiency of existing assets. As highlighted, some of these technologies already exist; however, it is expected that they will be more widely adopted over the coming years due to the competitive advantage realised by trial sites and the uptake of IoT. It is also expected that real time monitoring will occur across mine sites through the integration of low cost sensors with data interconnected emerging technologies such as wearables. This is expected to support more informed planning, control and decision making whilst ensuring the health and safety of mine workers.[208]

Though there are more technological developments to occur within the mining industry, many will leverage the existing technologies of automation and data analytics. Examples of these are likely to be seen in the area of genomics and renewable energy. Genomic solutions are being used in trials for in-situ mineral extraction processes as well as bio-remediation programs that use natural enzymes to clean contaminated sites through metal leaching and drainage.[209] Additionally, mining will be impacted by a reduction in the use of coal, leading to an increase in other sources of energy, such as lithium.

There is a continued strong focus from government on investment in the mining sector. For example, the Mackay Resources Centre of Excellence, a $7 million project jointly funded by the Queensland Government, Mackay Regional Council and the BHP Mitsubishi Alliance, has been developed to drive job creation throughout the region and the resource sector. The centre will ensure that the Mackay region remains a world leader in mining expertise and innovation in the METS sector. The centre includes a simulated underground coal mine to assist with training, research, product innovation and demonstration, focusing on job creation and growing the skills of the future.[210]

Technology impacts across the Mining and METS workforce

This rapid technological evolution of the Australian mining industry has brought concerns regarding the capability of its growing and future workforce needs. A new report commissioned by the Minerals Council of Australia (MCA) has found that over the next five years, more than 77 percent of jobs in the country's mining sector will be altered by technological innovations, increasing productivity by up to 23 percent.

For example, the Queensland Future Skills Partnership is a three-way partnership between BMA, TAFE Queensland and CQUniversity Australia. The partnership will facilitate the fast-tracked development and delivery of new autonomy-related qualifications in open-cut mining operations in Queensland.[211] The skills partnership provides an opportunity for industry and employer to work with vocational training to ensure that a range of flexible skilling solutions are provided to ensure employment outcomes.

The benefits of technology and innovation can range from broad high level strategic improvements through to more focused enhancement of worker's roles. The productivity benefits of technology and innovation include:

- Reduced operating costs from efficiency gains;
- Extended productive life of mines from enhanced extraction of deposits;
- Increased yields of metal recovery from ores;

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[207] Australian Mining. 2020. BMA to invest $100m in Daunia autonomous haulage. Available at https://www.australianmining.com.au/news/bma-to-invest-100m-in-daunia-autonomous-haulage/

[208] McHugh, B. 2017. The 'digital mine' is here and technology gallops head. Available at http://www.abc.net.au/news/rural/2017-08-09/the-digital-mine-revolution-underway-now/8786194

[209] Hutchens, G. 2017. Australia's manufacturing industry on rebound, report says. The Guardian. Available at https://www.theguardian.com/business/2017/jun/21/australias-manufacturing-industry-on-rebound-report-says

[210] Rio Tinto. 2017.Rio Tinto, TAFE and the WA State Government join forces for mining jobs of the future. Available at https://www.riotinto.com/en/news/releases/TAFE-WA-Government-partnership

[211] Minister for Employment and Small Business and Minister for Training and Skills Development, BMA, TAFE Queensland and CQUniversity launch new partnership, Available at http://statements.qld.gov.au/Statement/2019/8/12/bma-tafe-queensland-and-cquniversity-launch-new-partnership

- Improved safety requirements from simplified processes and earlier hazard detection; and
- Higher workforce satisfaction and productivity.[212]

The use of digital technologies across the Mining and METS industry will see the need for traditional, on the ground operators reduce with increasing demand for a more technologically skilled workforce. It is expected that this will see mining professionals combining technical mining skills with digital technology skills, whilst the recruitment of new technical roles such as data scientists and modellers will also increase.[213]

A regional lens

The Greater Whitsunday region

The Mining and METS industry has long been a cornerstone of the Greater Whitsunday economy. The region spans a large portion of the Bowen Basin, which is particularly resource rich and home to a large number of coal mines. As a result, the mining and METS industry is the main source of employment within the region. Additionally, the Mining and METS industry makes the greatest contribution to economic output in the region, representing $19.4 billion and 46.3 percent of total output.[214]

Coal mining

The Bowen Basin contains most of Queensland's high quality metallurgical (coking and pulverised coal injection) coal reserves, as well as significant deposits of thermal coal. In recent years, the Bowen Basin has experienced expanded production activities and planned maintenance at existing mining operations. In addition to the operation of new and reopened coal mines, these activities have significantly contributed to workforce growth particularly within the Isaac LGA.[215]

As shown in Figure 4.1, the Isaac LGA is home to 26 active coal mines. These mines produce more than half Queensland's total saleable coal, generating in excess of $1 billion in royalty payments each year.[216] Notably, two of these mines (Peak Downs and Goonyella Riverside) were also the largest producers of raw coal in 2019.[217]

In contrast, the Whitsunday and Mackay LGAs have a limited focus on producing coal. While Whitsunday has seven active coal mines, Mackay is largely focused on supporting the mining industry through the development and supply of mining equipment and technology.

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[212] *Deloitte Access Economics. 2017. Mining and METS: engines of economic growth and prosperity for Australians. Available at https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-mining-mets-economic-growth-prosperity-engines-170317.pdf*

[213] *Ernst & Young. 2019. Future of work: The economic implications of technology and digital mining. Available at https://minerals.org.au/sites/default/files/190214%20The%20Future%20of%20Work%20The%20economic%20implications%20of%20technology%20and%20digital%20mining.pdf*

[214] *REMPLAN. 2020. Economy Profile: Mackay, Isaac Whitsunday. https://app.remplan.com.au/greaterwhitsundayalliance/economy/summary?state=PRKLCbXEgFqdzeLHKoJYbZfGIbI8ZX*

[215] *Isaac Region. 2019. Economic Indicators Profile. https://www.isaac.qld.gov.au/downloads/file/845/economic-indicators-report*

[216] *REMPLAN. 2020. Economy Profile: Mackay, Isaac Whitsunday. https://app.remplan.com.au/isaac/economy/summary?state=GgGBf69kmu5e2QLHyvXYKxhdh8hoeL*

[217] *Queensland Government. 2019. Coal production statistics. https://www.data.qld.gov.au/dataset/annual-coal-statistics*

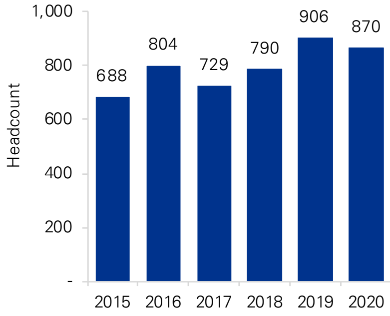
Figure 4.1: Regional differences in the Mining and METS industry

WHITSUNDAY

Whitsunday LGA population **35,000**

Mining and METS employment **870**

Number of coal mines **7**



Number of quarry rock mines **6**

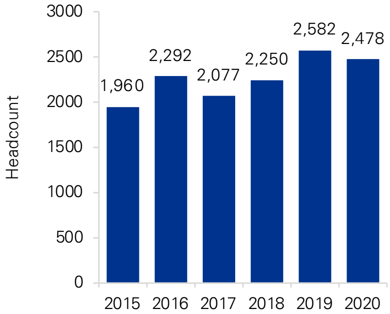
Number of gold mines **4**

MACKAY

Mackay LGA population **116,539**

Mining and METS employment **2,478**

Number of coal mines **0**



Number of quarry rock mines **13**

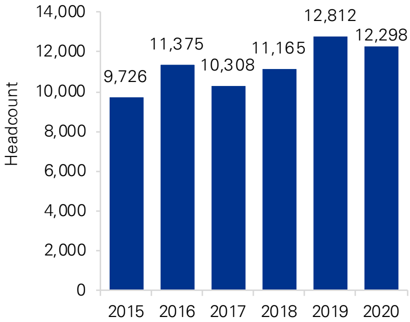
Number of gold mines **0**

ISAAC

Isaac LGA population **35,360**

Mining and METS employment **12,298**

Number of coal mines **26**



Number of quarry mines **7**

Number of gold mines **8**

Traditional Labour Market View

> *"Change is the only certainty for today's mining industry….However miners can help support growth and sustainability through the adoption of innovative technologies designed to better manage operational costs, improve extraction methods, streamline distribution, increase worker productivity, and mitigate risks by building new partnerships and attracting the right talent."*
>
> ***– Australian Mining Risk Forecast, KPMG***[218]

[218] *KPMG. Australian Mining Risk Forecast 2019-2020. 2019. Accessed 30 June 2020 https://assets.kpmg/content/dam/kpmg/au/pdf/2019/australian-mining-risk-forecast-2019-2020-report.pdf*

THE CURRENT STATE OF PLAY

Current workforce characteristics

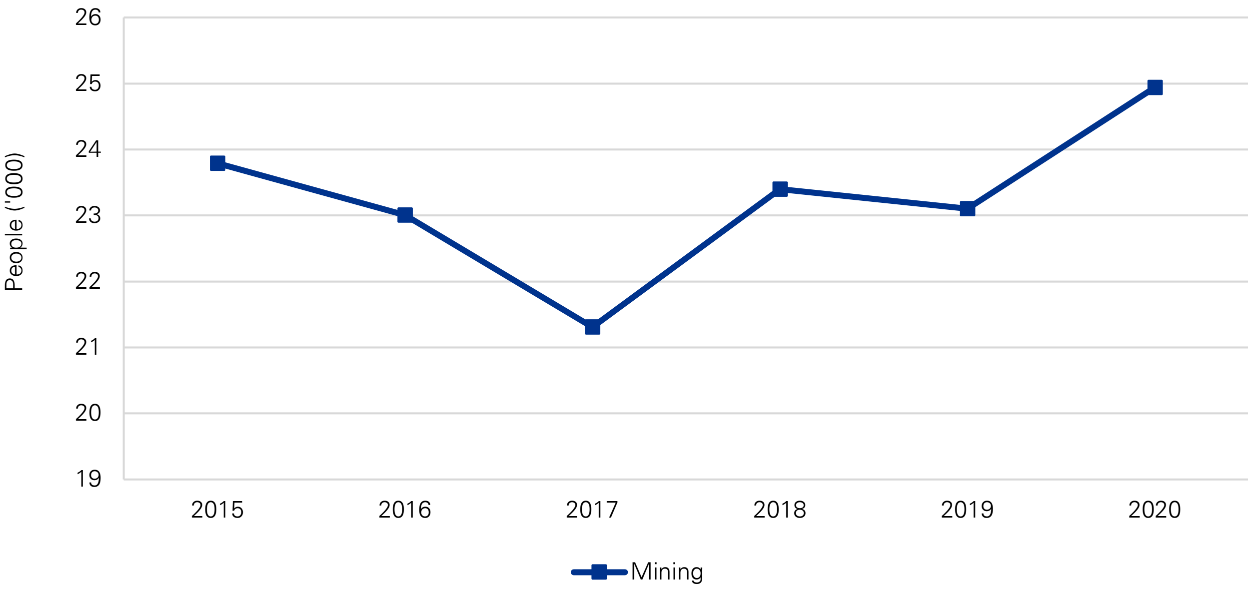
Overall employment

In recent years, the Mining and METS industry has made significant strides to navigate through digital disruption, commodity volatility and increased demands from communities and investors. Despite these challenges, the Mining and METS industry has experienced strong growth over the past five years. As at February 2020 the industry employed approximately 242,800 people across Australia, accounting for approximately 1.9 percent of the total national workforce.[219]

Across Queensland, almost all employees within the Mining and METS industry were employed by private sector businesses in 2020.[220] These private sector businesses included small firms specialising in METS and large corporate mining companies.

In the Greater Whitsunday region, the Mining and METS industry accounted for approximately 17.5 percent of the region's entire workforce in 2020 and was the largest employing industry. As shown in Figure 4.2, employment has increased at an annual rate of 1 percent. In comparison, nationally the Mining and METS industry grew on average by 2.2 percent annually between 2015 and 2020.[221] This indicates that employment in the Mining and METS industry in the Greater Whitsunday region has been growing at a subdued rate compared to the national trends. This growth has largely been attributed to the region's resource rich mines. In particular, the region is home to many coal mines in the Bowen and Galilee Basin, which have benefited in recent years from the continued global demand in Australian coal exports.[222]

Figure 4.2: Total employment in the Mining and METS workforce in the Greater Whitsunday region (2015-20)



Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A.

Regional differences

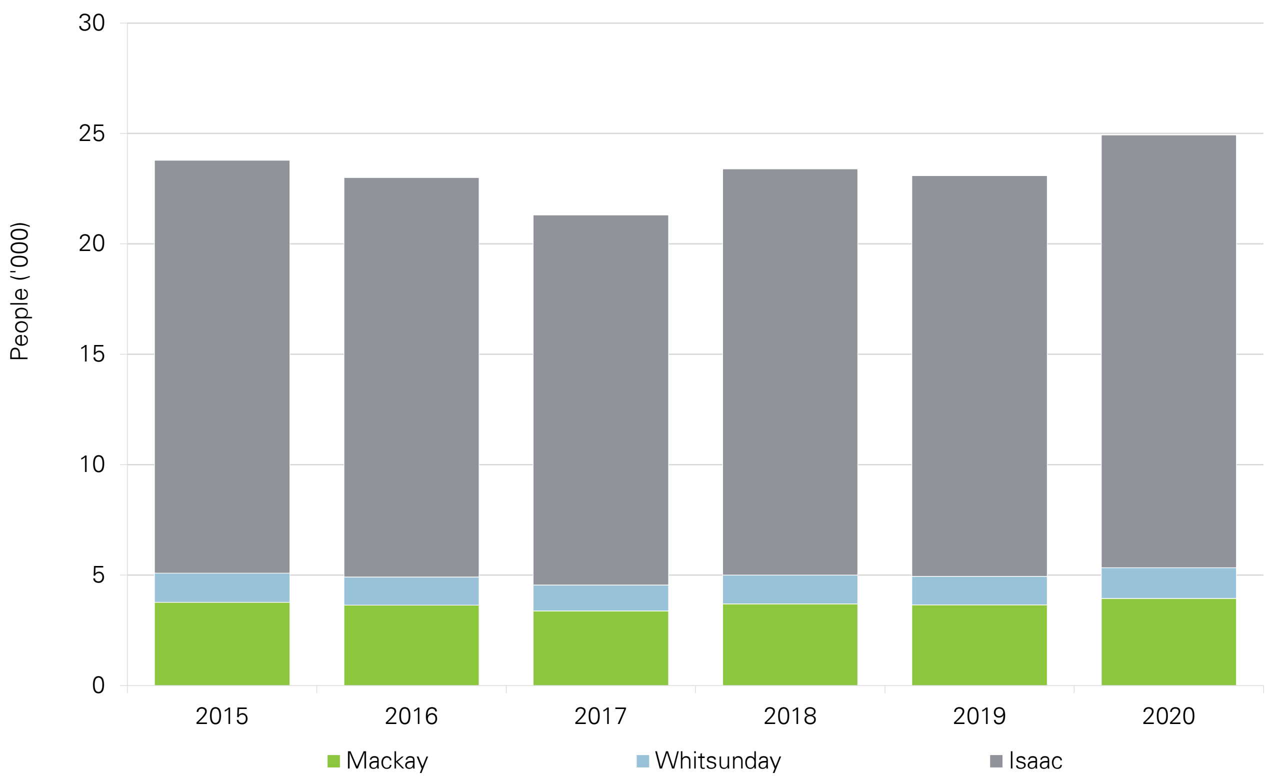
Within the Greater Whitsunday region there have been regional differences in the number of people employed in the Mining and METS industry. These differences are attributable to a range of issues including

[219] *Labour Market Information Portal. Mining. Accessed 4 July 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/IndustryInformation/Mining*
[220] *ABS, cat. no. 6150.0.55.003, Labour Force, Australia, March 2020.*
[221] *ABS, Labour Force, Australia, Detailed, Quarterly, cat. no. 6291.0.55.003, original.*
[222] *Reserve Bank of Australia. The Changing Global Markets for Australian Coal. Accessed 4 July 2020: https://www.rba.gov.au/publications/bulletin/2019/sep/the-changing-global-market-for-australian-coal.html*

regional variations in resource deposits. The Isaac LGA is a particularly resource rich region spanning a large portion of the Bowen Basin with a large number of active coal mines. In 2018, the Isaac LGA produced approximately 54 percent of Queensland's saleable coal, with the majority of that coal being metallurgical coal.[223] In comparison, the Mackay and Whitsunday LGAs have a smaller number of mines and a lesser focus on coal mining.

Figure 4.3 illustrates the impacts of these regional employment differences in the Mining and METS industry over a five year period between 2015 and 2020. Notably, during this period approximately 78.6 percent of the Mining and METS industry were employed in the Isaac LGA, 15.8 percent in the Mackay LGA and 5.6 percent in the Whitsunday LGA.

Figure 4.3: Total regional employment variations in the Mining and METS workforce in the Greater Whitsunday region (2015-20)



Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A.

Gender composition

Figure 4.4 shows the gender composition for the Mining and METS industry over a five year period between 2015 and 2020 in the Greater Whitsunday region. During this period, the number of males in the industry decreased at an annual average rate of 2.04 percent, the number of females increased at a rate of 19.84 percent. As at February 2020, males accounted for 78.1 percent of the workforce, marginally lower than the male share of the industry at the national level (82.8 percent).[224]

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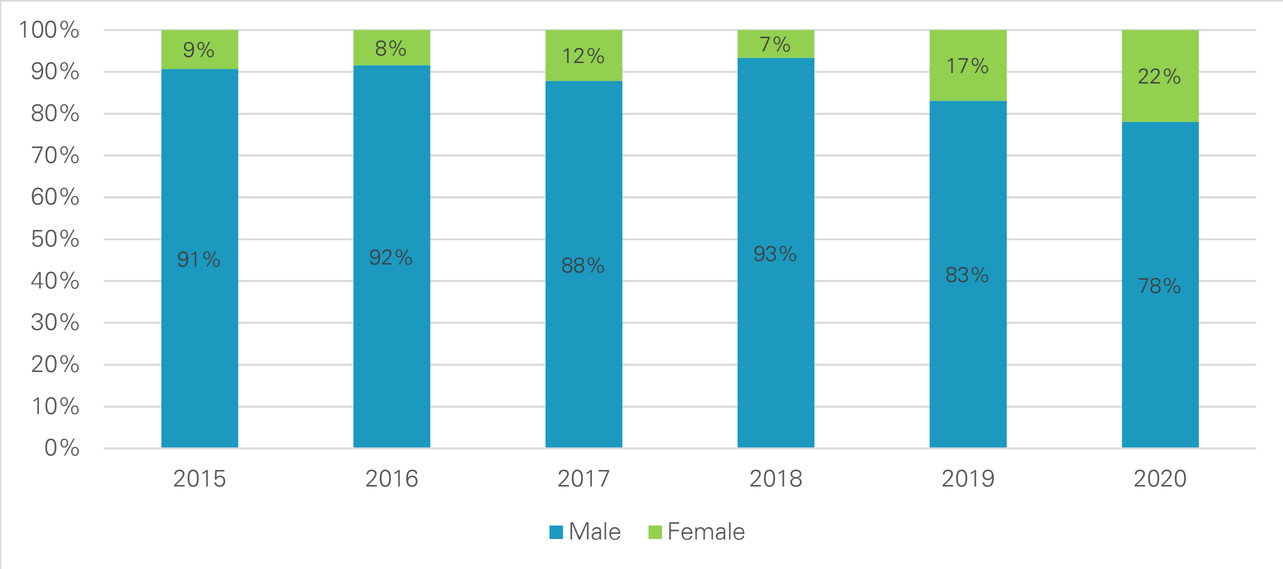
[223] *Isaac Regional Council. Submission to the House Standing Committee on Industry, Innovation, Science and Resources – Inquiry into how the mining sector can support businesses in regional economies. Submission 31.*

[224] *Labour Market Information Portal. Mining. Accessed 4 July 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/IndustryInformation/Mining*

Figure 4.4: Gender composition in the Mining and METS workforce in Greater Whitsunday region (2015-20)

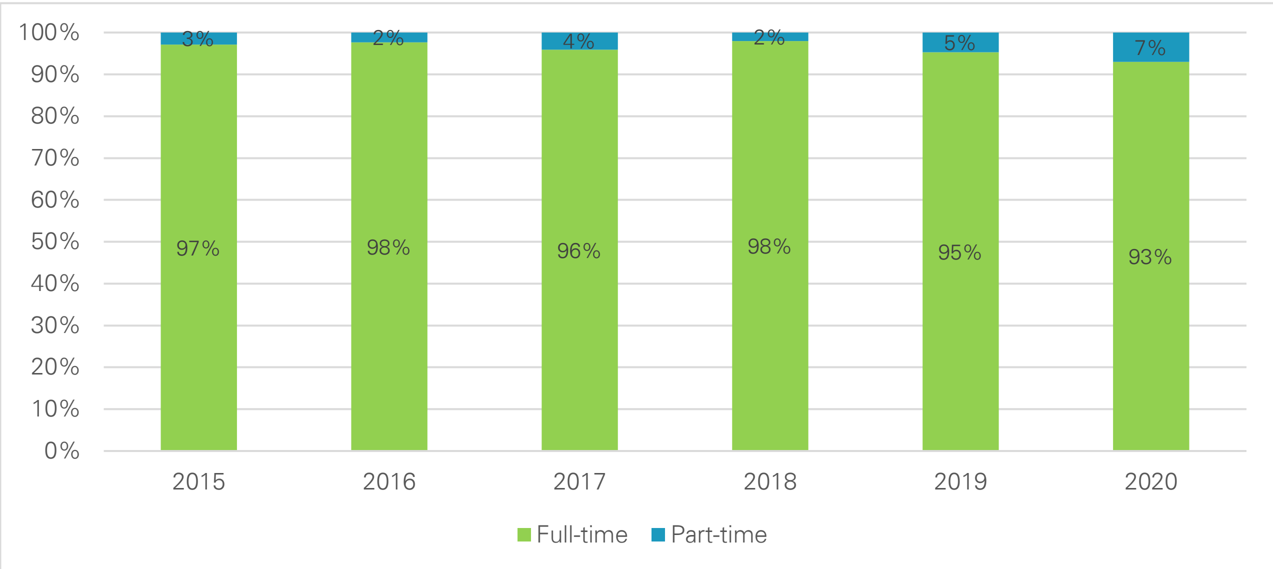


Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A.

Employment composition

Figure 4.5 shows the employment type composition (full-time versus part-time) for the Mining and METS industry over a five year period between 2015 and 2020 in the Greater Whitsunday region. Over the five year period, the industry has consistently employed more full-time employees than part-time employees. During this period the number of full-time employees increased at an average annual rate of 0.07 percent, while the number of part-time employees increased by 20.8 percent per annum during the five year period. As at February 2020, full-time workers accounted for 93.0 percent of the workforce, which was lower than share of full-time Mining and METS workers at the national level (95.5 percent). [225]

Figure 4.5: Employment type composition in the Mining and METS workforce in Greater Whitsunday region (2015-20)



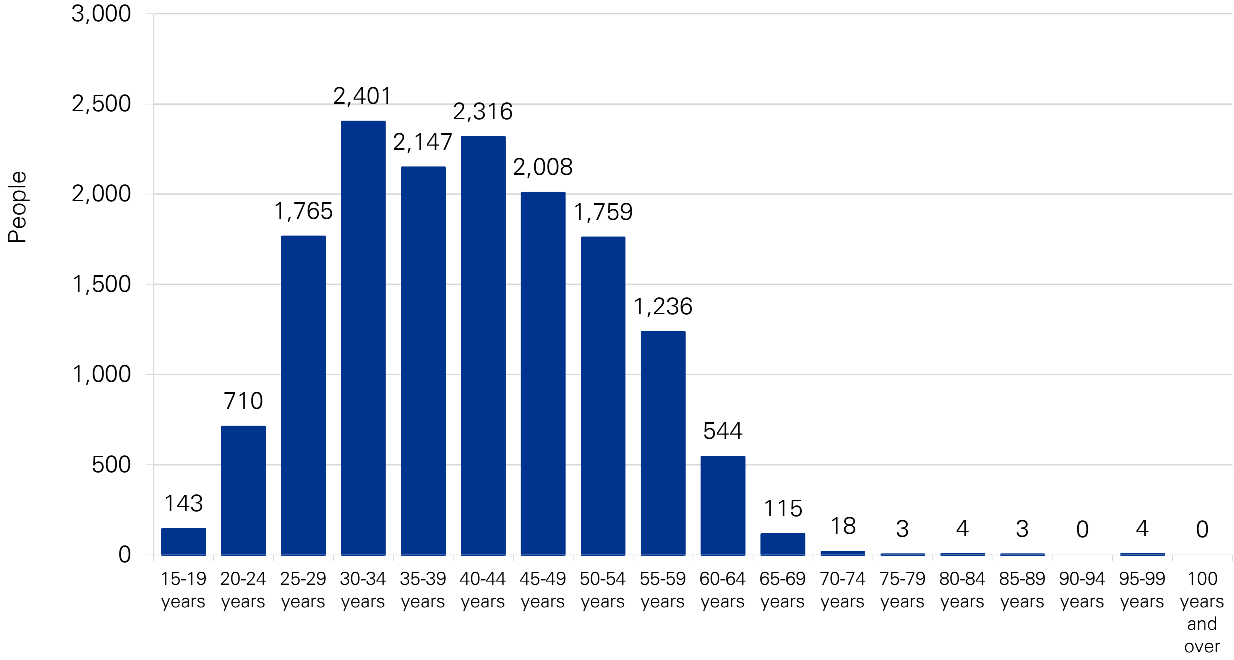
Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A.

[225] *Labour Market Information Portal Health Care and Social Assistance. Accessed 30 June 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/IndustryInformation/HealthCareandSocialAssistance*

Age distribution

As shown in Figure 4.6, the Mining and METS industry in the Greater Whitsunday region is characterised by a relatively young workforce. In 2016, approximately half of the workforce were aged 39 years or younger (47.3 percent of the workforce), with the 30 to 34 age bracket having the highest number of persons in the Mining and METS industry. This suggests the industry is less likely to face ageing workforce challenges than other industry sectors.

Figure 4.6: Age distribution of the Mining and METS industry in the Greater Whitsunday region (2016)

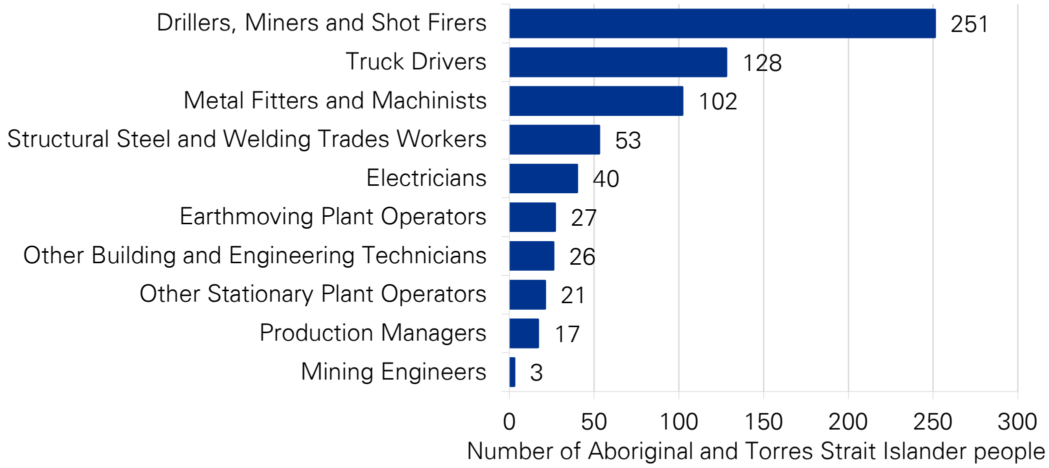


Source: KPMG based on ABS Census data

Aboriginal and Torres Strait Islander employment

The Mining and METS industry is the largest employer of Aboriginal and Torres Strait Islander people in the Greater Whitsunday region. In 2016, approximately 20.8 percent of the Aboriginal and Torres Strait Islander workforce in the Greater Whitsunday region were employed in the Mining and METS industry. As shown in Figure 4.7, the majority of these Aboriginal and Torres Strait Islander occupations were Drillers, Miners and Shot Firers, Truck Drivers and Metal Fitters and Machinists.

Figure 4.7: Aboriginal and Torres Strait Islander employment in the Mining and METS industry in the Greater Whitsunday region (2016)



Source: KPMG based on ABS Census data

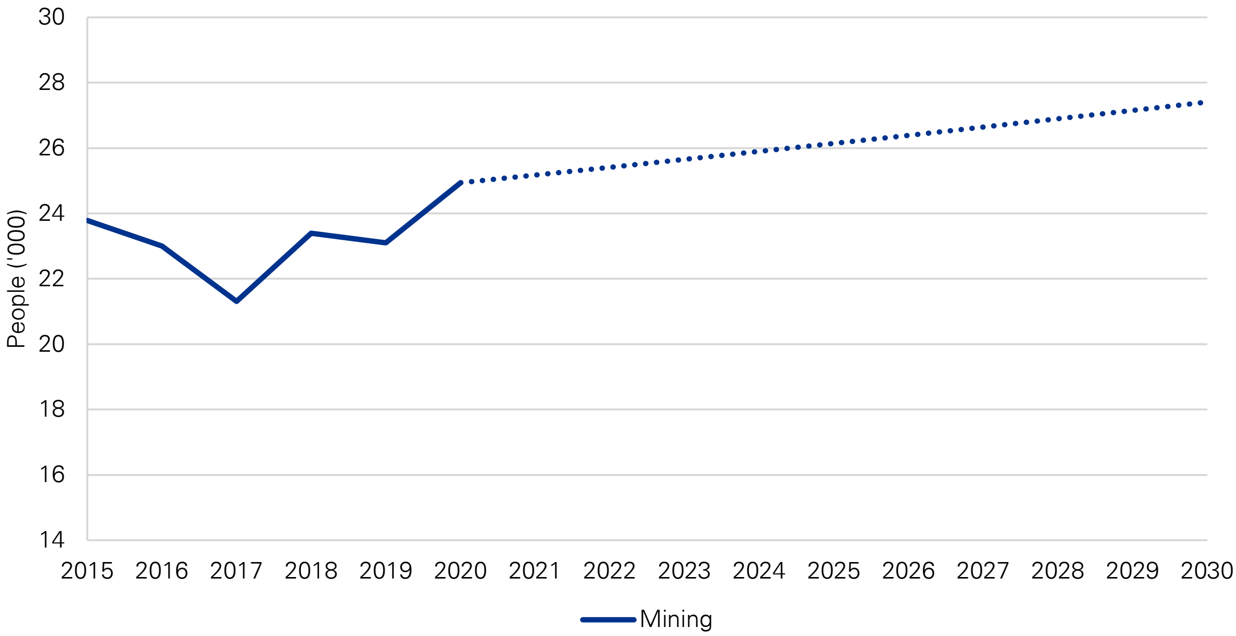
Future workforce projections based on current trends

Overall employment

National employment in the Mining and METS industry has been projected by the Australian Government's Department of Employment, Skills, Small and Family Business to increase by 15,400 (or 6.2 percent) over the next five years.[226] This projected increase in employment has largely been driven by the historical trend.[227] However, demand in the global market for coal has been evolving in recent years, which may in turn create some uncertainties for the longer-term outlook for coal production and exports in Australia. Looking forward, the Mining and METS industry will likely be shaped by the speed of the transition towards renewable energy sources, changing steel production technologies, the pace of global economic growth and changes in commodity prices.

Based on historical trends in the Greater Whitsunday region, Figure 4.8 shows the projected growth in the mining and METS industry over a ten year period from 2020 to 2030. With a historical annual growth rate of 1 percent, the workforce in the Mining and METS industry in the Greater Whitsunday region has been projected to increase from 24,939 people in 2020 to 27,409 people in 2030. However, this projection relies on historical trends and does not consider any impacts of the global COVID-19 pandemic. These potential impacts of the COVID-19 pandemic are further explored later in this report.

Figure 4.8: Projected workforce growth for the Mining and METS industry in the Greater Whitsunday region (2015-30)



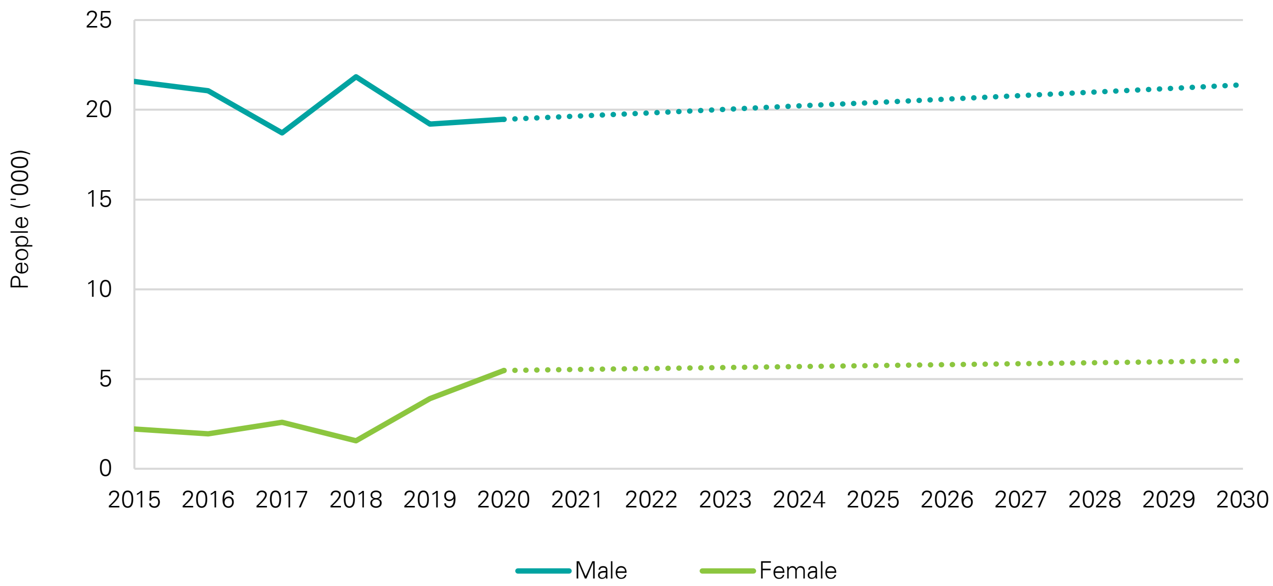
Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A.

Gender composition

Based on the historical trends described above, Figure 4.9 shows the projected gender composition for the Mining and METS industry in the Greater Whitsunday region over a 10 year period from 2020 to 2030. During this period, the number of males and females employed in the Mining and METS industry has been projected to increase at an average annual rate of 1.9 percent. By 2030, it has been projected that males will account for approximately 87.1 percent of the entire Mining and METS workforce in the Greater Whitsunday region. This will equate to approximately 21,392 males and 6,016 females in the workforce.

[226] *Labour Market Information Portal Employment Projections. Accessed 30 June 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/EmploymentProjections*
[227] *Ibid.*

Figure 4.9: Projected workforce growth by gender for the Mining and METS industry in the Greater Whitsunday region (2015-30)

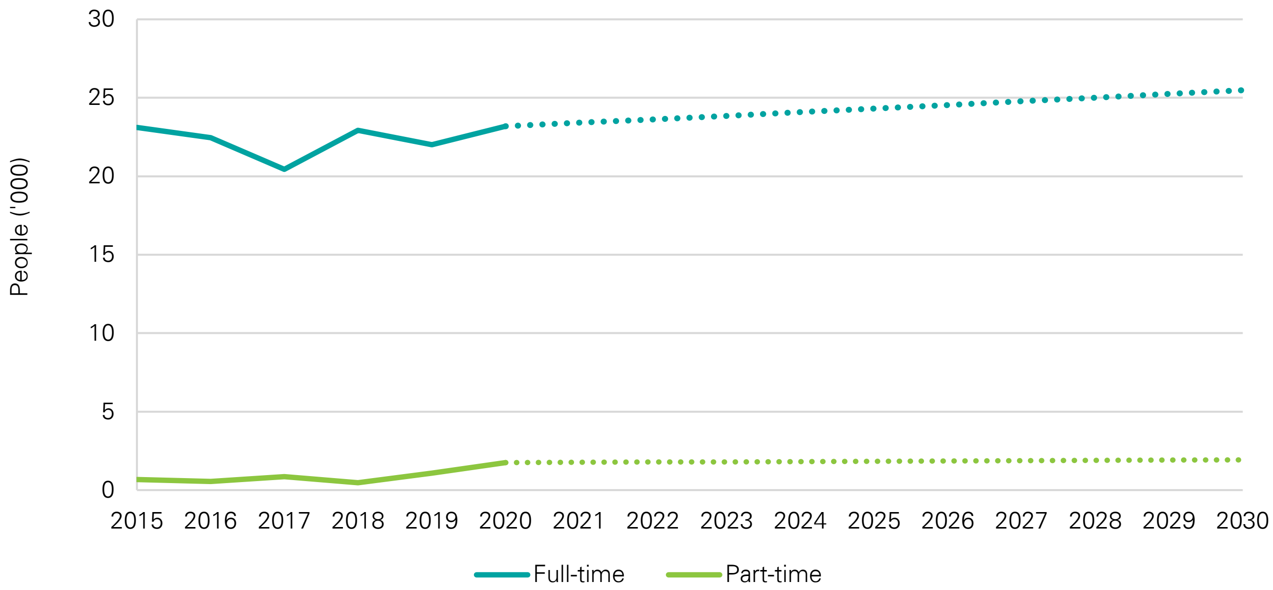


Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A.

Employment composition

Based on historical trends described above, Figure 4.10 shows the projected employment composition for the Mining and METS industry in the Greater Whitsunday region over a ten year period from 2020 to 2030. By 2030, it is projected that people working full-time will account for approximately 93 percent of the entire Mining and METS workforce in the Greater Whitsunday region. This will equate to approximately 25,482 full-time workers and 1,926 part-time workers.

Figure 4.10: Projected workforce growth by employment type for the Mining and METS industry in the Greater Whitsunday region (2015-30)



Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A.

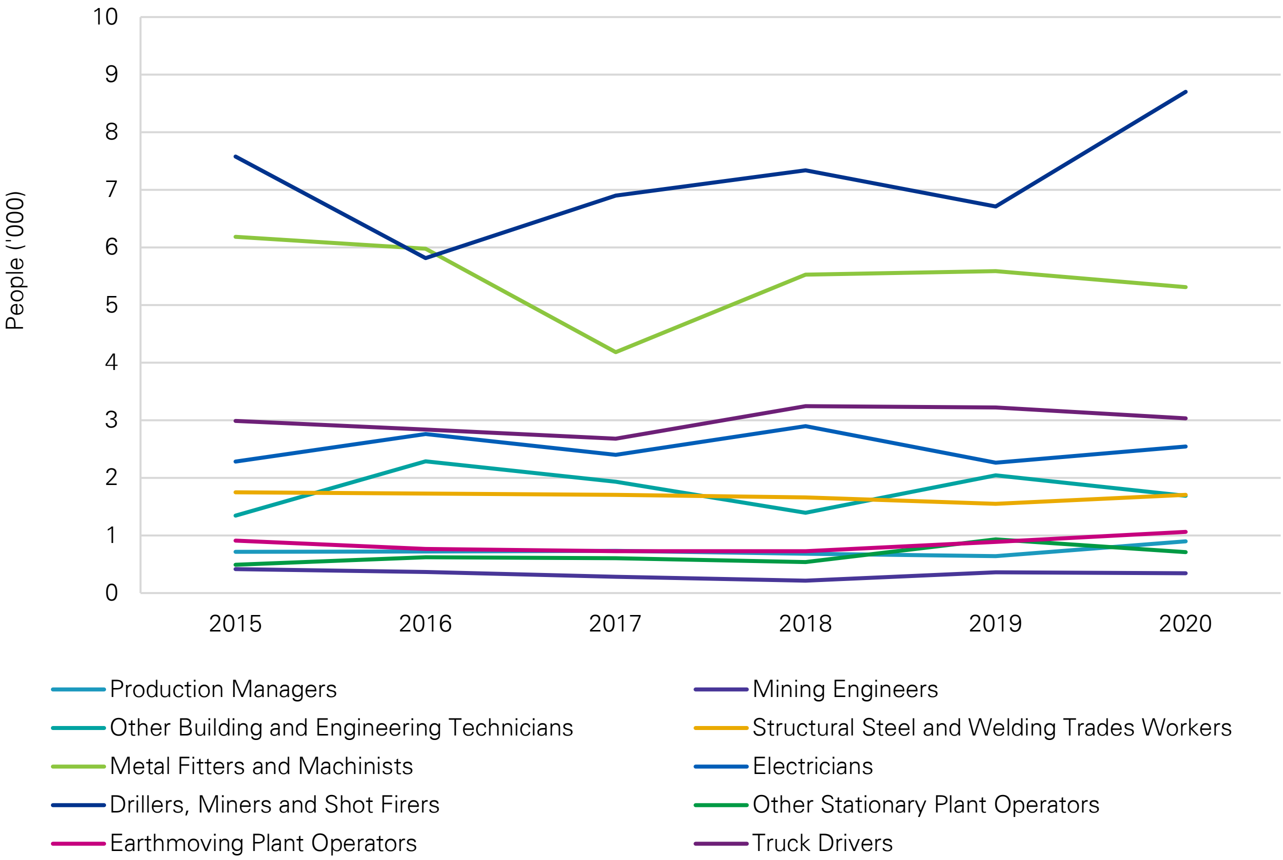
Occupational growth in the industry

As shown in Figure 4.11, the Mining and METS industry employs workers in a diverse range of occupations within the ANZSCO 4-digit unit groups. Consistent with recent national trends, the top three employing 4-digit unit groups in the Greater Whitsunday region in 2020 included Drillers, Miners and Machinists, Metal Fitters and Machinists, and Truck Drivers. In contrast, the three lowest employing unit groups in the Greater Whitsunday region included Mining Engineers, Other Stationary Plant Operators, and Production Managers.

Between 2015 and 2020, Other Stationary Plant Operators experienced the highest growth in employment in percentage terms from 491 to 708 persons (7.6 percent on average per annum). Second to this growth rate, the number of Production Managers grew at an average annual rate of 4.7 percent per annum from 714 to 898 persons.

Mining Engineers experienced the largest decline in employment between 2015 and 2020 in percentage terms from 416 to 345 persons (-3.6 percent on average per annum). Second to this, Metal Fitters and Machinists experienced a decline of -3.0 percent per annum from 6,185 persons to 5,313 persons.

Figure 4.11: Mining and METS employment trends by ANZSCO 4-digit unit groups (2015-20)



Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A

These ANZSCO 4-digit unit groups have been broken down into ANZSCO 6-digit occupations in Figure 4.12 to highlight the top ten occupations in the Greater Whitsunday region for the Mining and METS industry. The number of Miners in 2020 (7,855) is close to double the next highest occupation of Fitters (general) (4,772).

Figure 4.12 highlights different levels of average annual employment growth between 2015-2020, with Mine Deputies and Maintenance Planners experiencing the highest growth rate in the top ten occupations at 4.8 percent. Occupations experiencing declining employment rates include Metal Fabricators (-3.0 percent), Fitters and Turners (-0.6 percent) and Fitters (general) (-0.6 percent).

Key occupations in Mining and METS#

Figure 4.12: Mining and METS, top 10 ANZSCO 6-digit occupations, 2020

Miners

Those who *"operate plant to excavate, load and transport coal, ore and rock in an underground or open-cut mine"*

1.6% annual growth

Headcount 2015 **6,842**
Headcount 2020 **7,855**

Mackay **420**
Isaac **6,962**
Whitsunday **474**

8,691 Headcount by 2030

Fitters (general)

Those who *"fit and assemble metal parts and subassemblies to fabricate production machines and other equipment"*

-0.6% annual growth

Headcount 2015 **5,555**
Headcount 2020 **4,772**

Mackay **2,073**
Isaac **2,365**
Whitsunday **334**

5,052 Headcount by 2030

Truck drivers (general)

Those who *"driver a heavy truck, requiring a specially endorsed class of licence, to transport bulky goods"*

1.4% annual growth

Headcount 2015 **2,844**
Headcount 2020 **2,887**

Mackay **1,267**
Isaac **1,275**
Whitsunday **344**

3,507 Headcount by 2030

Electricians (general)

Those who *"install, test, connect, commission, maintain and modify electrical equipment, wiring and control systems"*

1.2% annual growth

Headcount 2015 **2,274**
Headcount 2020 **2,533**

Mackay **1,112**
Isaac **1,088**
Whitsunday **333**

2,735 Headcount by 2030

Metal Fabricators

Those who *"mark off and fabricate structural steel and other metal stock to make or repair metal products and structures such as boilers and pressure vessels"*

-3.0% annual growth

Headcount 2015 **1,562**
Headcount 2020 **1,524**

Mackay **1,068**
Isaac **331**
Whitsunday **125**

986 Headcount by 2030

Mine Deputies

Those who *"oversee the safety of mining operations and supervises Miners"*

4.8% annual growth

Headcount 2015 **822**
Headcount 2020 **1,031**

Mackay **226**
Isaac **741**
Whitsunday **64**

1,665 Headcount by 2030

Production Managers (mining)

Those who *"plan, organise, direct, control and coordinate the production activities of a mining operation including physical and human resources"*

0.9% annual growth

Headcount 2015 **495**
Headcount 2020 **623**

Mackay **259**
Isaac **315**
Whitsunday **49**

568 Headcount by 2030

Drillers

Those who *"assemble, position and operate a drilling rig and related equipment to extract ore, liquids or gases from the earth"*

1.6% annual growth

Headcount 2015 **402**
Headcount 2020 **462**

Mackay **25**
Isaac **409**
Whitsunday **28**

511 Headcount by 2030

Fitters and Turners

Those who *"fit, assemble, grind and shape metal parts and subassemblies to fabricate production machines and other equipment"*

-0.6% annual growth

Headcount 2015 **487**
Headcount 2020 **419**

Mackay **182**
Isaac **207**
Whitsunday **29**

443 Headcount by 2030

Maintenance Planners

Those who *"develop maintenance planning strategies, and schedule, coordinate and monitor the maintenance of all plant equipment"*

4.8% annual growth

Headcount 2015 **322**
Headcount 2020 **404**

Mackay **89**
Isaac **290**
Whitsunday **25**

652 Headcount by 2030

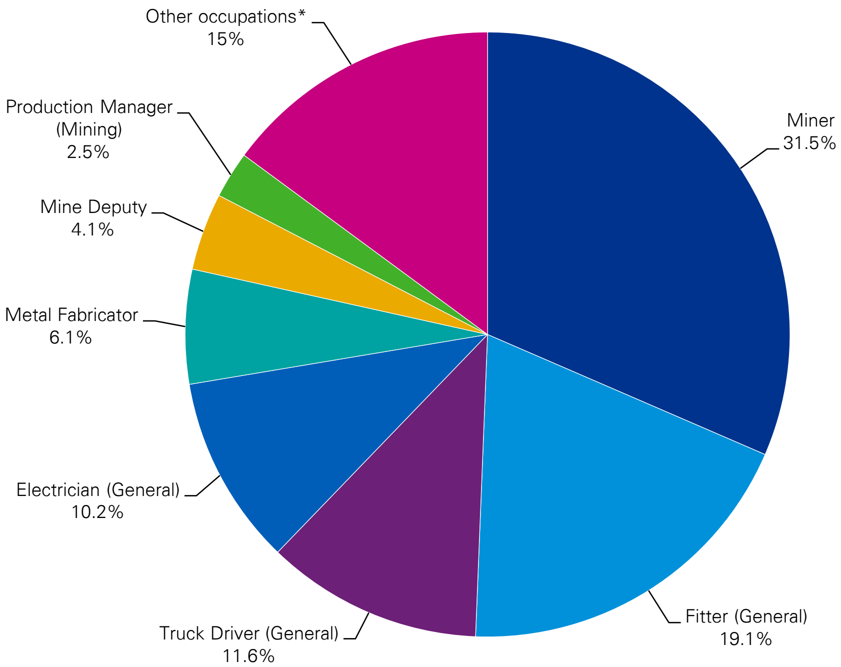
#. This information should be considered in conjunction with the data limitations presented in Appendix C of this report.

Note: Stakeholders identified that the historical growth in Mine Deputies between 2015-2020 would not continue if new mines are not opened, and this volatility and dependency needs to be considered for this occupation.

What would the future look like in 2030 if we continued on our current path?

The Mining and METS industry employs people in a diverse range of occupations that are classified as ANZSCO 6-digit occupations in the Greater Whitsunday region. Figure 4.13 illustrates the distribution of these occupations which employed 2 percent or more of the Mining and METS workforce in 2020. As shown in Figure 4.13, the over half of the Mining and METS industry were employed as Miners, Fitters (General) and Truck Drivers (General).

Figure 4.13: Distribution of ANZSCO 6-digit occupations that account for greater than 2 percent of the Mining and METS workforce in 2020

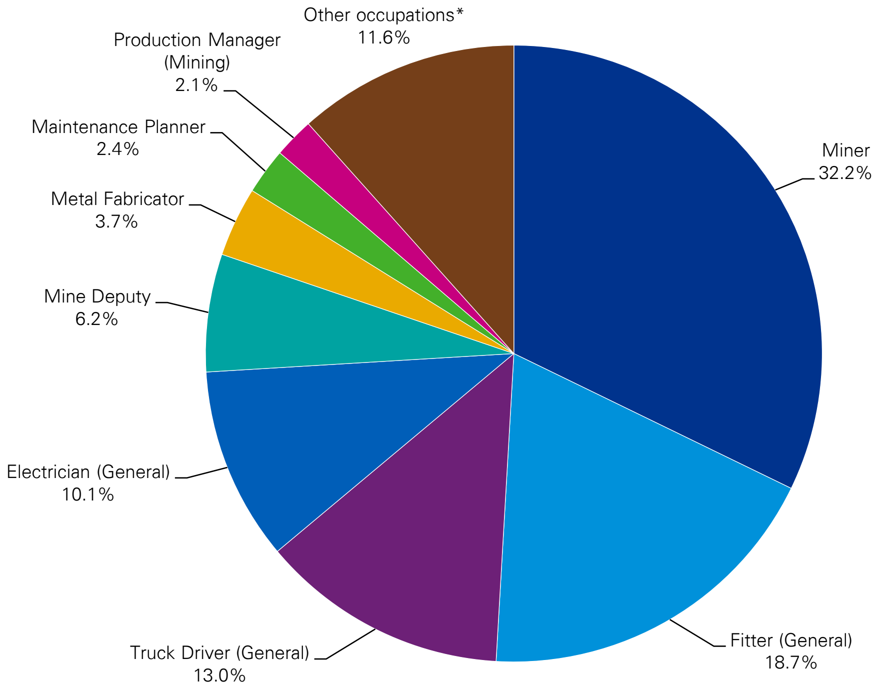


**Other occupations include: Driller (1.9%); Fitter and Turner (1.7%); Maintenance Planner (1.6%); Shot Firer (1.5%); Mining Engineer (excluding Petroleum) (1.4%); Bulldozer Operator (1.1%); Stationary Plant Operators nec (0.9%); Production Manager (Manufacturing) (0.9%); Excavator Operator (0.8%); Welder (First Class) (0.7%); Metallurgical or Materials Technician (0.6%); Waste Water or Water Plant Operator (0.4%); Building and Engineering Technicians nec (0.4%); Grader Operator (0.3%); Loader Operator (0.3%); Metal Fitters and Machinists nfd (0.2%); Metal Machinists (First Class) (0.2%); Metal Fitters and Machinists nec (0.1%).*

KPMG based on ABS Labour Market Quarterly and Census Data

Based on historical trends in ANZSCO 6-digit occupations in the Greater Whitsunday region, Figure 4.14 shows the distribution of these occupations which have been projected to employ 2 percent or more of the Mining and METS workforce in 2030. As shown in Figure 4.14, the employment of miners, Fitters (General) and Truck Drivers (General) is forecast to grow and continue to account for a large proportion of the Mining and METS workforce. In contrast, employment in Metal Fabricators and Fitters and Turners is forecast to decline over the ten year period between 2020 and 2030.

Figure 4.14: Distribution of ANZSCO 6-digit occupations that account for greater than 2 percent of the Mining and METS workforce in 2030



**Other occupations include: Driller (1.9%); Fitter and Turner (1.6%); Shot Firer (1.5%); Stationary Plant Operator nec (1.1%); Metallurgical or Materials Technician (1.0%); Production Manager (Manufacturing) (0.7%); Mining Engineer (excluding Petroleum) (0.6%); Bulldozer Operator (0.6%); Building and Engineering Technician nec (0.5%); Waste Water or Water Plant Operator (0.5%); Excavator Operator (0.4%); Welder (First Class) (0.4%); Metal Fitter and Machinist nfd (0.2%); Metal Machinist (First Class) (0.2%); Grade Operator (0.1%); Loader Operator (0.1%); Metal Fitter and Machinist nec (0.1%).*

KPMG based on ABS Labour Market Quarterly and Census Data

Key industry trends that are occurring in the region

The Mining and METS industry in the Greater Whitsunday region is in the midst of significant transformation. Rapid automation of services, major investments in infrastructure and evolving community and government preferences for renewal energy sources are driving well documented changes in the industry. The impact of these changes on the existing Mining and METS workforce in the region will be significant.

Regional trends in coal mining

Coal mining in the Bowen Basin has undergone significant revitalisation in recent years. Activity in the Bowen Basin has been influenced by expanded production activities and planned maintenance at existing mining operations.

Metallurgical coal, particularly hard coking coal produced within the Bowen Basin, is the largest exporting supply of metallurgical coal globally and considered superior quality with prices often benchmarked from this coal. [228]

The region has recently opened new mines and re-opened numerous existing mines, including:

- Byerwen mine;
- Meteor Downs South mine;
- Broadlea mine;
- Baralaba North mine; and
- Cook mine. [229]

Additionally, construction of the Carmichael Mine has recently commenced in the Galilee Bain and is forecast to generate up to 1,500 direct jobs during the peak of its construction. In its first stage of operation, the mine is expected to produce 10 million tonnes of coal per annum that will be transported to Abbott Point Port via rail. [230]

In turn, these investments in the Mining and METS industry will be met with increasing workforce demands as services are expanded across the Greater Whitsunday region.

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Regional responses to trends in automation and technology

Automation, AI, and analytics solutions have the potential to transform the Mining and METS industry. These technologies are continuing to gain momentum, as companies are focused on harnessing technology to improve safety, reduce the cost of maintenance and extraction and improve productivity.

In response to the acceleration of technology adoption in the Mining and METS industry, there is an increased focus on developing a diverse, talented and future-fit workforce within the Greater Whitsunday region through initiatives such as the Resources Centre of Excellence in Mackay.

Regional trends in renewable energy

Climate change, technology and changing consumer sentiment are among the defining business challenges. Driven both by pressure from stakeholders and the strengthening business case for decarbonisation, there has been growing interest in expanding the renewable energy sector in the Greater Whitsunday region.

In recent years, the Isaac LGA received approval for the construction of 195 wind turbines. The $1 billion wind farm project would involve approximately 350 jobs during construction and is set to be one of the nation's largest wind farms. Additionally, the region recently sought approval to construct 10 solar farms. [231]

These recent trends in the region may signify the beginning of a potential shift in the region towards balancing its focus on mining with renewable energy.

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[228] *Commodity Insights, Minerals Council of Australia, 2018, Market Demand Study: Australian Metallurgical Coal, Available at https://minerals.org.au/sites/default/files/181012%20Commodity%20Insights%20Met%20Coal%20Report.pdf*

[229] *Isaac Region. 2019. Economic Indicators Profile. https://www.isaac.qld.gov.au/downloads/file/845/economic-indicators-reportm*

[230] *Adani Australia. 2020. Carmichael Mine. https://www.adaniaustralia.com/projects-businesses/mine*

[231] *Isaac Region. 2018. $1 billion project in Isaac to help energise Australia. https://www.isaac.qld. gov.au/news/article/192/1-billion-project-in-isaac-to-help-energise-australia*

THE IMPACT OF COVID-19

Queensland Mining and METS industry

The Mining and METS industry globally has seen a slow, or in some cases a halt, in production as a result of the COVID-19 pandemic. Government regulations have seen travel restrictions placed on necessary personnel, uncertainty around the supply chain and interruptions to operations due to social distancing requirements.

The resources sector in the Greater Whitsunday region has focused on local recruitment in recent years. For example, BHP recently put on 125 apprentices in Mackay, while Pembroke has received conditional approval to build a new coking-coal mine in the Bowen Basin. [232] Though mining has remained Australia's most resilient industry throughout the pandemic, ABS data also indicates the number of payroll jobs in Queensland's mining sector decreased by five per cent between mid-March and early May. [233] Stakeholders noted that the mining industry (and employers) have undertaken significant measures to ensure mines remain operational during COVID0-19.

Travel restrictions

With most Australian jurisdictions closing their borders and requiring any arrivals to undertake a 14 day period of self-quarantine, mining companies with a reliance on interstate Fly-In Fly-Out (FIFO) workforce were concerned about the impact of staff shortages on production.

Queensland FIFO workers were not required to undertake an isolation period but were encouraged to reduce the reliance on FIFO workers to minimise mass movements of people. All Queensland mines were also requested to provide a COVID-19 plan that details the measures undertaken to improve on-site hygiene, tailored to the specific location, resources and facilities on site. [234]

The MCA state resource chambers and Australian Petroleum Production and Exploration Association implemented COVID-19 industry protocols to protect the workforce and jobs through ensuring high quality health and safety. The protocols covered health and safety matters related to education and communication, mental health and wellbeing, travel and accommodation, safety at work, Aboriginal and Torres Strait Islander communities and critical suppliers/contractors. [235]

Commodity prices

The COVID-19 pandemic resulted in drastic changes to global activity. As commodities are extensively utilised in global industrial production, the changes in global activity resulted in variations in commodity prices. As at July 2020, Australian commodity prices have recovered slightly from the March to April 2020 lows due to COVID-19 as key markets, such as China, seek to stimulate economic recovery through industry development. Metallurgical coal, a key commodity for the Bowen Basin, is a required input for steel production. As such, it is expected to be critical to stimulating Australia's economic recovery from the COVID-19 pandemic as demand from international markets continues to strengthen during the recovery period. However, due to the ongoing and unpredictable nature of the pandemic some commodities are still experiencing negative demand impacts from COVID-19 lockdowns in the major importing regions of Europe, India and developed Asia. [236]

Sustainability of production

In Australia and globally, mining companies have adopted automated technologies to ensure sustainability of production amongst workforce shut downs. Social distancing requirements meant that mine sites, accommodation and travel had to be managed through limitations on total capacity. Given the high level of safety standards required in mining, a limited workforce is not always a viable option. In these instances,

[232] *Sofie Wainwright, ABC North QLD, 25 May 2020, Resources industry creating much-needed jobs in regional Queensland despite coronavirus, Available at https://www.abc.net.au/news/2020-05-25/resources-expansion-coronavirus-covid-19-jobs-in-mining/12274794*

[233] *Wainwright, s. 2020. Resources industry creating much-needed jobs in regional Queensland despite coronavirus. Available at https://www.abc.net.au/news/2020-05-25/resources-expansion-coronavirus-covid-19-jobs-in-mining/12274794*

[234] *Hogan Lovells. 2020. Implications of COVID-19 on the Australian Mining Industry. Available at https://www.hoganlovells.com/~/media/hogan-lovells/pdf/2020-pdfs/2020_05_29_australian-mining-industry_implications-of-covid19.pdf*

[235] *Hogan Lovells. 2020. Implications of COVID-19 on the Australian Mining Industry. Available at https://www.hoganlovells.com/~/media/hogan-lovells/pdf/2020-pdfs/2020_05_29_australian-mining-industry_implications-of-covid19.pdf*

[236] *BHP. 2020. BHP Operational Review for the Year Ended 30 June 2020. Available at https://www.bhp.com/-/media/documents/media/reports-and-presentations/2020/200721_bhpoperationalreviewfortheyearended30june2020.pdf?la=en*

automated technologies and remote operated technologies have helped mining organisation to minimise risks and continue operations.

Regional impacts for the Mining and METS industry

Understanding the impact of the spread of the COVID-19 on the labour market – both on people and businesses, as well as the responses to government restrictions and government support packages – will be critical to understanding the evolution of the Mining and METS industry in the Greater Whitsunday region in the short term.

REMPLAN has collected and released new data measuring the labour market impacts of COVID-19 across the Greater Whitsunday region. As part of its COVID-19 Australia Business Economic Impact Survey, REMPLAN specifically investigated the business impacts in the Mining and METS industry and its results for the Greater Whitsunday region indicated that:

- 56 percent of businesses and organisations surveyed in the Mining and METS industry within the region reported to have been affected by COVID-19;
- 19 percent of businesses and organisations surveyed in the Mining and METS industry within the region reported to be prioritising the future employment of their staff over the next three months;
- 13 percent of businesses and organisations surveyed in the Mining and METS industry within the region reported to be prioritising the continued supply of goods and services that businesses require to operate over the next three months; and
- 19 percent of businesses and organisations surveyed in the Mining and METS industry within the region reported that they have benefited from the wider adoption of more flexible working arrangements as a result of COVID-19. [237]

These results indicate that just over half of the Mining and METS industry in the Greater Whitsunday region has been impacted by COVID-19 and that a large number of businesses and organisations have readily responded to the pandemic with the adoption of flexible working arrangements to ensure the job security of their staff.

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[237] *REMPLAN, 1st June 2020, COVID-19 Australian Business Economic Impact Survey, Mackay, Isaac and Whitsunday, Available at https://surveys.remplan.com.au/s3/REMPLAN-COVID-19-ABEIS*

Faethm Insights:

The Disrupted View

"As requirements change in the mining industry, reskilling of employees and upcoming generations will need to be a priority. The workforce will need to be comfortable with digital technologies and there will be increasing demand for more fundamental data science expertise, such as those with abilities to translate large amounts of data into trends to derive insights and high-value business related questions.

CSIRO Futures[238]

[238] 2017, Mining Equipment, Technology and Services – A roadmap for unlocking future growth opportunities for Australia. Available at https://www.csiro.au/en/News/News-releases/2017/Roadmap-to-drive-growth-for-Australian-METS

PREDICTIONS OF WHEN KEY TECHNOLOGIES WILL IMPACT THE MINING AND METS INDUSTRY

There are a range of emerging technologies that are expected to accelerate the rate of technological change and adoption over the coming years, and with this, impact on the workforce. Often, the discussion about the impact of technology on the Future of Work talks about digital disruption in sweeping terms without a clear or nuanced view of what technologies are planned for adoption, the maturity of the industry within the region and its readiness for technology, or the industry-specific technologies which will have a significant workforce impact.

The Faethm modelling provides a prediction of the key technologies that could be implemented at an industry level, specifically for the Greater Whitsunday region. It is important to note this is based on the opportunity that exists, and may not be fully realised. Based on these predictions, Faethm also examines the expected workforce impact of technology adoption. Further information on the Faethm methodology is provided in Appendix B.

What does the technology prediction tell us?

The Faethm technology prediction for the mining sector in the Greater Whitsunday region is summarised in Figure 4.15, Figure 4.16 and Figure 4.17. These figures show the technologies with the greatest predicted automation impact on the Mining and METS workforce measured in terms of $AUD total salary cost savings as a result of a reduction in FTE across the workforce.

This analysis for the Mining and METS industry shows:

- The mining sector demonstrates that Fixed Robotics (see Table 4.1) will be the main driver of workforce change over the next fifteen years, with the greatest impact expected over the next five years ($159.3 million in predicted salary savings), strong growth in impacts still expected until 2030, and a slowing of impact growth out to 2035 ($221.4 million in predicted salary savings);
- Despite this, the impact of Navigation Robotics on the workforce in this sector cannot be understated over the long term. By 2025, Navigation Robotics is the technology with the third highest impact ($36 million in predicted salary savings), and then grows by approximately three times between years 5 to 10 ($118.1 million in predicted salary savings), and then almost doubles again out to 2035 ($205.6 million in predicted salary savings);
- Process Automation continues with steady expected salary savings over time, which slows from $44.6 million in predicted salary savings in the 5 year projection to predicted salary savings of $66.1 million by 2030, and $71.6 million by 2035;
- The impact of Decision Generation Technologies will be relatively evenly spread over the next fifteen years, with a predicted salary saving of approximately $20 million each at the 5, 10 and 15 year projections. Its impact by 2035 is predicted to be a salary saving of $59.8 million;
- Mobile Robotics technologies will grow in impact, tripling in the predicted salary saving impact between years 5 to 10 (from a predicted salary saving of $10 million to $30.6 million) and then growing more moderately out to 2035 (to a predicted salary saving $48.3 million);
- Sensory Perception will grow in the predicted salary saving impact over the 15 year time horizon, estimated at approximately $12 million every five years, with slightly higher growth between years 5 to 10 than years 10 to 15. By 2035 its impact in salary savings for the workforce is predicted to be $37.2 million; and
- Predictive analysis is a technology whose impact is expected to be felt more strongly out to 2030, with a predicted salary saving impact of $13.1 million estimated to 2025, growing to $20 million by 2030.

Figure 4.15: Prediction of emerging technology types with the greatest opportunities to drive automation in the Mining and METS industry, Greater Whitsunday region, 5 year projection (2025) ($AUD salary cost saving)

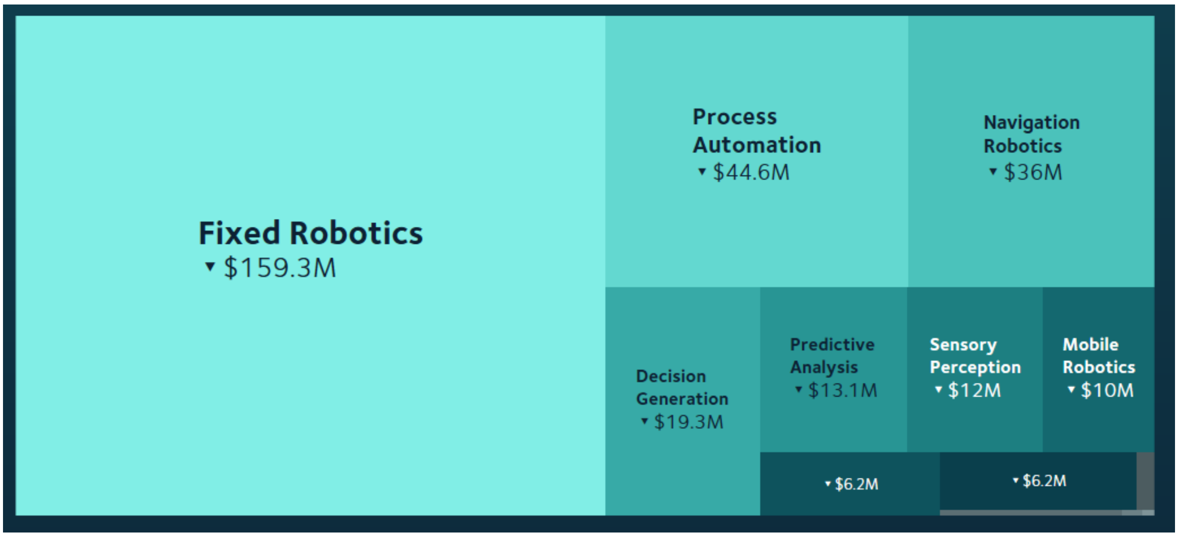


Figure 4.16: Prediction of emerging technology types with the greatest opportunities to drive automation in the Mining and METS industry, Greater Whitsunday region, 10 year projection (2030) ($AUD salary cost saving)

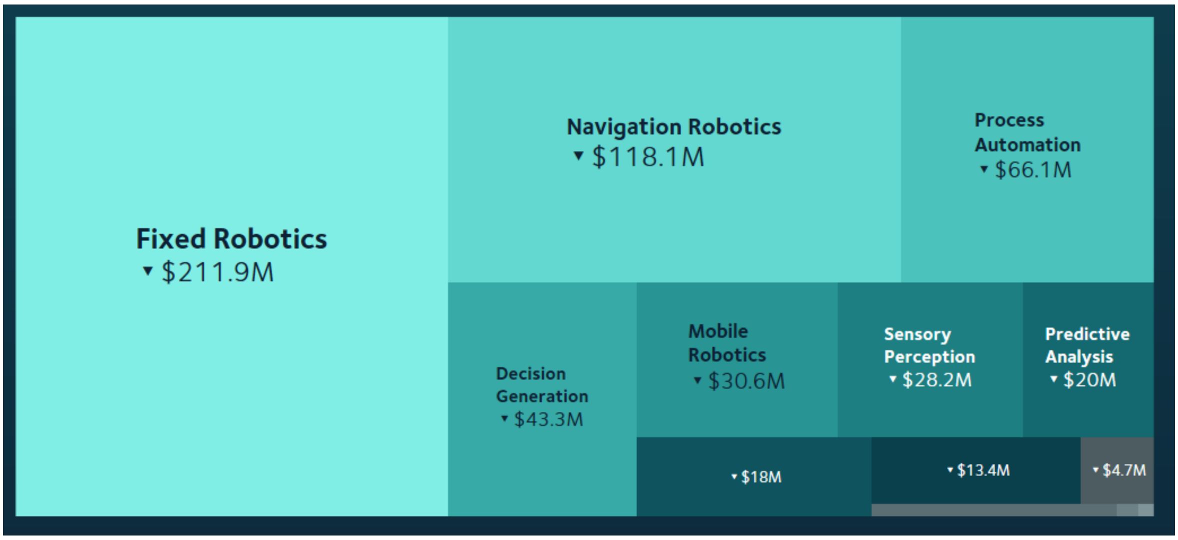
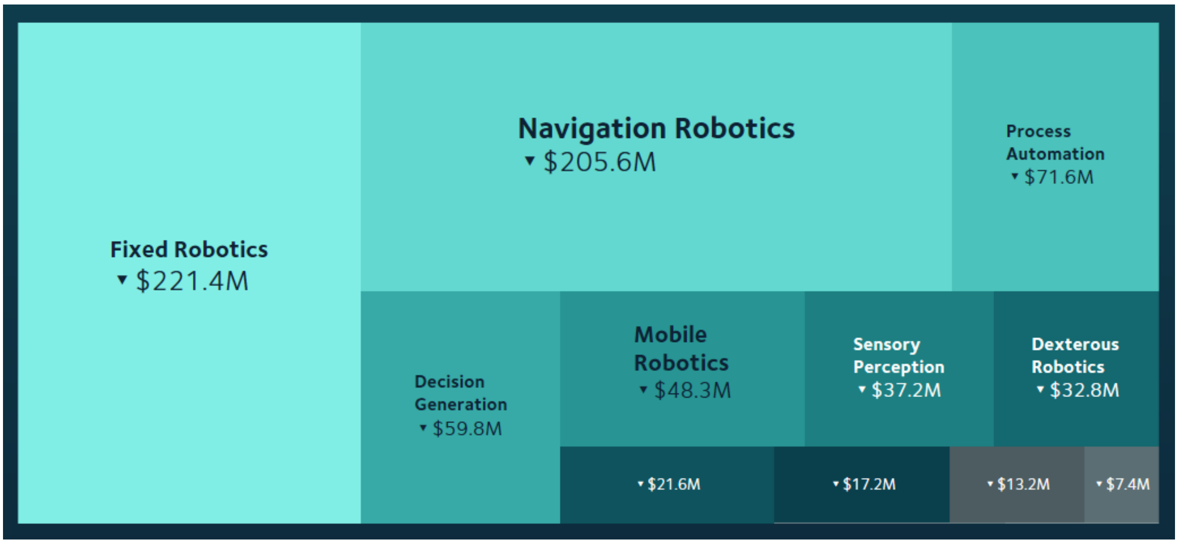


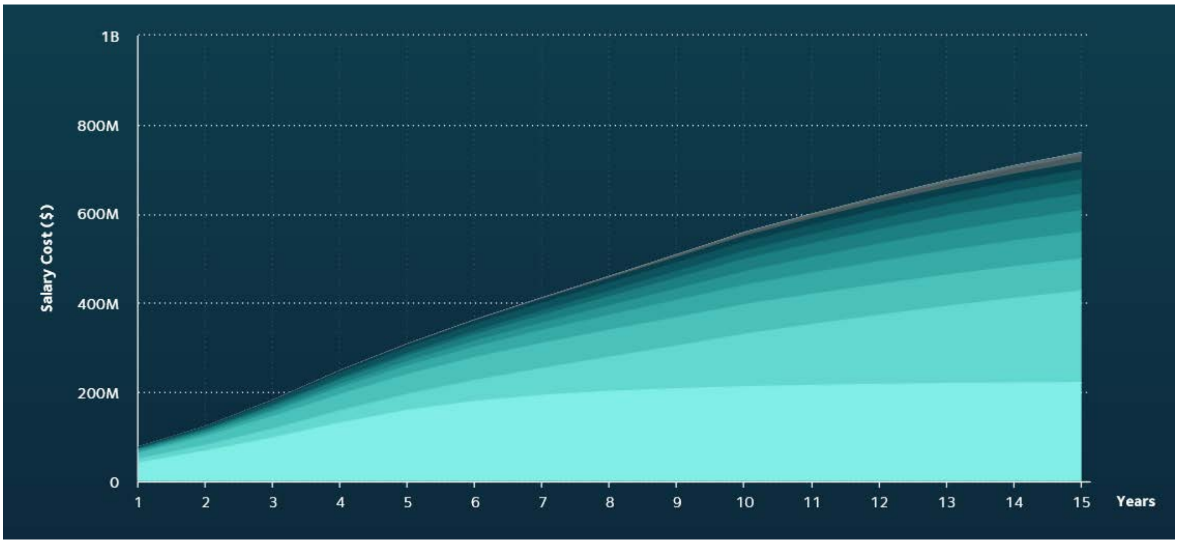
Figure 4.17: Prediction of emerging technology types with the greatest opportunities to drive automation in the Mining and METS industry, Greater Whitsunday region, 15 year projection (2035) ($AUD salary cost saving)



Source: Faethm (platform.faethm.ai)

The impact of these emerging technologies on the workforce are also summarised in the 15 year technology projection curve for the Mining and METS industry shown in Figure 4.18 below.

Figure 4.18: Technology adoption curve over the 15 year horizon (to 2035), Mining and METS industry, Greater Whitsunday region



Key from bottom to top – fixed robotics, navigation robotics, process automation, decision generation, mobile robotics, sensory perception, dexterous robotics, predictive analysis, conversation exchange, collaborative robotics, solution discovery, generative design and creative origination.

Source: Faethm (platform.faethm.ai)

What is meant by these technology categories in the Mining and METS context?

Table 4.1 below provides a definition for each of the Faethm technology clusters, and examples of what is meant by this in the mining sector context. These link together the technologies discussed in the next part of this chapter with the Faethm nomenclature.

Table 4.1: Technology clusters in Faethm and applicability to the mining sector

TECHNOLOGY	DEFINITION (FAETHM)	EXAMPLES IN A MINING CONTEXT
Fixed Robotics	Fixed Robotics technologies are machines that robotically handle and manipulate objects in a predefined way such as by painting or assembling. This works by combining programmed rules based instructions with vision, sensor systems and mechanics.	In the Mining and METS context, significant changes to robot-assisted mining operations are already underway, helping to create efficiencies across the value chain, but specifically within mine processing through conveyor belt robotics installed to enhance efficiency of material sorting and reduce waste.
Navigation Robotics	Navigation Robotics technologies are robots that can navigate autonomously in unstructured environments with specific functions. This works by applying reinforced learning, advanced sensors and mechanics to plan and conduct live movement between environments.	Navigation robotics is having a global impact on the Mining and METS industry and changing the way that mines operate. Examples include autonomous vehicles in the form of automated guided vehicles (AGVs) in the transport of materials within mining sites. Automated rail and automated drilling have also seen significant uptake across the sector to deliver efficient whilst enhancing safety standards.

TECHNOLOGY	DEFINITION (FAETHM)	EXAMPLES IN A MINING CONTEXT
Process Automation	Process Automation technologies use code programmed to complete pre-defined, logical and rule based processing tasks such as quantitative calculations, process onboarding, monitoring and simple robotic jobs and movements. This works by applying rules based logic to take structured inputs and using predefined executable steps, to deliver structured outputs.	This includes the automation of administration and business functions through remote control centres, and connection of devices through IoT. Process improvements are likely to occur through remote operated control centres that now have access to a wealth of data and devices.
Decision Generation	Decision Generation technologies are systems that use machine learning to evaluate input data, create options and determine the best course of action or outcome from a number of possibilities. This works by analysing and evaluating inputs, apply algorithmic process and trained logic and past experience to determine outcomes and decide on best course of action.	Key examples emerging in the mining and METS context include predictive analytics, prescriptive analytics and remote command centres. These technologies use data-enabled machine learning algorithms to detect useful patterns for prediction of optimal processes and potential business risks.
Predictive Analytics	Predictive Analytic technologies are tools that use algorithmic based process and prediction software to evaluate narrow data inputs, extracting relevant information and solving specific queries. This works via using machine learning to train and develop algorithms, applying unstructured inputs, unsupervised and supervised learning and adaptation to solve specific parameters.	Predictive Analytics is being used heavily across the Mining and METS industry to support the proactive management of assets throughout mining sites. Maintenance of assets are one of the largest costs for mining organisations, and the use of predictive analytics to proactively maintain these assets is resulting in large cost savings.
Sensory Perception	Sensory Perception technologies are systems that use sensors to detect and extract meaning from external stimuli and use this as a prompt to an action. This works by using sensors in combination with machine learning to detect and respond to specific external parameters such as information sources and interactions.	Smart devices and wearables provide a way to monitor the worker's health indicators and enhance safety measures for miners working on site. Sensors are also used widely in high risk areas such as underground mines or mounted on vehicles to relay rich information to remote control centres.
Mobile Robotics	Mobile Robotics technologies are machines that transition between locations and positions, completing robotic handling and object manipulation tasks. This works by combining programmed instructions with moving mechanics to transition between points in a controlled environment.	Key examples are robotics used in processing and sorting such as conveyor robots, which can work in warehouses with conventional shelving to pick cartons and boxes, and then move them to pallet-building areas, working alongside humans.

Predictions of the impact of these technologies being adopted in the mining workforce.

Based on the technology adoption rates for the Mining and METS industry in the region in Figure 4.18, Faethm predicts the opportunity that is created to automate, augment and add to the workforce. The analysis undertaken for the Greater Whitsunday region for the mining sector workforce over a 5, 10 and 15 year horizon is shown in Figure 4.19, Figure 4.20 and Figure 4.21.

This predicts that:

- By 2030, 19.2 percent of the total mining workforce functions and roles will be augmented (or supported) by technology, and 31.2 percent of the current tasks and functions undertaken by the Mining and METS workforce are predicted to be automated (or replaced) by technology;
- The degree of impact of a change in automation and augmentation is also partially determined by the overall size of the occupations across the Mining and METS workforce;
- Miners is the occupation expected to drive the highest overall workforce impact in the region as a result of both automation and augmentation over the 10 and 15 year horizon. By 2030, it is predicted that 30.5 percent of this role will be automated as a result of technology, and 17.4 percent of the role will be augmented by technology. The Fitter (General) is expected to be the occupation most impacted by technology at the 5 year time horizon.
- The top five occupations driving the greatest workforce impact for the region in Mining and METS by 2035 are predicted to be the occupations of Miner (42.9 percent automatable, 20.7 percent augmentable), Fitter (general) (49.7 percent automatable, 17.5 percent augmentable), Truck Driver (58.4 percent automatable, 8.7 percent augmentable), Electrician (24.8 percent automatable, 31.9 percent augmentable) and Metal Fabricator (49.7 percent automatable, 17.5 percent augmentable);
- The occupations with the highest predicted level of automation (where technology will replace the need for some tasks and functions) are the Grader Operator (67.6 percent), Truck Driver (58.4 percent), Stationary Plant Operators (56.3 percent), Loader Operator (56.1 percent), Bulldozer Operator (52.8 percent), Excavator Operator (52.8 percent), Metal Machinist (first class) (52.6 percent) and Welder (52.1 percent) ; and
- For most mining occupations by 2035, less than 20 percent of the role is projected to be augmented by technology. Those roles levels of projected augmentation by 2035 higher than 30 percent in Mining and METS in the Greater Whitsunday's region are Mine Deputy (50.7 percent), Production Manager (Mining) (43.7 percent), Production Manager (Manufacturing) (43.7 percent), Mining Engineer (excluding Petroleum) (39.3 percent), Building and Engineering Technicians not elsewhere classified (34.6 percent), Metallurgical and Materials Technicians (33.7 percent) and Electricians (31.9 percent).

Figure 4.19: Prediction of tasks within jobs exposed to augmentation and automation in the Mining and METS industry, Greater Whitsunday region, 5 year projection (top 15 occupations, by FTE)

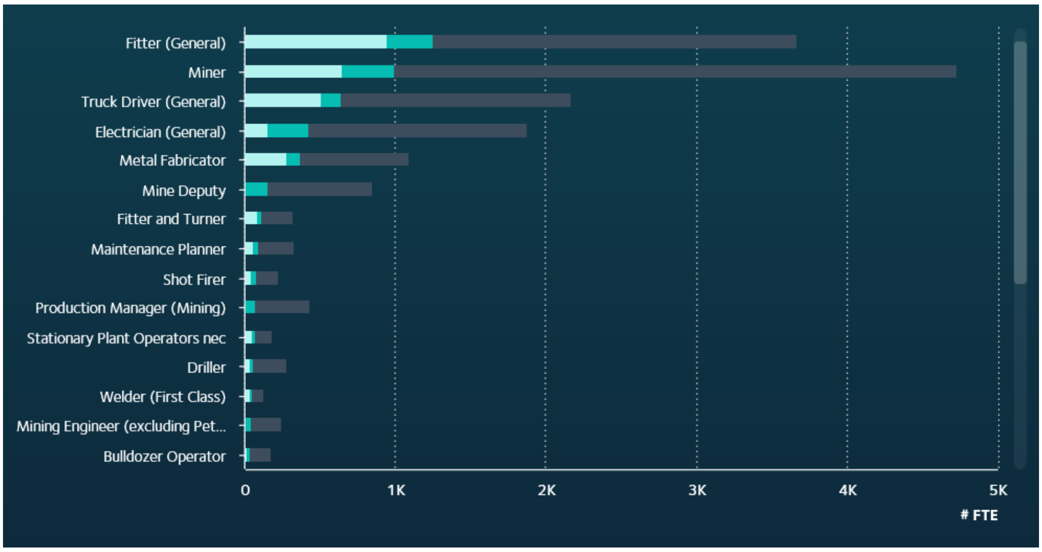


Figure 4.20: Prediction of tasks within jobs exposed to augmentation and automation in the Mining and METS industry, Greater Whitsunday region, 10 year projection (top 15 occupations, by FTE

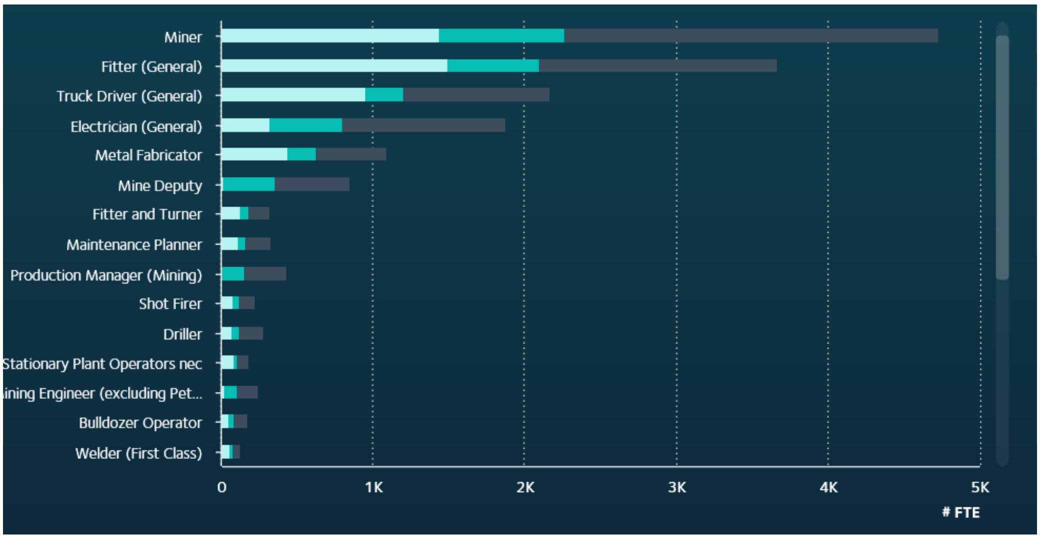
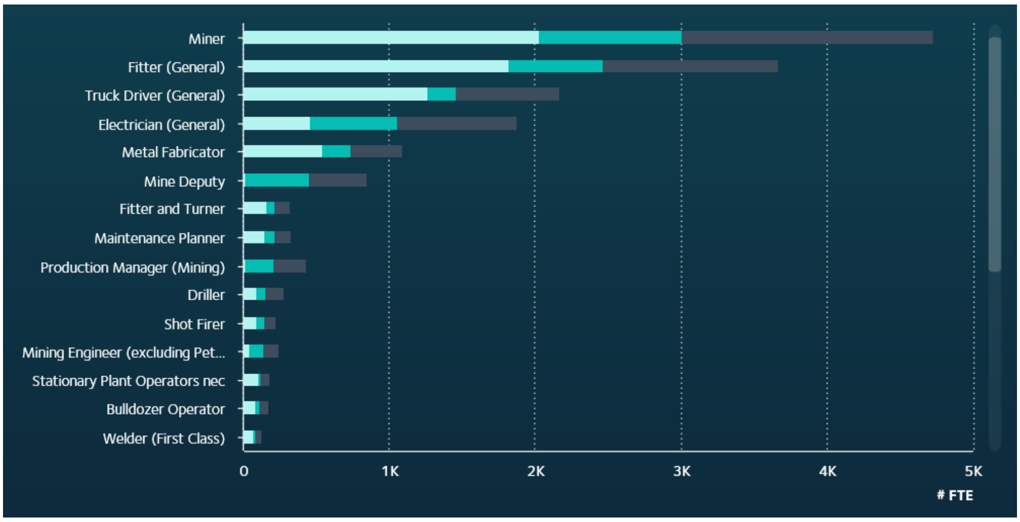


Figure 4.21: Prediction of tasks within jobs exposed to augmentation and automation in the Mining and METS industry, Greater Whitsunday region, 15 year projection (top 15 occupations, by FTE)



Source: Faethm (platform.faethm.ai)

It is also important to note that there are a number of new occupations that are expected to increase in demand as a result of the adoption of these technologies. Figure 4.22, Figure 4.23 and Figure 4.24 show the key occupations expected to be in demand over the 5, 10 and 15 year horizon based on adoption of new technologies in the Mining and METS industry. It shows that:

- By 2025, 765.9 FTE in additional jobs are predicted in the region to support the implementation of Mining and METS technology adoption, this grows to 1,800 FTE by 2035;
- The top five occupations predicted to grow in demand as a result of technology by 2035 are Software Developers and Applications, Software Developers and Systems Software, Data Engineers, Robotics Engineers and Data Integrators; and
- When viewed against predicted new occupations from the four included industry sectors, the mining sector will drive an increase in this ICT workforce by 46.1 percent of the total predicted additional 3,900 FTE required to support emerging technologies across the four industries analysed.

Figure 4.22: Prediction of additional jobs required to support new technologies adopted in the Mining and METS industry, Greater Whitsunday region, 5 year projection (top 15 occupations, by FTE)

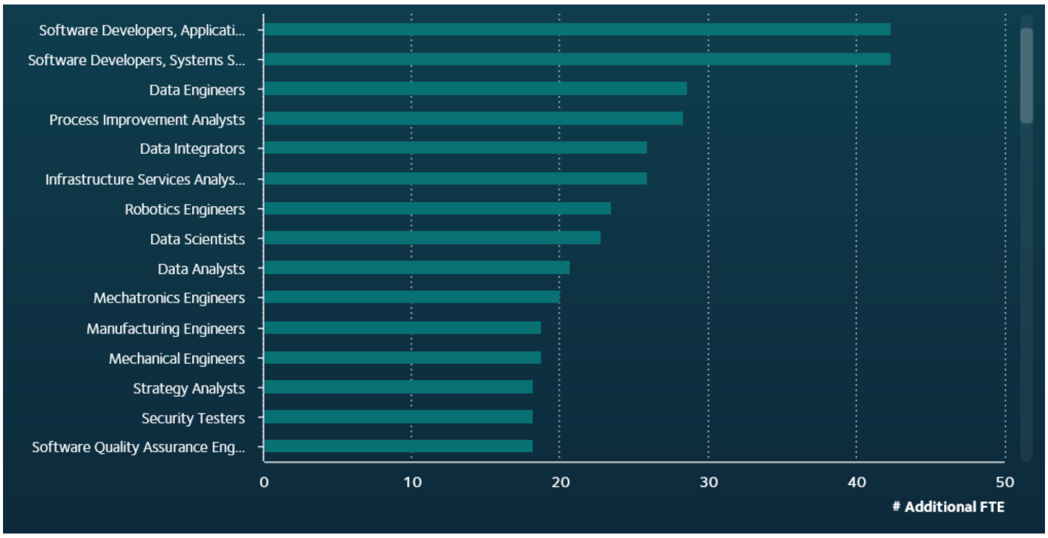


Figure 4.23: Prediction of additional jobs required to support new technologies adopted in the Mining and METS industry, Greater Whitsunday region, 10 year projection (top 15 occupations, by FTE)

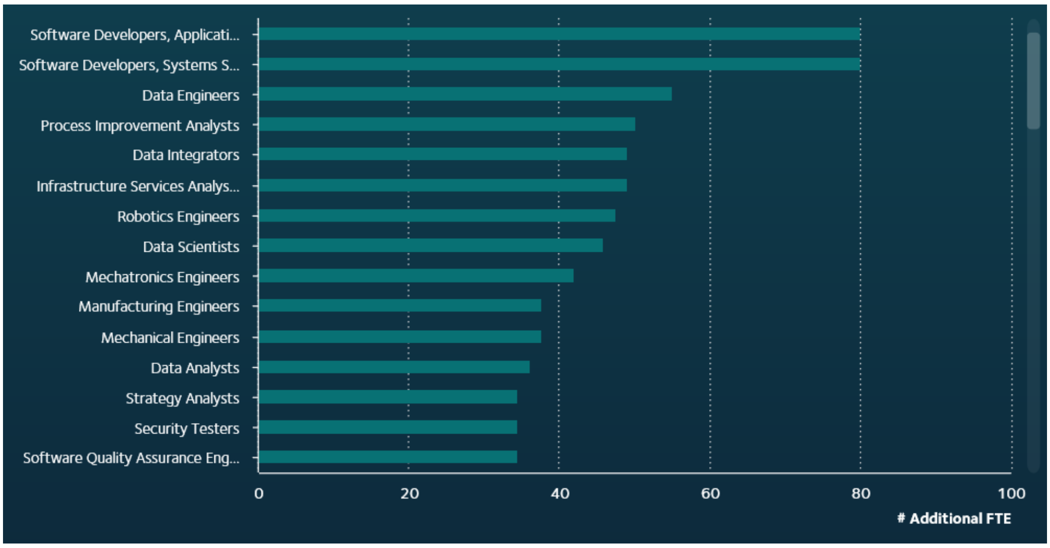
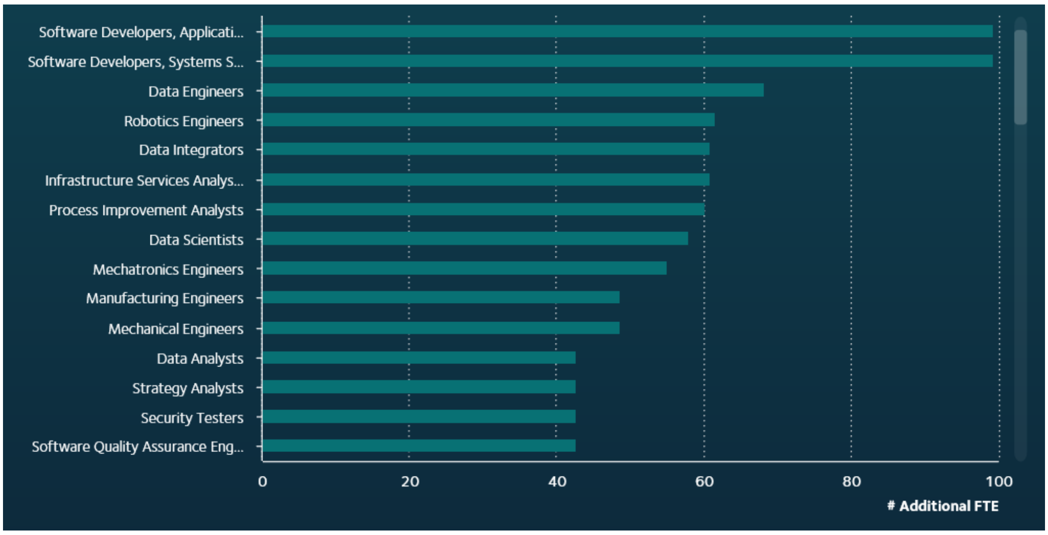


Figure 4.24: Prediction of additional jobs required to support new technologies adopted in the Mining and METS industry, Greater Whitsunday region, 15 year projection (top 15 occupations, by FTE)



Source: Faethm (platform. faethm.ai)

A deeper dive:

Technologies emerging in Mining and METS

“The mining industry has a window of opportunity over the next few years, created by strong operating fundamentals, to adapt to the growing and changing expectations of stakeholders. By utilising technology to operate safely and more efficiently, addressing global concerns, and maintaining a disciplined strategy to create ongoing value for its stakeholders, the industry can forge a better future for all beneficiaries of mining – industry, consumers, communities and other stakeholders.

– Global Mine 2019[239]

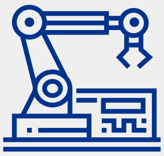
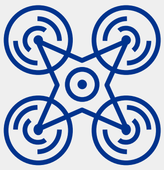
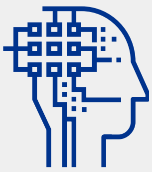
[239] *PWC. 2019. Mine 2019: Resourcing the future*

KEY TECHNOLOGIES

The Mining and METS landscape is changing globally as rates of discovery for high-quality and accessible commodities drop, productivity rates decline and operational costs rise. These challenges have seen Mining and METS organisations across the world look to innovative technologies to enhance productivity, improve safety standards and reduce costs. [240]

It is expected that there will be some technologies which will impact the roles, functions and / or ways of working across the whole of the Mining and METS industry, while there are other technologies which will impact individual occupation areas differently.

Table 4.2: These technologies and digital enablers include:

	**Automation and robotics:** These technologies are able to automate increasing amounts of manual tasks and augment others to increase productivity, safety and reduce labour costs. Automation and associated technologies are the primary driver of growth and productivity across the METS sector. Automation and navigation robotics technology are being utilised in many mines to increase access and productivity whilst reducing safety risks for workers.
	**Sensors and Sources**: Sensors utilise inputs from the physical environment and use internal programming to perform predefined functions and create new sources of data upon the detection of specific inputs. Sensors can be utilised in a variety of ways by being mounted on vehicles, unmanned aerial vehicles (UAVs), drones, aircraft and satellites, or placed directly in soil, water and on plants and animals.
	**Geo-Spatial Data and 3D Mapping:** These technologies include data regarding objects or events that have a location on the earth's surface, the location can be static such as the location of a road or earthquake event, or dynamic such as a moving vehicle or pedestrian. Geo-spatial data combines location information, attribute information and temporal information.
	**Energy Technologies**: Industry and government have long acknowledged the risks and environmental impacts from the use of fossil fuels in the Mining and METS industry, and are increasingly supporting adoption of renewal electricity and energy efficiency measures. In addition optimising points of inefficiencies throughout the value chain have the potential to reduce costs significantly.
	**Data and Analytics:** The collection and analysis of data creates the potential for efficiency gains across the entire value chain including extraction, processing and transportation. Various imaging technologies such as drones, satellite imagery and cameras can also be coupled with analytics to identify in real time the inefficient points in the mining value chain.
	**AI and Machine Learning:** AI and machine learning is being used in a variety of ways to improve the efficiency and accuracy of decision making, supporting health and safety standards, reducing error rates in exploration and reducing environmental footprint of Mining and METS companies.

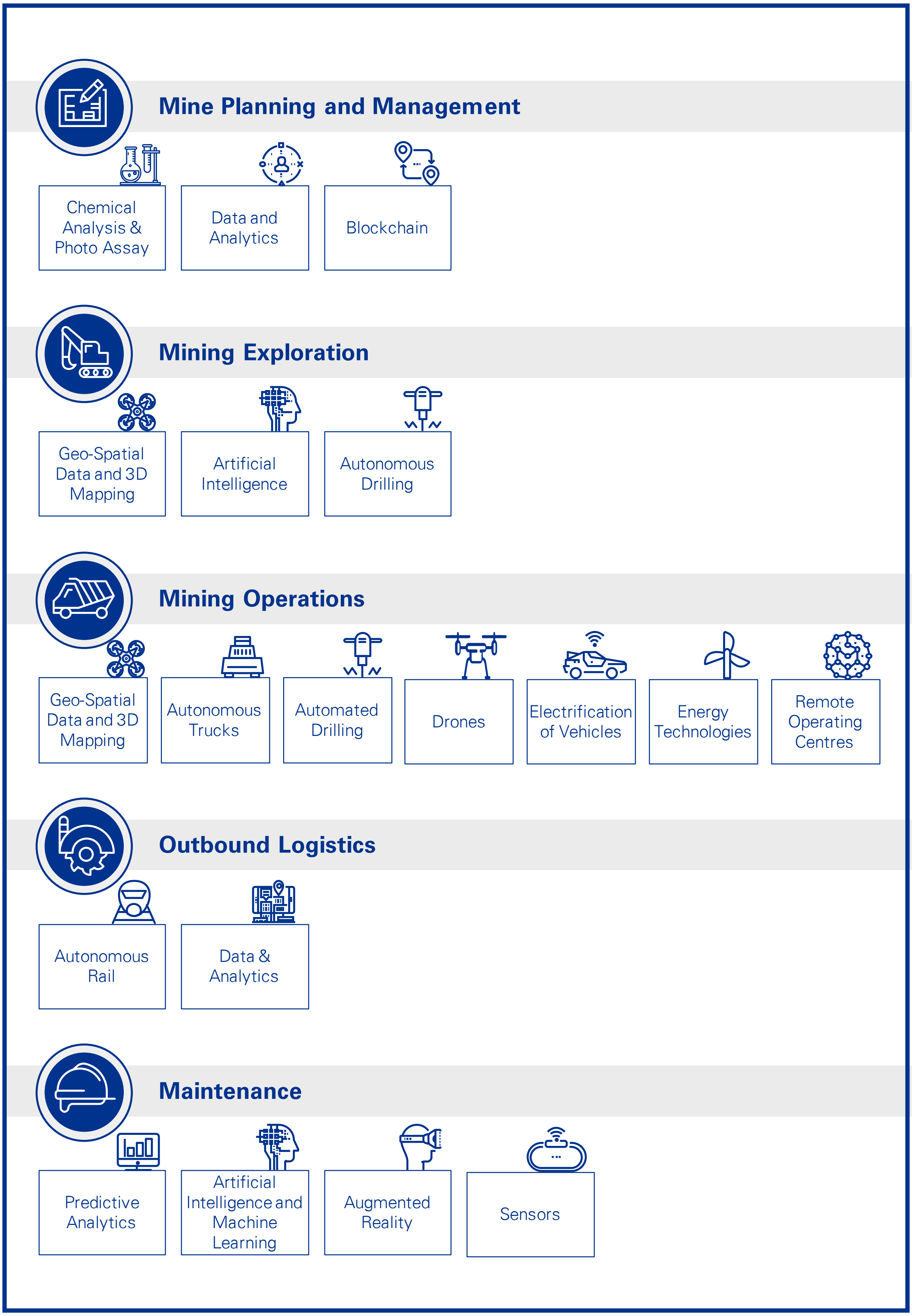
[240] *CSIRO. 2017. Mining Equipment, Technology and Services: A roadmap for unlocking future growth opportunity for Australia. Available at https://www.csiro.au/en/Do-business/Futures/Reports/METS-Roadmap%20*

To be able to effectively respond and adapt to these technologies it is expected that the workforce will require capability development to build foundational digital literacy knowledge. It will also require interventions to drive changes in behaviour that increase the adoption of digital mining solutions.

The Mining and METS industry in Australia leads the way in innovation and adoption of technologies, with many mines across Australia having already adopted autonomous haulage systems and leveraging advanced data and analytical capabilities. The immediate focus for mining organisations will be the augmentation that technology brings to traditional mine site roles, and identifying alterative occupations for their workforce such as roles within remote operations centres.

There are many additional technologies that are expected to impact on individual occupations areas in specific ways. Figure 4.25 below outlines at a high level the breath of technologies and how they impact occupations differently. Further detail on how these technologies impact key segments if the Mining and METS industry is provided in Appendix E.

Figure 4.25: High level the breadth of technologies



Automation and robotics

What is automation and robotics?

Robotic and automation technology is used in the Mining and METS industry to improve safety and productivity. Automation and robotic technologies can replace miners traditionally required to operate machinery and equipment in hazardous conditions below ground. The technology refers broadly to various applications within the industry, including allowing trucks to navigate independently to creating drilling algorithms. Automation and robotics utilise a range of technology applications including machine learning, GPS data and segmentation and recognition solutions to allow the automatic operation of technologies.[244]

How is it being applied within the sector?

Automation and associated technologies are the primary driver of growth and productivity across the METS sector, with the potential to uplift $52 billion in value for the industry by 2030. A recent industry report found that 73 per cent of surveyed mining executives believe that robotics and automation will be the biggest impacting technology on the industry over the next 15 years.[245]

Automation and navigation robotics technology are being used, in many mines to increase access and productivity whilst reducing risk for workers. The most common form of automation in the METS sector is autonomous vehicle systems, with automation ranging from no driver assistance to fully autonomous driving. Automation can also be found in specific mining equipment such as drilling systems, enabling remote operation of machinery.

In addition to BMA's introduction of 34 autonomous trucks at the Daunia coal mine in central Queensland in February 2021, an additional example of automation and robotic technologies within the Mining and METS industry is Rio Tinto's operations in the Pilbara region of Western Australia. Rio Tinto's Pilbara iron ore mining operations have more than 80 autonomous trucks that have moved more than one billion tonnes of ore and waste material across the Pilbara.[246] The site continues to employ 12,000 workers who have been transitioned from traditional mining work to roles in remote control centres.[247] Additionally, Rio Tinto has implemented a range of autonomous drilling systems (ADS), with a total of 20 in operation as of 2018. ADS technology enables the remote operation of the drilling system through single control.

CASE STUDY – RIO TINTO

Rio Tinto trialled automated drilling technology on the Pit Viper 271 rigs at the Yandi mine in the Pilbara. The technology is able to work for 11.5 hours of a 12 hour shift requiring only one person to oversee the drills, compared with around 8.5 hours with human operators. The automated drilling technology led to BHP reporting a 20 percent improvement in drill optimisation, and commencing the adoption of automation with a number of their other rigs.[241]

CASE STUDY – SUEK

Suek is one of the world's largest coal and energy companies with 27 mine sites across the world that produce 110 million tonnes of coal. Suek is testing autonomous queuing and manoeuvring technology on its trucks to speed up the loading, driving and unloading process.[242] In 2019 Suek partnered with VIST Group to develop unmanned drilling technology which requires mining human interaction. The system has built-in safety algorithms which respond to equipment and employees performing auxiliary work in its surroundings, meaning that the drill will alter its activity depending on its surroundings. The system also includes satellite navigation and special drill control programmes which are able to provide pointing accuracy of up to 10 centimetres.[243]

[241] Mining Technology. 2018. Mining robots: Rio Tinto doubles down on autonomous drilling. Available at https://www.mining-technology.com/features/mining-robots-rio-tinto-doubles-autonomous-drilling/

[242] NS Energy. 2019. How autonomous technology could make mining safer, cheaper and more valuable. Available at https://www.nsenergybusiness.com/features/autonomous-mining-technology-zyfra/

[243] Mining.com. 2019. Historic Siberian mine to become automated. Available at https://www.mining.com/historic-siberian-mine-become-automated/

[244] QUT Centre for Robotics. 2020. Automation-enabling positioning for underground mining. https://research.qut.edu.au/qcr/research/automation-enabling-positioning-for-underground-mining/

[245] Small Caps. 2019. Mining industry about to be transformed by automation and robotics. Available at https://smallcaps.com.au/mining-industry-transformation-automation-robotics/

[246] Rio Tinto. 2018. Rio Tinto to expand autonomous truck operations to fifth Pilbara mine site. Available at https://www.riotinto.com/en/news/releases/Automated-truck-expansion-Pilbara

[247] NS Energy. 2019. How autonomous technology could make mining safer, cheaper and more valuable. Available at https://www.nsenergybusiness.com/features/autonomous-mining-technology-zyfra/

In 2019, Rio Tinto announced the successful deployment of its AutoHaul technology at the site for the autonomous transportation of iron ore via train across the Pilbara region, the world's largest robot and first automated heavy-haul, long-distance rail network. [248] Each AutoHaul train is fitted with an on-board module which sends automatic reports on its position, speed and direction of travel to a control centre located in Perth. RioTinto has reported improved productivity, system flexibility and reduction in bottlenecks.

What is the impact?

The adoption of automation and robotics in the Mining and METS industry has caused concern regarding the future of the workforce, with many wondering how far away Australia is from a fully automated mine and what this might mean for employment in the sector.

However, METS organisations are saying that the adoption of these technologies presents an opportunity for employees rather than a risk with the potential for redesigned roles and creation of new roles. METS organisations see that automation will drive greater productivity, efficiency and safety therefore growing the industry and ultimately creating more roles. Analysis undertaken on the impact of technology on the Australian mining sector by AlphaBeta suggests that automation technologies in the closely aligned oil and gas sector could create 5,000 net jobs. They predict that while there will be an initial net loss of jobs in primary firms, this will later lead to job increases due to competitiveness and efficiency, jobs across the wider supply chain (if these are strengthened domestically) and additional employment stimulated by household spending form mining wages. [249]

The primary impact to date has been the reduction of high-risk roles, with autonomous vehicles now conducting these activities whilst the workers previously on site now being located at control centres.

[248] *Railway Gazette. 2019. Rio Tinto complete AutoHaul autonomous train project. Available at https://www.railwaygazette.com/australasia/rio-tinto-completes-autohaul-autonomous-train-project/47822.article*

[249] *AlphaBeta. 2019. Staying ahead of the game. Available at https://alphabeta.com/wp-content/uploads/2019/11/191106-mets_automation_report_web.pdf*

Sensors and Sources

What are sensors and Sources?

Sensors are utilised within the industry to collect data that is used for mineral exploration and mine closures. Sensors are connected to data acquisition units that provides real time data to inform decision making or community with central data systems.

How is it being applied within the sector?

Within the METS sector sensors are being used in a range of ways from being embedded within clothing to become smart work wear, mounted on autonomous haulage trucks to being used in underground mines to understand more about controlled explosions and create new sources of data for organisations to analyse.[251]

The traditional approach to controlled explosions included a team going underground to take photographs to gain an understanding of the environment. Through the use of sensor technology, this process can be carried out with no, or minimal risk to human life and greater detail can be captured through the sensors, with organisations estimating a $5 million to $20 million saving per mine.[252]

What is the impact?

The use of sensors in the mining sector is enabling real-time environmental and operational insights whilst supporting the safety of mine workers. It is expected with widespread adoption, the focus will then shift to utilising sensors and sources to integrate with other technologies to create a fully integrated and automated mire or plant. It is expected that around 2030, companies will continue to automate production using integrated technologies as large benefits and synergies continue to emerge.

CASE STUDY – 2CENSOR

Mackay based business 2Censor, has utilised sensor probes, sensor nodes, a base station unit and a 2Censor Dashboard to digitise plant operator intelligence based on inputs from assets such as pipelines and conveyors. Data insights provide clear actions that are designed to help to improve quality and reduce costs.

CASE STUDY – SMART SUITE 5.0

The SMART Suite 5.0 features sensors that can detect and report on components of worker health and safety, mine air quality, geo-location asset tracking, communication and ground stabilisation detection. The SMART technology utilises sensors and IoT to monitor worker health across the mine and deploy real-time communications with the ability to predict potential problems and recommend steps to avert health risks.[250]

CASE STUDY – VAYERON

Vayeron is a business based in Mackay which uses the Smart-Idler to provide 24 hour monitoring through a wireless and automated system. The system monitors roller temperate, vibration faults, acoustics and roller shell-wear to predict roller failure to increase productivity and reduce operating costs.

The Smart Idler is internally installed into the roller during manufacture, and is powered through the rotation of rollers and relays data via radio network.

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[250] *Mining Magazine. 2018. IoT sensors to improve mine safety. Available at https://www.miningmagazine.com/sustainability/news/1332076/iot-sensors-to-improve-mine-safety*

[251] *Australasian Mine Safety Journal. 2018. Sensing a serious problem. Available at https://www.amsj.com.au/sensing-a-serious-problem/*

[252] *NS Energy. 2019. How autonomous technology could make mining safer, cheaper and more valuable. Available at https://www.nsenergybusiness.com/features/autonomous-mining-technology-zyfra/*

AI and Machine Learning

What is AI and Machine Learning

AI technology is capable of performing tasks defined by humans without explicit guidance and demonstrates behaviours associated with human intelligence such as planning, learning, reasoning and problem solving. Machine learning algorithms can be utilised to identify patterns and trends in data analysis.

How is it being applied within the sector?

The Mining and METS industry is leveraging AI and Machine Learning in a variety of ways to improve the efficiency and accuracy of decision making, supporting health and safety standards, reducing error rates in exploration and reducing environmental footprint of Mining and METS companies.

The Mining industry is using AI to help improve accuracy of where and how they dig, significantly reducing exploration costs. AI is able to learn more about the terrain that the mine is located on, with the computer able to collate and analyse large amounts of data, precisely map out and predict risks. AI is also being used to predict likely locations for better resources, through the use of pattern matching, predictive analytics and computer vision systems. [255]

Embedding AI within pre-existing systems is also helping the mining industry reduce its energy demand and environmental footprint. For example, ventilation presents one of the largest energy costs in underground mining and AI can be used in underground mines to automatically adjust the ventilation systems, resulting in significant energy cost reductions. [256]

What is the impact?

AI is supporting frontline workers to make decisions more quickly, reducing human error, and reducing the need for human intervention in potentially dangerous situations. However, the implementation of AI requires specific workforce capabilities to be able to support the technology. [257]

CASE STUDY – GOLDCORP AND IBM WATSON

Mining company Goldcorp have collaborated with IBM Watson to leverage AI to improve the accuracy and predictability of gold exploration. IBM Exploration with Watson applies AI to predict the potential for gold mineralisation, using powerful search and query capabilities across datasets. The Chief Executive of Goldcorp has stated the potential that AI brings to accelerating mineral exploration whilst improving the economic hit rates of mineralisation. [253]

CASE STUDY – VALE SA

AI is being used by Vale, with the recent launch of the Value AI Centre in Brazil. The AI centre leverages the adoption of technologies across all areas of the business and aims to become a centre for development, collaboration, monitoring and maintenance of solutions with a team of professionals made up of scientists, data engineers and business experts. The centre aims to optimise the maintenance of assets, including off-road trucks and railroad trucks, improve the management of ore and plant processing and plant processing, improve environmental controls and improve health and safety prevention. [254] Vale have increased the lifespan of haul truck tyres by 30 percent and also reduced the occurrence of fractures by up to 85 percent.

[253] *IBM. 2018. Goldcorp and IBM Develop new AI Technology Solution to Improve Predictability for Gold Mineralization. Available at https://www.ibm.com/news/ca/en/2018/11/26/i702101t77169m61.html*

[254] *Vale. 2019. Value inaugurates Artificial Intelligence Center. Available at http://www.vale.com/EN/aboutvale/news/Pages/vale-inaugurates-artificial-intelligence-centre.aspx*

[255] *Forbes. 2019. AI Helping Extract Value in the Mining Industry. Available at https://www.forbes.com/sites/cognitiveworld/2019/08/09/ai-helping-extract-value-in-the-mining-industry/#68590b7b7006*

[256] *Deloitte. 2019 Future of mining with AI: Building the first step towards an insight driven organisation. Available at https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/deloitte-norcat-future-mining-with-ai-web.pdf*

[257] *Deloitte. 2019 Future of mining with AI: Building the first step towards an insight driven organisation. Available at https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/deloitte-norcat-future-mining-with-ai-web.pdf*

Energy Technologies

What are energy technologies?

Industry and government have long acknowledged the risks and environmental impacts from the use of fossil fuels in the Mining and METS industry and are increasingly supporting adoption of renewal electricity and energy efficiency measures. Wind and solar photovoltaic are existing mature technologies that reduce electricity costs and the reliance on fossil fuels. Organisations are adopting low or zero carbon reduction technologies such as electric vehicles.

How is it being applied within the sector?

The Mining and METS sector accounts for roughly 10 percent of Australia's total energy use, with most energy supplied by diesel, natural gas and grid electricity. Energy is primarily consumed as electricity and as diesel for vehicles and machinery.

The intensity of long-term energy use in the mining sector is predicted to increase as the average ore grade falls and overburden increases. The increasing challenge to find ore reserves has meant that many mining organisations are leveraging new technologies to streamline their operations and reduce the burden of energy costs.

For example, many mining organisations are investing in electric vehicles. Due to the volume of equipment and vehicles used on mining sites, one of the largest costs is diesel fuel and subsequent ventilation costs that occur from use of diesel powered machinery in underground mines. The transition to 'all electric' mines is expected to increase the importance of electricity generation and storage in the mining sector whilst reducing carbon emissions. [260]

Additionally, optimising points of inefficiencies throughout the value chain have the potential to significantly reduce costs. For example, crushing and grinding of material is responsible for at least 40 percent of the total energy use in mining and mineral processing and many organisations have started adopting technologies that can improve flow sheet design to reduce the direct and indirect energy use. [261]

CASE STUDY – SAFESCOPE BATTERY ELECTRIC VEHICLES

Switching to a Battery Electric Vehicle fleet increases the profit margin for mining organisations significantly, due to the reduced cost of "refuelling", minimal maintenance requirements, reduction in heat output and therefore the reduction in ventilation requirements. Safescape developed the Bortana EV, a specifically designed electric vehicle for the mining sector. The vehicle is made with corrosion resistant chassis and world-class battery technology from 3ME technology. [258]

CASE STUDY- CANNINGTON SILVER AND LEAD MINE

Built on a former sheep and cattle station in Queensland, South32's Cannington mine has been one of the world's largest producers of silver and lead since production began 20 years ago. In December 2018, the mine opened a 7,200-panel solar farm that will predominantly be used to power the mine's accommodation and airport, with additional power going to mining operations, as South32 tried to embed renewables into all aspects of the mining sector. The solar farm is one of the first to combine a hybrid set up with an existing gas generator. The solar farm will cut down annual greenhouse emissions by between 4,000 and 6,000 tonnes a year. [259]

What is the impact?

Adopting energy technologies in the Mining and METS industry will have a range of impacts including:

- Increased ability for mine sites to be remotely located through the use of off-grid energy sources;
- Increased efficiency throughout the value chain through the optimisation of inefficient processes;
- Reduced greenhouse gas emissions through the electrification of vehicles and equipment; and
- Reduced reliance on fossil fuels and the associated cost volatility that is associated with them. [262]

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[258] *Austmine. 2019. Electric Vehicles in the Mining Industry. Available at http://www.austmine.com.au/News/electric-vehicles-in-the-mining-industry*

[259] *Renew Economy. 2018. South32 orders 3MW solar farm for Cannington silver and lead mine. Available at https://reneweconomy.com.au/south32-orders-3mw-solar-farm-cannington-silver-lead-mine-55857/*

[260] *Australian Renewable Energy Agency. 2017. Renewable energy in the Australian mining sector – White Paper. Available at https://arena.gov.au/assets/2017/11/renewable-energy-in-the-australian-mining-sector.pdf*

[261] *Department of Industry, Science, Energy and Resources. 2020. Mining opportunities to save, Available at https://www.energy.gov.au/business/large-businesses/industries/mining/mining-opportunities-save*

[262] *Deloitte. Powering the future of mining: From energy technology to core design. Available at https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-norcat-report-future-of-energy-in-mining.pdf*

Data and Analytics

What is Data and Analytics?

Data sources in the mining industry can be classified as either direct or indirect measurements. Direct measurement sources are those taken by instruments such as surveys and GPS. Indirect sources include data collected from processes or operations such as fleet management systems or blast hole drills. The collection and analysis of this data creates the potential for efficiency gains across the entire value chain including extraction, processing and transportation.[265]

How is it being applied within the sector?

The mining industry is continuously focusing on end-to-end value chain optimisation to increase efficiency and increase profit margins.

There are a number of technologies that act as data sources that are able to generate large amounts of information in real time. These technologies are connected through the use of IoT to improve efficiency, safety and gain an edge over competitors. Research has found that the majority of mining companies around the world believe that IoT would give them significant edge against competitors, with 41 percent suggesting it would increase business process automation, and almost 50 percent claiming IoT could be used to identify cost saving opportunities.[266]

IoT is helping operators to monitor, collect and analyse information from pieces of mining equipment, creating insight into the health and performance of equipment and infrastructure that would not have previously been possible. This enables mining companies to measure data in real time such as fluid temperatures, pressures and vibrations. The use of data and analytics can help in identifying risks early in order to avoid unexpected downtimes or failures.[267]

CASE STUDY- RIO TINTO

Rio Tinto have used data analytics and IoT in their recent iron ore project in Koodaideri. This project aims to build the world's first intelligent mine where all the assets on the site are networked together and capable of making autonomous decisions, enabled through AI. This project, which also involves the development of a totally autonomous mine, will enable operators to quickly test scenarios and optimise production or operations accordingly.[263]

CASE STUDY – HECLA MINING

Hecla Mining have introduced Newtrax's Mobile Equipment Telementry to better manage their machinery downtime. The technology leverages real-time equipment diagnostics to determine optimal ways to utilise machines and make real time diagnosis of equipment issues in order to minimise downtime. Since the implementation of this technology the mine has seen a significant increase of operating hours per day.[264]

For example, sensors throughout the mine are able to generate geoscientific information that can be analysed in parallel, in real time and sent back to mining operators on the ground with recommendations on options for efficiency gains.

Various imaging technologies such as drones, satellite imagery and cameras can also be coupled with analytics to identify in real time the inefficient points in the mining value chain. This is particularly relevant with open pit mines, where real time capturing of the value chain can be analysed and recommendations made to reduce variation in operations.

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[263] *Australian Mining. 2018. Rio Tinto takes key step towards first intelligent mine. Available at https://www.australianmining.com.au/news/rio-tinto-takes-key-step-towards-developing-first-intelligent-mine/*

[264] *Newtrax. 2018. Newtrax helps Casa Berardi mine exceed production objectives by 4% in 2-018. Available at https://newtrax.com/newtrax_helps_helca-casa-berardi-ine_exceed_production_objectives/*

[265] *WIPRO. 2020. Application of Big Data Solution to Mining Analytics. Available at https://www.wipro.com/en-AU/natural-resources/application-of-big-data-solution-to-mining-analytics/*

[266] *Mining Technology. 2019. How the Internet of Things is transforming Australian mining. Available at https://www.mining-technology.com/process-instrumentation/how-the-internet-of-things-is-transforming-australian-mining*

[267] *Mining Global. 2016. Examining the Internet of Things and its impact on the mining industry in 2016. Available at https://www.miningglobal.com/technology/examining-internet-things-and-its-impact-mining-industry-2016*

What is the impact?

The Mining and METS industry is already integrating analytics and IoT with other technologies such as sensors, automated vehicles and drones. The connection of these technologies to the internet is creating the opportunity for a rich data set that can be used for a range of purposes such as optimising mine layouts and improving the efficiency of mining operations. Data and analytics have a big role to play in improving the operational efficiency of mining, through driving better utilisation, boosting productivity and addressing material flow delays. However, there are challenges in implementing IoT across mining operations such as limitations in connectivity within underground mine sites and in remote locations. It is likely, that as ore grade declines and becomes harder to mine, companies will have to overcome the challenge of connectivity by implementing more reliable connection methods that are able to operate within deep mine sites.

Bringing the story together:

Workforce impacts expected for the Greater Whitsunday Region

Though technology has already and is expected to further impact the workforce – for every role that is automated another two are created in back of house logistics. Roles across the sector are evolving rather than disappearing.

Stakeholder from consultation

WORKFORCE IMPACTS

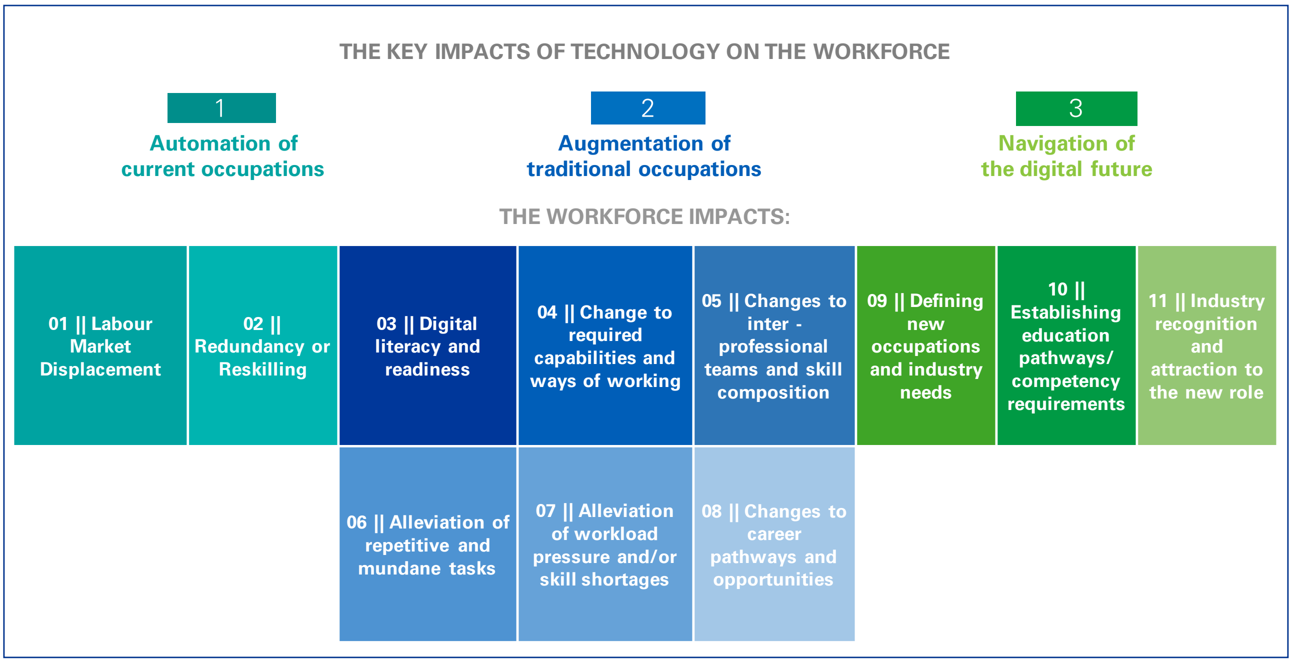
The workforce impacts of emerging technologies across the Mining and METS industry are expected to occur primarily through:

- Automation of current occupations (where technology will replace the need for some tasks and functions currently undertaken by humans);
- Augmentation of traditional occupations (where technology will work alongside humans and change the way in which tasks and functions are undertaken, driving improved workforce efficiency); and
- New roles that are created through the implementation of emerging technologies.

The impact of automation, augmentation and new and emerging job opportunities need to be considered together to determine the net impact on the Mining and METS industry. It should also be noted that there may be impacts across other related industry sectors that have been outside of the scope of the Future Employment Study, such as the impact on wider supply chains, related industry sectors and the wider Australian economy.

The detail of the impact of each of these across the Greater Whitsunday region, through combining the Faethm predictions, and current growth trajectories for occupations are detailed below and summarised in Figure 4.26 below.

Figure 4.26: Summary of the workforce considerations and impacts of technology on the workforce.



Source: KPMG

Automation for Mining and METS

Labour Market Displacement

Table 4.3 shows the key mining and METS occupations employed within the Greater Whitsunday region and the expected impact of automation on every role (where the impact is predicted to be more than 1 percent). Unlike some of the other occupations in industry sectors where the impact of automation is likely to largely be absorbed in occupation growth rates, in Mining and METS there are higher automation impacts of over 40 percent across many occupations by 2030. It is important to note however, that some occupations are already in decline and therefore the anticipated fall in FTE from the 2020 rates is not always predicted to be wholly attributable to the impacts of technology. In addition, it should be noted that automation figures present the opportunity provided by technology, and may not fully realised.

Occupations where the automation impact will drive reductions in employment requirements across every mining occupation *with the exception of* the Mine Deputy, Building and Engineering Technicians (not elsewhere classified), Metallurgical or Materials Technician and Maintenance Planner.

Occupations projected to fall due to occupation decline and the impact of technology include Mining Engineer (excluding Petroleum), Production Manager (both Manufacturing and Mining), Bulldozer Operator, Excavator Operator, Welder (first class), Metal Fabricator, Metal Fitters and Machinists (not elsewhere classified), Loader Operator and Grader Operator.

Some of the decline in workforce may not be desirable, although technology may help to reduce the demand in some professions. Currently Mining Engineers and Metal Machinists are reported as being in shortage, Electricians (general) are reported as being in recruitment difficulty, and Fitters are reported as having a mismatch in labour supply.[268]

Table 4.3: Automation impacts predictions for the Mining and METS occupations within the Greater Whitsunday region

OCCUPATION (6 DIGIT ANZSCO)	PREDICTED AUTOMATION IMPACT 2025 (FAETHM)	PREDICTED AUTOMATION IMPACT 2030 (FAETHM)	ANTICPATED IMPACT FOR GREATER WHITSUNDAY REGION (LABOUR MARKET AND FAETHM)
Building and Engineering Technicians nec	8.60%	21.00%	**Absorbed within occupation growth.**
Bulldozer Operator	10.10%	31.80%	**This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 110.9 FTE by 2025, and a further 61.4 FTE to 2030.**
Driller	12.30%	24.30%	**Automation is predicted to lead to a reduction in required staff from current levels by 56.7 FTE in 2025 and a further 18.4 FTE by 2030.**
Electrician (General)	8.50%	17.30%	**Automation is predicted to lead to a reduction in required staff from current levels by 114.2 FTE in 2025 and a further 158.0 FTE by 2030.**
Excavator Operator	10.10%	31.80%	**This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 83.8 FTE by 2025, and a further 46.4 FTE to 2030.**
Fitter (General)	25.70%	40.70%	**Automation is predicted to lead to a reduction in required staff from current levels by 1075.0 FTE in 2025 and a further 700.8 FTE by 2030.**
Fitter and Turner	25.70%	40.70%	**Automation is predicted to lead to a reduction in required staff from current levels by 94.3 FTE in 2025 and a further 61.5 FTE by 2030.**

[268] *Department of Education, Skills and Employment. 2020. Occupational skills shortage information. Accessed 30 June 2020. https://www.employment.gov.au/occupational-skill-shortages-information#engineering-professions-and-technicians*

OCCUPATION (6 DIGIT ANZSCO)	PREDICTED AUTOMATION IMPACT 2025 (FAETHM)	PREDICTED AUTOMATION IMPACT 2030 (FAETHM)	ANTICPATED IMPACT FOR GREATER WHITSUNDAY REGION (LABOUR MARKET AND FAETHM)
Grader Operator	39.80%	60.70%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 42.4 FTE by 2025, and a further 13.0 FTE to 2030.
Loader Operator	13.00%	34.60%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 29.1 FTE by 2025, and a further 15.1 FTE to 2030.
Maintenance Planner	17.50%	33.30%	Absorbed within occupation growth.
Metal Fabricator	25.70%	40.70%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 629.0 FTE by 2025, and a further 310.2 FTE to 2030.
Metal Fitters and Machinists nec	25.70%	40.70%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 5.6 FTE by 2025, and a further 3.6 FTE to 2030.
Metal Fitters and Machinists nfd	25.70%	40.70%	Automation is predicted to lead to a reduction in required staff from current levels by 9.1 FTE in 2025 and a further 15.0 FTE by 2030.
Metal Machinist (First Class)	15.80%	36.80%	Automation is predicted to lead to a reduction in required staff from current levels by 4.8 FTE in 2025 and a further 8.1 FTE by 2030.
Metallurgical or Materials Technician	1.60%	4.80%	Absorbed within occupation growth.
Mine Deputy	0.70%	1.60%	Absorbed within occupation growth.
Miner	13.80%	30.50%	Automation is predicted to lead to a reduction in required staff from current levels by 1084.8 FTE in 2025 and a further 727.3 FTE by 2030.
Mining Engineer (excluding Petroleum)	4.30%	10.20%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 124.7 FTE by 2025 and a further 72.6 FTE to 2030.
Production Manager (Manufacturing)	1.00%	2.50%	This occupation is in decline, and automation may accelerate this. Projected

OCCUPATION (6 DIGIT ANZSCO)	PREDICTED AUTOMATION IMPACT 2025 (FAETHM)	PREDICTED AUTOMATION IMPACT 2030 (FAETHM)	ANTICPATED IMPACT FOR GREATER WHITSUNDAY REGION (LABOUR MARKET AND FAETHM)
			decline is a fall of 28.5 FTE by 2025, with growth to 2030.
Production Manager (Mining)	1.00%	2.50%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 81.4 FTE by 2025, with growth to 2030.
Shot Firer	20.80%	34.00%	Automation is predicted to lead to a reduction in required staff from current levels by 78.5 FTE in 2025 and a further 123.2 FTE by 2030.
Stationary Plant Operators nec	28.20%	45.30%	Automation is predicted to lead to a reduction in required staff from current levels by 41.2 FTE in 2025 and a further 28.4 FTE by 2030.
Truck Driver (General)	23.60%	43.90%	Automation is predicted to lead to a reduction in required staff from current levels by 406.4 FTE in 2025 and a further 511.1 FTE by 2030.
Waste Water or Water Plant Operator	10.00%	25.00%	Automation is predicted to lead to a reduction in required staff from current levels by 4.3 FTE by 2030.
Welder (First Class)	30.40%	44.80%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 80.3 FTE by 2025, and a further 34.4 FTE to 2030.

Source: KPMG and Faethm (faethm ai)

Redundancy or Reskilling

For roles where redundancy or reskilling is required Faethm provides occupational skilling corridors based on the degree to which the current occupation's skills and competencies align with others. Table 4.4 includes occupations in Mining and METS where automation is predicted to reduce the current employment levels, and includes these Faethm employment corridors to assist with reskilling opportunities. Given the Mining and METS industry tend to lead a lot of technological adoption (comparative to other industry sectors) there may also be employment pathways for those in these occupations into other adjacent industry sectors in the short to medium term (for example Truck Drivers in the Transport and Logistics industry and Electricians in the Construction industry).

Table 4.4: Employment corridors for the impacted Mining and METS occupations within the Greater Whitsunday region

OCCUPATION/S (6 DIGIT ANZSCO)	IMPACT BASED ON FAETHM AND OCCUPATION GROWTH 2030	OCCUPATION SYNERGY FOR RESKILLING (FAETHM)
Miner	1,812.1	

OCCUPATION/S (6 DIGIT ANZSCO)	IMPACT BASED ON FAETHM AND OCCUPATION GROWTH 2030	OCCUPATION SYNERGY FOR RESKILLING (FAETHM)
Driller	75.1	Solar Photovoltaic Installer and Maintenance Managers- Mining.
Fitter (general)	1,775.8	Solar Photovoltaic Installer, Painters Construction and Maintenance Workers, and Model Makers- Wood.
Fitter and Turner	155.8	
Metal Machinist	12.9	Solar Photovoltaic Installer, Painters Construction and Maintenance Workers, and Model Makers- Wood. *Consideration could also be given to metal fabrication roles in other manufacturing and construction contexts.*
Metal Fabricator	939.2	
Welder (first class)	114.7	
Metal Fitters and Machinists (nec and nfd)	33.3	
Truck Driver	917.5	Heavy and Trailer- Tractor Truck Drivers, Light Truck or Delivery Services Drivers, Driving Instructors, Dredge Operators and Automotive Glass Installers and Repairers. *Consideration could also be given to heavy vehicle and truck driving occupations in the transport and logistics industry.*
Bulldozer Operator	172.3	
Excavator Operator	130.2	
Loader Operator	44.2	
Stationary Plant Operator	69.6	
Electrician	272.2	Solar Photovoltaic Installer, Wind Turbine Service Installers, Maintenance Managers- Mining, Heating and Air Conditioning Mechanics/ Installers and Solar Energy Installation Managers. *Consideration could also be given to electricians occupations in the construction industry.*
Shot Firer	101.7	Solar Energy Installation Managers, First Line Supervisors of Construction Trades, Forest Firefighting and Prevention Supervisors, Explosive Engineers and Municipal Firefighters.
Waste Water or Water Plant Operator	4.3	Frontline Supervisors of Aquaculture Workers, Wind Turbines and Service Technicians, and Frontline Supervisors of Agricultural Crop and Horticultural Workers.

Source: Faethm (faethm ai)

Augmentation Prediction

The impact of augmentation on the workforce is difficult given that it is expected to free capacity and change the way in which tasks and functions are completed. It is likely to both mean that the freed workforce capacity is used to undertake higher order tasks with a shift away from more repetitive and mundane tasks, and may also mean over time that there is a reduction in demand for some of the most impacted occupations. It is also important to note is that the augmented impacts may be felt in addition to the automation impacts.

Table 4.5 below provides an overview of the occupations in Mining and METS industry within the Greater Whitsunday region with the highest augmentation rates over the 5 and 10 year projections, along with the expected capacity gain (noting that this may be used for higher order tasks or, over time, to reduce supply).

The roles expected to have the highest percentage impact as a result of augmentation (over 30 percent by 2030) are the Mine Deputy, Mining Engineer, Production Manager (both Manufacturing and Mining) and Building and Engineering Technicians not elsewhere classified. However, the roles with the greatest impact when measured by FTE (and due to the size of these occupations in the region) are the Miner, Fitter, Electrician and Mine Deputy. These four occupations alone represent the opportunity for 2,250.2 FTE in freed capacity.

Table 4.5: Augmentation predictions for the Mining and METS occupations within the Greater Whitsunday region (where the impact is greater than 1 percent)

OCCUPATION (6 DIGIT ANZSCO)	PREDICTED AUGMENTATION IMPACT 2025 (FAETHM)	PREDICTED AUGMENTATION IMPACT 2030 (FAETHM)	AUGMENTATION FTE BY 2030 (FAETHM)
Building and Engineering Technicians nec	16.20%	31.90%	23
Bulldozer Operator	11.80%	17.80%	30.6
Driller	9.40%	18.10%	50.3
Electrician (General)	14.20%	25.10%	470.6
Excavator Operator	11.80%	17.80%	23.2
Fitter (General)	8.30%	16.60%	608.9
Fitter and Turner	8.30%	16.60%	53.6
Grader Operator	3.20%	3.40%	1.5
Loader Operator	7.30%	14.00%	6
Maintenance Planner	10.30%	17.40%	58
Metal Fabricator	8.30%	16.60%	181.4
Metal Fitters and Machinists nec	8.30%	16.60%	3
Metal Fitters and Machinists nfd	8.30%	16.60%	5
Metal Machinist (First Class)	4.90%	11.10%	3.3
Metallurgical or Materials Technician	12.20%	27.40%	35.9
Mine Deputy	17.90%	40.30%	342.2
Miner	7.20%	17.40%	823.5
Mining Engineer (excluding Petroleum)	14.30%	32.40%	79.5

OCCUPATION (6 DIGIT ANZSCO)	PREDICTED AUGMENTATION IMPACT 2025 (FAETHM)	PREDICTED AUGMENTATION IMPACT 2030 (FAETHM)	AUGMENTATION FTE BY 2030 (FAETHM)
Production Manager (Manufacturing)	14.30%	34.10%	51.5
Production Manager (Mining)	14.30%	34.10%	146.9
Shot Firer	11.90%	19.70%	44.8
Stationary Plant Operators nec	7.50%	12.30%	22.6
Truck Driver (General)	6.00%	11.70%	254.5
Waste Water or Water Plant Operator	7.00%	16.60%	14.3
Welder (First Class)	9.40%	15.40%	19.7

It is expected that as a result of these augmentation changes:

- There is a need to build digital literacy and readiness around new and emerging technologies, with an increased focus on those expected to be adopted more in the occupation and subsector (as outlined in the Emerging Technologies section of this report);
- There will be alleviation of repetitive and mundane tasks and a freeing of capacity to work on more complex tasks such as business intelligence and interpretation of analytics;
- The adoption of technologies may help to alleviate the demand pressure for occupations in shortage (which as discussed above in mining currently include the Metal Machinist, Mining Engineer, Electrician and Fitters);
- This will change requirements in relation to required capabilities and ways of working, which in turn will require organisations to support a lifelong learning focus, an investment in skilling (either formal or on the job), change management and leadership support, and change champions regarding the adoption of emerging technologies. This may, over time, change the job descriptions for key occupations;
- Over the medium to longer term it is expected that some of the freed capacity will result in changes to employment growth of some occupations, and this in turn will change the skill composition and structure of teams (noting that this will also likely include new occupations); and
- These changes to the Mining and METS labour market profile over time will change the career opportunities and pathways available to the workforce.

Education and Training in the region

It is noted that the majority of the Mining and METS workforce are trained domestically, across both the VET and University sectors.

Based on enrolments in 2018 in VET qualifications that relate to Mining and METS in Bowen, Mackay and the Whitsundays, the most popular qualifications in the Greater Whitsunday region are (further detail is provided in Appendix I):

- Certificate II in Surface Extraction with 2,643 enrolled in 2018. This qualification is designed to support occupations involved in production operations in an open cut mine or quarry for example an Excavator or Grader Operator.
- Certificate III in Surface Extraction with 2,923 enrolled in 2018. This qualification is designed to support occupations involved in production operations in an open cut mine or quarry for example an Excavator or Grader Operator.
- Certificate III in Civil Construction with 1,906 enrolled in 2018. This role is designed to support occupations involved in the construction of roads, bridges, tunnels. This is expected to support a range

of occupations in other industry sectors but may also support Mining and METS occupations for example Building and Engineering Technicians.
- Certificate III in Mine Emergency Response and Rescue with 429 enrolled in 2018. This qualification is not necessarily linked to an occupation, but rather is an additional skillset that may be obtained to support urgent, complex and non-routine occupational health and safety issues in relation to mining.
- Certificate IV in Surface Coal Mining with 320 enrolled in 2018. This qualification is designed to support occupations involved in production operations in an open cut mine or quarry and may supervise or coordinate other staff.
- Certificate II in Underground Metalliferous Mining with 94 enrolled in 2018. This qualification is designed to support operator roles in an underground metalliferous mine, for example an Excavator.

It is noted there is not a direct correlation between qualification attainment and specific job roles for these occupations. Better matching of education and training pipelines to in demand occupations could occur to strengthen employability and jobs within the region. No university qualification information was available for the Mining and METS industry within the Greater Whitsunday region.

Navigation of the Digital Future

As was identified in the Disrupted View discussed earlier in this chapter, there are a number of new occupations expected as a result of the adoption of emerging technologies as detailed in Table 4.6. In addition, new and emerging roles are expected in areas such as:

A “bridging role”- the mining technology professional

As with other industry sectors, there is already demand for roles that combines together the technology understanding and deep understanding of the mining sector. These roles have been argued to be vital for the sector, with research suggesting a technology site champion is the single biggest determinant of success or failure at the mine site level. [269]

The mining technology professional would be expected to have deep knowledge of the mining value chain, experience in integrating technology into practice, expertise in change management and the necessary seniority to enact change.

Human resources, change management and capability development roles

Given the degree of workforce change that is predicted, many suggest the role of the Chief Human Resources officer will become critically important to organisations. Growth areas predicted include:

- Human resources and organisational development specialists;
- Roles aimed at facilitating talent development, and capability development; and
- Senior management roles aimed at driving significant change across organisations.

Roles supporting stronger networks and interconnections across business and industry

With the greater interconnectedness of a range of things as a result of technology, it is expected that there will be a demand for occupations that help facilitate the networking and interconnectedness of elements across business, cities and industry. Growth occupations expected include:

- Network broking support roles connecting cities, regions and business ecosystems; and
- Occupations focused on new business models and systems integration.

[269] *Jordaan J T and Hendricks C, 2009. The Challenge of Technology Adoption and Utilisation in the Mining Industry – A Focus on Open Pit Mining Technologies*

Roles supporting research and development (R&D), and building the evidence around technology adoption

The introduction of new technologies, particularly as an early adopter, will drive businesses to measure the impact of this change on their business, to assist in driving continuous improvement and benefits realisation for the business. This may be impacted by the size of the business, but some of these occupations may start to emerge in education and training sector.

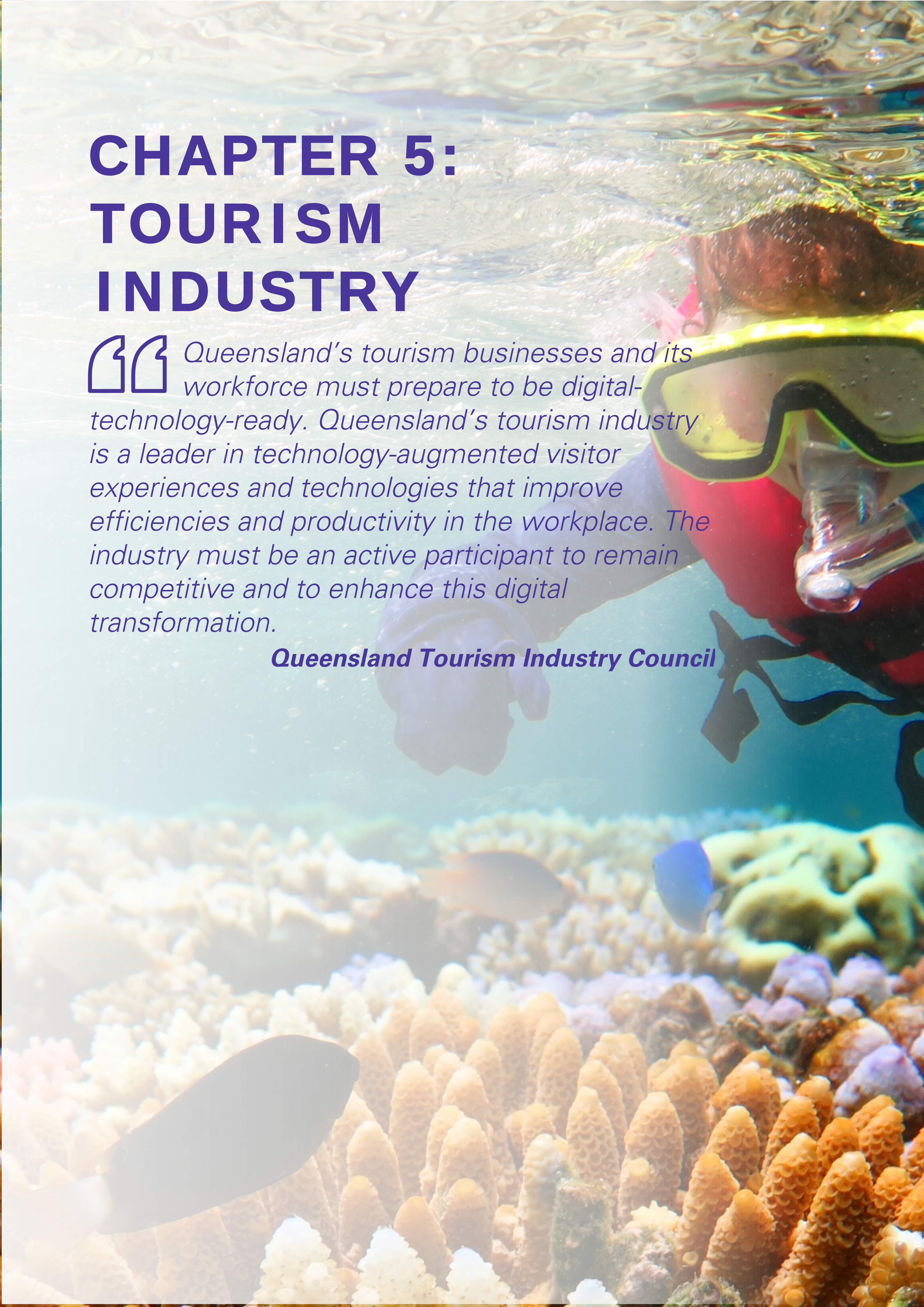
Table 4.6: New occupations predicted to be required as a result of technological adoption in the Mining and METS Industry within the Greater Whitsunday region by 2030

OCCUPATION TITLE (FAETHM)	PREDICTED GROWTH IN DEMAND (HEADCOUNT) (FAETHM)	OCCUPATION TITLE (FAETHM)	PREDICTED GROWTH IN DEMAND (HEADCOUNT) (FAETHM)
Software Developers, Applications	80.1	Educational, Guidance, and Career Counsellors and Advisors	29.3
Software Developers, Systems Software	80.1	Process Improvement Managers	29.3
Data Engineers	55.0	Operations Research Analysts	29.3
Process Improvement Analysts	50.1	Tester/Test Analysts	29.3
Data Integrators	49.2	Computer Systems Engineers/Architects	29.3
Infrastructure Services Analysts (IT)	49.2	Industrial Production Managers	28.8
Robotics Engineers	47.5	Industrial Safety and Health Engineers	28.8
Data Scientists	45.7	Industrial Engineering Technologists	28.8
Mechatronics Engineers	42.0	Change Analysts	19.8
Manufacturing Engineers	37.6	Data Architects	19.8
Mechanical Engineers	37.6	IT Governance Analysts	19.8
Data Analysts	36.2	Agile Testers	19.8
Strategy Analysts	34.5	Project Analyst	15.5
Security Testers	34.5	Business Intelligence & Analytics Managers	15.5
Software Quality Assurance Engineers and Testers	34.5	Communications Analysts	14.7
Industrial Engineers	33.4	Workforce Planners	14.7
Operations Analysts	29.3	Strategy Managers	14.7
Cyber Security Analysts	29.3		

OCCUPATION TITLE (FAETHM)	PREDICTED GROWTH IN DEMAND (HEADCOUNT) (FAETHM)
Training & Development Analysts	14.7
Human Resources Analyst	14.7
Change Manager	14.7
Data Warehousing Specialists	14.7
Test Automation Engineers	14.7
Project Leader	14.7
Communications Managers	14.7
AI Research Scientists	13.2
AI Research Scientists, Language Processing	12.3
AI Research Scientists, Image and Videos	12.3
Business Analysts	10.3
Scrum Masters	9.9
Cyber Security Managers	7.3
Industrial-Organizational Psychologists	7.3
Human Resources Managers	7.3
Technical Leads	7.3
Product Development Managers	7.3
Resource Managers	7.3
Agile Coaches	7.3
Test Managers	7.3
Infrastructure Services Managers (IT)	7.3
Human Resources Specialists	7.3
Test Coaches	7.3
IT Governance Managers	7.3
Test Coordinators/Test Leads	7.3
Information Security Managers	7.3
Risk Management Specialists	7.3
Product Owners	2.6

CHAPTER 5: TOURISM INDUSTRY

> *Queensland's tourism businesses and its workforce must prepare to be digital-technology-ready. Queensland's tourism industry is a leader in technology-augmented visitor experiences and technologies that improve efficiencies and productivity in the workplace. The industry must be an active participant to remain competitive and to enhance this digital transformation.*
>
> ***Queensland Tourism Industry Council***



The opportunity provided by technology in Tourism

Queensland context

Queensland's Tourism industry has a reputation for its pristine stretches of beach, rugged outback locations and friendly locals to greet visitors. The Whitsunday tourism region is one of Australia's most iconic tourism destinations with attractions including the Great Barrier Reef, the Whitsunday Islands, Heart Reef and Whitehaven Beach. [270] The Mackay Isaac tourism region extends from Cape Palmerton National Park and Sarina, Eungella National Park to Credlin Reef and is a popular destination for its abundance of natural attractions. [271]

Service is the underpinning pillar of the Tourism industry. However, technology presents an opportunity for Queensland tourism operators to enhance visitor experiences and target and attract new travellers to the region. Additionally, increased uptake of emerging technologies within the industry will provide opportunities to improve productivity and efficiency for tourism operators.

Technology has already significantly disrupted some sectors within the Tourism industry. The accommodation and ground transport sectors have been disrupted by peer-to-peer platforms such as Airbnb and Uber and the strong growth of the sharing economy. The aviation sector has also seen significant disruption with the implementation of digital technologies such as self-service, process efficiency and digital passenger processing.

The next wave of disruption is expected to impact broader sectors within the industry, such as retail, tours, travel agents and food and beverage. Disruption is expected to occur through the expansion of the sharing economy, people increasingly utilising applications on their mobile devices, new and emerging payment platforms and augmented reality and virtual reality technologies.

As technology continues to shape the Tourism industry into the future and transform the visitor experience, it creates both challenges and opportunities. Industry players are anticipated to enhance their digital presence and boost their technology capabilities over the next five years as technology becomes an increasingly important part of providing tourism services. [272] For example, many tourism companies such as accommodation providers and travel agencies are likely to build up their social media platforms. In addition, more tourism companies in regional areas are projected to provide easy payment options for domestic and inbound visitors. Traditional operators will be forced to adapt to the new normal to remain competitive in a digital future.

A regional lens

Mackay, Isaac and Whitsunday Region

The Tourism industry is a major contributor to the Queensland economy, responsible for contributing approximately $28 billion each year and accounting for 7.7 percent of the total Gross State Product in 2018-19. [273]

In 2017-18, Tourism industry employment accounted for 10,160 people within the Mackay and Whitsunday tourism regions. [274] In 2018, there were 1,684 tourism businesses within the Mackay, Isaac and Whitsunday LGAs, ranging from sole operators to employing more than 20 people. [275] In 2018-19, tourism directly and indirectly employed 9.3 percent of the workforce in Queensland, with cafes, restaurants and takeaway food services the largest direct employing sector.

Whitsunday region

[270] Jobs Queensland, Whitsundays Regional Tourism Workforce Plan 2018 – 2020, June 2018.

[271] Jobs Queensland, Mackay Regional Tourism Workforce Plan 2018 – 2020, June 2018.

[272] IBIS World, 2020.

[273] Tourism and Events Queensland, Queensland Tourism Economic Key Facts, 2020, https://cdn2-teq.queensland.com/~/media/f0da725dad2f4f3da34a910d65179b98.ashx?vs=1&d=20200529T142151.

[274] Tourism Research Australia, Regional Tourism Satellite Accounts, 2018. Please note Isaac falls within the Mackay Tourism Region.

[275] Tourism Research Australia, Local Government Area Profiles 2018 – Isaac, Mackay and Whitsunday.

The Whitsunday region is described by local residents as a beautiful beach paradise that is characterised by its iconic islands, tourism market and peaceful setting. [276] As shown in Figure 5.1, the Whitsunday LGA had the highest average visitor expenditure per trip in 2018 ($728 per trip) of the three LGAs in the Greater Whitsunday region. Overall, tourism contributes $651 million or 25 percent of the Gross Regional Product of the Whitsunday region. [277]

Isaac and Mackay regions

The Isaac region forms part of the broader Mackay region tourism area and features a diverse landscape. The Mackay tourism region is characterised by local residents as a 'beautiful, tropical region with a quiet, peaceful, friendly community and prominent mining industry'. [278] As shown in Figure 5.1, the Mackay LGA had the highest number of visitors in the Greater Whitsunday region in 2018. Overall, tourism contributes $382 million or 2.0 percent to Gross Regional Product.

Tourism industry employment

Within the Greater Whitsunday region, the Tourism (Accommodation and Food Services) industry supports an estimated 7,903 jobs which is approximately 9.3 percent of total employment. [279] Of the total jobs supported by tourism in the Greater Whitsunday region, 12.1 percent of jobs are in Isaac, 36.7 percent in Mackay and 41.8 percent in Whitsunday. Employment within the Greater Whitsunday region is heavily reliant on tourism compared to the Queensland State total, where tourism supports 7.4 percent of total jobs.

International visitors

Queensland's large international regional visitation is largely driven by visitor trips to the Great Barrier Reef. In 2018, within the Mackay, Isaac and Whitsunday region, international visitors accounted for 276,260 visitors (4,983 in Isaac, 45,489 in Mackay and 225,260 in Whitsunday) spending approximately $218 million across these three regions. [280] The top international visitor markets to the Greater Whitsunday region include the United Kingdom, Germany, the United States of America, China and New Zealand. [281]

However, according to Tourism and Events Queensland, the Whitsunday region experienced a decrease in international visitors in 2019. Visitation to the Whitsunday region for 2019 by international visitors decreased by 5.9 percent to approximately 220,000 visitors, resulting in a 28 percent decrease in expenditure to approximately $151.7 million. Visitation across major international source markets all decreased, including the United Kingdom (down 8.1 percent), continental Europe (down 3.0 percent) and Asia (down 12.0 percent) and China (down 11.4 percent). [282] Visitation from Germany remained stabled (0.2 percent increase) while visitation from the United States of America increased 7.6 percent.

Mackay has a significantly smaller international visitor market compared to the Whitsunday's, however experienced an average increase of 0.7 percent over the three years prior to December 2019, reaching 48,000 international visitors who spent $16.6 million in 2019.

Domestic visitors

Domestic overnight and day visitors accounted for approximately 2.5 million visitors across the Greater Whitsunday region and spent approximately $1.09 billion in 2018.

The Whitsunday's has experienced strong growth, with domestic visitation increasing on average by 10.8 percent over the three years ending December 2019 to approximately 631,000 visitors. The domestic market accounts for 74 percent of total overnight visitors and 78 percent of total visitor expenditure in the

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[276] *https://cdn1-teq.queensland.com/~/media/8d642698de954924af7d3df164dde8a0.ashx?vs=1&d=20191024T122353*

[277] *Tourism and Events Queensland, Social Indicators 2019 Whitsundays, Available at https://cdn1-teq.queensland.com/~/media/8d642698de954924af7d3df164dde8a0.ashx?vs=1&d=20191024T122353*

[278] *Tourism and Events Queensland, Social Indicators 2019 Mackay, Available at https://cdn1-teq.queensland.com/~/media/ad55ff7f8d974e9da58e02136c42551e.ashx?vs=1&d=20191024T121820*

[279] *REMPLAN, Economy Jobs and Business Insights, Available at Available at https://app.remplan.com.au/greaterwhitsundayalliance/economy/tourism/employment?state=ndMBh1!vdWNhM27whaAenWuPZb2gF2TalRj7F7bKbrlqlDJcdlKHDEx5hLgr*

[280] *Tourism Research Australia, Local Government Area Profiles, Isaac, Mackay and Whitsunday, 2018.*

[281] *Austrade and Deloitte Access Economics, Understanding visitor regional dispersal in Australia, 2019; Tourism and Events Queensland, Whitsundays Regional Snapshot Year Ending December 2019, Available at https://cdn1-teq.queensland.com/~/media/dbba387cc1f04582a6e9ee1dffafb934.ashx?vs=1&d=20200514T164348*

[282] *Tourism and Events Queensland, International Tourism Snapshot Year ending December 2019, Available at https://images.impartmedia.com/tourismwhitsundays.com.au/ResearchInsights/International/International_Tourism_Snapshot_Year_ending_December_2019.pdf*

region.[283] Intrastate visitors represent 63 percent of the domestic visitor market to the region and experienced strong growth (15.6 percent) on average over the prior three years compared to the interstate market (3.4 percent growth). New South Wales accounts for more than half (59 percent) of all interstate visitors.

Domestic visitors represented 96 percent of the overnight visitation to the Mackay region, with business travel accounting for 55 percent of visitation.[284] Intrastate visitors represent 87.0 percent of the domestic market that travels to the Mackay region. The region experienced an average 13.6 percent growth in the three years prior to December 2019 of overnight expenditure to $515 million.

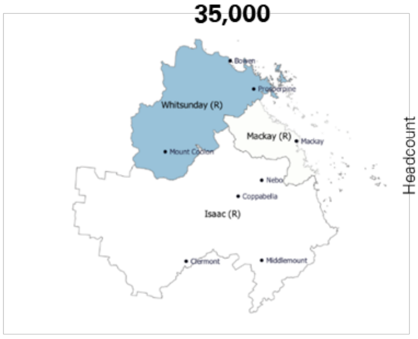
[283] *Tourism and Events Queensland, Whitsundays Regional Snapshot Year Ending December 2019, Available at https://cdn1-teq.queensland.com/~/media/dbba387cc1f04582a6e9ee1dffafb934.ashx?vs=1&d=20200514T164348*

[284] *Tourism and Events Queensland, Mackay Regional Snapshot Year Ending December 2019, Available at https://cdn1-teq.queensland.com/~/media/d4ba4501f22a461290565a8cd8ec699e.ashx?vs=1&d=20200514T155028*

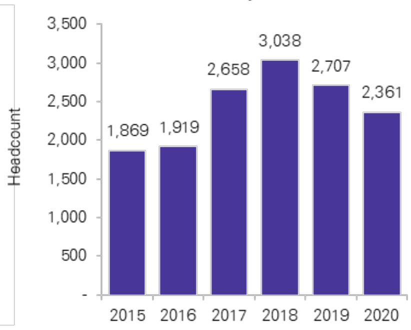
Figure 5.1: Regional differences in the Tourism industry

WHITSUNDAY

Whitsunday LGA population
35,000



Accommodation and Food Services employment
6,763



Number of tourists in 2018
1,048

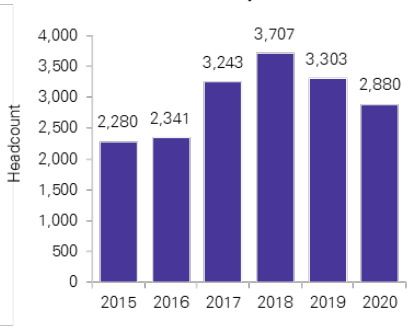
Average stay length in 2018
5 nights

Average spend per trip in 2018
$752 per trip

MACKAY

Mackay LGA population
116,539

Accommodation and Food Services employment
8,251



Number of tourists in 2018
1,152

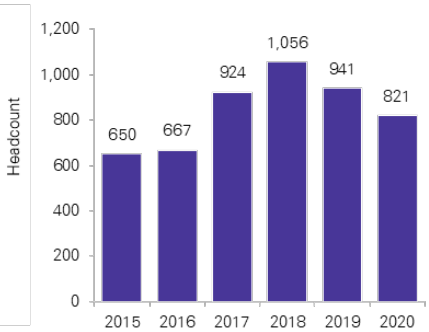
Average stay length in 2018
4 nights

Average spend per trip in 2018
$338 per trip

ISAAC

Isaac LGA population
35,360

Accommodation and Food Services employment
2,351



Number of tourists in 2018
525

Average stay length in 2018
5 nights

Average spend per trip in 2018
$246 per trip

Traditional Labour Market View

> *Tourism is an "industry of industries". It involves businesses directly providing services to visitors, local, interstate and international, as well as businesses that provide services to those businesses, together with other organisations that provide indirect support. It is an industry of people providing services for other people.*

Rachel Hunter
Former Chair, Jobs Queensland[285]

[285] *Jobs Queensland. 2017. Queensland Tourism Workforce Plan 2017-20. Available at https://jobsqueensland.qld.gov.au/projects/queensland-tourism-workforce-plan/*

THE CURRENT STATE OF PLAY

Current workforce characteristics

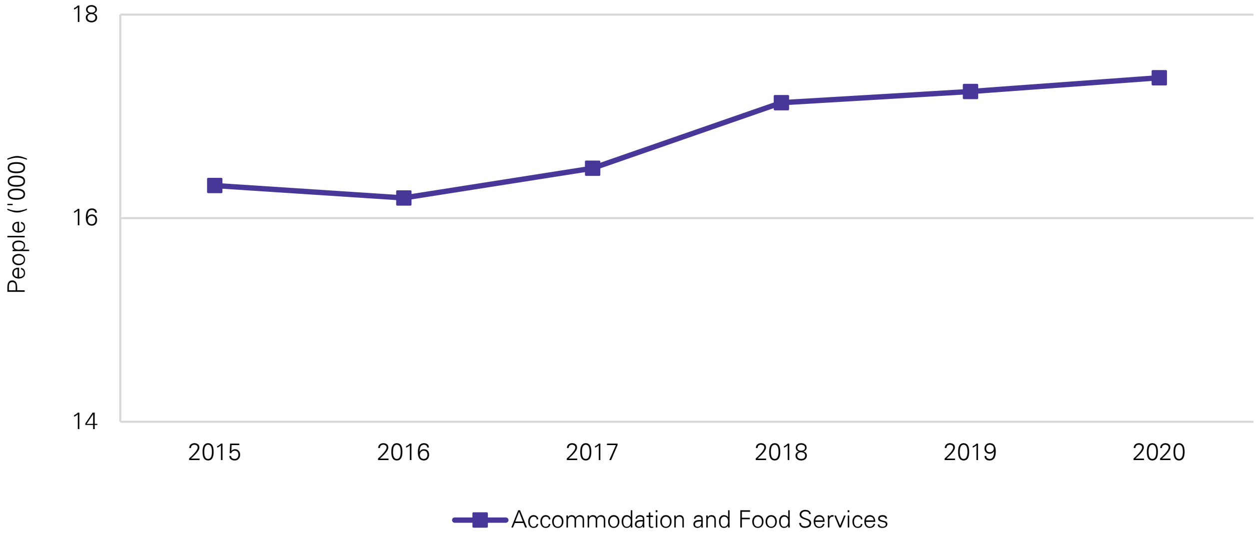
Overall employment

In recent years, the Tourism industry in Australia has experienced increasing international tourism, particularly from Asian countries, as a result of the lower Australian dollar. The weak dollar also made it more expensive for Australians to travel overseas, which has boosted the number of domestic visitor nights over the past five years. [286] This trend in the number of international and domestic visitors, has consequently increased demand in the Accommodation and Food Services industry which can be in turn used as a proxy measure of the size of the Tourism industry. The Accommodation and Food Services industry has experienced strong national growth over the past five years and as at February 2020 the industry employed approximately 934,800 people across Australia. This accounted for approximately 7.2 percent of the total national workforce. [287]

Across Queensland, approximately 99.4 percent of employees in the Accommodation and Food Services industry were employed by private sector businesses in 2020. [288] These private sector businesses included small family owned and operated cafes, restaurants, bars and accommodation services as well as large enterprises and franchises that have sought to optimise economies of scale. While public and private divide in employment is not available for the Greater Whitsunday region, it can be assumed that private sector businesses employ the majority of Accommodation and Food Services employees in the region.

In the Greater Whitsunday region, the Accommodation and Food Services industry accounted for approximately 6.8 percent of the region's entire workforce in 2020 and was the sixth largest industry in terms of employment. As shown in Figure 5.2, occupation employment in the industry has increased at an annual rate of 1.3 percent over the period from 2015 to 2020. In comparison, at the national level the Accommodation and Food Services industry grew on average by 2.0 percent between 2015 and 2020. [289] This indicates that employment in the Accommodation and Food Services industry in the Greater Whitsunday region has been growing at a slightly lower rate than national trends. This growth in the region has largely been sustained by the region's tourist attractions including the Great Barrier Reef, Whitsunday Islands and Coast as well as the regional boating and sailing, fishing, touring, recreational activities.

Figure 5.2: Total employment in the Tourism workforce in the Greater Whitsunday region (2015-20)



Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A.

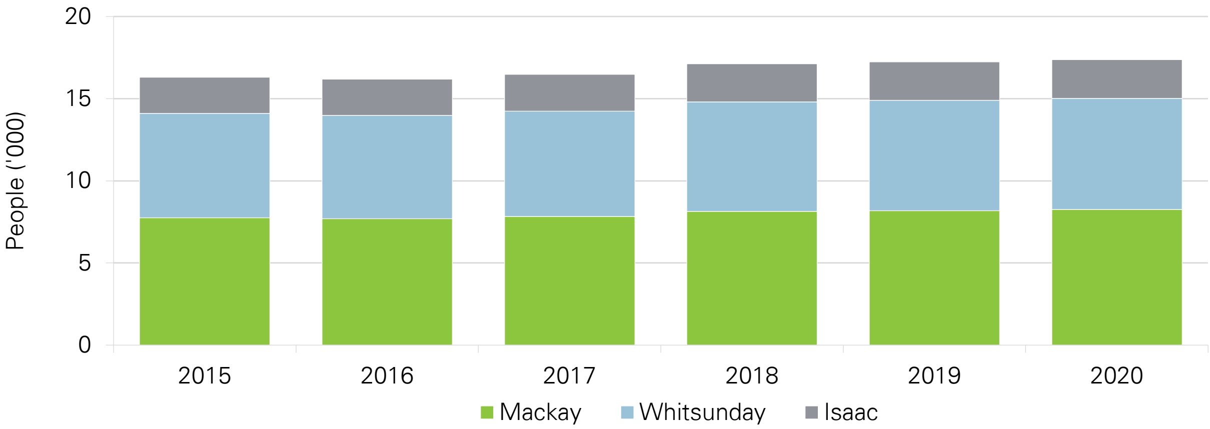
[286] *IBIS World. Total tourist visitor nights. Australia Business Environment Report B5344. Accessed 6 July 2020.*
[287] *Labour Market Information Portal. Accommodation and Food Services. Accessed 6 July 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/IndustryInformation/AccommodationandFoodServices*
[288] *ABS, cat. no. 6150.0.55.003, Labour Force, Australia, March 2020.*
[289] *ABS, Labour Force, Australia, Detailed, Quarterly, cat. no. 6291.0.55.003, original.*

Regional differences

Within the Greater Whitsunday region there have been regional differences in the number of people employed in the Accommodation and Food Services industry. These differences are largely attributable to regional differences in tourist attractions and destinations, population size, remoteness and accessibility by air, road and rail. The Whitsunday LGA is a particularly desirable tourist destination that is home to an archipelago of 74 tropical islands located in the heart of the Greater Barrier Reef. The Mackay LGA also hosts a diverse range of natural and cultural attractions as well as recreational activities. It is also is a major population and transport hub in the region and can be accessed via the Mackay Airport, the Bruce Highway and rail services. In comparison, the tourist attractions and recreational activities in the Isaac LGA are more remotely located than the destinations in the Mackay and the Whitsunday LGAs.

Figure 5.3 illustrates the regional employment differences in the Accommodation and Food Services industry over a five year period between 2015 and 2020. During this period approximately 47.5 percent of the Accommodation and Food Services industry was employed in the Mackay LGA, 38.9 percent in the Whitsunday LGA and 13.5 percent in the Isaac LGA. Notably, the Accommodation and Food Services industry was the largest employer in the Whitsunday LGA in 2020 and employed almost 1 in 10 of the LGA's residents.

Figure 5.3: Total regional employment variations in the Tourism workforce in the Greater Whitsunday region (2015-20)



Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A

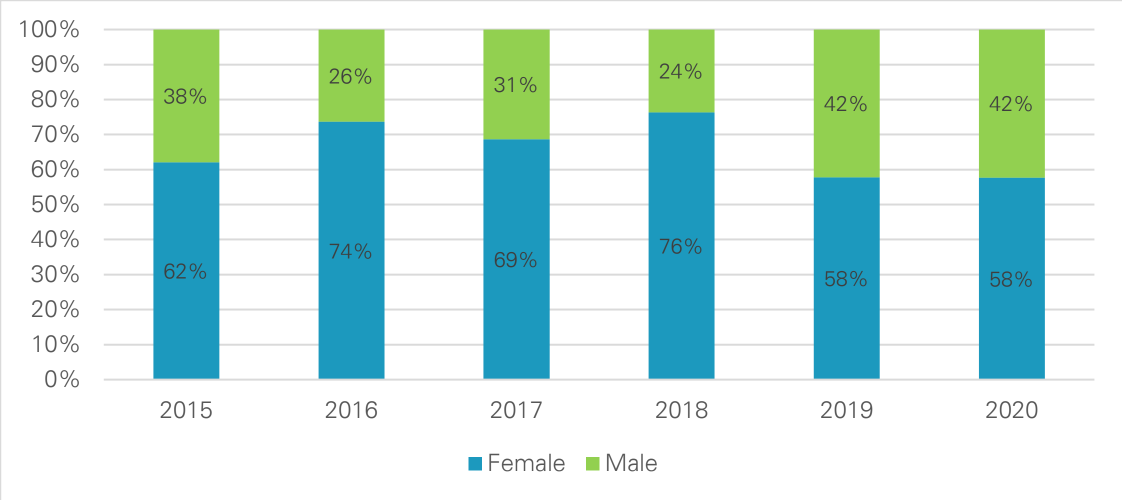
Data limitations in the ABS labour market data should be taken into account for the Tourism industry, particularly in relation to the counting of casual employees, particularly given the seasonal fluctuations reported by stakeholders within the Greater Whitsunday region. This is discussed further as a data limitation in Appendix C.

Gender distribution

Figure 5.4 shows the gender distribution for the Accommodation and Food Services industry over a five year period between 2015 and 2020 in the Greater Whitsunday region. The industry's gender ratio has changed over time from being a female-dominant workforce in 2015 to being slightly more gender balanced in 2020. During this period, the number of males and females in the industry increased at an annual average rate of 3.47 percent and declined at 0.19 percent, respectively. As at February 2020, females accounted for 57.7 percent of the workforce, which was slightly higher than the industry female share nationally (55.0 percent). [290]

[290] *Labour Market Information Portal. Accommodation and Food Services. Accessed 6 July 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/IndustryInformation/AccommodationandFoodServices*

Figure 5.4: Gender distribution in the Accommodation and Food Services workforce in Greater Whitsunday region (2015-20)

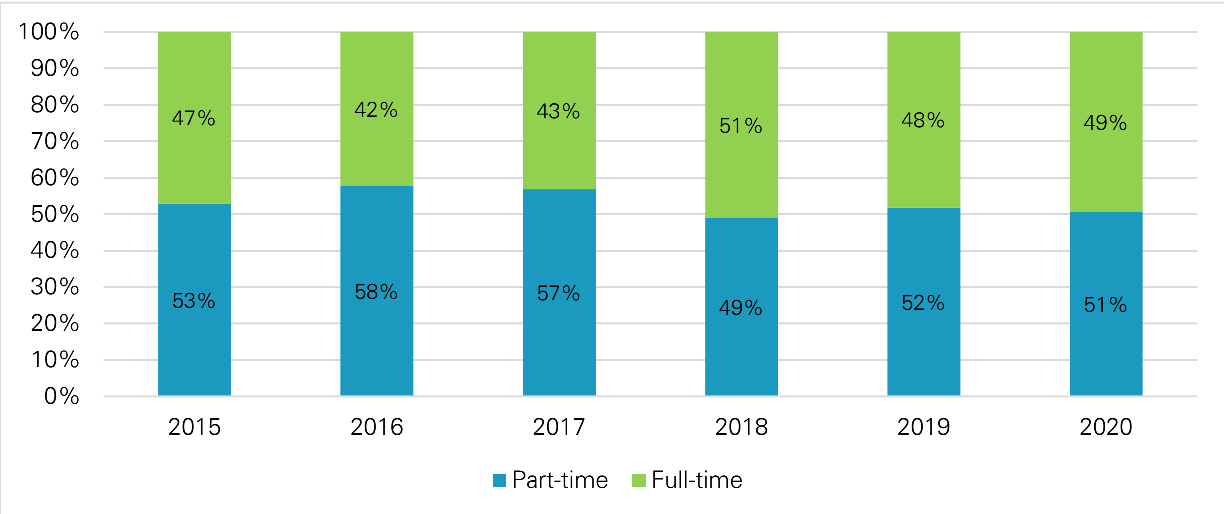


Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A

Employment type distribution

Figure 5.5 shows the employment type distribution (full-time versus part-time) for the Accommodation and Food Services industry over a five year period between 2015 and 2020 in the Greater Whitsunday region. The industry's employment type has changed over time from being predominantly part-time in 2015 to being evenly distributed between full-time and part-time employees in 2020. During this period the number of full-time employees increased at an average annual rate of 2.21 percent, while the number of part-time employees increased by 0.39 percent per annum. As at February 2020, full-time employees accounted for 49.4 percent of the workforce, which was notably higher than share of full-time Accommodation and Food Services employees at the national level (38.1 percent).[291]

Figure 5.5: Employment type distribution in the Accommodation and Food Services workforce in Greater Whitsunday region (2015-20)



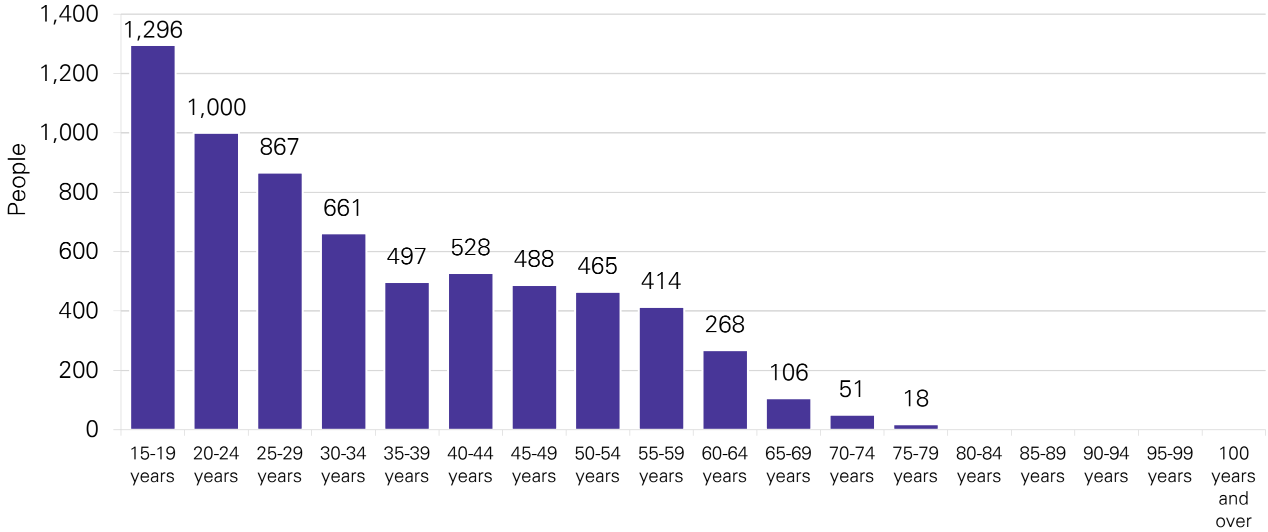
Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A

[291] *Labour Market Information Portal. Accommodation and Food Services. Accessed 6 July 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/IndustryInformation/AccommodationandFoodServices*

Age distribution

As shown in Figure 5.6, the Accommodation and Food Services industry in the Greater Whitsunday region is characterised by a relatively young workforce. In 2016, over half of the workforce were aged 39 years or younger (64.8 percent of the workforce), with the 15 to 19 age bracket having the highest number of persons in the Accommodation and Food Services industry. This indicates that the industry's workforce will be relatively stable over the next decade with a relatively small proportion of employees expected to retire.

Figure 5.6: Age distribution of the Accommodation and Food Services industry in the Greater Whitsunday region (2016)

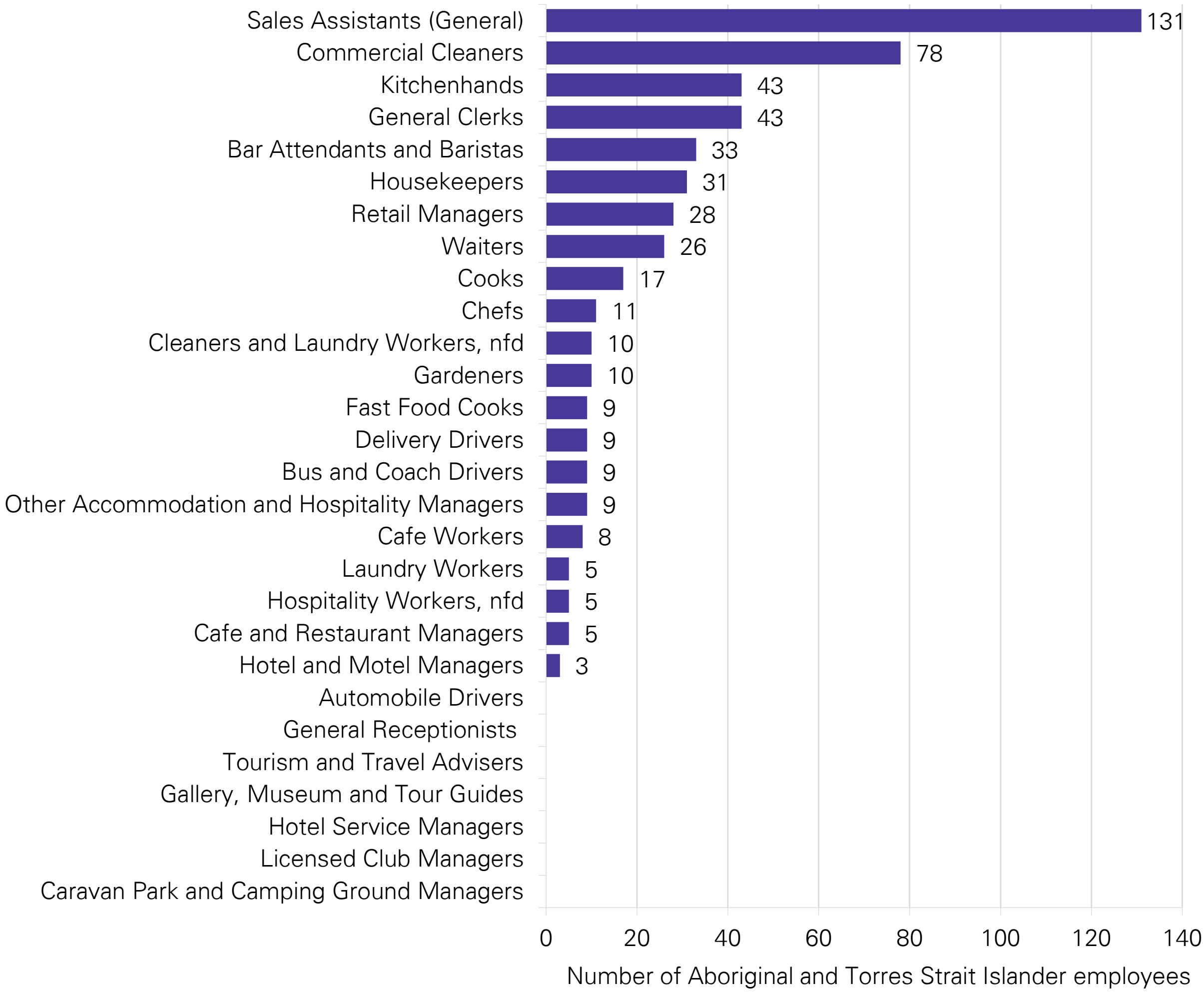


Source: KPMG based on ABS Labour Market Quarterly and Census Data

Aboriginal and Torres Strait Islander employment

The Accommodation and Food Services industry is the fourth largest employer of Aboriginal and Torres Strait Islander people in the Greater Whitsunday region. In 2016 approximately 8.3 percent of the Aboriginal and Torres Strait Islander workforce in the Greater Whitsunday region were employed in the Accommodation and Food Services industry. As shown in Figure 5.7, the majority of these Aboriginal and Torres Strait Islander employees were Sales Assistants (General), Commercial Cleaners and Kitchenhands.

Figure 5.7: Aboriginal and Torres Strait Islander employment in the Accommodation and Food Services industry in the Greater Whitsunday region (2016)



Source: KPMG based on ABS Labour Market Quarterly and Census Data

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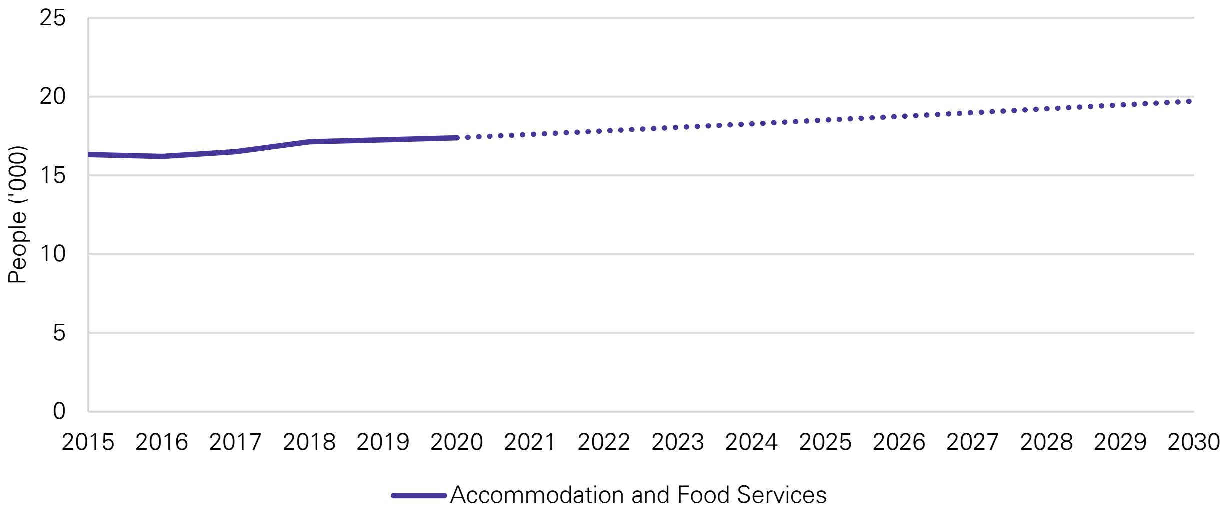
Projected trends

Overall employment

National employment in the Accommodation and Food Services industry was projected by the Commonwealth Department of Employment, Skills, Small and Family Business to increase by 91,400 (or 10.0 percent) over the next five years.[292] This projected increase in employment has been based on historical trends and the strength of both domestic and international tourism as a result of the lower Australian dollar and an expanding middle class in Asia. However, this employment projection does not take account of any impact caused by the COVID-19 pandemic. In the near future, the global outbreak of COVID-19 is expected to significantly limit tourism activity in Australia as a result of the implementation of strict travel restrictions for both domestic and international travellers.[293]

Based on historical trends in the Greater Whitsunday region, Figure 5.8 shows the projected growth in the Accommodation and Food Services industry over a ten year period from 2020 to 2030. With a historical annual growth rate of 1.3 percent, the workforce in the Accommodation and Food Services industry in the Greater Whitsunday region has been projected to increase from 17,380 people in 2020 to 19,705 people in 2030. This projection, however, is based only on historical trends and does not take account of any impact caused by COVID-19 pandemic. These potential impacts of the COVID-19 pandemic are further explored later in this report.

Figure 5.8: Projected workforce growth for the Accommodation and Food Services industry in the Greater Whitsunday region (CAGR growth, 2015-30)



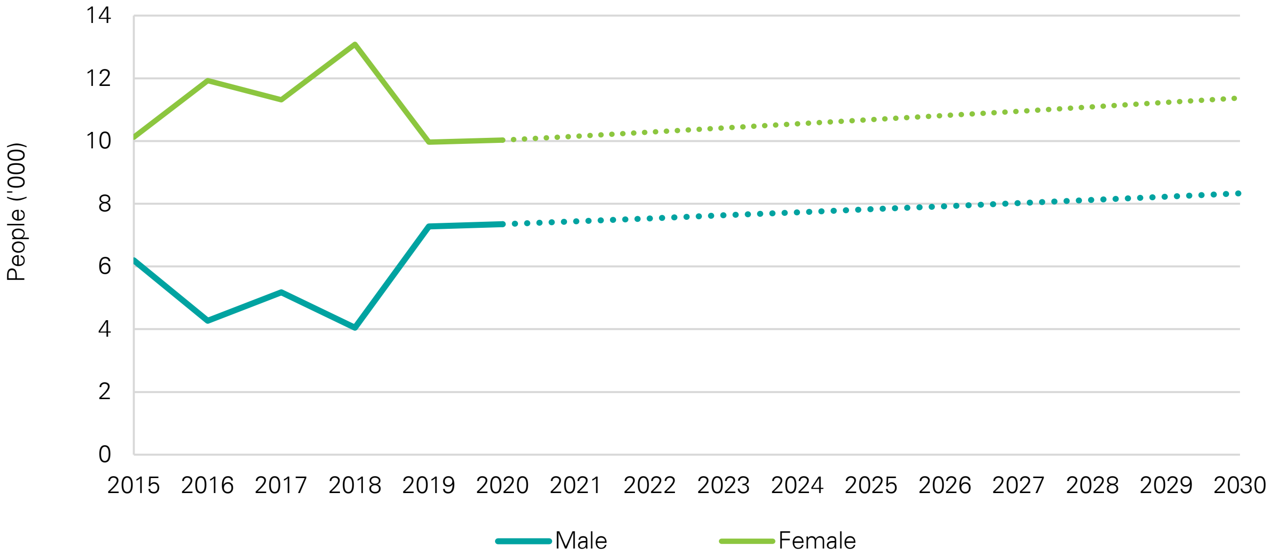
Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A

Gender distribution

Based on the historical trends described above, Figure 5.9 shows the projected gender distribution for the Accommodation and Food Services industry in the Greater Whitsunday region over a 10 year period from 2020 to 2030. During this period, the number of females and males employed in the Accommodation and Food Services industry has been projected to increase at an average annual rate of 2.5 percent. By 2030, it has been projected that females will account for approximately 57.7 percent of the entire Accommodation and Food Services workforce in the Greater Whitsunday region.

[292] Labour Market Information Portal Employment Projections. Accessed 30 June 2020: https://lmip.gov.au/default.aspx?LMIP/GainInsights/EmploymentProjections
[293] IBIS World. Total tourist visitor nights. Australia Business Environment Report B5344. Accessed 6 July 2020.

Figure 5.9: Projected workforce growth by gender for the Accommodation and Food Services industry in the Greater Whitsunday region (2015-30)

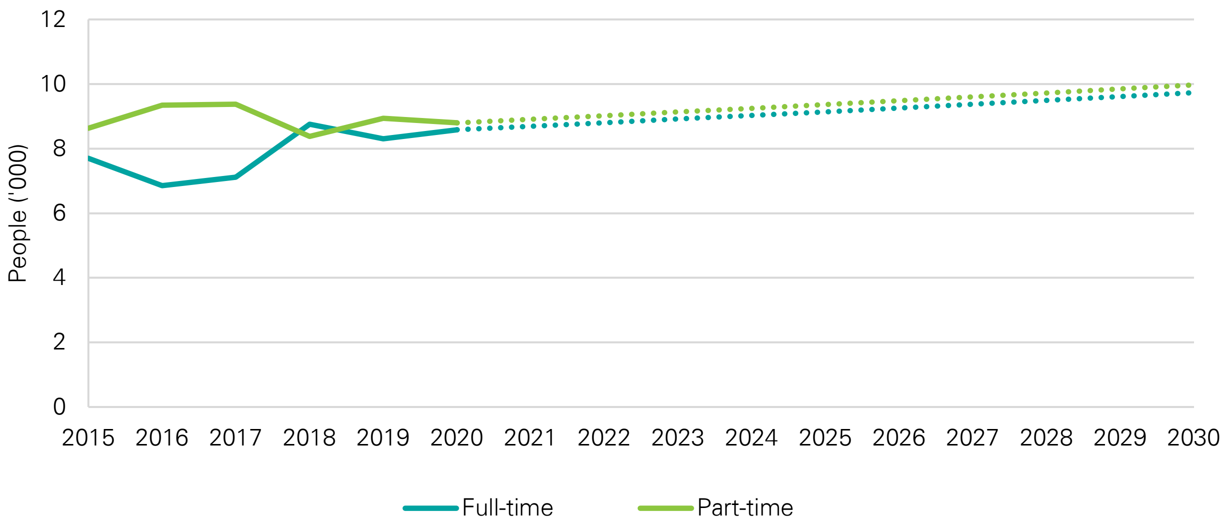


Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A

Employment type distribution

Based on historical trends described above, Figure 5.10 shows the projected employment type distribution for the Accommodation and Food Services industry in the Greater Whitsunday region over a ten year period from 2020 to 2030. By 2030, it has been projected that people working part-time will account for approximately 51 percent of the entire Accommodation and Food Services workforce in the Greater Whitsunday region. This will equate to approximately 9,733 full-time employees and 9,972 part-time employees.

Figure 5.10: Projected workforce growth by employment type for the Accommodation and Food Services industry in the Greater Whitsunday region (2015-30)



Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A

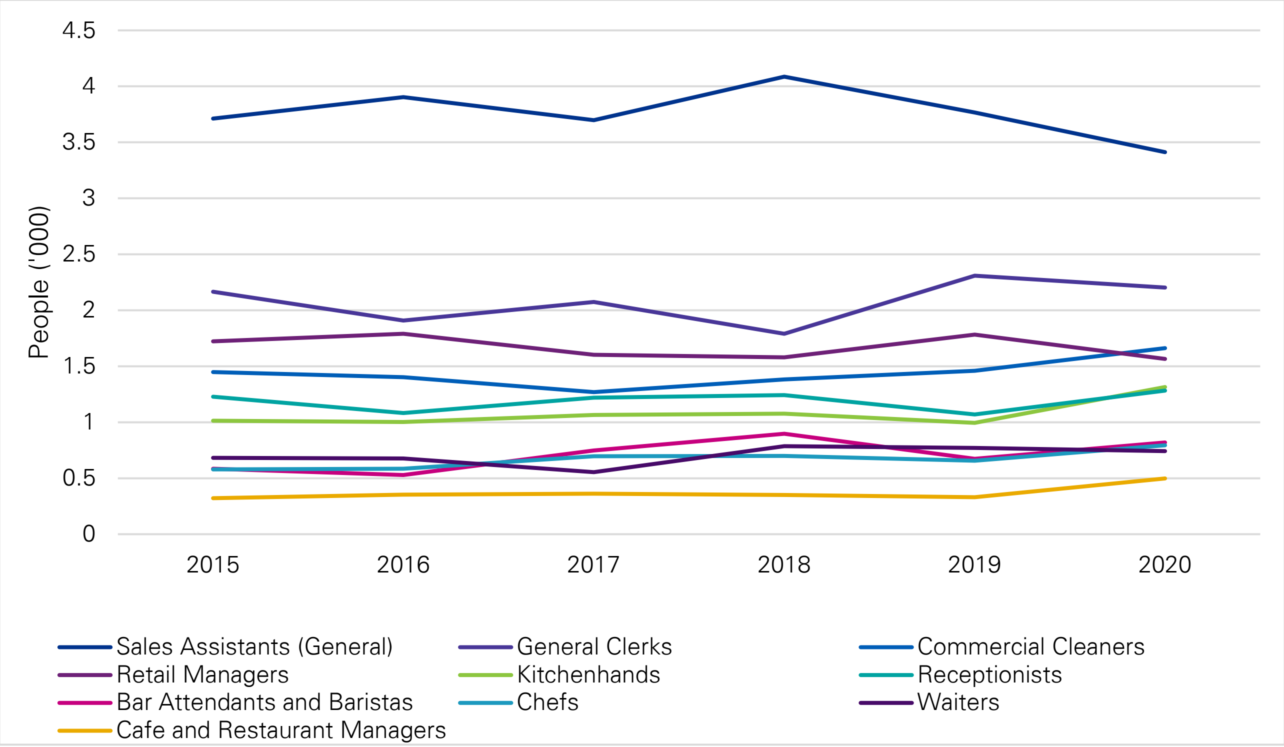
Occupational growth in the sector

As shown in Figure 5.11, the Accommodation and Food Services industry employs people in a diverse range of jobs that are classified as ANZSCO 4-digit unit groups. In 2020 the top three employing unit groups in the Greater Whitsunday region included Sales Assistants (General), General Clerks and Commercial Cleaners. In contrast, the bottom three employing unit groups in the Greater Whitsunday region were Other Accommodation and Hospitality Managers, Gallery, Museum and Tour Guides, and Licensed Club Managers.

Between 2015 and 2020, Gallery, Museum and Tour Guides experienced the highest growth in employment in percentage terms from 27 to 47 persons (11.6 percent on average per annum). Second to this growth rate, the number of Fast Food Cooks grew at an average annual rate of 10.9 percent per annum from 215 to 362 persons.

Housekeepers experienced the largest decline in employment between 2015 and 2020 in percentage terms from 493 to 286 persons (-10.9 percent on average per annum). Second to this, Other Accommodation and Hospitality Managers experienced a decline of -9.5 percent per annum from 77 persons to 47 persons.

Figure 5.11: Accommodation and Food Services employment trends by ANZSCO 4-digit unit groups (2015-20)



Source: KPMG based on ABS Labour Market Quarterly and Census data and the 6 digit occupations considered in scope in Appendix A

These ANZSCO 4-digit unit groups have been broken down into ANZSCO 6-digit occupations in Figure 5.12 in order to highlight the top ten occupations in the Greater Whitsunday region for the Accommodation and Food Services industry.

Figure 5.12 highlights different levels of average annual employment growth between 2015-2020, with Café or Restaurant Managers and Bar Attendants experiencing the highest growth rate in the top ten occupations at 9.0 and 7.0 percent annual growth respectively. The only occupation in the top ten employing occupations for the region that is in decline in Tourism is Retail Managers with 1.9 percent annual average decline over the period 2015-2020.

Key occupations in Tourism

Figure 5.12: Tourism, top 10 ANZSCO 6-digit occupations, 2020

Sales Assistants (general)

Those who *"sell goods and services, such as food, clothing, hardware, household appliances, office supplies and cosmetics, in a retail or wholesale establishment"*

4.8% annual growth

Headcount 2015 **3,713**
Headcount 2020 **3,412**

Mackay **2,446**
Isaac **239**
Whitsunday **727**

2,882 Headcount by 2030

General Clerks

Those who *"perform a range of clerical and administrative tasks"*

0.3% annual growth

Headcount 2015 **2,166**
Headcount 2020 **2,202**

Mackay **1,485**
Isaac **314**
Whitsunday **402**

2,274 Headcount by 2030

Commercial Cleaners

Those who *"clean offices, residential complexes, hospitals, schools, industrial work areas, industrial machines, construction sites and other commercial premises using heavy duty cleaning equipment"*

2.5% annual growth

Headcount 2015 **1,449**
Headcount 2020 **1,662**

Mackay **944**
Isaac **364**
Whitsunday **353**

2,185 Headcount by 2030

Retail Managers (general)

Those who *"organise and control the operations of a retail trading establishment"*

-1.9% annual growth

Headcount 2015 **1,628**
Headcount 2020 **1,480**

Mackay **1,009**
Isaac **158**
Whitsunday **399**

1,222 Headcount by 2030

Kitchen Hands

Those who *"assist kitchen and service staff in preparing and serving food, and clean food preparation and service areas"*

5.3% annual growth

Headcount 2015 **1,014**
Headcount 2020 **1,314**

Mackay **824**
Isaac **234**
Whitsunday **257**

2,206 Headcount by 2030

Chefs

Those who *"plan and organise the preparation and cooking of food in dining and catering establishments"*

6.5% annual growth

Headcount 2015 **579**
Headcount 2020 **794**

Mackay **261**
Isaac **195**
Whitsunday **338**

1,495 Headcount by 2030

Receptionists (general)

Those who *"greet clients and visitors, and respond to personal, telephone, email and written inquiries and requests"*

0.9% annual growth

Headcount 2015 **748**
Headcount 2020 **780**

Mackay **558**
Isaac **62**
Whitsunday **161**

849 Headcount by 2030

Waiters

Those who *"serve food and beverages in hotels, restaurants, clubs and dining establishments"*

1.7% annual growth

Headcount 2015 **682**
Headcount 2020 **743**

Mackay **404**
Isaac **59**
Whitsunday **279**

882 Headcount by 2030

Bar Attendants

Those who *"prepare, mix and serve alcoholic and non-alcoholic drinks to patrons in a bar in a licensed establishment"*

7.0% annual growth

Headcount 2015 **421**
Headcount 2020 **590**

Mackay **366**
Isaac **81**
Whitsunday **143**

1,162 Headcount by 2030

Café or Restaurant Managers

Those who *"organise and control the operations of a cafe, restaurant or related establishment to provide dining and catering services"*

9.1% annual growth

Headcount 2015 **322**
Headcount 2020 **498**

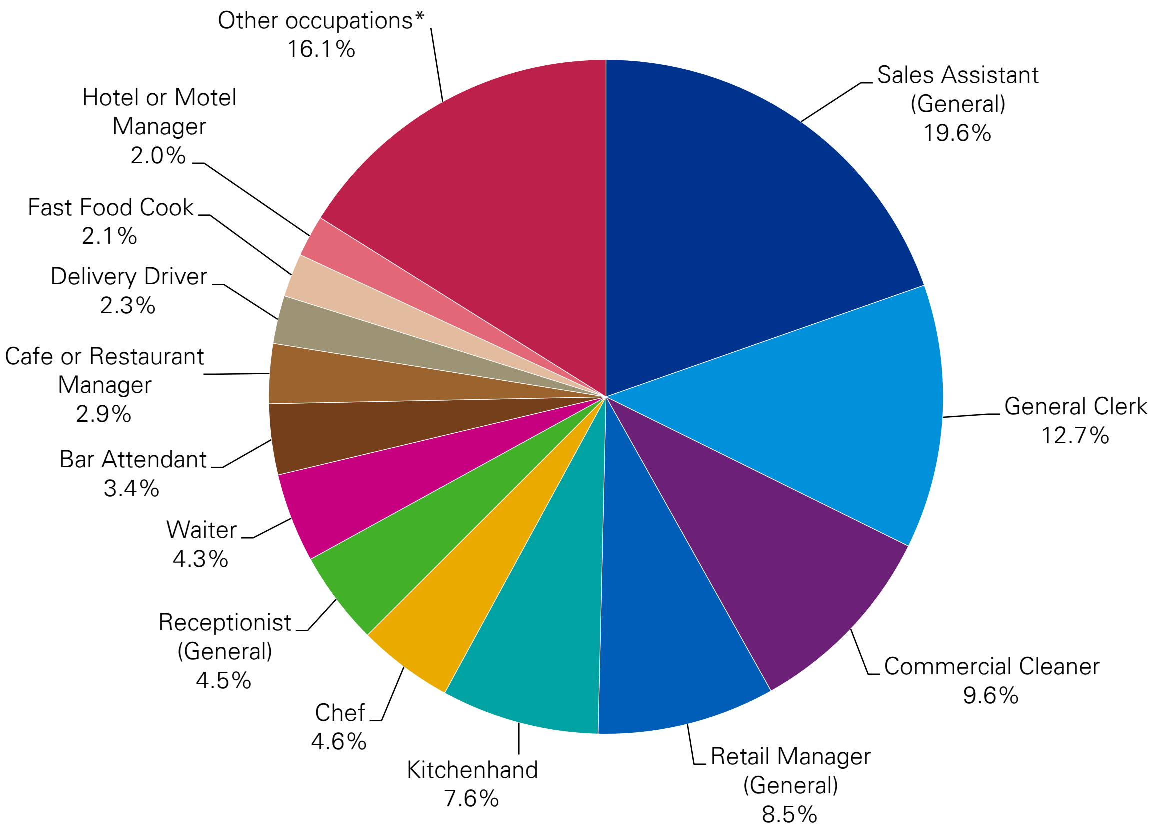
Mackay **268**
Isaac **48**
Whitsunday **182**

1,193 Headcount by 2030

What would the future look like in 2030 if we continued on our current path?

The Accommodation and Food Services industry employs people in a diverse range of occupations that are classified as ANZSCO 6-digit occupations in the Greater Whitsunday region. Figure 5.13 illustrates the distribution of these occupations which employed 2 percent of more of the Accommodation and Food Services workforce in 2020. As shown in Figure 5.14, the majority of the Accommodation and Food Services industry was employed as Sales Assistants (General), General Clerks, Commercial Cleaners, Retail Managers (General) and Kitchenhands.

Figure 5.13: **Accommodation and Food Services employment distribution of ANZSCO 6-digit occupations that account for greater than 2 per cent of the Accommodation and Food Services workforce in the Greater Whitsunday region in 2020**



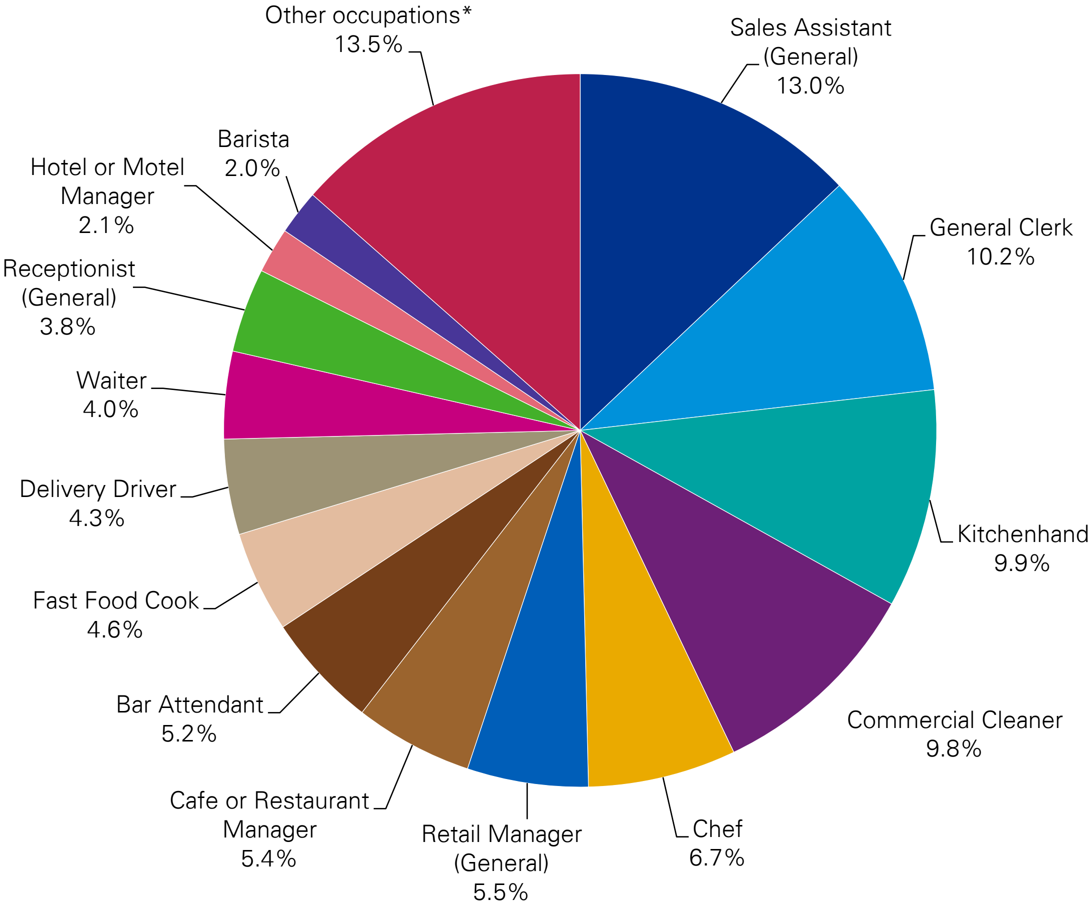
** Other occupations include: Cook (1.7%); Commercial Housekeep (1.4%); Gardener (General) (1.3%); Barista (1.3%); Caravan Park And Camping Group Manager (1.3%); Bus Driver (1.1%); Café Worker (1.0%); Travel Consultant (1.0%); Hotel Or Motel Receptionist (0.9%); Taxi Driver (0.8%); Cleaners And Laundry Worker nfd (0.7%); Hotel Service Manager (0.7%); Landscape Gardener (0.4%); Laundry Worker (General) (0.4%); Hospitality Worker nfd (0.4%); Passenger Coach Driver (0.4%); Licensed Club Manager (0.3%); Domestic Housekeeper (0.3%); Tour Guide (0.3%); Automobile Driver nec (0.2%); Accommodation And Hospitality Manager nec (0.2%); and Arborist (0.2%).*

Source: KPMG based on ABS Labour Market Quarterly and Census Data

Based on historical trends in ANZSCO 6-digit occupations in the Greater Whitsunday region, Figure 5.13 shows the distribution of these occupations which have been projected to employ 2 percent of more of the Accommodation and Food Services workforce in 2030. As shown in Figure 5.13, the employment of Kitchenhands, Chefs, Café or Restaurant Managers, Bar Attendants and Fast Food Cooks is forecast to grow at a considerable rate and account for a large proportion of the Accommodation and Food Services workforce. In addition, the number of Baristas is forecast to grow at a high rate and increase from accounting for 1.3 percent of the Accommodation and Food Services workforce in 2020 to 2.0 percent in 2030.

In contrast, employment in Sales Assistants (General), General Clerks, Commercial Cleaners and Waiters is forecast to grow at a relatively modest rate. At the same time, employment in Retail Managers (General) is forecast to decline over the ten year period between 2020 and 2030.

***Figure 5.14:* Accommodation and Food Services employment distribution of ANZSCO 6-digit occupations that account for greater than 2 per cent of the Accommodation and Food Services workforce in 2030**



** Other occupations include: Café Worker (1.7%); Gardener (General) (1.7%); Cook (1.3%); Travel Consultant (1.3%); Bus Driver (1.2%); Caravan Park and Camping Ground Manager (1.1%); Taxi Driver (0.8%); Hotel or Motel Receptionist (0.7%); Tour Guide (0.6%); Landscape Gardener (0.5%); Hospitality Worker nfd (0.4%); Passenger Coach Driver (0.4%); Commercial Housekeeper (0.4%); Hotel Service Manager (0.3%); Arborist (0.2%); Licensed Club Manager (0.2%); Automobile Driver nec (0.2%); Cleaner and Laundry Worker nfd (0.2%); Laundry Workers (General) (0.2%); Domestic Housekeeper (0.1%); and Accommodation and Hospitality Manager nec (0.1%).*

Source: KPMG based on ABS Labour Market Quarterly and Census Data

THE IMPACTS OF COVID-19

Early impacts on the Queensland Tourism industry

The COVID-19 pandemic will have widespread and long-lasting impacts on the domestic and global Tourism industry. In Queensland, the strong impacts of COVID-19 on the industry have already been felt, and are expected to continue over the medium term. China is Australia's largest international tourist visitor market, with approximately 1.4 million visitor arrivals in 2018-19. In Queensland, in the year ending December 2019, 497,000 short-term Chinese visitors contributed $1.6 billion to the Queensland visitor economy.[294] Travel bans initially targeting China were imposed from 1 February 2020, with Australian borders closing to all non-residents from 20 March 2020. As of April 2020, the Queensland Government estimated the impact to the Tourism industry within Queensland to have affected 70,000 jobs and resulting in lost economic activity of $6.5 billion.[295]

The short-term future of the international Tourism industry remains unknown while the closure of international borders remains in place. As the COVID-19 pandemic continues to escalate in various other countries, there is no clear indication as to when the Australian Government will safely reopen international borders.

The Queensland Tourism industry was further impacted with the closure of domestic State borders in response to the COVID-19 pandemic. The Queensland Government prohibited domestic entry into Queensland unless travel was exempt under the Chief Health Officer's Border Restrictions Direction.[296]

Workforce impacts

The COVID-19 pandemic has significantly impacted the tourism workforce within Queensland due to the high reliance on international tourists. These impacts have been further compounded by the closure of the Queensland State borders preventing domestic tourism. It is estimated that one in three jobs has already been lost in Accommodation and Food Services in Queensland due to COVID-19 restrictions.[297] As such, a future-focused workforce with the skills required to support future growth and adoption of emerging technologies is increasingly critical. Digital skills will be an increasingly critical core skill for the tourism workforce to ensure that technology is seamlessly integrated into the customer service experience.

Inquiry into the Working Holiday Maker Program

In response to the COVID-19 pandemic, the inquiry into migration in regional Australia was suspended as the economic impacts of the public health emergency potentially changed the needs of regional communities. Instead, the Australian Government announced the inquiry into the Working Holiday Maker program to ensure it is working effectively to support the tourism, health care and agriculture industries during the COVID-19 economic recovery.[298] A focus of the new inquiry will be to explore how to appropriately transition out-of-work Australians into jobs that are typically filled by working visa tourists and backpackers. Additionally, the inquiry will consider a longer term focus regarding how Australians transitioned into these roles can complement the traditional working visa tourist and backpacker workforce when the Australian borders re-open and approximately 50,000 backpackers are expected to re-enter the regional workforce.

Easing of COVID-19 restrictions

With sustained low transmission rates within Queensland, the Queensland Government is slowly easing restrictions including allowing unlimited travel and overnight stays across the State for all Queensland residents. On 30 June 2020, the Queensland Government announced that stage three of easing restrictions would be

[294] *Tourism and Events Queensland, Tourism Data Explorer V2.5, International Overnight Visitation by State (By Source Market) https://teq.queensland.com/research-and-insights/tourism-data-explorer/power-bi-ivs*
[295] *https://www.abc.net.au/news/2020-04-20/coronavirus-six-billion-dollar-hit-to-queensland-tourism/12151078*
[296] *Queensland Government, Border Restrictions, https://www.qld.gov.au/health/conditions/health-alerts/coronavirus-covid-19/current-status/public-health-directions/border-restrictions*
[297] *Anastacia Palaszczuk, Queensland tourism boost to Unite and Recover from COVID-19, http://statements.qld.gov.au/Statement/2020/5/19/queensland-tourism-boost-to-unite-and-recover-from-covid19#:~:text=%E2%80%9CTourism%20was%20contributing%20%2427%20billion,would%20witness%20in%20my%20lifetime.*
[298] *Parliament of Australia, Media Release, Review of the Working Holiday Maker Program and its role in the economic recovery, 24 June 2020, Available at https://www.aph.gov.au/About_Parliament/House_of_Representatives/About_the_House_News/Media_Releases/Review_of_the_Working_Holiday_Maker_Program_and_its_role_in_the_economic_recovery*

implemented from noon on 3 July 2020. This stage allows for businesses to reopen including casinos, nightclubs, food courts, and a maximum number of customers to be determined by the four square meter rule for large venues, or two square metre rule for venues below 200 square metres.[299]

The reopening of State borders has been a key concern for the Tourism industry in the Greater Whitsunday region. From 10 July 2020, any person from Australia may enter Queensland subject to completing and signing a border declaration. Due to COVID-19 hotspots in Victoria, strict border controls remain in place for all Victorians or people who have travelled from Victoria in the past 14 days.

Air travel to the Greater Whitsunday region

Despite the easing of restrictions and opening of state borders, due to the regional location of the Greater Whitsunday region, flights are a critical access route for tourists to access the region.

The Whitsunday Regional Council successfully worked in partnership with the Queensland Government to secure direct flights from Brisbane to Proserpine four times a week with Alliance Airlines. It is estimated the flights will support 85 local jobs and bring approximately 5,300 tourists to the region over the next 12 months.[300]

The Queensland Government has committed $15 million to secure new flights to Queensland that is designed to 'support airports to negotiate with carriers in partnership with Tourism and Events Queensland to secure aviation routes to regional Queensland and into Brisbane'.[301]

Queensland Government tourism support packages

Through this challenging period for Queensland tourism regions and operators, the Queensland Government is supporting the industry through a range of economic stimulus packages to begin the long and difficult recovery. The Queensland Government is providing:

- $50 million to support Queensland's Tourism industry to fast track tourism projects and assist national tourism icons;
- $7 million Domestic Tourism Campaign—to support jobs and businesses in tourism regions by marketing Queensland as the destination of choice for Australian travellers;
- $15 million airline route support – to support and encourage domestic tourism spend across Queensland;
  - $5 million for flights within Queensland – the funding will support 15 regional airports and Brisbane Airport to negotiate with airlines to establish new routes or reopen pre-COVID19 services in regional Queensland and into Brisbane.
  - $10 million to bring tourists back from outside Queensland – investing $10 million for key regional airports and Brisbane Airport to work in partnership with Tourism and Events Queensland to secure aviation routes into regional Queensland and into Brisbane from interstate and other markets.
- $8.93 million national parks works and jobs boost – to provide visitor infrastructure upgrades and enhancements to reenergise nature-based tourism;
- $4.2 million – to provide a pipeline of performing arts and live music to support cultural and tourism recovery; and
- Relief for Queensland tourism businesses including:
  - Waiving application fees for some variations to liquor licences;
  - Waiving registration renewal fees for inbound tour operators;
  - Waiving of daily fees for commercial activity agreements and permits;
  - Rebate on marina charges and passenger levies; and
  - Deferral of tourism lease rent payments.

[299] Queensland Government, Roadmap to easing restrictions, https://www.covid19.qld.gov.au/government-actions/roadmap-to-easing-queenslands-restrictions

[300] Queensland Government, Media Statements, New flights to pump millions into Whitsundays economy, 3 June 2020, Available at http://statements.qld.gov.au/Statement/2020/6/3/new-flights-to-pump-millions-into-whitsundays-economy

[301] Queensland Government, Media Statements, $15 million dollar package for interstate and intrastate flights, 16 June 2020, Available at: http://statements.qld.gov.au/Statement/2020/6/16/15-million-dollar-package-for-interstate-and-intrastate-flights

Future opportunity and the path back

Despite the significant and prolonged challenges the Tourism industry will face within Queensland, Australia and globally, there is significant opportunity within the domestic market. In the year ended March 2019, Australians took 9.9 million trips and spent $62.3 billion on international travel.[302] As transmission rates within Australia remain low, the Queensland Tourism industry has the opportunity to gain significant economic benefit from Australian domestic overnight travellers. In addition to Queensland Government support for a domestic tourism campaign and airline route support to encourage domestic tourism spend, tourism operators within the Mackay, Isaac and Whitsunday region should seek to utilise technology to promote and enhance visitor experiences.

> *"This COVID-19 crisis has been the greatest disruption we have ever faced and the operators have hope for the future but it is really tough…The international market will not be returning anytime soon, we can predict that with some certainty unfortunately.*
>
> *We have to hope that the 5 to 6 million Australians that normally would take their holidays overseas spending $50 billion will consider Queensland destinations."*
>
> ***Daniel Gschwind – CEO, Queensland Tourism Industry Council***

Regional impacts for the Tourism Industry

REMPLAN has collected and released new data measuring the labour market impacts of COVID-19 across the Greater Whitsunday region. As part of its COVID-19 Australia Business Economic Impact Survey, REMPLAN specifically investigated the business impacts in the Tourism industry and its results for the Greater Whitsunday region indicated that:

- 100 percent of businesses and organisations surveyed in the tourism (Accommodation and Food Services) industry within the Greater Whitsunday region reported to have been affected by COVID-19;
- 17 percent of businesses and organisations surveyed in the tourism (Accommodation and Food Services) industry within the Greater Whitsunday region reported to be prioritising paying suppliers over the next three months;
- 21 percent of businesses and organisations surveyed in the tourism (Accommodation and Food Services) industry within the Greater Whitsunday region reported to be prioritising job security over the next three months;
- 61 percent of businesses and organisations surveyed in the tourism (Accommodation and Food Services) industry within the Whitsunday region reported it would be impossible to adapt to the new environment (e.g. physical distancing and working from home); and
- 81 percent of businesses and organisations surveyed in the tourism (Accommodation and Food Services) industry within the Greater Whitsunday region reported that there were either likely no, or no operational benefits to their businesses from the COVID-19 pandemic.[303]

It is clear these impacts have been profound and more substantial than for the other three industry sectors examined in this report.

[302] *Tourism Research Australia, Travel by Australians Year Ending June 2019.*

[303] *REMPLAN, 1st June 2020, COVID-19 Australian Business Economic Impact Survey, Mackay, Isaac and Whitsunday, Available at https://surveys.remplan.com.au/s3/REMPLAN-COVID-19-ABEIS*

Key employment trends that are occurring in the region

As with the rest of Australia, the Tourism industry in the Greater Whitsunday region is in the midst of significant transformation. Increasing interest in ecotourism, growing importance of social media tourism campaigns and the impacts of global travel booking websites are driving well documented changes in the industry. The impact of these changes on the existing tourism workforce in the region will be significant.

Trends in ecotourism

Ecotourism is a major economic source for rural and remote communities, generating significant community benefit and resilience. Ecotourism businesses actively work toward conservation of the natural areas central to their operations. As such, many ecotourism businesses support regional economies and provide social outcomes through developing local pride, supporting festivals and events. [304]

Currently, there are seven ecotourism operators that have been accredited by Ecotourism Australia in the Greater Whitsunday region. With increasing interest in ecotourism experiences, it is expected that ecotourism will likely become an increasingly prevalent form of tourism in the Greater Whitsunday region. This is particularly the case for the Whitsunday LGA which encompasses the natural beauty of the Great Barrier Reef and the surrounding environment. [305]

As a result, it is expected that inbound tour operators will likely focus on specialising their services over the period, to cater for the variety of ecotourism experiences that travellers demand. As a result, industry establishment and enterprise numbers are anticipated to rise over the next five years, as smaller, niche ecotourism operators providing different package options enter the industry. This will in turn drive demand for tourism operators and employees which have specialised skills and knowledge in providing ecotourism experiences. [306]

Importance of social media tourism campaigns

Tourism operators in the Greater Whitsunday region are increasingly focusing on stimulating conversations about tourism and tourism campaigns in the region through the use of key social media platforms including Facebook, Twitter, Instagram and Pinterest. These social media platforms concentrate on showcasing beautiful and unique images from all over the region in order to attract tourists to the Greater Whitsunday region.

The increasing use of social media by tourism operators in the region has also encouraged the sharing of user-generated social media content. This content involves tourists sharing their own stories and experiences with their social media networks, which in turn can attract a broader audience to choose the Greater Whitsunday region as a tourist destination.

As a result of this increasing uptake of social media in the Tourism industry, it is expected that there will be sustained workforce demand for people with skills in creating and sharing digital content on social media platforms. Consequently, tourism businesses will potentially need to develop proactive and creative strategies to train their staff in effectively utilising social media.

Impacts of global travel booking websites

Tourists have been changing the way they book travel over recent years. Global travel booking websites have become increasingly popular and have enabled tourists to compare prices among service providers in the Greater Whitsunday region.

In response to these trends, industry operators are anticipated to redesign the way in which food, accommodation and tour services are marketed and sold to tourists. In particular, industry operators are projected to increase their use of computer systems and online tools to reduce employee-related costs. [307] In turn, this is likely to increase the demand for online marketing and sales skills in employees in the Tourism industry.

[304] *IBIS World. Specialised Industry Report: Inbound Tour Operators in Australia. Report OD5397. Accessed 13 July 2020.*
[305] *Ecotourism Australia. Ecotourism in the Whitsundays. Accessed 13 July 2020 https://www.ecotourism.org.au/news/ecotourism-in-the-whitsundays/*
[306] *IBIS World. Specialised Industry Report: Inbound Tour Operators in Australia. Report OD5397. Accessed 13 July 2020.*
[307] *IBIS World. Specialised Industry Report: Inbound Tour Operators in Australia. Report OD5397. Accessed 13 July 2020*

Faethm Insights:

The Disrupted View

"Skill requirements, including both specialist hard skills and general soft skills are increasing. Digitisation and the changing nature of the industry is also driving a greater requirement for ICT skills, soft skills and entrepreneurship among Small-to- and Medium Enterprises (SMEs).

***APEC Tourism Working Group**[308]*

[308] *2017. Developing the Tourism Workforce of the Future in the APEC Region. Available at https://www.griffith.edu.au/__data/assets/pdf_file/0023/90905/217_TWG_-Developing-the-Tourism-Workforce-of-the-Future.pdf*

PREDICTIONS OF WHEN KEY TECHNOLOGIES WILL IMPACT THE TOURISM INDUSTRY

There are a range of emerging technologies that are expected to accelerate the rate of technological change and adoption over the coming years, and with this, impact on the workforce. Often, the discussion about the impact of technology on the Future of Work talks about digital disruption in sweeping terms without a clear or nuanced view of what technologies are planned for adoption, the maturity of the industry within the region and its readiness for technology, or the industry-specific technologies which will have a significant workforce impact.

The Faethm modelling provides a prediction of the key technologies that could be implemented at an industry level, specifically for the Greater Whitsunday region. It is important to note this is based on the opportunity that exists, and may not be fully realised. Based on these predictions, Faethm also examines the expected workforce impact of technology adoption. Further information about the Faethm modelling is provided in Appendix B.

What does the technology prediction tell us?

The Faethm technology prediction for the Tourism industry in the Greater Whitsunday region is summarised in Figure 5.15, Figure 5.16 and Figure 5.17. These figures show the technologies with the greatest predicted impact on the Tourism workforce measured in terms of $AUD total salary cost savings as a result of a reduction in FTE across the workforce.

This analysis for the Tourism industry shows:

- Process Automation is the technology that is anticipated to drive the greatest degree of workforce impact of all technologies over the 5, 10 and 15 year horizon. Its impact will be greatest in the first five years ($22.2 million in predicted salary savings to 2025) and it will continue to grow in impact until 2030 ($32.5 million in predicted salary savings), and then its impact will plateau over the next five years to 2035;
- The impact of Mobile Robotics will grow significantly over time. It is the third highest technology predicted to drive salary reductions in the Tourism industry to 2025 ($5.4 million in predicted salary savings), and is then projected to more than double in its impact on the workforce to 2030 ($13.9 million in predicted salary savings).Mobile robotics impact on the workforce will continue to grow significantly out to 2035 ($20.3 million in predicted salary savings);
- Fixed Robotics will impact more significantly on the workforce (in terms of salary savings) within the first five years ($6.0 million in predicted salary savings to 2025), and will grow at a more moderate pace in impact until 2030 ($9.5 million in predicted salary savings) before it plateaus over the next five years;
- Conversation Exchange technologies will drive $10.2 million in predicted salary savings by 2030, more than three times that projected by 2025 ($3.0 million in predicted salary savings);
- Decision Generation technologies will grow in influence, more than doubling in impact between years 5 and 10 ($5.4 million in predicted salary savings in 2025 and $11.1 million by 2030), before more moderate growth to 2035; and
- Navigation Robotics is predicted to achieve $2.3 million in predicted salary savings in 2025 and $6.9 million by 2030, continuing to grow in impact out to 2035.

Figure 5.15: Prediction of Emerging technology types with the greatest opportunities to drive automation in the Tourism industry, Greater Whitsunday region, 5 year projection ($AUD salary cost saving)

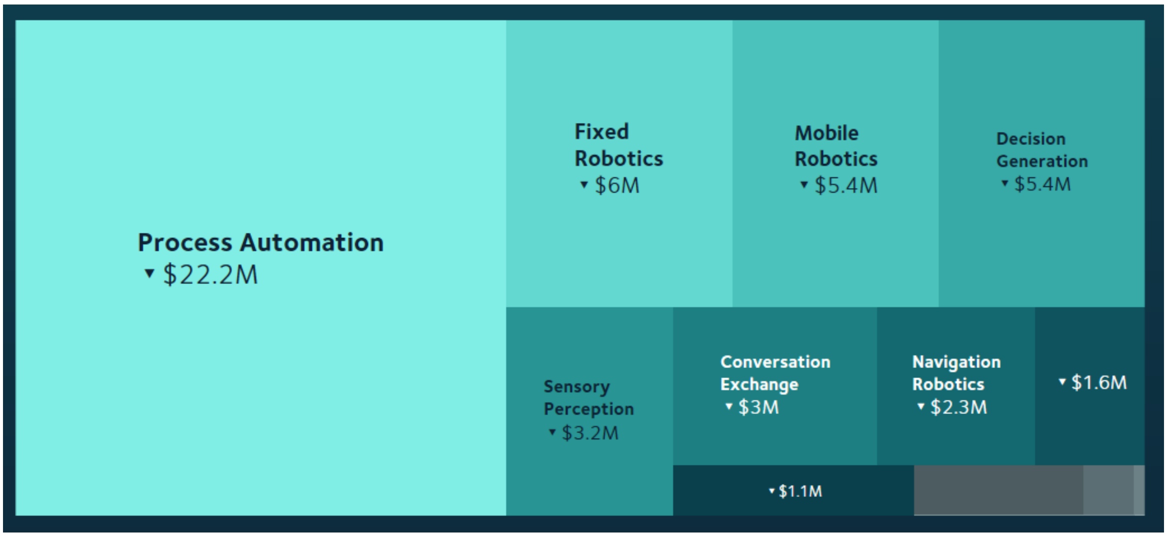


Figure 5.16: Prediction of Emerging technology types with the greatest opportunities to drive automation in the Tourism industry, Greater Whitsunday region, 10 year projection ($AUD salary cost saving)

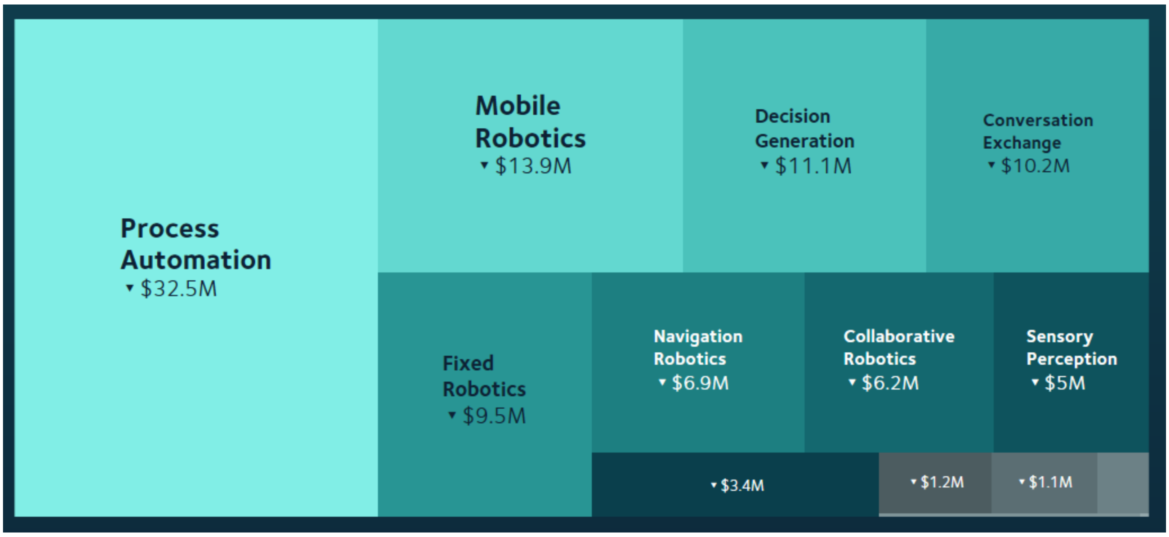
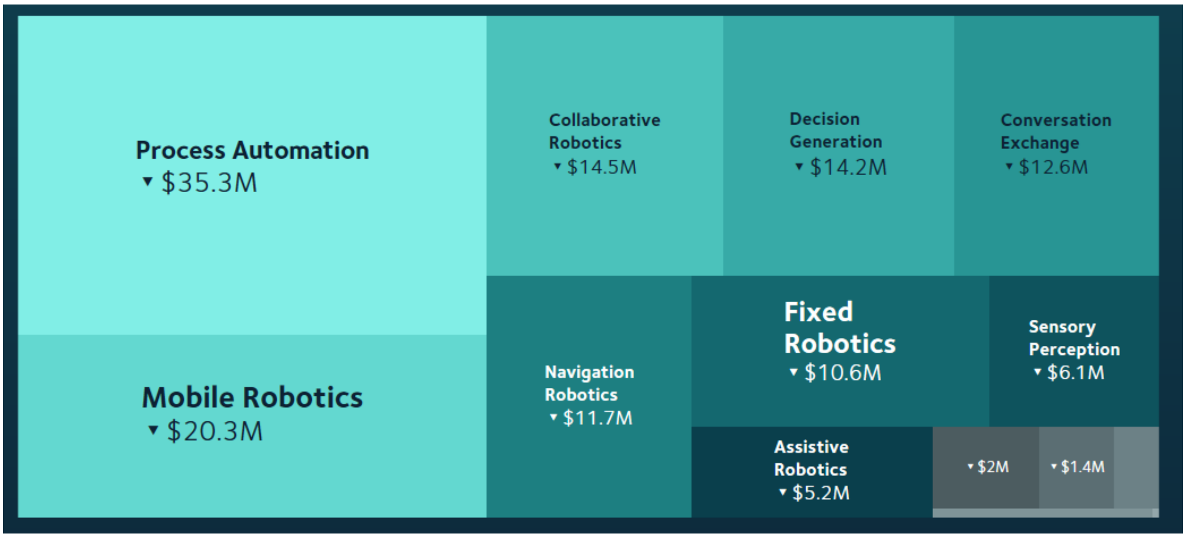


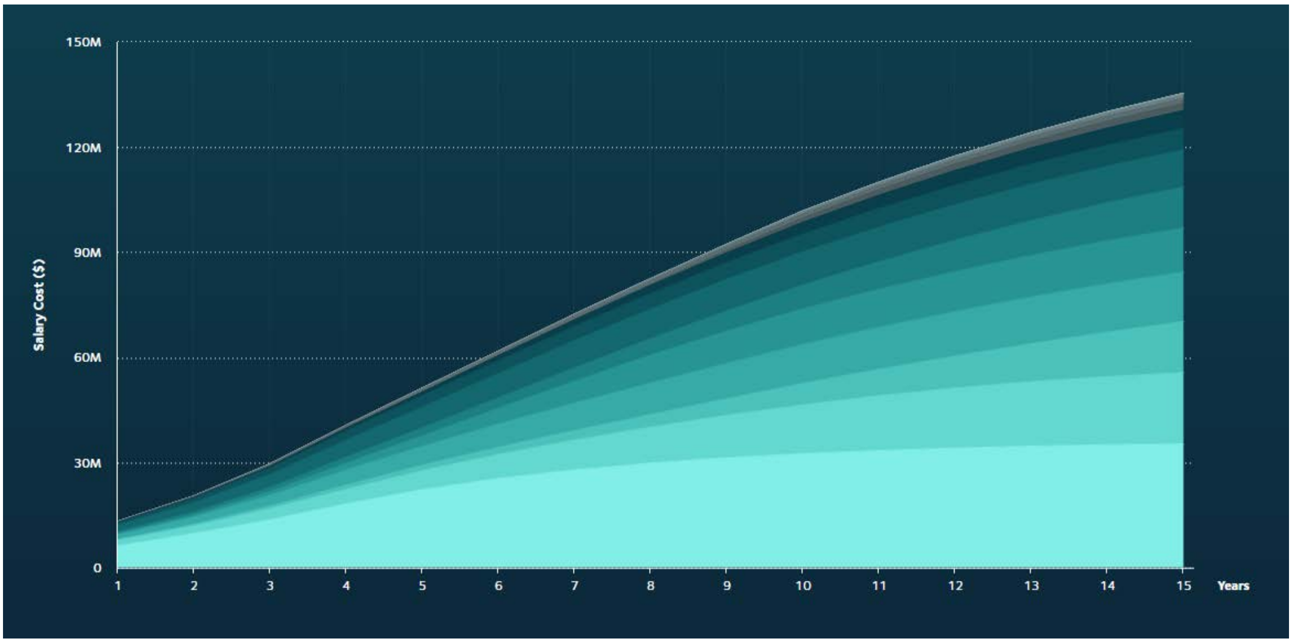
Figure 5.17: Prediction of Emerging technology types with the greatest opportunities to drive automation in the Tourism industry, Greater Whitsunday region, 15 year projection ($AUD salary cost saving)



Source: Faethm (platform.faethm.ai)

These impacts are also summarised in the 15 year technology projection curve for the Tourism industry shown in Figure 5.18 below.

Figure 5.18: Automation technology adoption curve over the 15 year horizon (2035), Tourism industry Greater Whitsunday region



Key from bottom to top – process automation, mobile robotics, collaborative robotics, decision generation, conversation exchange, navigation robotics, fixed robotics, sensory perception, assistive robotics, generative design, predictive analysis, dexterous robotics, solution discovery, creative origination.

Source: Faethm (platform.faethm.ai)

What is meant by these technology categories in the tourism context?

Table 5.1 below provides a definition for each of the Faethm technology clusters, and examples of what is meant by this in the agriculture sector context. This table links the technology discussion later is this chapter with the Faethm nomenclature.

Table 5.1: Technology clusters in Faethm and applicability to the agriculture sector

TECHNOLOGY	DEFINITION (FAETHM)	EXAMPLES IN AN TOURISM CONTEXT
Process Automation	Process Automation technologies use code programmed to complete pre-defined, logical and rule based processing tasks such as quantitative calculations, process onboarding, monitoring and simple robotic jobs and movements. This works by applying rules based logic to take structured inputs and using predefined executable steps, to deliver structured outputs.	Self-service kiosks are becoming increasingly common in fast food restaurants, domestic and international airports and hotels. These kiosks allow diners to customise an order, guests to check-in with the information already supplied during the booking, and air passengers to avoid queues and check-in quickly and efficiently.
Mobile Robotics	Mobile Robotics technologies are machines that transition between locations and positions, completing robotic handling and object manipulation tasks. This works by combining programmed instructions with moving mechanics to transition between points in a controlled environment.	Hotels are increasingly using robots to make front desk deliveries and room service deliveries to guests. The robots use sensors, 3D cameras and Wi-Fi networks to operate throughout the hotel and navigate to guest rooms to deliver items and meals.

TECHNOLOGY	DEFINITION (FAETHM)	EXAMPLES IN AN TOURISM CONTEXT
Collaborative Robotics	Collaboration Robotics technologies are agents that contribute to and work jointly with humans to generate shared ideas and work outputs. This works by sensing, supporting and cooperating with humans to complete tasks and assist in designing end solutions.	Examples of collaborative robotics within the Tourism industry include to perform housekeeping, where machines or robots will work with housekeeping staff to perform repetitive or strenuous tasks. The robots are instructed, controlled and managed by workers to enable humans to perform higher value tasks.
Decision Generation	Decision Generation technologies are systems that use machine learning to evaluate input data, create options and determine the best course of action or outcome from a number of possibilities. This works by analysing and evaluating inputs, apply algorithmic process and trained logic and past experience to determine outcomes and decide on best course of action.	Developments in visitor tracking highlights the opportunities for decision generation technologies within the Tourism industry. The use of big data and tourism tracking allows tourists access to real-time updates for wait times at popular tourist locations, personalised recommendations and personal records of their travel history for personal use or to share with family and friends.
Conversation Exchange	Conversation Exchange technologies are systems that use machine learning and sensors to interpret and engage in conversation, exchanging ideas and information with humans. This works by applying auditory and speech sensors in combination with Natural Language Processing and speech generation technologies to detect communication and to respond in a social dialogue.	Conversation exchange enabled robots used in museums are capable of answering questions about exhibits and history, provide additional information, guide visitors to exhibits and notify of operating hours. [309] Tourist information centres utilise conversation exchange technology to quickly and efficiently answer questions and provide a wide range of local information to users.
Navigation Robotics	Navigation Robotics technologies are robots that can navigate autonomously in unstructured environments with specific functions. This works by applying reinforced learning, advanced sensors and mechanics to plan and conduct live movement between environments.	Navigation robotics are used in the hotel industry to deliver and collect room service items (see also mobile robotics above). Navigation robotics can also be used to deliver and collect linen in a hotel setting. The technology is capable of delivering fresh linen and streamlining the return of soiled linen to the laundry.
Fixed Robotics	Fixed Robotics technologies are machines that robotically handle and manipulate objects in a predefined way such as by painting or assembling. This works by combining programmed rules based instructions with vision, sensor systems and mechanics.	Advanced fixed robotics capable of folding laundry are emerging, such as the Foldimate Laundry Robot. The Foldimate is able to fold a range of linen types commonly used in a hotel, including towels and sheets.

[309] *Doreen Carvajal, The New York Times, Let a robot be your museum tour guide, 14 March 2017, Available at https://www.nytimes.com/2017/03/14/arts/design/museums-experiment-with-robots-as-guides.html*

Predictions of the impact of these technologies being adopted in the tourism workforce

Based on these technology adoption rates, Faethm predicts the opportunity that is created to automate, augment and add to the workforce. The analysis undertaken for the Greater Whitsunday region for the Tourism industry workforce over a 5, 10 and 15 year horizon shown in Figure 5.19, Figure 5.20 and Figure 5.21 below.

This predicts that:

- By 2030, 15.2 percent of the total tourism workforce functions and roles will be augmented (or supported) by technology, and 24.1 percent of the current tasks and functions are predicted to be automated (or replaced) by technology;
- The degree of impact of a change in automation and augmentation is also partially determined by the overall size of the workforce;
- The Sales Assistant is the occupation expected to drive the highest overall workforce impact in the tourism workforce in the region as a result of automation and augmentation over the 5, 10 and 15 year horizon. By 2030, it is predicted that 24.7 percent of this role will be automated as a result of technology, and 25.6 percent of the role will be augmented by technology;
- The top five occupations driving the greatest workforce impact (measured by FTE) for the region in tourism over the fifteen year period (and at the five and ten year increments) are predicted to be the Sales Assistant, General Clerk (46.6 percent automatable, 3.7 percent augmentable), Commercial Cleaner (44.4 percent automatable, 8.9 percent augmentable), Retail Manager (18.9 percent automatable, 34.6 percent augmentable); and Kitchenhand (54.8 percent automatable, 1.2 percent augmentable);
- The occupations with the highest predicted level of automation (where technology will replace the need for some tasks and functions) are the Kitchenhand (54.8 percent), Fast Food Cook (53.2 percent), Receptionist (50.7 percent) and Travel Consultant (50.0 percent); and
- For most tourism occupations by 2035, less than 20 percent of each role is projected to be augmented by technology. The six occupations with augmentation predictions of higher than 20 percent by 2035 in tourism in the Greater Whitsunday region are Cook (41.0 percent), Licenced Club Manager (38.4 percent), Bar Attendant (32.1 percent), Hotel or Hotel Manager (30.3 percent), Café or Restaurant Manager (27.3 percent), Sales Assistant (25.6 percent), Retail Manager (24.6 percent) and Waiter (22.6 percent).

Figure 5.19: Prediction of tasks within jobs exposed to augmentation and automation in the Tourism industry, Greater Whitsunday region, 5 year projection (top 15 occupations, by FTE)

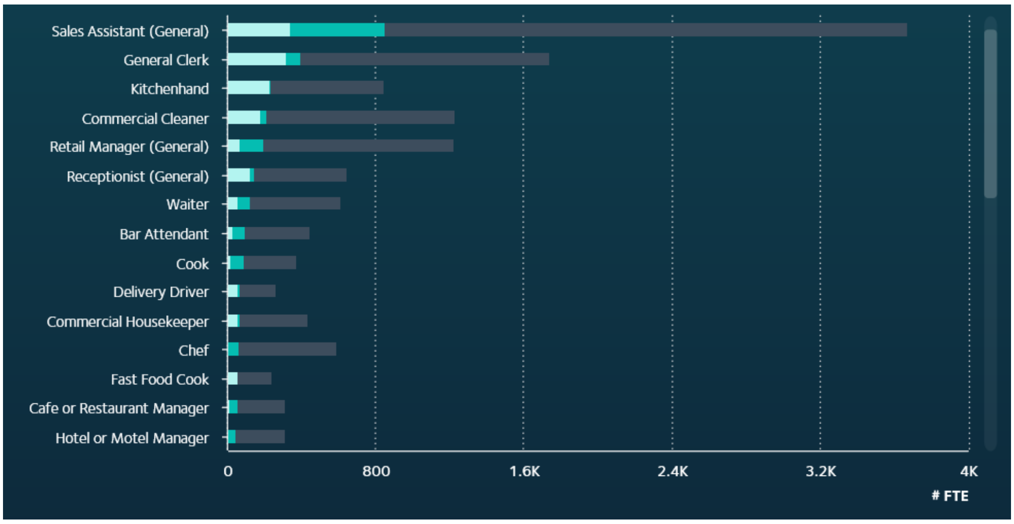


Figure 5.20: Prediction of tasks within jobs exposed to augmentation and automation in the Tourism industry, Greater Whitsunday region, 10 year projection (top 15 occupations, by FTE)

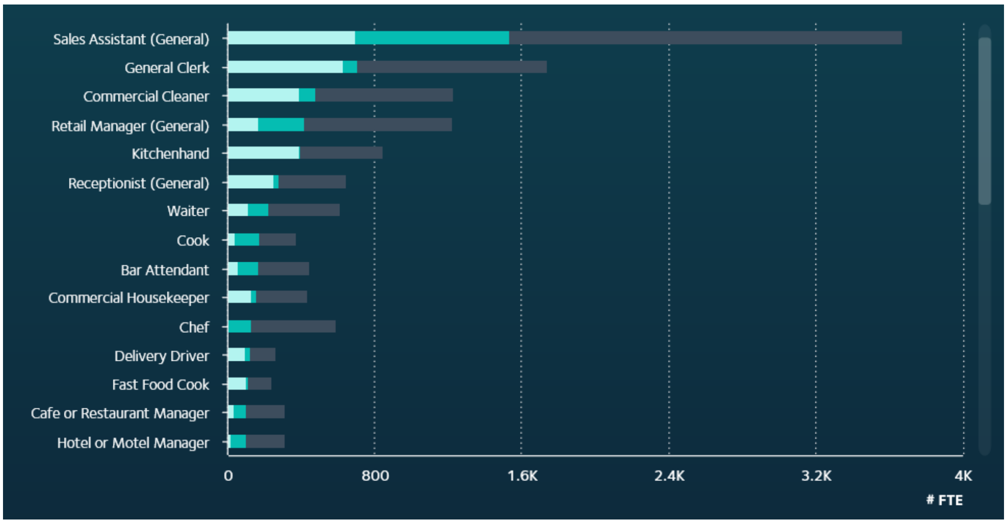
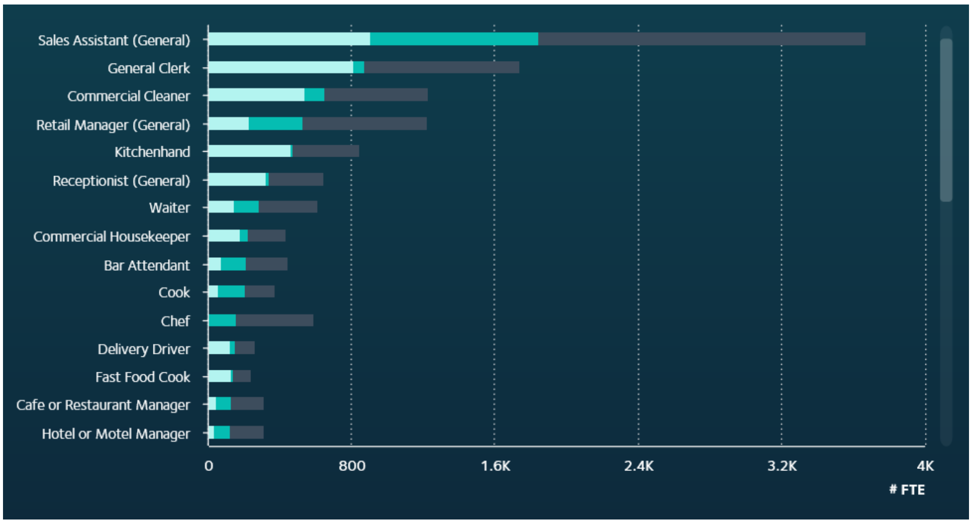


Figure 5.21: Prediction of tasks within jobs exposed to augmentation and automation in the Tourism industry, Greater Whitsunday region, 15 year projection (top 15 occupations, by FTE)



Source: Faethm (platform.faethm.ai)

It is also important to note that there are a number of new occupations that are expected to increase in demand as a result of the adoption of these technologies. Figure 5.22, Figure 5.23 and Figure 5.24 show the key occupations expected to be in demand over the 5, 10 and 15 year horizon based on adoption of new technologies in the Tourism industry. It shows that:

- By 2025, 518 FTE in additional jobs are predicted in the region to support the implementation, maintenance and governance of tourism technology adoption, this grows to 1,200 FTE by 2035;
- The top five occupations predicted to grow in demand as a result of technology are Software Developers and Application Developers, Software Developers and Systems Support, Process Improvement Analysts, Data Engineers and Data integrators; and
- When viewed against predicted new occupations from the four included industry sectors, the Tourism industry will increase this workforce by 30.8 percent of the total predicted additional 3,900 FTE required to support emerging technologies by 2035.

Figure 5.22: Prediction of additional jobs required to support new technologies adopted in the Tourism industry, Greater Whitsunday region, 5 year projection (top 15 occupations, by FTE)

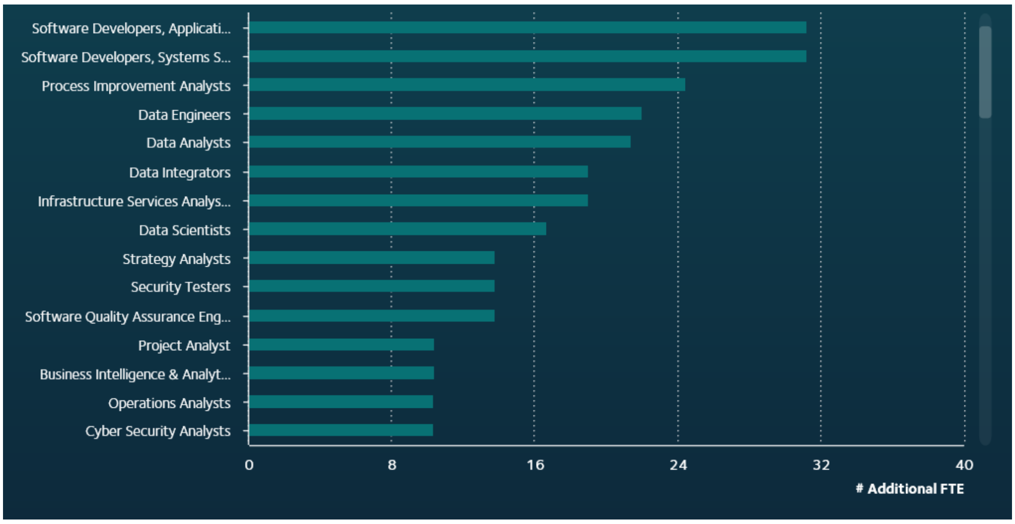


Figure 5.23: Prediction of additional jobs required to support new technologies adopted in the Tourism industry, Greater Whitsunday region, 10 year projection (top 15 occupations, by FTE)

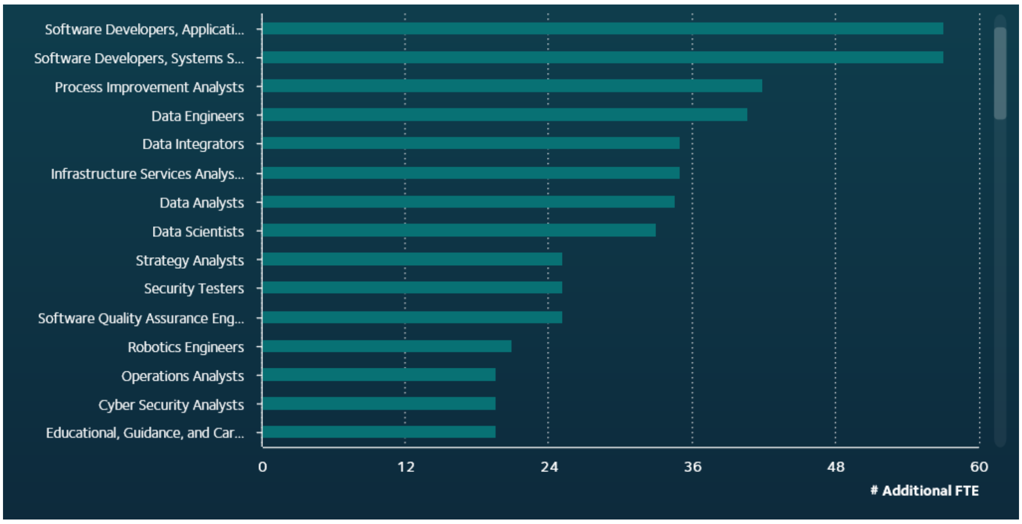
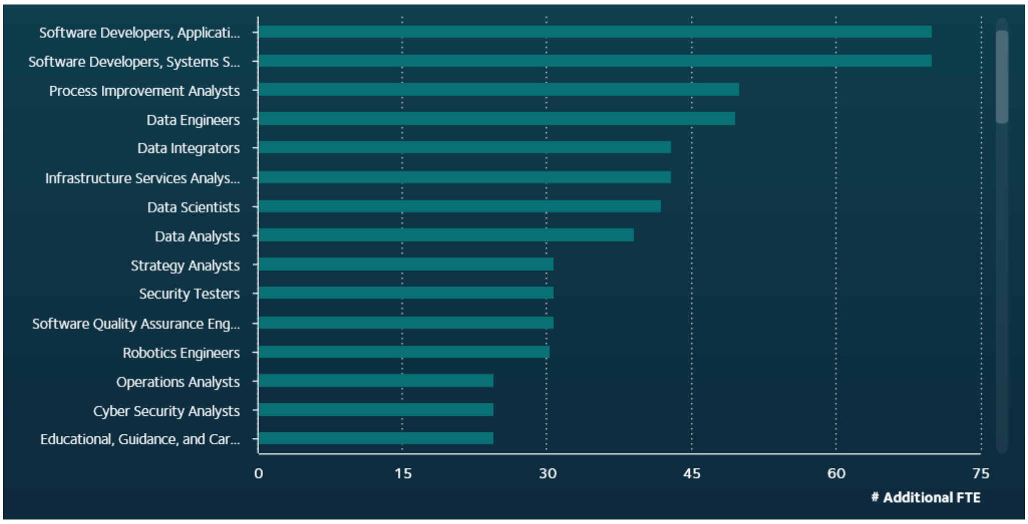


Figure 5.24: Prediction of additional jobs required to support new technologies adopted in the Tourism industry, Greater Whitsunday region, 15 year projection (top 15 occupations, by FTE)



Source: Faethm (platform. faethm.ai)

A deeper dive:

Technologies emerging in tourism

New technologies have the potential to enhance and challenge sectors of the tourism industry, changing the way operators target travellers, disrupting existing service offerings and forcing a re-imagining of the visitor experience and the end-to-end visitor journey.

Tourism Research Australia

KEY TECHNOLOGIES

Tourism is a driver of growth for the Australian economy, contributing $60.8 billion to GDP in 2018-19. For this same period, Australian domestic tourist spend exceeded $100 billion for the first time.

It is expected that technologies will increasingly be used to streamline administrative functions, increase the ease of booking and processing payments and to promote destinations to new markets. However, while technology is expected to increasingly be utilised within the industry, the human service experience will remain a core component of the Tourism industry that is likely unable to be replaced or replicated by technology.

As such, the key emerging technologies within the Tourism industry are primarily focused on enhancing the visitor experience through providing a personalised, connected and streamlined visitor experience.

Table 5.2: The emerging technologies and digital enablers include:

	Augmented and Virtual Reality: Augmented Reality (AR) and Virtual Reality (VR) provide interactive experiences between the real, physical environment and a computer-generated simulated reality. AR incorporates real world elements with computer-generated environments while VR provides a completely simulated digital experience.
	In-room technologies: Hotel guests no longer see Wi-Fi as a perk but as an essential part of their experience. Technologies that are increasingly important for hotel guests include smart room keys that allow guests to unlock their doors through their smartphones, in-room entertainment systems that seamlessly connect with guest smartphones and applications for a personalised and seamless experience, sensors to notify housekeeping of when the room is vacant to service and robots to deliver room service.
	Sharing economy: The sharing economy has been driven by technology platforms that capitalise off peer-to-peer (P2P) activity of providing or sharing access to goods and services that are facilitated by online platforms.
	Emerging payment platforms: Emerging payment platforms use applications such as PayPal, PayPass and Tap'n'Go to create a seamless payment transaction that reduces interference with the customer experience. Mobile application based payment systems and technology are offering rapid, secure transactions that move payment to the background, rather than interfering with customer experience.
	Visitor tracking and big data: The increased use of GPS, cameras, smartphones and sensors in everyday life has led to the increased generation of data and the ability to track individual's movement. Data sources such as transaction and financial data, social media and reviews, bookings, ticketing and telecommunications and location data are all sources of information regarding a visitor's experience. Enhanced data analysis can be used to provide insights on visitor behaviours to inform business and policy decisions.
	Social media: Social media has become a part of everyday life for more than 3.8 billion users globally. With more than 4.5 billion people globally connected to the internet and mobile devices accounting for more than half of all the time spent online, a social media presence is becoming increasingly critical to the success of many businesses.

To be able to effectively respond and adapt to these technologies it is expected that the workforce will require capability development to build foundational digital literacy knowledge. It will also require interventions to drive changes in behaviour that increase the adoption of digital solutions.

However, there are many additional technologies that are expected to impact on individual occupation areas in specific ways. These are explored in more detail later in the chapter, Figure 5.25 outlines at a high level the breadth of technologies and how they impact occupations differently. Deeper analysis is provided on these technologies in Appendix H.

Figure 5.25: High level the breadth of technologies

Accommodation

- Sharing economy platforms
- Smart rooms and in-room technologies
- Social media
- Robotics

Ground Transport

- Ride sharing platforms
- Autonomous vehicles
- Mobility platforms

Retail

- Social media influencers
- Emerging payment platforms
- Online retailing

Food and Beverage

- Peer-to-peer food delivery services
- Social media
- Workforce management automation

Tours and Travel Agent

- Augmented and Virtual Reality
- Sharing economy
- Social media

Augmented Reality and Virtual Reality

What is AR and VR?

AR and VR provide interactive experiences between the real, physical environment and a computer-generated simulated reality. AR incorporates real world elements with computer-generated environments while VR provides a completely simulated digital experience.

How is it being applied within the sector?

AR and VR is used to improve tourist experiences by enhancing interaction with the individuals surrounds. Navigation and way finding technologies utilise AR to assist tourists finding their path in a destination, such as finding restaurants and understanding the layout of attractions.

AR mobile applications are increasingly being used at historical and cultural destinations to increase engagement, educate visitors and showcase delicate or fragile exhibitions. Museums use AR to deliver knowledge and showcase exhibitions. In Queensland, VR goggles are used by tour guides in Charters Towers to enhance tourist experiences and there are plans to expand the AR experience throughout the town and set up free Wi-Fi to support the implementation.[312]

What is the workforce impact?

AR and VR can be used to improve tourist experiences and provide opportunities for users who are unable to travel due to accessibility, time or cost barriers. China is one of the top international markets for Queensland tourism and millennial travellers from China who are often familiar with AR and VR technologies.

The technology can increasingly be incorporated in a variety of ways in the future, including:

- Adding value to the travellers for traditional tourism experiences;
- Providing education and information for tourists;
- Informing planning, policy decisions or potential infrastructure investments;
- Protecting sensitive travel environments and reduce physical impacts of tourist (e.g. on the Great Barrier Reef); and
- Creating new revenue streams through the use of AR and VR to create new experience for tourism operators.

CASE STUDY – TOURISM AUSTRALIA

VR is used successfully in tourism marketing, enabling consumers to experience a destination and presenting a compelling and dynamic experience to make consumers consider new travel destinations.

In 2016, Tourism Australia developed 18 VR film sequences to highlight Australia's aquatic and coastal destination. The campaign recorded over 10.5 million views since the launch across Facebook, YouTube and Australia.com. Snorkelling in the Great Barrier Reef was a popular feature among users and the campaign helped to drive a 9 percent increase in visitation and 64 percent rise in engagement on Australia.com.[310]

CASE STUDY – JINSHA SITE MUSEUM

In China, the Jinsha Site Museum is an archaeological site of the ancient Shu Kingdom established on the ruins of the Jinsha Site. The museum utilises three mobile applications to facilitate the onsite experience utilising AR technology. The technologies use smartphone cameras to scan pictures and play associated commentary, restore destroyed ancient buildings based on your location and camera, and provide maps and exhibit guides.[311] Key to the success of the applications are free full coverage Wi-Fi that allows visitors to download the application at the location.

The adoption of AR and VR presents significant challenges for tourism operators to adopt, particularly small and medium sized operators, due to the costs of establishing the technology, workforce skills required for setup and maintenance and potential negative impacts to the authenticity of visitor experiences.

While AR and VR is unlikely to replace 'real' travel experiences, it is a diversification opportunity for operators to connect with people who are unable to afford travel. COVID-19 has presented an opportunity for AR and VR to connect people with tourist destinations while international borders remain closed.

[310] *Tourism Australia, New research confirms the potential of virtual reality for destination marketing, https://www.tourism.australia.com/content/dam/assets/document/1/6/y/7/t/2003897.pdf.*
[311] *The University of Queensland and the Department of Innovation and Tourism Industry Development, The Future is Here, Augmented Reality in Tourism, 2018.*
[312] *https://www.abc.net.au/news/2019-08-07/augmented-reality-bring-to-life-charters-towers-ww2-history/11384536*

Visitor Tracking and Big Data

What is visitor tracking and big data?

The increased use of GPS, cameras, smartphones and sensors in everyday life has led to the increased generation of data and the ability to track individuals' movement. Data sources such as transaction and financial data, social media and review, bookings and ticketing and telecommunications and location data are all sources of information regarding a visitor's experience. Enhanced data analysis can be used to provide insights on visitor behaviours to inform business and policy decisions.

How is it being applied within the sector?

Currently, data is not widely used to inform the Tourism industry as there are significant challenges regarding high costs, privacy concerns, security issues and a lack of national connectivity. Traditional approaches to capturing tourism data are still widely used including experience surveys or public record data on tourism activities. Widespread data analysis that captures growth areas, such as digital platforms, could:

- Provide stronger understanding of what is driving supply and demand;
- Deliver understanding of the wider industry impacts on society and the environment;
- Drive increased government and industry collaboration; and
- Inform nuanced understanding of tourism insights to drive policies and future investment.

Visitor tracking is not widely used within the industry as privacy and security is a major concern for tourists. However, devices or mobile applications can track movements to provide real time information on travel and waiting times and provide personal reviews on nearby offerings.[314] Additionally, tourism operators can utilise data to adapt their offerings to better meet visitor expectations.

CASE STUDY – TOURISM TRACER

Tourism Tracer deploys a range of flexible approaches, including tracking apps, customised hardware, survey design, recruitment 'knowhow', visualisation tools and specialised analysis, to gain a rich understanding of visitor travel, decision-making and preferences through the combination of locational and survey data.

Tourism Tracer began in 2016 when the University of Tasmania, the CSIRO and the Tasmanian Government partnered to work on the 'Sensing Tourist Travel in Tasmania' project. The study initially tracked 472 tourists' complete trips through Tasmania. The second phase of the project launched an online dashboard allowing data to be visualised and explored in a user-friendly and accessible format. This second phase included tracking 1,000 tourists in Tasmania.

The data provides industry, regional tourism authorities and government with intelligence to:

- improve marketing and infrastructure investment decisions;
- identify emerging trends;
- inform strategies designed to increase the duration and spending during visits;
- improve the visitor experience by allowing the provision of more timely and relevant tourist information; and
- assess visitor use and safety of key touring routes.[313]

In 2018, the University of Tasmania issued its first commercial licence for the technology to develop scalable commercial solutions.

Business Research and Innovation Initiative

The Business Research and Innovation Initiative (BRII) is an Australian Government program designed to drive innovation and develop solutions to public policy and service delivery challenges nominated by Government. The Department of Industry, Innovation and Science in partnership with Austrade established the 'Intelligent data to transform tourism service delivery' challenge which is designed to unlock and integrate new data sources to better measure tourism and better inform decision-makers.[315]

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[313] *University of Tasmania, Tourism Tracer, About Tracer,* https://tourismtracer.com/about/.

[314] *Tourism Research Australia, Austrade and Deloitte Access Economics. 2019, Technology Disruptors in Tourism.*

[315] *Department of Industry, Innovation and Science, BRII Challenge – Intelligent data to transform tourism service delivery fact sheet, 2019.*

The key challenges government is seeking to address include:

- Unlocking new data to measure the impacts of the sharing economy on tourism goods and services to capture the diversity of visitor behaviour;
- Integrating new data sources with existing sources such as tourism investment projects and visitation statistics; and
- Leveraging the data to provide innovative, informative and detailed metrics specific to geographies.

In early 2020, two companies were awarded the grant to develop a proof of concept for the challenge. The solution is expected to assist government and business to better meet the client needs in a technology driven environment with increasing expectations of accountability, connectivity, responsiveness and effective service delivery.

What is the workforce impact?

Governments are able to utilise data generated from visitor tracking to inform decision making and infrastructure investment within local regions. Increased collaboration between tourism operators, government and researchers is likely to create increased opportunities to attract tourists to specific regions.

In-room technologies

What are in-room technologies?

Hotel guests no longer see Wi-Fi as a perk but as an essential part of their experience. Technologies that are increasingly important for hotel guests in the current context include smart room keys that allow guests to unlock their doors through their smartphones, in-room entertainment systems that seamlessly connect with guest smartphones and applications for a personalised, seamless experience, sensors to notify housekeeping of when the room is vacant to service and robots to deliver room service.

How is it being applied within the sector?

Automated check-in and check-out improves efficiencies and allows operators to focus on guest experiences, creating a streamlined and seamless experience for guests.

Rooms that are equipped with 'smart' technology utilise IoT technologies to immediately sync and exchange data with products such as lighting controls, automated curtains, temperature controls and smart televisions. Hotels can utilise these networks and data to create personalised experiences for guests who travel throughout various hotel chains or are repeat visitors to the destination.

CASE STUDY – HILTON HOTELS

Digital key technologies have been implemented by the Hilton Hotel chain, allowing guests to open any door that would normally be accessed with a key card with their smart phone. The technology requires guests to have the Hilton mobile application and once the room is ready on the day of arrival, guests receive a push notification that the key has been delivered. Once guests are within range of an equipped lock, a Bluetooth signal is sent between the lock and your smartphone or tablet to communicate and unlock the doors with the tap of a button. Guests are able to share their digital key with one other guest, sending a secure link requiring activation for security.

Hotels are increasingly utilising energy-saving technologies to increase their sustainability and reduce their energy consumption. Sensors can be used to adjust indoor lighting, automatically turn lighting on and off and adjust temperature controls in shared areas when the space is unoccupied.

What is the workforce impact?

Technology is enabling hotels to create a competitive advantage as tourists are increasingly after a compelling value-proposition for their hotel stays with the increased uptake of the sharing economy and affordable short-term accommodation. Hotel guests value investment in technology that enhances the guest experience and assists in attracting new, high-value customers. As such, the workforce will increasingly need to have digital skills to complement the level of service provided to guests.

Emerging payment platforms

What are emerging payment platforms?

Emerging payment platforms use applications such as PayPal, PayPass and Tap'n'Go to create a seamless payment transaction that reduces interference with the customer experience.

How is it being applied within the sector?

Mobile application based payment systems and technology are offering rapid, secure transactions that move payment to the background, rather than interfering with customer experiences.[317] Travellers are increasingly choosing to pay with card instead of cash for holidays, with most users preferring to tap a mobile phone payment over a terminal opposed to a physical bank card.

The sharing economy means that many transactions are completed online with no transaction occurring between people in person, with the online providers acting as the payment intermediary for the parties. Additionally, with travel bookings and tourist attraction reservations primarily occurring online, the tourist experience is shifted to a seamless transaction focused on customer service rather than payment processing.

What is the workforce impact?

New payment platforms offer rapid, secure transactions that decrease transaction times and reduce the need for handling cash. Consumers are increasingly becoming digital natives and seek convenience and practical usability from their payment platforms. Efficiency, reliability and individual payment offerings will be critical to ensure consumer experience is maximised into the future.

Domestic travellers are increasingly using emerging payment systems, particularly younger travellers. International travellers' payment system preferences differ to those of Australian travellers, with Chinese tourists preferring platforms such as UnionPay and Alipay.[318] As such, tourism operators in Queensland must adapt their payment platforms to create seamless transaction experiences for key international markets.

Tourism operators will need to identify profitable payment infrastructure that caters to both Australian and international tourist preferences into the future as they seek to adopt these emerging payment platforms.

Emerging payment platforms also offer tourism operators benefits, such as flexible infrastructure, integrated business platforms to provide greater analytics and customer management functions and instant client interfaces.

CASE STUDY – UNIONPAY, ALIPAY AND WECHAT PAY

China is the largest and most valuable inbound tourist market for Queensland, with more Chinese tourists travelling as flexible and independent travellers. As travel composition for Chinese tourists shifts from group to independent travel, tourism operators have greater opportunity to capture destination expenditure. Chinese travellers have a greater willingness to spend overseas where merchants accept Chinese mobile payment.[316]

Due to government regulation restricting Visa, MasterCard and American Express, UnionPay is the state-run bank that control card payments within China. UnionPay's dominance is being challenged through the rapid adoption of mobile payments by Chinese consumers such as Alipay, established by Alibaba Group with 54 percent market dominance. WeChat Pay is the second largest mobile payment platform, accounting for 39 percent of market share. It is estimated that mobile payment users exceed 940 million active users. To tap into this market and increase spend, Queensland tourism operators should increasingly offer UnionPay, Alipay and WeChat Pay for Chinese tourists.

[316] *Tourism and Events Queensland, Understanding Chinese Payment Systems – A Practical Guide for Tourism Operators, 2019.*
[317] *Tourism Research Australia, Austrade and Deloitte Access Economics. 2019, Technology Disruptors in Tourism.*
[318] *Tourism Research Australia, Austrade and Deloitte Access Economics. 2019, Technology Disruptors in Tourism.*

Sharing economy

What is the sharing economy?

The sharing economy has been driven by technology platforms that capitalise off P2P activity of providing or sharing access to goods and services that are facilitated by online platforms.

How is it being applied within the sector?

Sharing economy platforms such as Airbnb, Uber and Deliveroo have experienced substantial success in providing new accommodation, transport and food service offerings to travellers. Almost half of domestic travellers use sharing economy services while travelling, with one-third using accommodation or ride sharing platforms during their trip.[320] Usage of P2P platforms is greater in metropolitan areas with usage for accommodation at 40 percent and ride share at 51 percent, compared to 17 percent and 16 percent respectively for regional areas.[321] In 2018, Uber has targeted regional Queensland by launching the service in Bundaberg, Gladstone, Hervey Bay, Mackay and Rockhampton.[322] The Queensland Government is responsible for the regulation of ride sharing services and have implemented a range of regulatory changes to address the introduction of Uber.

CASE STUDY – UBER BOAT

While Uber is a well-established technology in the domestic ride sharing market, internationally Uber is expanding to multiple transport modes including boats, helicopters, public transport, motorcycles and scooters.

Tourism is a major industry in Croatia, with its coastal location on the Adriatic Sea, mild Mediterranean climate and clear waters making it a popular destination. To capitalise on the coastal location, Uber Boat was launched in Croatia in 2017 allowing users to select a boat transfer or boat trip for up to eight passengers.[319] The Uber Boat trip is a multiple destination transfer service that enables users to take a roundtrip to Croatia's beaches, bays and caves.

Regulation of short-term rental accommodation is addressed at a local government level. The Whitsunday Regional Council "values the complementary role that a range of temporary accommodation options can play in the support of tourism in the Whitsunday's" and has provisions for Airbnb and short-term rental accommodation approvals under the *Whitsunday Regional Council Planning Scheme 2017* (the Scheme).[323]

The Mackay Regional Council has the requirement for a shared facility accommodation licence for short-term accommodation if that is the sole use of the property.[324] The licence generally applies to fully commercial back-packers and bed and breakfast facilities. Similarly, the Isaac Regional Council is responsible for the regulation of short term accommodation within the region.

What is the workforce impact?

The sharing economy offers users benefits such as lowers costs, increased choice and ease of use. These benefits for users result in more frequent travel, larger groups travelling together, longer trips spent in one location and an expanded market for those who cannot afford traditional hotel accommodation. This provides significant opportunity for the region to attract additional tourists for longer periods if P2P networks can be effectively utilised.

As P2P activities have increased, traditional operators have experienced major disruptions where they have failed to innovate in response.[325] It is expected that in the next five years, approximately one-quarter of domestic travellers will increase their personal use of P2P services.[326]

[319] *Uber Boat, Uber, https://www.uber.com/hr/en/u/uberboat/*
[320] *Tourism Research Australia, Austrade and Deloitte Access Economics. 2019, Technology Disruptors in Tourism.*
[321] *Tourism Research Australia, Austrade and Deloitte Access Economics. 2019, Technology Disruptors in Tourism.*
[322] *Alex Golden, Queensland State Manager for Uber, More transport options for residents of regional Queensland, 5 December 2018, https://www.uber.com/en-AU/newsroom/regionalqldlaunch/*
[323] *Whitsunday Regional Council, Airbnb and short term rental accommodation, Available at https://www.whitsunday.qld.gov.au/650/Airbnb-and-Short-Term-Rental-Accommodati*
[324] *Mackay Regional Council, Accommodation, Available at https://www.mackay.qld.gov.au/business/permits_and_licenses/ accommodation*
[325] *Tourism Research Australia, Austrade and Deloitte Access Economics. 2019, Technology Disruptors in Tourism.*
[326] *Tourism Research Australia, Austrade and Deloitte Access Economics. 2019, Technology Disruptors in Tourism.*

Recognition technology

What is recognition technology?

Recognition technology utilises biometric identifiers including finger prints, facial recognition and retina scanning to facilitate seamless transactions.

How is it being applied within the sector?

Facial recognition technology has the ability to streamline purchasing, check-in hotel guests and enhance customer experience through greater personalisation. It is predicted that facial recognition technology will be able to be utilised to easily identify people and control and grant specific access to locations for personnel.

Security is both an opportunity and risk for facial recognition technology, as the technology can be used to quickly verify an individual's identity, prevent crime and identify high-risk individuals. However, lack of government regulation, inaccuracy of the technology, potential biases and misinformation has led to increasing concerns of potential human rights infringements for individuals resulting from wide-spread adoption of facial recognition technology.

Facial recognition technology is likely to increase the amount of data collected automatically and provide key demographic statistics for tourist destinations such as sex, age and moods.

Finally, facial recognition technology is increasingly being utilised to authorise payment processing, where payments can be authorised on smartphones equipped with facial recognition technology.

What is the workforce impact?

Biometrics based technology is impacting both the experience of the workforce and the skills required. With widespread adoption of facial recognition technology at hotels the receptionists required to greet guests will decline, and workers will be required to assist guests with using technology. Workers will require increased problem solving, interpersonal and digital skills to utilise these technologies. As biometrics-based workforce management increases this will also change the way workers record time and perform security checks and other requirements.

CASE STUDY – MARRIOTT CHINA

In July 2018, Marriott International, one of the world's largest hotel chains, launched a rollout of facial recognition software for check-ins.[327] The launch is occurring in partnership with Alibaba Group, a Chinese multinational technology company, and utilising Alibaba's travel service platform, Fliggy.

The check-in kiosks are located at two Marriott International properties in China - Hangzhou Marriott Hotel Qianjiang and Sanya Marriott Hotel Dadonghai Bay. The technology is capable of scanning and identifying guest's faces, locating their reservations and checking them in. The technology is designed to reduce check-in times from three minutes to one minute and reduce queues that are often found at check-in desks.

Marriott guests will check in digitally by providing a form of ID, pause to have their photo taken by the machine, sign any customer terms of service agreements and input their contact information.[328] The facial recognition software will verify that the identities match and then dispense room keys.

The goal of the program is to establish a global rollout of the technology at all of the Marriott International's properties.

[327] *Marriott International News Centre, Joint Venture of Alibaba Group and Marriott International Trials Facial Recognition Check-In Technology, 11 July 2018, Available at https://news.marriott.com/news/2018/07/11/joint-venture-of-alibaba-group-and-marriott-international-trials-facial-recognition-check-in-technology*

[328] *Jenna Wang, Forbes, You Can Now Check In With A Facial Scan At Marriott In China, 24 July 2018, Available at https://www.forbes.com/sites/jennawang/2018/07/24/you-can-now-check-in-with-a-facial-scan-at-marriott/#348038d3f7a6*

Social media

What is social media?

Social media has become a part of everyday life for more than 3.8 billion users globally.[330] With more than 4.5 billion people globally connected to the internet and mobile devices accounting for more than half of all the time spent online, a social media presence is becoming increasingly critical to the success of many businesses.

How is it being applied within the sector?

Social media platforms such as Facebook, YouTube, WhatsApp, Twitter and Instagram are well-established and widely recognised globally. Various sharing platforms such as blogs, forums and review websites are also used to share content, knowledge and experiences. Approximately 72 percent of people post travel photos on social media, with 36 percent of domestic travellers being influenced by social media on destination locations and accommodation choices.[331]

Social media impacts the Tourism industry through increased reach to wide audiences to promote and advertise destinations, experiences and products. Social media has enabled businesses to build a strong, customer-centred strategy. Customers are looking for authentic reviews, meaningful connections and increased convenience in accessing information and customer journeys.

Social media provides an opportunity for tourism operators and regional destinations to attract new visitors and increase tourist numbers.

CASE STUDY – BRIDESTOWE LAVENDER ESTATE

In 2008, a small lavender farm, Bridestowe Lavender Estate, located in Tasmania serviced approximately 20,000 tourists annually. In 2009, a group of Taiwanese students first posted lavender-coloured cream from the estate on social media, garnering increased attraction. Additional posts to Instagram of the lavender fields continued to increase visitor numbers.

In 2013, the development of a lavender-stuffed teddy bear that doubled as a microwave aromatic heat-pack was posted on Weibo, a Chinese social media site, by a Chinese model that attracted significant engagement. By 2014, the Estate was hosting 65,000 tourists annually, including the Chinese President Xi Jinping, and selling 40,000 bears.

In 2019, 85,000 tourists visited the Estate and were supported by 40 staff working as guides, parking attendants and interpreters for up to 2,500 people that visit the estate per day.[329]

What is the workforce impact?

Social media has many impacts for tourism and the associated workforce, however the rise of ‘influencers’ is perhaps the strongest impact. With COVID-19 meaning people are spending increasing amounts of time on devices and social media platforms, sharing experiences and curated content is increasingly critical.

Social media platforms mean that businesses have increased responsibility in creating and enforcing healthier digital habits, championing transparency and respect within their digital communities while generating genuine engagement and complex stories across multiple social platforms. The ability to attract new visitors and deliver meaningful experiences will be critical to successfully navigating social media platforms for tourism operators.

[329] *Richard Guilliatt, The Australian, How social media is redrawing the tourist map, 2020, https://www.theaustralian.com.au/weekend-australian-magazine/how-social-media-is-redrawing-the-tourist-map/news-story/b6ed9dd941fe5f06b4e8fb3d6c6a4a0f.*
[330] *Simon Kemp. We Are Social and Hootsuite. 2020. Digital 2020 – Global Digital Overview. Available at https://wearesocial.com/digital-2020*
[331] *Tourism Research Australia, Austrade and Deloitte Access Economics. 2019, Technology Disruptors in Tourism.*

Automation and Robotics

What is automation and robotics?

Automation and robotic technologies are expected to be able to automate increasing amount of routine tasks and augment others to increase productivity, personalise guest experiences and reduce labour costs.

How is it being applied within the sector?

Automation and robotic technologies are increasingly used to perform routine tasks in the Tourism industry. Automation technologies include self-service kiosks, chatbots, voice controlled technologies, artificial intelligence and internet of things and are utilised for the production and delivery of goods and services.

Within the accommodation services sector these technologies are used to perform concierge functions, deliver room service and handle luggage. However, automation for front-of house processes is often hard to implement as customers are often resistant to change. Automation presents a greater opportunity for back-of-house processes as these are easier to control and could be reorganised to facilitate automation.[334]

Tasks that require information processes, movement of items, or producing batch items (for example buffet breakfast items such as pancakes) are increasingly replaced by self-service kiosks for hotel check-in and out, social robots to provide concierge information, room service delivery robots, automated pricing software and automated refunds for cancelled flights.

What is the workforce impact?

Automation and robotic technologies provide a competitive advantage to businesses who adopt these technologies by providing increased productivity and profitability. The technologies allow hotels to employ smaller teams of hotel staff that are focused on optimising the guest experience as opposed to performing routine, administrative tasks such as those associated with check-in processes. The workforce who provide services to guests will likely be less affected by the impacts of automation technologies, as service quality requires empathy and emotional intelligence.

Automation and robotic technologies will change the nature of work and the required skills to perform new job roles. In addition to increased technical skills to effectively use the various automation technologies, the workforce will likely require increased social and soft skills. Soft skills focused on leadership, change management and project management will be necessary facilitate technological adoption, adjust operational processes and assist both customers and employees to adjust to the new environment and experience. Increased social skills and emotional intelligence will likely become increasingly critical as automation would allow the workforce to focus on the provision of service as the core element that provides customer value within the industry.

CASE STUDY – HILTON HOTELS

In 2016, Hilton Worldwide and IBM announced a collaboration to pilot a robot concierge named Connie. The robot was designed to greet guests upon arrival, respond to their questions regarding hotel features, services and amenities, and provide information on local tourist attractions and dining recommendations.[332]

CASE STUDY – COUNTRY GARDEN

In Shunde, China, a restaurant complex, Country Garden, was recently opened and is completely operated by robots. Country Garden uses 20 robots to serve a menu featuring over 200 items that are available within 20 seconds of ordering. The restaurant is equipped to serve 600 diners simultaneously.

Country Garden plans to expand its operations and achieve mass production of approximately 5,000 robotic units per year. The COVID-19 pandemic has highlighted the opportunity for Country Garden to expand its robot run restaurants as people are still extremely hesitant about human to human contact and the robots are able to be completely sanitised to ensure they do not carry the virus.[333]

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[332] Hilton, Hilton And IBM Pilot "Connie," The World's First Watson-Enabled Hotel Concierge, 2016, Available at https://newsroom.hilton.com/corporate/news/hilton-and-ibm-pilot-connie-the-worlds-first-watsonenabled-hotel-concierge
[333] Lana Bondoim, Forbes, Country Garden opens restaurant operated completely by robots, Available at https://www.forbes.com/sites/lanabandoim/2020/06/30/country-garden-opens-restaurant-operated-completely-by-robots/#354a7eea46d6
[334] Ivanov S, Webster C, Adoption of robots, artificial intelligence and service automation by travel, tourism and hospitality companies – a cost-benefit analysis, 2018, In: Marinov V, Vodenska M, Assenova M, Dogramadjieva E (eds) Traditions and Innovations in Contemporary Tourism, Cambridge Scholars Publishing, pp 190-203.

Drivers and barriers of industry technology adoption

Key drivers of technology adoption

Stakeholders consulted across the Greater Whitsunday region acknowledge that there is continued pressure to keep pace with technological advancements driven by consumer expectations, and the ability for consumers to report on their experience which directly impacts on future business for the tourism provider. They felt the key drivers for technological adoption were:

- Cost savings for travellers;
- Ease of use and access to accommodation, transport and other services;
- Increased convenience for people when travelling (e.g. no cash is required, contactless and streamlined check in and payment processes);
- Consumer expectations and experience in a highly competitive industry; and
- Personalised recommendations and real-time updates and alerts.

Key barriers to technology adoption

Tourism is a primarily service-based industry that is built off strong connections between people. While technology has a role to play in assisting future growth of the industry and a strong recovery from the impacts of COVID-19, key barriers to technology adoption include:

- Increased privacy, safety and security concerns regarding personal information;
- Quality of internet connectivity;
- Increasing regulatory restrictions on technology platforms that push traditional boundaries (e.g. short term rentals and ride sharing);
- High cost for adopting technology given the significant initial investment for some technologies (e.g. AR/VR);
- Short and medium term benefits realisation of the technology that has been adopted to make the investment worthwhile; and
- Workforce lacking digital skills to support implementation of technology.

Bringing the story together:

Workforce impacts expected for the Greater Whitsunday Region

“Advances in technology will provide opportunities for tourism businesses to improve productivity and efficiency and enhance consumer experiences throughout the purchase journey by enabling greater customisation of marketing and service delivery. The tourism industry must be equipped with appropriately skilled ICT and social media marketing prodigies, while developing the systems required to deliver visa processing and passenger facilitation environments expected of the modern traveller.

***Beyond Tourism 2020 Steering Committee**[335]*

[335] Australian Trade and Investment Commission. Report to Government. Available at https://www.tourisminvestment.com.au/content/dam/assets/document/1/7/4/7/s/2011672.pdf

WORKFORCE IMPACTS

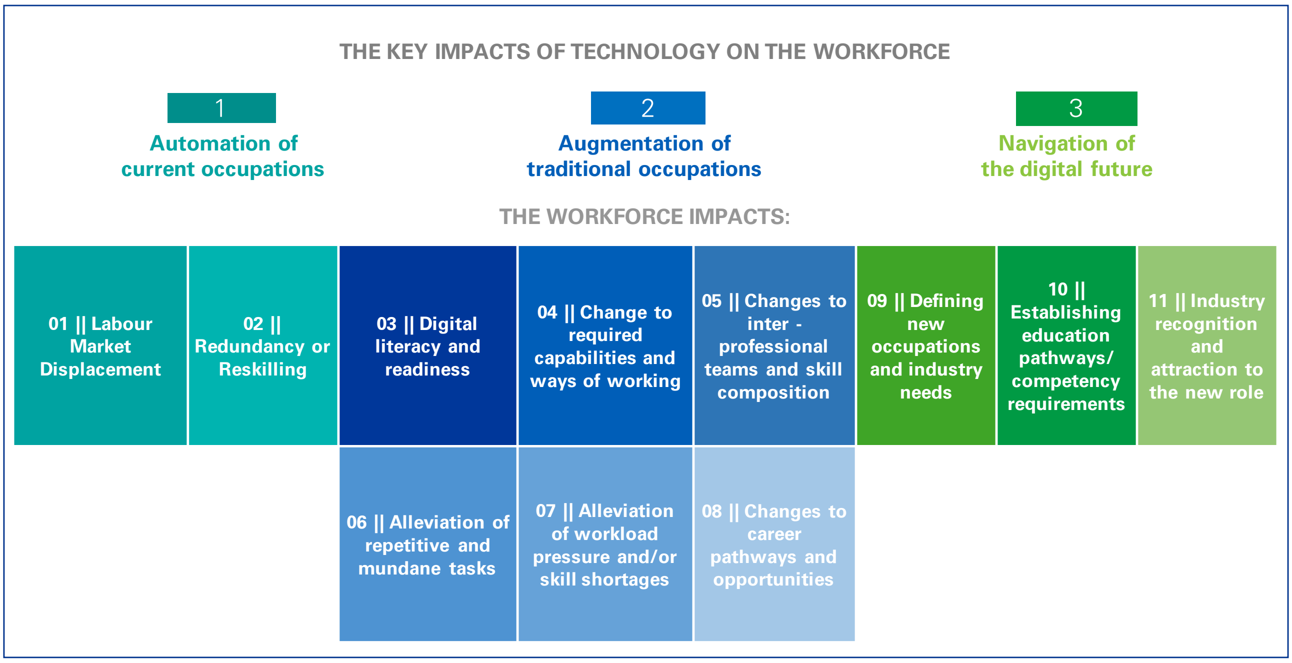
The workforce impacts of emerging technologies across the Tourism industry are expected to occur primarily through:

- Automation of current occupations (where technology will replace the need for tasks and functions currently undertaken by humans);
- Augmentation of traditional occupations (where technology will work alongside humans and change the way in which tasks and functions are undertaken, and promoting greater efficiency); and
- New roles that are created through the implementation of emerging technologies.

The impact of automation, augmentation and new and emerging job opportunities need to be considered together to determine the net impact on the Tourism industry. It should also be noted that there may be impacts across other related industry sectors that have been outside of the scope of the Future Employment Study, such as the impact on wider supply chains, related industry sectors and the wider Australian economy.

The detail of the impact of each of these across the Greater Whitsunday region, through combining the Faethm predictions, and current growth trajectories for occupations are detailed below and summarised in Figure 5.26 below.

Figure 5.26 Summary of the workforce considerations and impacts of technology on the workforce.



Source: KPMG

Automation for Tourism

Labour Market Displacement

Table 5.4 shows the key tourism occupations employed within the Greater Whitsunday region and the expected impact of automation on every role (where the impact is predicted to be more than 1 percent). What is important is that based on the growth trajectories of each of these occupations automation is expected to lower occupational growth rate rather than lead to a reduction in workforce size. These occupations include Fast Food Cook, Delivery Driver, Café Worker, Barista, Hospitality Workers (not further defined), Arborist, Bar Attendant, Gardener (general), Landscape Gardener, Café or Restaurant Manager, Caravan Park and Camping Ground Manager, Hotel or Motel Manager, Tour Guide and Chef.

For other occupations, while there is a reduction predicted from the employment rates in 2020, these occupations are already in decline and automation will slightly increase this predicted reduction. This includes the occupations of Cleaners and Laundry Workers (not further defined), Laundry Worker (general) Commercial Housekeeper, Domestic Housekeeper, Sales Assistant General, Cook, Retail Manager (general), Licenced Club Manager, Accommodation and Hospitality Managers (not elsewhere classified) and Hotel Service Managers.

Occupations where the automation impact will drive reductions in employment requirements are in the roles of Kitchenhand, Travel Consultant, Hotel or Motel Receptionist, Receptionist (general), General Clerk, Bus Driver, Passenger Coach Driver, Commercial Cleaner, Automobile Drivers (not elsewhere classified), Taxi Drivers, and Waiters.

The five occupations that are expected to be impacted the most heavily from technology and or occupation decline are Receptionist (reduction of 260.9 FTE by 2030), Commercial Cleaner (reduction of 168.5 FTE by 2030), General Clerk (750.5 FTE by 2030), Sales Assistant (reduction of 1072.6 FTE by 2030) and Retail Manager (reduction of 424.5 FTE by 2030). These five roles result in an employment reduction predicted of 2,677.0 FTE predicted by 2030.

The national skills shortage lists do not include any of these tourism occupations, however it is noted that these have not been updated since the start of COVID-19 and this is expected to have dramatically changed both the demand for, and supply of the tourism workforce in the region and nationally.

Table 5.4: The impact of automation predictions to 2030 for the Tourism occupations, taking occupation growth into account, Greater Whitsunday region

OCCUPATION (6 DIGIT ANZSCO)	PREDICTED AUTOMATION IMPACT 2025 (FAETHM)	PREDICTED AUTOMATION IMPACT 2030 (FAETHM)	ANTICPATED IMPACT FOR GREATER WHITSUNDAY REGION (LABOUR MARKET AND FAETHM)
Accommodation and Hospitality Managers nec	3.10%	6.90%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 14.3 FTE in 2025 and a further 22.9 FTE by 2030.
Arborist	10.70%	21.80%	Absorbed within occupation growth.
Automobile Drivers nec	12.20%	25.10%	Automation is predicted to lead to a reduction in required staff from current levels by 0.6FTE by 2030.
Bar Attendant	7.00%	12.40%	Absorbed within occupation growth.
Barista	14.20%	26.40%	Absorbed within occupation growth.
Bus Driver	14.90%	27.60%	Automation is predicted to lead to a reduction in required staff from current

OCCUPATION (6 DIGIT ANZSCO)	PREDICTED AUTOMATION IMPACT 2025 (FAETHM)	PREDICTED AUTOMATION IMPACT 2030 (FAETHM)	ANTICPATED IMPACT FOR GREATER WHITSUNDAY REGION (LABOUR MARKET AND FAETHM)
			levels by 0.8 FTE by 2025, and a further 1.6 FTE by 2030.
Cafe or Restaurant Manager	5.50%	10.60%	Absorbed within occupation growth.
Cafe Worker	15.60%	27.50%	Absorbed within occupation growth.
Caravan Park and Camping Ground Manager	3.10%	6.90%	Absorbed within occupation growth.
Chef	-	-	Absorbed within occupation growth.
Cleaners and Laundry Workers nfd	14.70%	31.70%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 54.0 FTE by 2025 and a further 30.9 FTE to 2030.
Commercial Cleaner	14.70%	31.70%	Automation is predicted to lead to a reduction in required staff from current levels by 36.4 FTE by 2025, and a further 132.1 FTE by 2030.
Commercial Housekeeper	12.90%	29.60%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 116.8 FTE by 2025 and a further 16.3 FTE to 2030.
Cook	6.00%	11.30%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 18.4 FTE by 2025 and a further 16.3 FTE to 2030.
Delivery Driver	21.40%	37.20%	Absorbed within occupation growth.
Domestic Housekeeper	12.90%	29.60%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 24.8 FTE by 2025 and a further 38.3 FTE to 2030.
Fast Food Cook	22.20%	42.60%	Absorbed within occupation growth.
Gardener (General)	6.90%	20.40%	Absorbed within occupation growth.
General Clerk	18.40%	36.20%	Automation is predicted to lead to a reduction in required staff from current levels by 375.9. FTE by 2025, and a further 374.6 FTE by 2030.
Hospitality Workers nfd	11.20%	21.00%	Absorbed within occupation growth.
Hotel or Motel Manager	3.10%	6.90%	Absorbed within occupation growth.

OCCUPATION (6 DIGIT ANZSCO)	PREDICTED AUTOMATION IMPACT 2025 (FAETHM)	PREDICTED AUTOMATION IMPACT 2030 (FAETHM)	ANTICPATED IMPACT FOR GREATER WHITSUNDAY REGION (LABOUR MARKET AND FAETHM)
Hotel or Motel Receptionist	19.80%	33.10%	Automation is predicted to lead to a reduction in required staff from current levels by 24.1FTE by 2025 and a further 16.1 FTE to 2030
Hotel Service Manager	3.10%	6.90%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 24.1 FTE by 20205 and a further 16.1 FTE to 2030.
Kitchenhand	27.00%	46.10%	Automation is predicted to lead to a reduction in required staff from current levels by 70.9 FTE by 2025 and a further 53.5 FTE by 2030.
Landscape Gardener	6.90%	20.40%	Absorbed within occupation growth.
Laundry Worker (General)	14.20%	34.50%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 19.7FTE by 2025 and a further 17.5 FTE to 2030.
Licensed Club Manager	3.60%	7.40%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 12.9 FTE in 2025 and a further 17.5 FTE by 2030.
Passenger Coach Driver	14.90%	27.60%	Automation is predicted to lead to a reduction in required staff from current levels by 0.3 FTE by 2025, and a further 0.6 FTE by 2030.
Receptionist (General)	18.80%	38.80%	Automation is predicted to lead to a reduction in required staff from current levels by 119.6 FTE by 2025, and a further 141.3 FTE by 2030.
Retail Manager (General)	5.90%	13.60%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 214.9 FTE in 2025 and a further 209.6 FTE by 2030.
Sales Assistant (General)	9.30%	18.80%	This occupation is in decline, and automation may accelerate this. Projected decline is a fall of 567.6 FTE in 2025 and a further 505 FTE by 2030.
Taxi Driver	12.20%	25.10%	Automation is predicted to lead to a reduction in required staff from current levels by 2.2FTE by 2030.
Tour Guide	1.50%	5.10%	Absorbed within occupation growth.

OCCUPATION (6 DIGIT ANZSCO)	PREDICTED AUTOMATION IMPACT 2025 (FAETHM)	PREDICTED AUTOMATION IMPACT 2030 (FAETHM)	ANTICPATED IMPACT FOR GREATER WHITSUNDAY REGION (LABOUR MARKET AND FAETHM)
Travel Consultant	24.70%	40.40%	Automation is predicted to lead to a reduction in required staff from current levels by 1.7 FTE by 2025, and no further reduction to 2030.
Waiter	9.70%	18.20%	Automation is predicted to lead to a reduction in required staff from current levels by 11.9 FTE by 2025 with no further reduction predicted out to 2030.

Source: KPMG and Faethm

Redundancy or Reskilling

For roles where redundancy or reskilling is required, Faethm provides occupational skilling corridors based on the degree to which the current occupation's skills and competencies align with others. These are used below where the scores show sufficient compatibility. Table 5.5 shows the occupations where there is an expected workforce reduction, and the possible employment options that provide a high level of skilling synergy (requiring less reskilling than other occupations).

Table 5.5: Employment corridors for the impacted Tourism occupations within the Greater Whitsunday region

OCCUPATION/S (6 DIGIT ANZSCO)	IMPACT BASED ON FAETHM AND OCCUPATION GROWTH 2030	EMPLOYMENT CORRIDORS ACROSS ALL OCCUPATIONS (FAETHM)
Sales Assistant	1072.6	Merchandise Displayers and Window Trimmers, First Line Supervisors of Personal Service Workers, First Line Supervisors of Customer Service Representatives, and Spa Managers.
Retail Manager	424.5	
Hotel or Motel Receptionist	40.2	Concierges, Speech-Language Pathology Assistants, Child Care Workers, Home Health Aides, First Line Supervisors of Personal Service Workers, and First Line Supervisors of Customer Service Representatives.
Receptionist (general)	260.5	
General Clerk	750.5	
Cleaners and Laundry Workers (not further defined),	132.1	Home Health Aides, and Personal Care Aides. It is noted that these projections do not take into account the impact of COVID-19, which is expected to create additional demand for cleaning occupations which may mean that the predicted reduction based on pre-COVID-19 labour market analytics and technology predictions are not realised in the short to medium term.
Laundry Workers (general)	37.2	
Commercial Housekeeper	133.1	
Commercial Cleaner	168.5	
Domestic Housekeeper	63.1	
Cook	34.7	Home Health Aides, Personal Care Aides and Cooks, Private Household. Given that chefs nationally have been in demand and pockets of labour market shortage, it is presumed there would be some opportunity in skilling and retraining as a chef.
Kitchenhand	124.4	
Licenced Club Manager	50.4	Education Administrators (preschool and childcare), Social and Community Service Managers and Meeting, Convention and Event Planners.
Accommodation and Hospitality Manager (nec)	37.2	
Hotel Service Manager	40.2	
Bus Driver	2.4	

OCCUPATION/S (6 DIGIT ANZSCO)	IMPACT BASED ON FAETHM AND OCCUPATION GROWTH 2030	EMPLOYMENT CORRIDORS ACROSS ALL OCCUPATIONS (FAETHM)
Passenger Coach Driver	0.9	This reduction is expected to be absorbed through attrition and retirements, and is not likely to require reskilling corridors.

As has been noted in this chapter, one of the key challenges with tourism is the significant impact that COVID-19 has had on the demand for the workforce, and this is expected to have fundamentally reshaped the employment growth trajectories for all of these occupations. As has been noted, it is expected that tourism impact will be most strongly felt in the Whitsunday LGA because it is more reliant on the interstate and international tourism market, with a much lesser impact expected in the Mackay LGA which is more reliant on the local visitation.

Augmentation Prediction

The impact of augmentation on the workforce is difficult given that it is expected to free capacity and change the way in which tasks and functions are completed. It is likely to both mean that the freed workforce capacity is used to undertake higher order tasks with a shift away from more repetitive and mundane tasks, and may also mean over time that there is a reduction in demand for some of the most impacted occupations. It is also important to note that the augmented impacts may be felt in addition to the automation impacts.

Table 5.6 below provides an overview of the occupations in the Tourism industry within the Greater Whitsunday region with the highest augmentation rates over the 5 and 10 year projections, along with the expected capacity gain (noting that this may be used for higher order tasks or, over time to reduce supply).

The occupations with the highest predicted augmentation impact on the occupation (over 20 percent impact predicted by 2030) are Cook, Licenced Club Manager, Bar Attendant, Accommodation and Hospitality Manager (not elsewhere classified), Caravan Park and Camping Manager, Hotel or Motel Manager, Sales Assistant (general), Café or Restaurant Manager, Chef and Retail Manager (general).

In terms of the opportunity for freed capacity and due to the workforce size of some occupations, the greatest impact (of more than 100 FTE each by 2030) will be provided in the occupations of Sales Assistant (general), Retail Manager (general), Cook, Chef, Bar Attendant and Waiter. These six occupational groups account for the opportunity for 1,574.6 FTE in freed capacity by 2030.

Table 5.6: Augmentation impacts predictions for the Tourism occupations within the Greater Whitsunday region

OCCUPATION (6 DIGIT ANZSCO)	PREDICTED AUGMENTATION IMPACT 2025 (FAETHM)	PREDICTED AUGMENTATION IMPACT 2030 (FAETHM)	AUGMENTED FTE 2030 (FAETHM)
Barista	6.40%	11.00%	19.2
Bus Driver	3.80%	10.00%	19.1
Cafe or Restaurant Manager	11.80%	22.90%	71.5
Cafe Worker	9.20%	15.20%	24.4
Caravan Park and Camping Ground Manager	12.50%	25.20%	19.7
Chef	10.70%	21.40%	127.1
Cleaners and Laundry Workers nfd	2.80%	7.20%	13.3
Commercial Cleaner	2.80%	7.20%	88.1
Commercial Housekeeper	2.90%	6.80%	29.6
Cook	18.70%	34.30%	128.3
Delivery Driver	5.50%	11.40%	29.9
Domestic Housekeeper	2.90%	6.80%	6.3
Fast Food Cook	1.10%	1.90%	4.6
Gardener (General)	2.90%	11.80%	22.3

OCCUPATION (6 DIGIT ANZSCO)	PREDICTED AUGMENTATION IMPACT 2025 (FAETHM)	PREDICTED AUGMENTATION IMPACT 2030 (FAETHM)	AUGMENTED FTE 2030 (FAETHM)
General Clerk	4.50%	4.60%	80.8
Hospitality Workers nfd	10.60%	15.90%	11.7
Hotel or Motel Manager	12.50%	25.20%	79.4
Hotel or Motel Receptionist	11.00%	15.30%	18.8
Hotel Service Manager	12.50%	25.20%	31.5
Kitchenhand	0.60%	1.00%	8.2
Landscape Gardener	2.90%	11.80%	7.4
Laundry Worker (General)	4.50%	4.70%	3.8
Licensed Club Manager	16.80%	32.40%	17.2
Passenger Coach Driver	3.80%	10.00%	6.3
Receptionist (General)	3.80%	3.80%	24.5
Retail Manager (General)	10.20%	20.30%	248.5
Sales Assistant (General)	14.00%	23.00%	845.4
Taxi Driver	6.60%	15.30%	14.5
Tour Guide	6.20%	16.30%	5.7
Travel Consultant	6.70%	11.40%	12.9
Waiter	10.80%	18.40%	111.7

Source KPMG and Faethm

It is expected that as a result of these augmentation changes:

- There is a need to build digital literacy and readiness around new and emerging technologies, with an increased focus on those expected to be adopted more in the occupation and subsector (as outlined in the Emerging Technologies section of this report);
- There will be a level of alleviation of repetitive and mundane tasks and a freeing of capacity to work on more complex tasks in some cases, noting that customer expectations may mean that some of these predictions are not realised as people may expect human interaction for some key occupations (such as Hotel or Motel Receptionist roles, Bar Attendant and Waiter roles and even Retail roles for boutique shopping expected within luxury tourism segments of the Whitsunday tourism market); and
- However, it is noted that the impact of COVID-19 has fundamentally reshaped the tourism workforce and demand in the region. This disruption is expected to impact on the above predictions. One of the key impacts on the supply of this workforce into the future which stakeholders in the region noted is that there will need to be a lesser reliance on the holiday visa workforce, which may create demand for local jobs in the Tourism industry.

Education and Training in the region

Within the Greater Whitsunday region, stakeholders noted that there is a blended workforce of domestically trained and those on overseas working visas in the Tourism industry.

Based on enrolments in 2018 in VET qualifications that relate to Agriculture in Bowen, Mackay and the Whitsundays, the most popular qualifications in the Greater Whitsunday region are (further detail is provided in Appendix I):

- Certificate I in Hospitality with 397 enrolled in 2018. This qualification is designed to support individuals with a defined range of operational skills in relation to accommodation and food services including Café Workers and Hospitality Workers.
- Certificate II in Hospitality with 248 enrolled in 2018. This qualification is designed to support individuals with a defined range of operational skills in relation to accommodation and food services including Café Workers and Hospitality Workers.
- Certificate III in Hospitality with 180 enrolled in 2018. This qualification is designed to support individuals with a defined range of operational skills in relation to accommodation and food services including Café Workers and Hospitality Workers.
- Certificate II in Tourism with 117 enrolled in 2018. This qualification is designed to support individuals with a defined range of operational skills in relation to travel planning and tourism including Tour Guides and Travel Consultants.

It is noted there is not a direct correlation between qualification attainment and specific job roles for these occupations. Better matching of education and training pipelines to in demand occupations could occur to strengthen employability and jobs within the region. No university qualification information was available for the Tourism industry within the Greater Whitsunday region.

Navigation of the Digital Future

As was identified in the Disrupted View discussed earlier in this chapter, there are a number of new occupations expected as a result of the adoption of emerging technologies. These are detailed in Table 5.7 In addition, new and emerging roles are expected in areas such those set out below. This suggests significant new opportunities within the Greater Whitsunday region by 2030.

Roles supporting stronger networks and interconnections across business and industry

With the greater interconnectedness of a range of things as a result of technology, it is expected that there will be a demand for occupations that help facilitate the networking and interconnectedness of elements across business, cities and industry. Growth occupations expected include:

- Roles that seek to support the customer service journey and experience, including through the use of technologies such as virtual reality; and (as a result of this); and

Network broking support roles connecting cities, regions and business ecosystems.

Table 5.7: New occupations predicted to be required as a result of technological adoption in the Tourism Industry within the Greater Whitsunday region by 2030

OCCUPATION TITLE (FAETHM)	PREDICTED GROWTH IN DEMAND (HEADCOUNT) (FAETHM)
Software Developers, Applications	57.1
Software Developers, Systems Software	57.1
Process Improvement Analysts	42.0
Data Engineers	40.8
Data Integrators	35.0
Infrastructure Services Analysts (IT)	35.0
Data Analysts	34.5
Data Scientists	33.1
Strategy Analysts	25.2
Security Testers	25.2
Software Quality Assurance Engineers and Testers	25.2
Robotics Engineers	20.9
Operations Analysts	19.6
Cyber Security Analysts	19.6
Educational, Guidance, and Career Counselors and Advisors	19.6
Process Improvement Managers	19.6
Operations Research Analysts	19.6
Tester/Test Analysts	19.6
Computer Systems Engineers/Architects	19.6

OCCUPATION TITLE (FAETHM)	PREDICTED GROWTH IN DEMAND (HEADCOUNT) (FAETHM)
Project Analyst	16.8
Business Intelligence & Analytics Managers	16.8
Change Analysts	15.4
Data Architects	15.4
IT Governance Analysts	15.4
Agile Testers	15.4
Mechatronics Engineers	15.3
Industrial Engineers	14.8
Manufacturing Engineers	14.5
Mechanical Engineers	14.5
Industrial Production Managers	12.8
Industrial Safety and Health Engineers	12.8
Industrial Engineering Technologists	12.8
Business Analysts	11.2
Communications Analysts	9.8
Workforce Planners	9.8
Strategy Managers	9.8
Training & Development Analysts	9.8
Human Resources Analyst	9.8
Change Manager	9.8

OCCUPATION TITLE (FAETHM)	PREDICTED GROWTH IN DEMAND (HEADCOUNT) (FAETHM)
Data Warehousing Specialists	9.8
Test Automation Engineers	9.8
Project Leader	9.8
Communications Managers	9.8
AI Research Scientists	9.2
AI Research Scientists, Language Processing	8.0
AI Research Scientists, Image and Videos	8.0
Scrum Masters	7.7
Cyber Security Managers	4.9
Industrial-Organizational Psychologists	4.9
Human Resources Managers	4.9
Technical Leads	4.9
Product Development Managers	4.9
Resource Managers	4.9
Agile Coaches	4.9
Test Managers	4.9
Infrastructure Services Managers (IT)	4.9
Human Resources Specialists	4.9
Test Coaches	4.9
IT Governance Managers	4.9
Test Coordinators/Test Leads	4.9
Information Security Managers	4.9
Risk Management Specialists	4.9
Product Owners	2.8

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CHAPTER 6: THE BLUEPRINT

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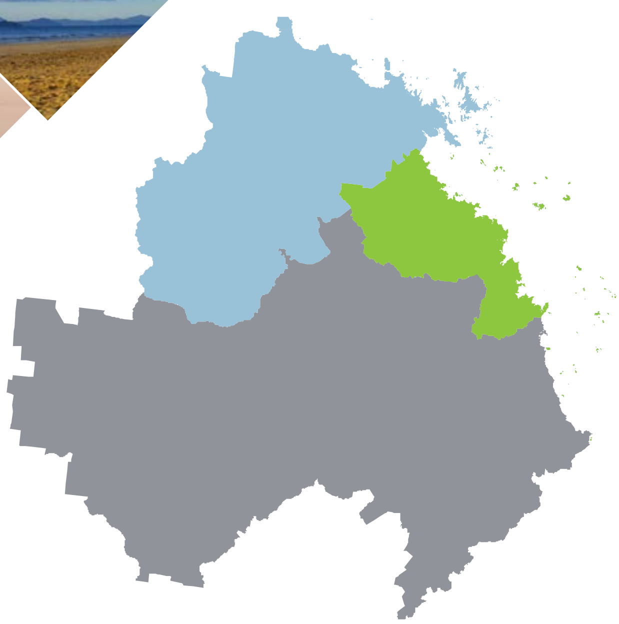
WHY CREATE A FUTURE EMPLOYMENT BLUEPRINT FOR THE GREATER WHITSUNDAY REGION?

As the Greater Whitsunday region prepares for the Fourth Industrial Revolution and the changing landscape of workforces in the future, it is vital that there is an understanding of the future employment environment to best leverage employment and economic development opportunities to keep the region thriving.



PREDICTING THE FUTURE

Any predictions of future employment carry with them a degree of uncertainty, and can only be made with the best available information, data and stakeholder views. It is inevitable that there will be some unforseen changes over the next decade that will impact the employment landscape in the Greater Whitsunday region.

However the Greater Whitsunday region will continue to be able to draw on its competitive advantages including; boasting a strong agribusiness sector with one of the nation's largest sugar and bio-commodity producers; attracting tourism from around the world for the region's beaches, reef and marine life, and having one of the largest coal mining deposits in Australia. New opportunities for employment are also expected as a result of technology, regional investment and innovation that if leveraged now will help to ensure the prosperity of the region into the future.

Multi-layered impacts

The impacts on future employment are currently subject to a number of changing dynamics which are all interwoven and driving changes to traditional employment models and the tasks and functions of traditional occupations. These changes include the impact of COVID-19, a greater focus on regional development and investment, and the impact of emerging technologies and the Fourth Industrial Revolution. All of these factors are expected to reshape the labour market across Australia, and challenge long-held perceptions about career pathways and opportunities, education and training, and single careers to a more dynamic view of occupations, industries, career pathways and lifelong learning.

Accelerated change, but change we have seen before

The impact of the Fourth Industrial Revolution and emerging technologies on occupations will drive change, and these impacts will lead to a changing labour market profile where some occupations will increase in demand and others will decline in demand.

While technology may accelerate some of these changes, it is important to note that occupations have always been subject to changes in demand in response to changes across the community, and there have always been occupations in growth and decline which change the employment composition of the labour market over time.

Emerging technologies will shape the change

The changes to the tasks and functions and occupations expected will be dependent on business and industry decisions about the type, rate and order of technology adoption. As there are differing levels of maturity across every industry, business and region, the workforce change will occur at different rates across different segments of the workforce and across different workplaces.

FUTURE EMPLOYMENT BLUEPRINT REMIT

Four Industry Sectors

Employment within the Greater Whitsunday region is driven by a number of key industry sectors with Health Care and Social Assistance and Mining and Mining Equipment, Technology and Services (METS) the largest industries for employment across the region.

The Tourism sector is comprised of occupations that extend across industry sectors, including Accommodation and Food Services, Transport Postal and Warehousing, Retail and Other Services and is key to employment in the Whitsunday Local Government Area (LGA), as well as driving strong employment opportunity in the Mackay and Isaac LGAs.

The Greater Whitsunday region has held a strong reputation in terms of its Agricultural contribution, however the industry has experienced large levels of decline in employment within the region over the last five years which are reflective of a volatility in the industry that has been seen over the last 20 years. Employment growth opportunities are currently emerging in this industry, including in relation to aquaculture (including prawn farming).

Due to these factors, this Future Employment Blueprint has been limited to analysis of four industry sectors - Mining and METS, Health Care and Social Assistance, Agriculture and Tourism.

A 10 year time horizon

A time horizon of 10 years (to 2030) has been selected for this Future Employment Blueprint in recognition that:

- a number of these future of work predictions and projections will take time to realise (with recognition that this journey will be different across different organisations, and industry sectors);
- the training of the needed future workforce, including education and training pipeline and pathways, require significant forward planning; and
- any reskilling and upskilling of the workforce will require time, consideration of employment corridors and a whole of region approach to ensure individual skillsets are matched to employment opportunity.

A focus on employment and workforce change

It is important to note that the Future Employment Blueprint is focused on the disruption impact that emerging technologies will have on the workforce and employment opportunities across the region. It is important to note that many other factors will drive employment, including government policy, regional investment, environmental factors and demographic factors, this Future Employment Blueprint assumes that these factors will continue to influence the employment opportunities in a similar way to the last five years.

While historical data has been used to predict future growth, there are a number of future developments that are in the pipeline that could have a very positive impact on employment in the region. These have not been factored in to this study because of where they are in the planning stage.

Exploring the impact of emerging technologies specific to each industry sector within the Greater Whitsunday region provides the opportunity for employers within the region to implement workforce strategies that will support strong employment growth into the future.

Continuing the skilling conversation

Education and training and skilling is a critical step to ensure the contemporary competencies and skills required of the workforce and to meet the future employment opportunities. Education and training reforms will be essential to the success of jobs in the Greater Whitsunday region, and will need to include (but are not limited to):

- challenging the current education and training pathways for key occupations and challenging traditional tasks and functions;
- ensuring baseline digital literacy for all occupations;
- ensuring that education and training pathways exist for new occupations;
- better enabling recognition of prior learning to enable transition into other related occupations;
- supporting micro credentialing approaches and lifelong learning of employees; and
- ensuring that where possible education and training is provided within the Greater Whitsunday region.

Transformation of the digital age is upon us and, as a regional workforce across all traditional industries, it is vital that industry is skilled and prepared for the jobs of tomorrow.

Preparing workforces of the future lies in collaboration with industry groups and companies across sectors, confirming emerging industries, jobs and workforce needs as well as a digital infrastructure plan to understand the regional infrastructure needs to support jobs of the future.

-Greater Whitsunday Alliance

AGRICULTURE INDUSTRY

The Agriculture industry comprises 2.0 percent of total employment in the Greater Whitsunday region (February 2020). The average annual employment growth between 2015 to 2020 was 3.0 percent.

Of those employed within the Agriculture industry, 40.0 percent are employed within the Mackay LGA, 34.8 percent in the Whitsunday LGA, and 25.2 percent in the Isaac LGA.

The current workforce as at February 2020 (and based on the 6 digit occupations codes included in scope) is over 5,000 headcount across the Greater Whitsunday region. Taking into account the impact of emerging technologies and employment growth at an occupation level suggests this industry sector will increase by 37.8 percent by 2030.

1. WORKFORCE CHANGE EXPECTED FROM AUTOMATION

There are a number of occupations within the agriculture sector where a rate of automation is predicted above 25 percent by 2030, however many of these are expected to be absorbed within predicted occupation growth.

There are a number of agricultural occupations in decline when viewed over the last five years, where more moderate automation impacts are unable to be absorbed.

Significant employment opportunity exists in agriculture occupations including (but not limited to) Crop Farmers, Fruit and Nut Farmers, Growers and Pickers, Mixed Crop and Livestock Farmers, Sugar Cane Growers, Vegetable Farm Workers Growers and Pickers and Beef Cattle Farmers.

New employment pathway opportunities should be explored before 2030 for:

- Bookkeeper (approx. 380 FTE impact); and
- Meat Packers, Fruit and Vegetable Packers and Packers nec and nfd) (approx. 150 FTE impact).

Automation is expected to impact on some farming, farm management and aquaculture related occupations reducing future employment demand. Despite this, it is noted that both stakeholders locally and the National Farmers Federation nationally predict a shortfall in agricultural related occupations, suggesting employment supply will continue to need to be boosted in the future.

2. WORKFORCE CHANGE EXPECTED FROM AUGMENTATION

Augmentation has much lower expected impacts on the workforce in the Agriculture industry compared with the other industries included in this analysis.

The occupations expected to be most impacted by augmentation (over 10 percent impact by 2030) are **Farmers and Farm Managers not further defined, Agricultural and Horticultural Mobile Plant Operators, Agricultural Technicians, Deck Hands and Fishing Hands.**

The occupations with the greatest impact in terms of freed capacity (due to occupation size in the region) are the **Sugar Cane Grower, Agricultural and Horticultural Mobile Plant Operator, Beef Cattle Farmer, Farmers and Farm Managers not further defined, Bookkeeper and Beef Cattle Farm Worker**.

Of the thirty occupations analysed in agriculture, twenty-five will be impacted by less than 10 percent by augmentation by 2030. This includes (but is not limited to) Meat Packers, Crop Farm Workers and Farmer, Fruit and Nut Farm Workers and Farmers, Grain, Oilseed and Pasture Growers, Mixed Crop and Livestock Farm Workers and Farmers.

As with other industry sectors, it is expected augmentation will lead to a demand for digital literacy skills across all occupations, with targeted and specific training for technologies specific to each workforce segment. Augmentation will also require a shift towards lifelong learning and continuing professional development and may help to alleviate some workforce shortages particularly around picking and harvesting.

3. NEW ROLES CREATED AS A RESULT OF EMERGING TECHNOLOGIES

ICT and Engineering Occupations

The technology advancements and adoption predicted in the Agriculture sector is expected to result in approximately 311 FTE in information technology occupations including Software Developers, Process Improvement Analysts, Data Analysts and Data Engineers by 2030.

As a result of technology adoption it is also expected that the following changes will occur across the Agricultural sector:

Increased specialisation of the agriculture workforce

It is expected that into the future, the occupations involved in agricultural production will become more specialised and advanced in order to improve yields, profitability and competitiveness of farms. Technology is seen as a necessary adoption, and this is requiring deeper knowledge and skill sets in relation to the business viability and improvements expected from key technologies that may be specific to the produce that is being farmed.

Agricultural research and development roles.

It is expected that there will be increased demand for research and development related roles that support the advancement of technology and food production in the agriculture industry. This currently occurs through a range of key advocacy and research based organisations and universities, and will be critical if Australia seeks to maintain and improve its position in agricultural production and exports.

A lesser reliance on holiday visa workforce

There is significant anecdotal evidence that the sector in Queensland and across Australia remains reliant on the working holidays and work and holiday visas for picking and packing of agricultural produce for seasonal work. If automation and robotics technologies are adopted as predicted by 2030, this will reduce the reliance on this workforce.

"The key barrier to technology adoption is the cost of implementation. The only way we could afford some of these new advancements is to be part of a trial."

"The growth in beef cattle farm workers has to do with improvements in the price of beef, particularly in the export markets."

Stakeholders noted the key role of seasonal workers in picking and harvesting - these roles have been filled by holiday visa workers. In the COVID-19 context, this may cause significant problems in future picking seasons.

Stakeholders in consultation

HEALTH CARE AND SOCIAL SERVICES INDUSTRY

Greater Whitsunday employment in the Health Care and Social Assistance industry currently accounts for 10.4 percent (or a headcount of 7,000) of total employment in the region (February 2020).

There is significant employment opportunity in the Health Care and Social Assistance sector which is growing at a faster rate than any other industry sector. Growth between 2015 and 2020 was 5.2 percent.

Of those employed in the Health Care And Social Assistance industry, 78.2 percent are in the Mackay LGA, 15.4 percent are in the Whitsunday LGA and 6.4 percent are in the Isaac LGA.

For most occupations in Health Care and Social Assistance, the augmentation and automation impacts will be absorbed within occupation growth.

1. WORKFORCE CHANGE EXPECTED FROM AUTOMATION

The majority of occupations across Health Care and Social Assistance are predicted to be in employment growth including (but not limited to) Aged and Disabled Carers, Child Carers, Enrolled Nurses, Health and Welfare Services Managers, Registered Nurses, Personal Care Assistants, Out of School Hours Care Workers, Optometrists, Dentists and Registered Medical Officers.

For Ambulance Officers, Medical Diagnostic Radiographers and Environmental Health Officers there is a reduction predicted from current employment levels, however this is attributed to occupational declining trends rather than automation.

New employment pathway opportunities should be explored before 2030 for:

- Medical Receptionists (approx. 110 FTE impacted).

For other impacted occupations the predicted change is small, and may be managed through attrition over the next decade. These are:

- Admissions Clerk;
- Pathology Collector; and
- Pharmacy Technician.

The Sonographer and Medical Diagnostic Radiographer occupations are also expected to be impacted, but are currently in workforce shortage.

2. WORKFORCE CHANGE EXPECTED FROM AUGMENTATION

The impact of augmentation on the Health Care and Social Assistance workforce is expected to be more significant than the impact of automation. Of the 51 occupations analysed, 34 are expected to have more than 25 percent of FTE capacity as a result of working alongside technology. This may be used to undertake higher order clinical tasks, with a shift away from more repetitive and mundane tasks, and may also mean over time that there is a reduction in demand for some of the most impacted occupations.

The roles expected to have the highest percentage impact as a result of augmentation (over 40 percent by 2030) are the **Registered Nurse (Critical Care and Emergency), Resident Medical Officer, Physiotherapists and Optometrists.**

The roles with the greatest impact from augmentation when measured by FTE (and due to the size of these occupations in the region) are the **Registered Nurses (Aged Care, not further defined, not elsewhere classified, Medical), Registered Nurse (Perioperative, Medical Practice), Diversional Therapist, Health and Welfare Service Managers, Midwives and Pharmacy Technicians.**

As with other industry sectors, it is expected augmentation will lead to a demand for digital literacy skills across all occupations, with targeted and specific training for technologies specific to each workforce segment. It will also require a shift towards lifelong learning and continuing professional development, will help to alleviate some workforce shortages, and over time, will lead to a different employment composition in the Health Care and Social Assistance sector.

3. NEW ROLES CREATED AS A RESULT OF EMERGING TECHNOLOGIES

ICT and Engineering Occupations

The technology advancements and adoption predicted in the Health Care and Social Assistance sector are expected to result in the need for approximately 339 FTE in information technology occupations including Software Developers, Process Improvement Analysts, Data Engineers and Data Integrators by 2030.

Other Expected In-Demand Occupations

Other occupations expected to be in demand as a result of technology adoption include:

- **Bridging roles between clinical practice and technology.** Within the health sector there is already the emergence of roles that provide the bridge between clinical practice and ICT related roles, and often involve clinicians who become project leads for the implementation of emerging technologies in the workplace. There may also be better recognition of specialist digital competencies and knowledge in clinical occupations, such as medicine and nursing into the future.
- **Human resources occupations.** These roles are expected to assist with the workforce upskilling that is expected in the Health Care and Social Assistance sector from augmentation are expected to be in demand, as will change management roles to assist in the successful implementation of emerging technologies; and
- Roles that support **translational research and development** and build the evidence around technology adoption. This will include evidence based practice regarding the impact of technologies on health outcomes and experience.

> There has been increased demand in studying health qualifications as a result of COVID-19, suggesting a strong future pipeline.

Apart from some key standout pockets of innovation, stakeholders noted that the level of maturity and readiness for technological adoption was not necessarily there, although COVID-19 has accelerated adoption of some technologies such as telehealth.

Stakeholders in consultation

MINING AND METS INDUSTRY

Greater Whitsunday employment in Mining currently accounts for 17.5 percent of total employment in the region (February 2020). The METS employment profile is more difficult to accurately determine, however it is expected that a significant proportion of the manufacturing employment in the region (5.2 percent) relates to the METS sector.

The employment composition has 78.6 percent of mining employment in Isaac LGA, 15.8 percent in Mackay LGA and 5.6 percent in Whitsunday LGA.

While some traditional roles in mining are projected to be impacted by emerging technologies into the future, new job opportunities will open in ICT and engineering related roles. Jobs growth may also be triggered through increasing uplift and competitiveness in Australian mining, the wider supply chain and through employment from the contribution of mining to the Australian economy.[1]

1 Alpha Beta. 2019. Staying Ahead of the Game

1. WORKFORCE CHANGE EXPECTED FROM AUTOMATION

Many of the current Mining and METS occupations within the Greater Whitsunday region are expected to be impacted by a combination of automation driven by technology adoption, as well as declining employment trends in some occupations.

Some roles will remain in growth including Maintenance Planners, Metallurgical or Materials Technicians, Mine Deputies and Building and Engineering Technicians.

New employment pathway opportunities should be explored before 2030 for:

- Miners, Drillers and Shot Firers (approx. 2,000 FTE impact);
- Fitters and Fitters and Turners (approx. 1,900 FTE impact);
- Metal Fabricators and Welders (approx.1,050 FTE impact;
- Truck Drivers and other machinery operators (approx. 1,300 FTE impact); and
- Electricians (approx. 150 FTE impact).

Noting that some of these roles are not exclusive to Mining and METS.

2. WORKFORCE CHANGE EXPECTED FROM AUGMENTATION

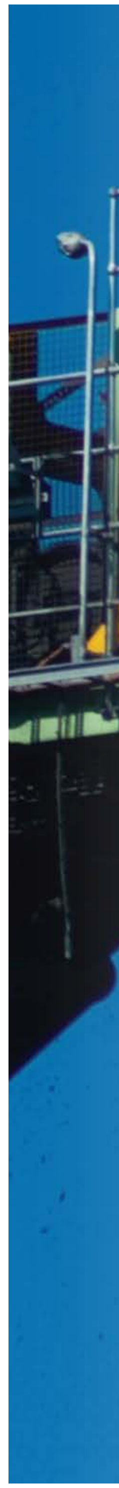
The impact of augmentation on the Mining and METS sector is likely to both mean that the freed workforce capacity is used to undertake higher order tasks with a shift away from more repetitive and mundane tasks, and may also mean over time that there is a reduction in demand for some of the most impacted occupations.

The roles expected to have the highest percentage impact as a result of augmentation (over 30 percent by 2030) are the **Mine Deputies, Mining Engineers, Production Managers (both Manufacturing and Mining) and Building and Engineering Technicians not elsewhere classified.**

The roles with the greatest impact from augmentation when measured by augmented FTE (and due to the size of these occupations in the region) are **Miners, Fitters, Truck Drivers and Electricians**.

As with other industry sectors, it is expected augmentation will lead to a demand for digital literacy skills across all occupations, with targeted and specific training for technologies specific to each workforce segment. It will also require a shift towards lifelong learning and continuing professional development, will help to alleviate some workforce shortages, and over time, will lead to a different employment composition in the mining and METS industry.

3. NEW ROLES CREATED AS A RESULT OF EMERGING TECHNOLOGIES



ICT and Engineering Occupations

The technology advancements and adoption predicted in the Mining and METS sector are expected to result in the need for approximately 1,500 FTE in information technology occupations including Software Developers, Process Improvement Analysts, Data Engineers and Data Integrators by 2030.

Other Expected In-Demand Occupations

Other occupations expected to be in demand as a result of technology adoption include:

- **Mining technology professional occupations** that combine together mining expertise with an understanding of information technology. These roles may be key to the successful implementation of technology and also require skills around change management and have the seniority to enact change.
- **Human resources occupations** that assist with the workforce reskilling and upskilling that is expected in the Mining and METS sector are expected to be in demand, as will change management roles to assist in the successful implementation of emerging technologies;
- **Occupations that provide stronger networking and interconnections** across business, including roles that work across cities, regions and business ecosystems, understanding intersections between Mining and METS, and can support systems integration and business analytics; and
- Roles that support **research and development** and build the evidence around technology adoption. This will include driving continuous improvement and benefits realisation for businesses.

"We need to be careful in looking at the five year historical trend, as every few years the mining industry will go through periods of up and downturns which impact on employment in the region."

"Some of the changes as a result of COVID-19 such as greater access to working from home arrangements, are likely to remain in place into the future."

"The Resources Centre of Excellence has to promote true collaboration in order to build the regions' credibility in research and development and create a hub for the future."

Stakeholders in consultation

TOURISM INDUSTRY

Tourism is comprised of occupations that span across various industry sectors, including Accommodation and Food Services, Transport, Postal and Warehousing and Other Services.

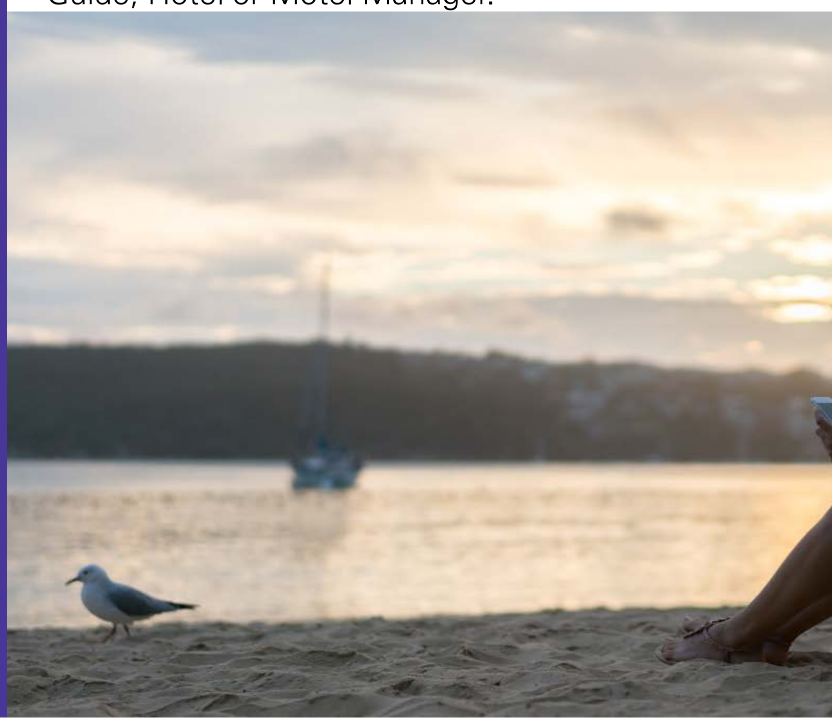
Based on the Accommodation and Food Services industry as an indicator, tourism comprised 6.8 percent of employment across the Greater Whitsunday region, and annual employment growth of 1.3 percent between 2015- 2020. The majority are employed in the Mackay and Whitsunday LGAs (47.5 and 39.9 percent, respectively).

Employment growth is expected at 0.25 percent per year to 2030 taking automation, augmentation and employment growth into account. **COVID-19 has significantly reduced recent employment in the tourism industry.**

1. WORKFORCE CHANGE EXPECTED FROM AUTOMATION

The predicted impact of automation on the tourism occupations is expected to be quite high with 20 of the 35 occupations predicted to have more than 20 percent of the occupation automated by 2030. Of these occupations, some absorb this impact within employment growth, while in others automation will accelerate projected decline in supply.

Employment growth is predicted for a significant number of occupations in this industry, including (but not limited to) Fast Food Cook, Delivery Driver, Barista, Hospitality Worker, Bar Attendant, Restaurant Manager, Caravan Park and Camping Ground Manager, landscape Gardener and Arborist, Tour Guide, Hotel or Motel Manager.



Once the impact of COVID-19 is known for tourism occupations, employment pathway opportunities may need to be explored by 2030 for:

- Sales Assistant and Retail Manager (approx. 1,500 FTE impact);
- Hotel or Motel Receptionist, Receptionist (general) and General Clerk (approx. 1,050 FTE impact);
- Cleaners and Laundry Workers (not further defined), Laundry Workers (general), Commercial Housekeeper, Commercial Cleaner and Domestic Housekeeper (approx. 490 FTE impact);
- Cook and Kitchenhand (approx. 160 FTE impact); and
- Licenced Club Manager, Accommodation and Hospitality Manager (nec) and Hotel Service Manager (approx. 125 FTE impact).

2. WORKFORCE CHANGE EXPECTED FROM AUGMENTATION

The impact of augmentation on the Tourism sector is expected to be less than the automation impacts of emerging technologies.

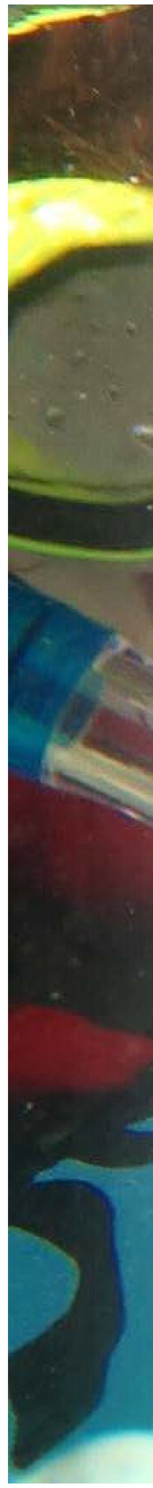
The occupations with the highest predicted augmentation impact on the occupation (over 20 percent impact predicted by 2030) are **Cook, Licenced Club Manager, Bar Attendant, Accommodation and Hospitality manager (not elsewhere classified), Caravan Park and Camping Manager, Hotel or Motel Manager, Sales Assistant (general), Café or Restaurant Manager, Chef and Retail Manager (general).**

The occupations with the greatest impact in terms of augmented FTE (due to occupation size) are the **Sales Assistant (general), Retail Manager (general), Cook, Chef, Bar Attendant and Waiter.**

A number of occupations will be impacted by less than 10 percent from augmentation to 2030. This includes (but is not limited to) Cleaners and Laundry Workers, Commercial Cleaners, Domestic Housekeepers, Fast Food Cooks, General Clerks, Kitchenhands, Laundry Workers and Receptionists.

It is expected augmentation will lead to a demand for digital literacy skills across all occupations. Augmentation will also require a shift towards lifelong learning and continuing professional development, but may assist in addressing workforce shortages created through the absence of the holiday visa workforce in the COVID-19 environment.

3. NEW ROLES CREATED AS A RESULT OF EMERGING TECHNOLOGIES

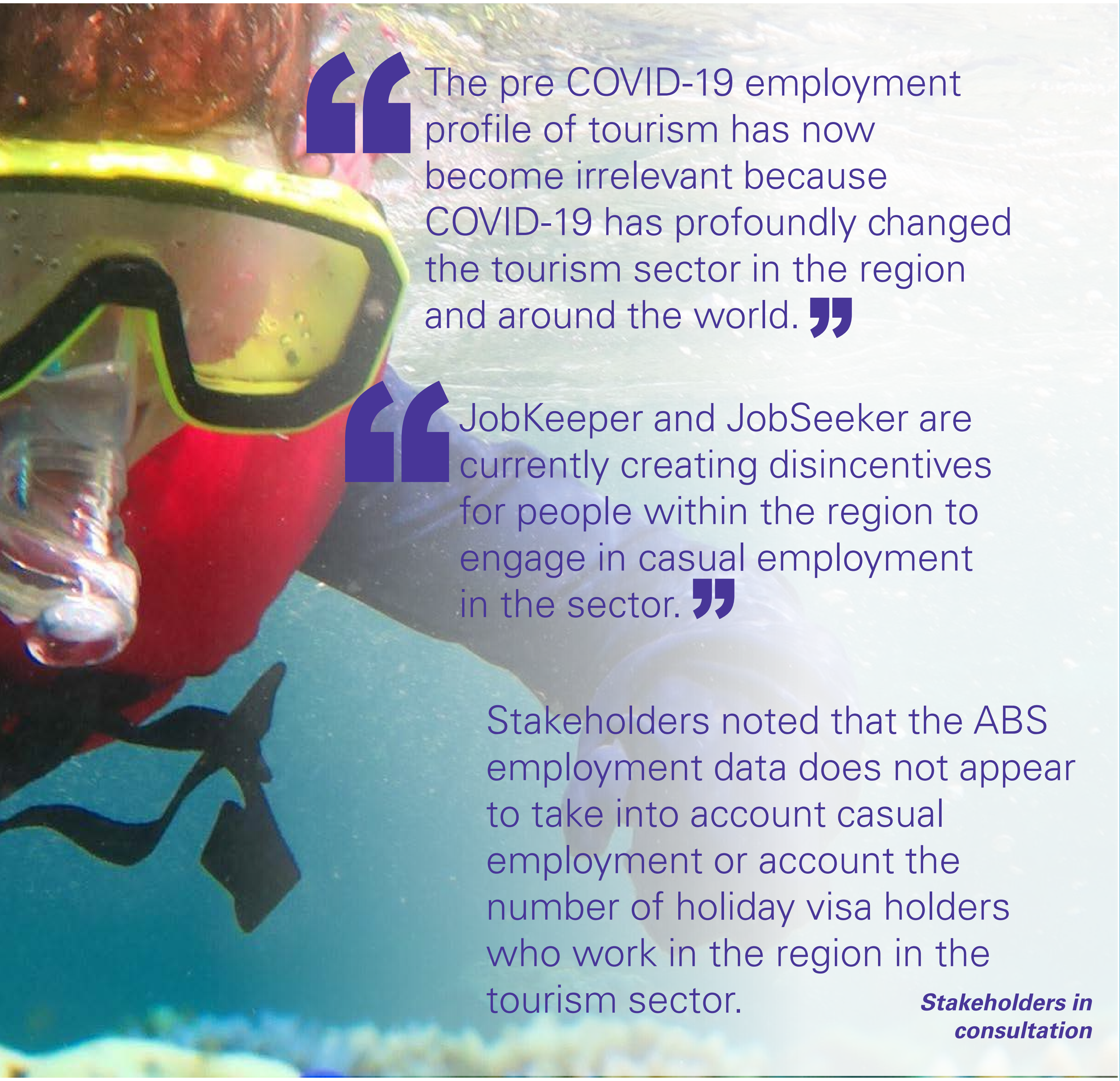


ICT and Engineering Occupations

The technology advancements and adoption predicted in the Tourism sector is expected to result in approximately 979 FTE in information technology occupations including Software Developers, Process Improvement Analysts, Data Engineers and Data Analysts. This is significantly higher than the job creation predicted in the Health Care and Social Assistance and Agriculture industry sectors by 2030

Roles supporting stronger networks and interconnections across business and industry and the customer service journey

It is expected that technology adoption will provide the opportunity for occupations that seek to support the customer service journey and experience, including through the use of technologies such as virtual reality; and network broking support roles connecting cities, regions and business ecosystems.



> "The pre COVID-19 employment profile of tourism has now become irrelevant because COVID-19 has profoundly changed the tourism sector in the region and around the world."

> "JobKeeper and JobSeeker are currently creating disincentives for people within the region to engage in casual employment in the sector."

Stakeholders noted that the ABS employment data does not appear to take into account casual employment or account the number of holiday visa holders who work in the region in the tourism sector.

Stakeholders in consultation

ABORIGINAL AND TORRES STRAIT ISLANDER EMPLOYMENT

The impact of technology on occupations that have a high Aboriginal and Torres Strait Islander composition has been specifically examined, noting that Aboriginal and Torres Strait Islander employment is a critical priority within the Greater Whitsunday region.

Due to the high susceptibility to automation for many occupations that employ Aboriginal and Torres Straight Islander people, a greater focus on the long term trajectory is required to support the workforce into the future.

To support the workforce transition with the appropriate skills, some of the key education and training pathways and employment pathway options can work better when they are based on a tailored approach to the needs of Aboriginal and Torres Strait Islander persons.

2. Refer to Appendix G of the Final Report for data analysis.

IMPACT OF TECHNOLOGY

The largest employing industries for Aboriginal and Torres Strait Islander people in the Greater Whitsunday region are in the Mining and METS, Health Care and Social Services, Retail and Accommodation and Food Services sectors.[2] Stakeholder consultation identified that employment in the agriculture sector has also increased in recent years.

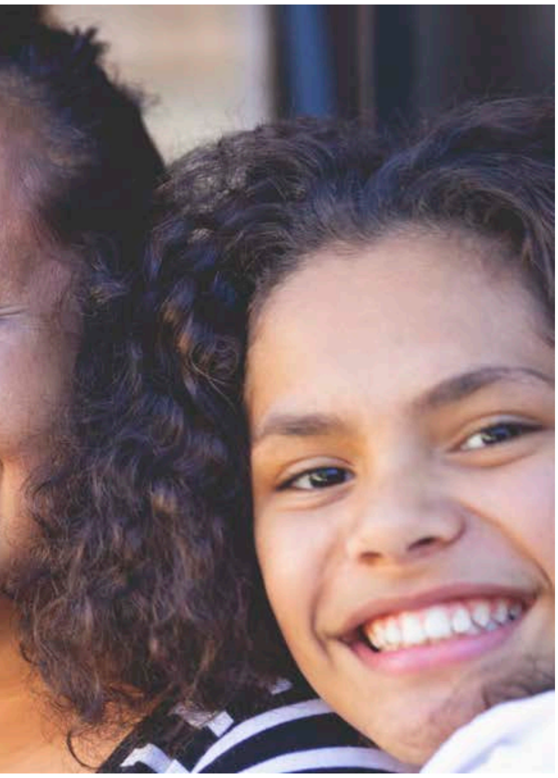
The key occupations for Aboriginal and Torres Strait Islander people within the Greater Whitsunday region are understood to include mining truck driving, mining manual labour and retail assistant roles.

These occupations are exposed to a high risk of job augmentation or automation.

New roles will increasingly require digital and analytical skill sets; however, these jobs are often sources from other metropolitan centres (such as Brisbane) with local employment programs focused on occupations that are likely to be highly impacted by the Fourth Industrial Revolution.

STRENGTHENING ABORIGINAL AND TORRES STRAIT ISLANDER PATHWAYS

A greater focus on skilling and education that supports sustainable long-term occupations for Aboriginal and Torres Strait Islander persons (and the wider Greater Whitsunday region's population) is needed.



Improving attainment outcomes in tertiary education would help to ensure pathways to meaningful employment for Aboriginal and Torres Strait Islander peoples. Evidence shows that Aboriginal and Torres Strait Islander students who complete Year 12 are more likely to be employed when they leave school, with even better opportunities after post-school study. This trend is likely to continue, with many new occupation opportunities requiring greater expertise due to greater complexity.

Tertiary education targets should be more closely linked with employment outcomes for graduates. For example, a Certificate IV was identified as the most suitable minimum benchmark qualification for Aboriginal and Torres Strait Islander students due to the large proportion of professions that require it.

Education and skilling needs to be linked to areas of occupations in growth and jobs data needs to be provided to policy makers, education and skilling providers and employers to assist them. Mentoring, career coaching and support in education and training programs have also been shown to assist individual Aboriginal and Torres Strait Islander persons with fulfilling their potential and accessing incentives and supports.

The reskilling opportunities that will exist as support is provided to those whose jobs are automated, provide a unique opportunity for mature Aboriginal and Torres Strait Islander persons to pursue new careers and embrace lifelong learning.

KEY STEPS TO ENABLE CHANGE AND SUPPORT EMPLOYMENT

Sustainable future employment for the Greater Whitsunday region will require proactive planning, workforce initiatives, skilling and education supports and co-ordinated community effort. While much is already occurring, the evidence gathered throughout this study identified some future directions that may help support the change ahead.

The Greater Whitsunday Alliance will drive to achieve these identified steps, along with key stakeholders in the region. This will better prepare our region's workforce for success in the future.

1. Develop targeted workforce transition plans for occupations at most risk of automation.

Based on the evidence gathered in the Final Report, workforce transition plans may need to be developed for occupations where significant automation is predicted.

Strategies should consider skill alignment both within the industry sector (such as Mining and METS) but also into adjacent sectors where there is high level of alignment. For example, Mining is expected to adopt autonomous vehicles much more quickly than Transport and Logistics businesses, therefore truck drivers may be able to be transitioned into this adjacent labour market.

This also provides opportunities for reskilling, and career conversations with individuals may support them with their next chosen career.

It is noted that analysis suggests an impact of -2.1 percent annually in Mining and METS by occupations to 2030, and that this will need to be a key focus of workforce transition planning.

2. Increase the digital foundation skillset for the Greater Whitsunday region's workforce, including actions to:

a) Build digital foundations into all para-professional and professional qualifications

Education and training will be critical to supporting the workforce where their occupations have been augmented by technology and they are required to adapt to the new occupational skills, tasks, functions and working requirements.

b) Develop micro-credentials to support digital foundations for the existing workforce accessible within the Greater Whitsunday region

The workforce will increasingly require ongoing training as new technologies continue to emerge. This will require a dynamic, contemporary and short-course based approach to upskilling both for digital foundations and around specific technologies for the profession, sub sector or industry.

Consideration should be given to the most suitable education and training approach and delivery method for the occupation, and to support the Greater Whitsunday's regional growth. Some occupations will require a mix of practical and theoretical training and skilling which may be wholly, particularly or unsuitable for online learning.

3. Develop local training opportunities that are aligned with future skill needs

Many stakeholders identified that one of the challenges in recruiting locally was that the required education and training for key occupations was not offered within the region. Analysis of all Vocational Education and Training (VET) and university enrolment and completion rates is included in Appendices I and J of the Final Report and do not show a clear link to occupational growth and industry demand in the Greater Whitsundays region.

This may provide the opportunity for the Greater Whitsunday region to identify better alignment for education and training, micro-credentialing or other professional training growth based on the expertise within the region, and the workforce needed into the future.

Stakeholders also identified a need to strengthen Science, Technology, Engineering and Mathematics (STEM) in schools, and provide education and training in some of the ICT occupations which are typically sourced from outside the Greater Whitsundays region.

4. Job redesign of roles with high levels of predicted augmentation

Jobs will require redesign to transition the workforce from performing tasks that are capable of being performed by technology, into roles that utilise essential human skills such as leadership, management, problem solving and empathy.

Organisations will be responsible for designing their augmented workforce including what jobs will be impacted by technology and to what degree and how these employees will be utilised in new tasks and functions.

This will provide the opportunity to drive further efficiency and points of difference for the Greater Whitsundays region within the Australian context, and if done well, will exceed customer expectations.

Job redesign will be increasingly important in a financially constrained environment and will require specialist skillsets that support business improvement.

5. Leadership and change management supporting digital adoption and workforce transition

The changes expected to arise from automation and augmentation of the workforce will require supportive leadership, clear vision and strategy and a commitment to innovation and positive culture.

This is expected to require investment in leadership to ensure that the benefits of technology are realised, that people are treated with compassion, and that the workforce are inspired by the future employment opportunities. This will require Chief Executives to become digital transformation sponsors and executive change champions while also requiring middle management leadership capability to enable lifelong learning, drive opportunity, manage change resistance, and ensure organisational readiness for technology adoption. This may also require micro-credentialing, executive coaching and other supports to support leadership development.

6. Recognise the importance of and create “bridging” roles that combine industry and ICT knowledge and skills.

Roles that combine industry expertise with technology expertise are already being increasingly required across organisations to help tailor technology to local practice and support workforce adoption.

These new roles may require micro-credentialing or coaching support from others who have undertaken a similar role. Recognition may be sought through professional associations for this as a specialist area of expertise or occupation.

7. Education and training pathways for emerging occupations

There will be a need to develop new curricula, professional standards and training for the new and emerging occupations.

Education and training for new emerging roles will require different approaches to suit the relevant role and will likely include combinations of specific tailored programs or courses, development of undergraduate curricula, VET courses and micro- credentials to support these occupations.

This will require a more industry led, contemporary and agile approach to education and training that may be best led through partnership arrangements between education and training providers, industry and employers within the Greater Whitsunday region.

8. Consolidate and build on the innovation and entrepreneurial ecosystem

With the widespread adoption and utilisation of technology within each industry, there is an increasing opportunity for innovation and entrepreneurialism to capitalise on the emerging technology market.

There is a significant opportunity for local markets to develop innovative technology platforms that address local, national and even global problems. Encouraging an entrepreneurial culture within the Greater Whitsunday region will become increasingly critical to the future workforce and draws on the innately human skills that cannot be replicated by technology.

9. Promote skilling opportunities to attract and retain young people

Stakeholders identified that the Greater Whitsunday region could do more to attract and retain young people to the regional workforce and to the Greater Whitsunday region's education and training providers. Targeted skilling could be enhanced for example through CQUniversity's School of Mining and Manufacturing.

Initiatives such as the Regional Jobs Committees and the current regional jobs and employment focus provide significant opportunity for the Greater Whitsunday region into the future.

APPENDICES

APPENDIX A

Occupations included in scope

Appendix A details the key occupations for each industry sector within the region that were agreed for analysis to inform the development of the Blueprint.

Mining and METS

ANZSCO 4 Digit Code and Identifier	ANZSCO 6 Digit Code	Occupation name
1335 – Production Managers	133512	Production Manager (Manufacturing)
	133513	Production Manager (Mining)
2336 – Mining Engineers	233611	Mining Engineer (excluding Petroleum)
3129 – Other Building and Engineering Technicians	312911	Maintenance Planner
	312912	Metallurgical or Materials Technician
	312913	Mine Deputy
	312999	Building and Engineering Technicians nec
3223 – Structural Steel and Welding Trades Workers	322311	Metal Fabricator
	322313	Welder (First Class)
3232 – Metal Fitters and Machinists	323200	Metal Fitters and Machinists nfd
	323211	Fitter (General)
	323212	Fitter and Turner
	323214	Metal Machinist (First Class)
	323299	Metal Fitters and Machinists nec
3411 – Electricians	341111	Electrician (General)
7122 – Drillers, Miners and Shot Firers	712211	Driller
	712212	Miner
	712213	Shot Firer

Mining and METS

ANZSCO 4 Digit Code and Identifier	ANZSCO 6 Digit Code	Occupation name
7129 – Other Stationary Plant Operators	712921	Waste Water or Water Plant Operator
	712999	Stationary Plant Operators nec
7212 – Earthmoving Plant Operators	721213	Bulldozer Operator
	721214	Excavator Operator
	721215	Grader Operator
	721216	Loader Operator
7331 – Truck Drivers	733111	Truck Driver (General)

Health Care and Social Assistance

ANZSCO 4 Digit Code and Identifier	ANZSCO 6 Digit Code	Occupation name
1342 – Health and Welfare Services Managers	134212	Nursing Clinical Director
	134299	Health and Welfare Services Managers nec
2512 – Medical Imagine Professionals	251211	Medical Diagnostic Radiographer
	251214	Sonographer
2513 – Occupational and Environmental Health Professionals	251311	Environmental Health Officer
2514 – Optometrists and Orthoptists	251411	Optometrist
2515 – Pharmacists	251513	Retail Pharmacist
2519 – Other Health Diagnostic and Promotion Professionals	251911	Health Promotion Officer
2521 – Chiropractors and Osteopaths	252111	Chiropractor
2522 – Complementary Health Therapists	252213	Naturopath
2523 – Dental Practitioners	252312	Dentist
2524 – Occupational Therapists	252411	Occupational Therapist
2525 – Physiotherapist	252511	Physiotherapists
2527 – Audiologists and Speech Pathologists \ Therapists	252712	Speech Pathologist

Health Care and Social Assistance

ANZSCO 4 Digit Code and Identifier	ANZSCO 6 Digit Code	Occupation name
2531 – General Practitioners and Resident Medical Officers	253111	General Practitioner
	253112	Resident Medical Officer
2541 – Midwives	254111	Midwife
2543 – Nurse Managers	254311	Nurse Manager
2544 – Registered Nurses	254400	Registered Nurses nfd
	254412	Registered Nurse (Aged Care)
	254413	Registered Nurse (Child and Family Health)
	254414	Registered Nurse (Community Health)
	254415	Registered Nurse (Critical Care and Emergency)
	254418	Registered Nurse (Medical)
	254421	Registered Nurse (Medical Practice)
	254422	Registered Nurse (Mental Health)
	254423	Registered Nurse (Perioperative)
	254424	Registered Nurse (Surgical)
	254425	Registered Nurse (Paediatrics)
	254499	Registered Nurses nec
2721 – Counsellors	272100	Counsellors nfd
	272199	Counsellors nec
2722 – Ministers of Religion	272211	Minister of Religion
2723 – Psychologists	272311	Clinical Psychologist
	272312	Educational Psychologist
2725 – Social Workers	272511	Social Worker

Health Care and Social Assistance

ANZSCO 4 Digit Code and Identifier	ANZSCO 6 Digit Code	Occupation name
2726 – Welfare, Recreation and Community Arts Workers	272613	Welfare Worker
3112 – Medical Technicians	311215	Pharmacy Technician
	311216	Pathology Collector
4111 – Ambulance Officers and Paramedics	411111	Ambulance Officer
4113 – Diversional Therapists	411311	Diversional Therapist
4114 – Enrolled and Mothercraft Nurses	411411	Enrolled Nurse
4115 – Aboriginal and Torres Strait Islander Health	411511	Aboriginal and Torres Strait Islander Health Worker
4117 – Welfare Support Workers	411711	Community Worker
	411712	Disabilities Services Officer
4211 – Child Carers	421100	Child Carers nfd
	421111	Child Care Worker
	421112	Family Day Care Worker
	421113	Nanny
	421114	Out of School Hours Care Worker
4231 – Aged and Disabled Carers	423111	Aged or Disabled Carer
4232 – Dental Assistants	423211	Dental Assistant
4233 – Nursing Support and Personal Care Workers	423311	Hospital Orderly
	423312	Nursing Support Worker

Health Care and Social Assistance

ANZSCO 4 Digit Code and Identifier	ANZSCO 6 Digit Code	Occupation name
	423313	Personal Care Assistant
	423314	Therapy Aide
5122 – Practice Managers	512211	Health Practice Manager
5421 – Receptionists	542112	Admissions Clerk
	542114	Medical Receptionist

Agriculture, Forestry and Fishing

ANZSCO 4 Digit Code and Identifier	ANZSCO 6 Digit Code	Occupation name
1210 – Farmers and Farm Managers nfd	121000	Farmers and Farm Managers, nfd
1211 – Aquaculture Farmers	121111	Aquaculture Farmer
1212 – Crop Farmers	121200	Crop Farmers nfd
	121213	Fruit or Nut Grower
	121214	Grain, Oilseed or Pasture Grower
	121216	Mixed Crop Farmer
	121217	Sugar Cane Grower
	121221	Vegetable Grower
1213 – Livestock farmers	121300	Livestock Farmers nfd
	121312	Beef Cattle Farmer
1214 – Mixed Crop and Livestock Farmers	121411	Mixed Crop and Livestock Farmer
3111 – Agricultural Technicians	311111	Agricultural Technician
5512 – Bookkeepers	551211	Bookkeeper
7211 – Agricultural, Forestry and Horticultural Plant Operators	721111	Agricultural and Horticultural Mobile Plant Operator
8321 – Packers	832100	Packers nfd
	832113	Fruit and Vegetable Packer
	832114	Meat Packer
	832199	Packers nec

Agriculture, Forestry and Fishing

ANZSCO 4 Digit Code and Identifier	ANZSCO 6 Digit Code	Occupation name
8410 – Farm, Forestry and Garden Workers, nfd	841000	Farm, Forestry and Garden Workers nfd
8411 – Aquaculture Workers	841111	Aquaculture Worker
8412 – Crop Farm Workers	841200	Crop Farm Workers nfd
	841211	Fruit or Nut Farm Worker
	841212	Fruit or Nut Picker
	841214	Vegetable Farm Worker
	841215	Vegetable Picker
8415 – Livestock Farm Workers	841511	Beef Cattle Farm Worker
8416 – Mixed Crop and Livestock Farm Workers	841611	Mixed Crop and Livestock Farm Worker
8419 – Other Farm, Forestry and Garden Workers	841999	Farm, Forestry and Garden Workers nec
8992 – Deck and Fishing Hands	899211	Deck Hand
	899212	Fishing Hand

Tourism

ANZSCO 4 Digit Code and Identifier	ANZSCO 6 Digit Code	Occupation name
1411 – Cafe and Restaurant Managers	141111	Cafe or Restaurant Manager
1412 – Caravan Park and Camping Ground Managers	141211	Caravan Park and Camping Ground Manager
1413 – Hotel and Motel Managers	141311	Hotel or Motel Manager
1414 – Licensed Club Managers	141411	Licensed Club Manager
1419 – Other Accommodation and Hospitality Managers	141999	Accommodation and Hospitality Managers nec
1421 – Retail Managers	142111	Retail Manager (General)
3513 – Chefs	351311	Chef
3514 – Cooks	351411	Cook
3622 – Gardeners	362211	Gardener (General)
	362212	Arborist
	362213	Landscape Gardener
4310 – Hospitality Workers, nfd	431000	Hospitality Workers nfd
4311 – Bar Attendants and Baristas	431111	Bar Attendant
	431112	Barista
4312 – Cafe Workers	431211	Cafe Worker
4314 – Hotel Service Managers	431411	Hotel Service Manager

Tourism

ANZSCO 4 Digit Code and Identifier	ANZSCO 6 Digit Code	Occupation name
4315 – Waiters	431511	Waiter
4514 – Gallery, Museum and Tour Guides	451412	Tour Guide
4516 – Tourism and Travel Advisers	451612	Travel Consultant
5311 – General Clerks	531111	General Clerk
5421 – Receptionists	542111	Receptionist (General)
	542113	Hotel or Motel Receptionist
6211 – Sales Assistants (General)	621111	Sales Assistant (General)
7311 – Automobile Drivers	731112	Taxi Driver
	731199	Automobile Drivers nec
7312 – Bus and Coach Drivers	731211	Bus Driver
	731213	Passenger Coach Driver
7321 – Delivery Drivers	732111	Delivery Driver
8110 – Cleaners and Laundry Workers nfd	811000	Cleaners and Laundry Workers nfd
8112 – Commercial Cleaners	811211	Commercial Cleaner
8114 – Housekeepers	811411	Commercial Housekeeper
	811412	Domestic Housekeeper
8115 – Laundry Workers	811511	Laundry Worker (General)

Tourism

ANZSCO 4 Digit Code and Identifier	ANZSCO 6 Digit Code	Occupation name
8511 – Fast Food Cooks	851111	Fast Food Cook
8513 – Kitchenhands	851311	Kitchenhand

APPENDIX B

Faethm Methodology

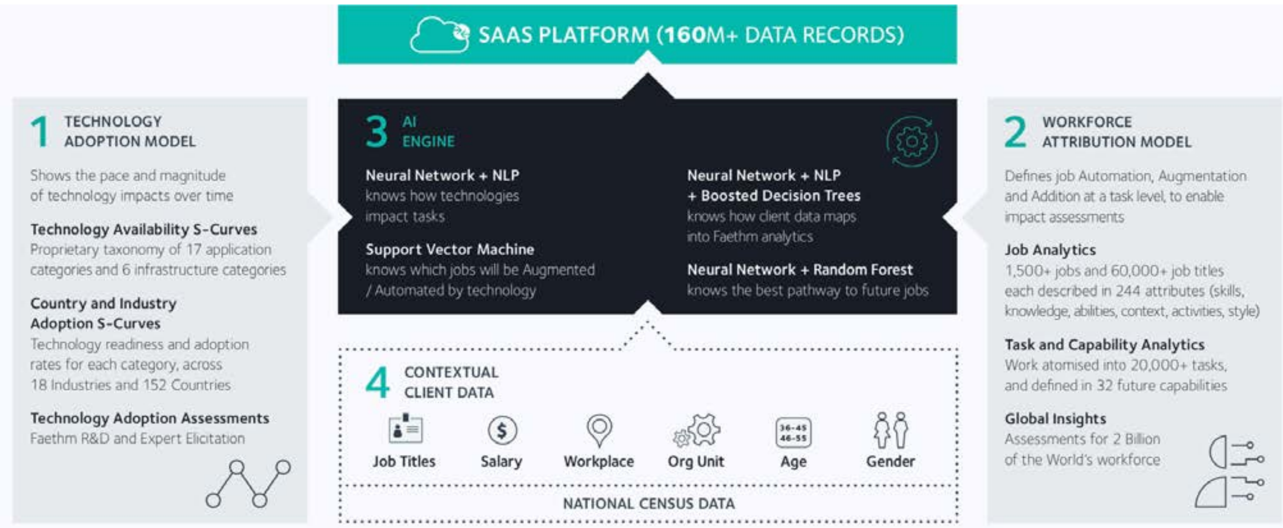
Faethm is on a mission to drive economic and social value from the impacts of emerging technology on the workforce. To do this, they combine public and client data with proprietary analytics to provide insights to leaders globally.

Faethm enables scenario planning to deliver predictions and commercial information that - unlike other reports and studies - are constantly updated, and can be made specific to any economy, industry, geography, company, business unit, team or job. Data and insights are provided in a secure **SaaS platform** which can be used to scenario plan and model transition pathways and skills requirements for workers over time (up to 15 years).

Using Australian census industry workforce data, the Faethm platform calculates and visualises the opportunity to *Automate* (replace workers with technology); *Augment* (enhance workers with technology); or *Add* new jobs (those needed to implement, maintain and run new technology). These analytics are presented on platform though a variety of charts and insights that span strategic, technology and people implications:

STRATEGIC IMPACT INSIGHTS	TECHNOLOGY IMPACT INSIGHTS	PEOPLE IMPACT INSIGHTS
Automation Impact: assess opportunity and risk at the industry or business unit level derived as a budget or FTE impact figure. **Augmentation Impact:** Overall market FTE resource capacity created through augmentation programs. **Location Impact & breakdown):** Focused view of what portion of the Australian workforce will be augmented vs. automated by location each year.	**Technology Portfolio:** Focused suite of emerging technologies driving the most opportunity across the market. **Technology Timeline:** Full view of emerging technologies, their adoption rate and impact on the workforce over time.	**Job Impact:** granular breakdown of percentage of a job that is able to be automated and or augmented each year. **Job Corridor:** Faethm's Job Corridor identifies ideal transition jobs based on several characteristics: jobs with future growth; similar salary; ease of transfer; lower levels of automation risk; and jobs that an individual might actually like to work in based on their vales, interests and behaviours. Ultimately identifying the skill gaps between roles. All job attributes describing the future job are presented and gaps to future skills highlighted to help focus training plans. **Business Resilience**: inform business continuity planning both now and ongoing by identifying employees in a workforce at greater risk of workforce exposure and associated business risk. This is measured though a higher degree of human interaction and or lower remote productivity potential. **Age Impact:** See how technological impact on the workforce differs by age and when this occurs. **Gender Impact:** See how employees are impacted by technologies as well as how that impact differs by gender. **Jobs added:** the types of jobs required to implement, maintain and run emerging technologies across a workforce.

Faethm Data Source:



1) Technology Adoption Model: Shows the pace and magnitude of technological adoption impact over time specific to an industry and/ or country. To breakdown this impact Faethm developed a Technology Taxonomy to distinguish which emerging technologies could impact a workforce.

The Faethm Technology Taxonomy: is a human-centred classification of technology. Using this classification system, Faethm first identified human abilities required for work and then used those to construct a mutually exclusive collectively exhaustive (MECE) grouping of technologies that could either disrupt or enhance one or more of these abilities. Each of the 17 AI and robotics technology classes represent a group of many technologies that directly impact work that are either currently available or will be within the next 15 years.

Programmed Intelligence	**Narrow AI**	**Broad AI**	**Reinforced AI**
Depends entirely on human input. These technologies can perform highly structured and simple process tasks by employing rules based logic, processes, instructions and simple robotics.	Acts semi-autonomously when prompted by humans. These technologies perform structured, familiar tasks in defined domains by using machine learning to interpret certain problems.	Can self initiate actions with no human input. These technologies perform unstructured tasks and engage with their environment using perception and sensory processing of external input data.	Can independently learn from experience to perceive and complete new tasks. They perform creative, unfamiliar actions across domains through using reinforced learning.
This includes: • Process Automation • Fixed Robotics • Mobile Robotics	This includes: • Predictive Analysis • Recognition vision • Suggestion Provision • Voice Response	This includes: • Sensory perception • Decision Generation • Conversation Exchange • Dexterous Robotics	This includes: • Navigation Robotics • Collaborative Robotics • Solution Discovery • Generative Design • Creative Origination • Assistive Robotics

2) Work Attribution Model: Defines job automation, augmentation and addition at a task level, to inform impact assessments. To enable this Faethm developed a workforce ontology which classifies 1,500+ jobs which are each defined by 244 attributes (skills, knowledge, abilities, context, activities, style) and underpinned by a database of 32,000 tasks.

KPMG & Faethm and building resilience in light of COVID-19

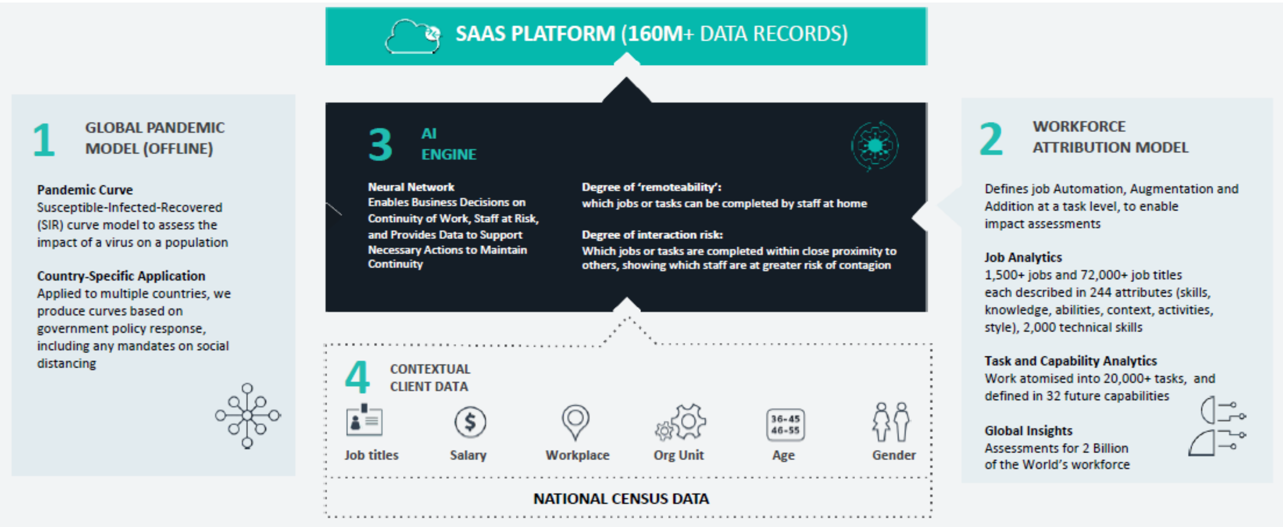
Business resilience for workforce planning

Faethm analytics inform workforce interventions at task, job, business unity and organisational level to reduce workplace transmission of COVID-19 by informing the 'remote-ability' of staff and the degree of interaction between workers, co-workers and the public. This is achieved by:

- Determining the degree of workforce 'remote-ability' and 'interaction risk'. Which jobs or tasks can be completed by staff at home? Focus interventions on critical roles at high risk
- Understanding possible severity of impact linked to the age and locations of your employees
- Identifying which technologies are available to immediately replace on-site tasks? How do you re-prioritise your automation investment roadmap
- Informing which L&D actions are needed to enable the transition to remote working
- When the curve flattens, ensuring an Orderly Return to Work by assisting in informing who remains remote, who goes back and who goes back first?
- Determining a new or revised recruiting strategy by understanding who can and should be hired in remote locations to give you best talent and resilience?

Faethm's methodology (+COVID-19)

In response to COVID-19, Faethm has the capability to apply AI to inform COVID-19 policy and strategy. Faethm's analytics inform workforce interventions at task, job, business unit and organisational level to reduce workplace transmission of COVID-19 by informing the 'remotability' of staff and the degree of interaction between workers, co-workers and the public.



APPENDIX C

Data Limitations

There are a number of assumptions and limitations in the available data and information and modelling that have been captured throughout the development of the Future Employment Study and accompanying Blueprint.

For the labour market analytics, the data limitations include:

- Balancing the relevancy of data with the depth of data in supply modelling. The most recent data is the Labour Market Quarterly reports but these do not provide the depth required in terms of occupational codes and geographical information. Therefore, Census data from 2011 and 2016 has been used to help apportion the labour market that should be included in the analysis. This makes assumptions that the geographical distribution of labour across the Region has remained stable since 2016, and the proportion of occupations to be included at the 6 digit code has remained the same in each of their four digit occupational clusters.
- Forecasting is based on compound annual growth, for any future projections, and is based on the historical trend from 2015-2020 unless otherwise stated.
- Occupations included at the 6 digit ANZSCO level are based on occupations agreed in consultation between KPMG and the Greater Whitsunday Alliance. In most cases occupation numbers lower than 10 were not included (unless there was specific exception made). It is also recognised that some of these occupations are not specific to industry sectors (such as Truck Drivers) but there is no way to apportion the split across industry sectors. For this reason all headcount recorded as working within that occupation in the region have been include in the Mining and METS industry.
- The 6 digit ANZSCO data from the 4 digit occupation codes is based on a custom data set provided by the ABS to KPMG in May 2020.
- The limitations of the ABS data sets also apply, with some data sets specific to Queensland and the industry, but not the region (for example the business counts data) or may be cut by a certain desirable field such as occupation but not by another, for example public and private sector split. In addition the employment composition data is only collected for full-time and part-time employment and does not include casual or contracting arrangements that fall outside of this collection.
- The ABS include part time and full-time employees in their Census and labour market quarterly data, but do not explicitly include casual employees who they define as "employees (excluding owner managers of incorporated enterprises) who are not entitled to paid sick or holiday leave (the ABS proxy measure for casuals)." However, these employees may be counted as part-time employees by meeting the hours worked definitions of data capture in the labour market surveys. This means the ABS has a wider definition of part-time employment in the labour market quarterly data than the industrial relations legislation that applies in Australia (that is both part-time and casual employees will meet the definition according to hours worked). Further information on how the labour market quarterly data is captured based on these types of employment is available in Labour Statistics, Concepts, Sources and Methods.[336]

[336] *ABS 6102.0.55.001 - Labour Statistics: Concepts, Sources and Methods, Feb 2018, Available at https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/6102.0.55.001~Feb%202018~Main%20Features~Employment~4*

APPENDIX D

Stakeholders Consulted

F or the purposes of developing this Future Employment Study and the accompanying Blueprint, the following stakeholders were consulted:

Mining and METS

Individual consultations

- G & S Engineering
- Downer

Workshop

- BHP
- JCV Services
- Resource Industry Network
- Resource Centre of Excellence
- Hastings Deering
- TAFE Queensland
- Mastermyne
- TWAM Group (Aust)
- Mackay Conveyor Equipment

Health care and social assistance

Individual Consultations

- Queensland Nurses and Midwives Union
- Mackay HHS
- GP Mx Solutions Pty Ltd
- Neighbourhood Hub
- Mackay Women's Services
- Move and Play Paediatric Therapy
- Mackay Urology

Workshop

- Regional Social Development Coalition
- Whitsunday Community Services Inc
- Connect Housing Group
- Mackay GP Superclinic Group
- James Cook University

Agriculture

Indiviudal Consultations

- Angus Beef
- Tassal Group

Workshop

- Mackay Cane Growers Association
- Queensland Agriculture Workforce Network (Bowen Gumlu Growers Association)
- Thomas Borthwick & Sons
- AgForce (Central)
- CQUniversity

Tourism

Individual consultations

- Mackay Tourism

Workshop

- Red Cat Adventures
- Tourism Whitsundays
- Comfort Resort Blue Pacific
- Fish D'vine

Aboriginal and Torres Strait Islander Employment

- Girudala Community Co-Operative Society Ltd
- Department of Aboriginal and Torres Strait Islander Partnerships
- BHP

APPENDIX E

Agriculture Key Technologies

Technologies specific to agriculture workforce segments

Agriculture takes a lead in some areas of technology adoptions such as genetics and genomics, however lags in other areas of adoption such as financing instruments, automation and market access. Lead times in bringing on and adopting new technologies can be long. As usual the story isn't just about the technology, it's usually about people. Investment and adoption decisions are risk based decisions, and this is one of the greatest hurdles for farmers, which are often asset rich but cash poor. [337]

Farmers, Farm Managers and Workers

The integration of multiple sources of data such as weather, market data, agronomic data or benchmarks with other farms further enhances its effectiveness. With a multitude of sources, AI increases the value of data being collected by analysing and converting it into information to support farm management decision-making. It can be applied at a range of scales from converting data collected on individual animals and plants, to a whole farm level by presenting information for crop planning and monitoring. –

KPMG and Skills Impact [338]

SUMMARY

Technology is transforming the future of work for Farmers, Farm Managers and Workers. Technology is increasingly replacing repetitive, labour intensive tasks, reducing the labour force requirements and costs. However, higher skilled jobs are expected to increase within the sector into the future as technology is widely adopted.

Imaging, drones and UAVs

Satellite imaging, intelligent drones, and unmanned aerial vehicles (UAVs) can assist farmers to collect images to identify changes to soil and vegetation, identify crop stress, and assess irrigation and assist crop spraying. Farmers can conduct crop forecasting and better manage their agricultural production and inputs.

Integrated mapping from various images can identify issues and improve yields and efficiency of time for farmers. It can also be used as a tool to track livestock, and drones can be used to deliver inputs such as fertiliser.

Pest management

Most farms currently monitor pests using visual cues which is common practice but is performed periodically by qualified pest technicians. The ability to remotely monitor pests will assist with the maintenance and health of a farm. Collecting and understanding data on a pest's activity, location and patterns allows for efficient and sustainable treatment of pests, integrated biosecurity tracking and more rapid responses across affected areas.

Weather and climate monitoring

Climate, rainfall and extreme weather conditions create further uncertainty for farmers in an already volatile environment. Technology to monitor external factors, such as weather predictions, puts the farmer back in the driver's seat to manage their farm with more certainty. For example, picking a crop a day early could offset the wipe-out of an entire crop if they know a storm is coming.

The ability to precisely manipulate inputs also enables the farmer to be in better control as to what they put into their farming systems as a management tool. As heat increases, for example, they can adjust their irrigation systems to input more water to offset dry conditions.

Smart irrigation

The use and management of water on farms is in the spotlight. Approximately 70 percent of the total volume of water withdrawals in the world is used in agriculture irrigation. Around 60 percent of the water that is intended for irrigation is lost,

[337] *Queensland Alliance for Agriculture and Food Innovation. 2019. What is digital agriculture? Available at https://qaafi.uq.edu.au/blog/2019/01/what-digital-agriculture*

[338] *KPMG and Skills Impact, 2019, Agricultural workforce digital capability framework.*

either due to evapotranspiration, land runoff, or inefficient usage methods.

Smart irrigation solutions offer an IoT fuelled management platform that can closely monitor and adjust a farm's water utilisation. A dashboard that integrates irrigation information means farmers have access to tools that enhance decision making around water. This means they can reduce water wastage and improve the quality of crop growth in their fields through precision agriculture practice. Factors such as timing, being able to minimise wastage and runoff, and analysing soil moisture levels give power to farmers to fine tune their irrigation requirements. Implementing smart irrigation also reduces the chance of human error, with automated systems such as smart valves alleviating this.

Farm management platforms

Utilising production data collected off the farm through IoT sensors, farm management platforms offer a congregated dashboard of information for farmers. The dashboard allows farmers to manage and optimise the production activities and operations of their farms. As well as monitoring variables such as soil quality, weather variables and fertilisation, there is also an ability to track livestock.

Aquaculture and Fisheries

Through a combination of careful fisheries management and modern aquaculture techniques, the Australian fishing industry, government organisations, scientists and other user groups are responding to the challenge of growing a profitable and competitive fishing industry while protecting the long-term future of Australia's marine ecosystem. –

AusTrade[339]

SUMMARY

There is a small aquaculture industry within the region, with onshore aquaculture and fishing being the main industries. Australia utilises advanced technologies for harvesting and post-harvest processing and production as most species grown in Australian aquaculture farms are high value.

Tassal Group is a large producer within Australia, with approximately 70 percent of its workforce located in Tasmania. In 2018-19, Tassal acquired an Australian aquaculture business comprising three prawn farms with hatchery and processing facilities. Two of the facilities are located in Proserpine and Mission Beach, with the operations currently employing 47 people in Queensland. As Tassal seeks to grow its operations in the future, technologies that support the expansion of the operations and a workforce that is suitably skilled will be necessary.

Precision feeding technologies

Sensor based feeding control technology for aquaculture is used to control feeding for aquaculture farms to drive productivity, increase growth, minimise environmental outputs and improve the consistency of size and flesh characteristics at harvest.

AQ1 Systems is a Tasmanian based aquaculture engineering company that has developed an intelligent process for feeding prawns and fish through sound detection. AQ1 Systems products include:

- Sound Feeding System for shrimp and fish that uses passive acoustics to identify feeding activity to inform and control temporal feed delivery through adaptive feeding algorithms to ensure the feed distributed is adequate.
- Cameras and analysis software that sizes and counts fish underwater moving past a fixed point to assist with fish transfer and ecological time-related density analysis.

Augmented reality

The CSIROs future science platform, Digiscape, is developing novel pond and animal sensor technologies to provide farmers with immediate, pond-side understanding of key way quality parameters including oxygenation, pH and turbidity. Currently, methods for monitoring water quality are labour intensive and affected by time delays between measurements and data analysis. Technology that is under development is wearable, hands-free technology that can provide real time analysis. Pacific Reef Fisheries based in Ayr near Townsville, is working with the CSIRO to provide real world conditions for testing the system.

Water quality sensors

Traditional methods of testing water quality was through period measurements using handheld sensors. The development of low-cost small sensors that connect to wireless sensor networks monitor water quality through measuring, collecting and transmitting information that provides farmers with real-time updates and monitoring.

Traceability technology

Blockchain technology is used to improve traceability of seafood products to reduce illegal and unsustainable fishing globally. The World Wildlife Fund (WWF) in Australia, New Zealand and Fiji are partnering with technology innovation company, ConsenSys, based in the United States, TraSeable and Sea Quest Fiji, to trace Pacific Islands tuna using blockchain technology to track the tuna's journey 'from bait to plate'. The TraSeable software platform integrates with blockchain technology and leverages IoT technology to provide a transparent end-to-end traceability of aquaculture products.

339 *Aquaculture and Fisheries Industry Capability Report.*

Cropping and Horticulture

The main challenge facing the agricultural industry is the need to increase yields and outputs while protecting the environment, as well as the ability to feed the growing population with limited resources. Agritech solutions will help the industry overcome these challenges and enhance traditional agricultural practices. Though technology has been applied to agriculture for a long time, innovative agritech is seen as the future of farming. Basic solutions such as automated machinery are already making a difference to farmers' lives every day by improving profitability while saving time and resources. –

Enterprise Ireland [340]

SUMMARY

Within the region there are small vegetable, fruit and tree nut and grain growing industries. However, the predominant employing industry within the cropping and horticulture sector is the sugar cane growing industry, representing 31.1 percent of agricultural workforce within the region. [341]

Falls in cropping prices over the past 20 years have been offset by volume growth that has been achieved through improved productivity by adopting new technologies, combined with increased crop sizes. [342]

Larger farms are often early adopters of new technologies as they are able to utilise economies of scale to implement expensive technologies. As costs reduce over time and technologies such as automation and the adoption of precision agriculture technologies are widely utilised, it is likely that low-skilled labour will be required to upskill or reskill to remain employable.

Farm management platforms

Farm management platforms are utilised to collect extensive cropping data to assist farmers to make informed strategic cropping decisions regarding cropping and land use management.

AGDATA is a Toowoomba based company that specialises in financial and farm management systems for farming, grazing, horticulture and business operations. The Phoenix Cropping solution collects extensive cropping data including complete cropping production records, extensive season and performance reporting and auto create cropping plans with projected gross margins, break even yield and price and product requirements.

Precision technology

Precision technologies can boost the overall efficiency of farming in the cropping industry, utilising satellite-driven GPS technologies to track farm equipment and usage, and ensure inputs such as water, fertiliser and pesticide are applied only where needed on a schedule that optimises efficiency.

Farm Doctors is an Atherton, Queensland based precision agriculture company that delivers paddock operations support, crop health monitoring, position and data analytics products and services. Solutions such as Taranis enables farmers to make informed decisions by detecting early symptoms of weeds, uneven emergence, nutrient deficiencies, disease or insects, water damage and machinery problems through automated scouting technology. Other technologies include spray drones and land profile counts that profiles land as a critical element in paddock planning and auto steering configuration.

Robotics and automation

Robotics and automation are broadly utilised across the cropping and horticulture industry for autosteer (more relevant for broadacre cropping such as grain), automated technology for seeding or planting, plant nutrition, harvesting, grading, processing and packaging. The technologies provide opportunities to improve profitability and sustainability and reduce reliance on manual labour.

Harvesting and post-harvesting technologies enable growers to mechanise the labour-intensive harvesting process. With improvements in machine learning, AI and mechatronics, this technology is set to have big impacts in areas including safety, resource management, and logistics and value chain efficiencies.

Harvesting and Post-Harvesting Technology that combines AI and machine learning with precision robotics and sensors will allow growers to:

- Generate real-time analysis about harvest quantity and quality;

[340] *Agritech: The Future of Profitable Farming.*
[341] *ABS, Census of Population and Housing, 2016.*
[342] *Jackson, T, Zammit, K & Hatfield-Dodds, S 2020, Snapshot of Australian Agriculture 2020, Australian Bureau of Agricultural and Resource Economics and Sciences.*

- Support selective harvesting thereby more accurately targeting quality and/or yield specifications;
- Reduce the cost of labour for picking, packing, and sorting; and
- Operate around-the-clock and perform multiple functions (e.g. picking and sorting) simultaneously.

The difficulty of harvest automation in horticulture, compared to broadacre cropping, is that horticultural produce requires a higher degree of accuracy and manual dexterity. This means robots need improved perception and sensors to detect produce specifications and then selectively harvest without causing damage to other produce or the supporting plant. This sophisticated technology requires significant investment and is unlikely to provide a return on investment for smaller operators.

Traceability technology

Traceability technology provides an opportunity to use data and insights to reduce food safety and quality assurance inspection workforce and time, record provenance, grain breed, and construction and storage processes that align with the requirements and expectations of premium export markets. These technologies will likely demand a workforce that is capable of operating increasingly complex technologies.

Digital solutions will transform the way goods and data are managed and monitored along the supply chain. For example:

- Sensors can be used to track temperature sensitive products along the supply chain, and any changes above acceptable temperature requirements can be made accountable, protecting the farmer from potential losses.
- Using QR-codes or near-field communication sensors and blockchain technology, consumers can scan and learn about the 'paddock to plate' process, confirm whether claims such as brand name, 'Product of Australia', 'Organic' and 'Free From' are valid, and make more informed choices. This is also valuable for growers when combating food fraud in exported products such as premium quality wines.

Water irrigation technologies

Growers can improve their water and nutrients efficiency with a range of tools and strategies, such as:

- Innovative irrigation system design;
- Crop and soil sensor technology to capture in-field variation in water and nutrient requirements;
- Satellite imagery and drone sensors;
- Drip irrigation and fertigation to schedule fertiliser as required by the plant to reduce costs and nutrient loss;
- Visualisation software to accurately understand water use and crop requirements; and
- Decision support tools for water and nutrient management to improve irrigation scheduling and reduce evaporation losses.

Rubicon Water is an Australian agricultural technology company that uses advanced technology to manage gravity fed irrigation networks, enabling them to manage their water resources with unprecedented levels of efficiency and control. Rubicon uses technology, such as automated irrigation, to control flow rates and water levels. The technology automatically coordinates and control water input to reduce human operation to tasks such as problem solving and diagnostics.

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Livestock farming

As an industry heavily exposed to the international market, the livestock sector will be substantially affected by international market trends and biosecurity risks. At the same time, there is an increasing national demand for smaller scale ethically sourced and environmentally sustainable beef and lamb. Technology and data are also transforming livestock farming practices. Technologies such as virtual fencing and electronic tagging have the potential to assist in livestock management and data collection, and boost productivity. –

CSIRO and Data61 [343]

SUMMARY

Livestock farming is a strong industry within the region, with beef cattle farming the dominant employing sector within the region representing 28.6 percent of the workforce.[344] The industry is affected by domestic and global trends, as Australians consume less red meat but global demand increases leading to our position as one of the largest exporters of beef and sheep. The sector is under pressures to increase productivity, improve export margins while meeting demand for sustainable and ethically sourced beef and lamb. Technologies such as virtual fencing and electronic tagging have the potential to assist in livestock management and data collection and boost productivity.

Whole of Farm Management

Whole Farm Management utilises data to inform and consolidate business information from across the farm into a central database. Data analysis assists management decisions by providing the insights to support on-farm operations and production activities by collecting, communicating, storing, analysing, planning and reporting important business information.

Farm management platforms that utilise data inputs can be used to:

- Streamline purchasing, procurement and inventory management;
- Analyse financial and production data, live and historical;
- Plan labour and operations;
- Automate reporting and processes such as irrigation cycles and robotic harvesting;
- Assist with reporting for regulatory compliance and governance;
- Farm mapping to manage farms visually; and
- Expose trends and discover animals not tracking to targets.

Online auctions

AuctionsPlus was established in 1986 to provide electronic ownership of livestock and to provide pricing information for producers. AuctionsPlus has developed with the widespread adoption of the internet to an agricultural commodities platform that allows auctions to be conducted virtually. With the introduction of COVID-19 restrictions disrupting traditional saleyards, AuctionsPlus has experienced a significant increase in demand. Online auction platforms establish a truer value for livestock, increased animal welfare and performance by minimising stress through allowing animals to remain on-farm until sold, reduces freight costs and reduces market volatility.

Animal and Herd Management

Technology is assisting farmers to monitor and manage heard health, movement and behaviour and resulting in efficiencies in animal management for the livestock. The capacity to monitor and control the movement and location of herds provides a wide range of useful metrics for livestock producers. Data is collected through ear tags, smart fencing, remote monitoring tools, and paddock management software and is used to:

- Remotely monitor individual animal health, movement, and location;
- Collect data which can be used further along the supply chain to provide quality and providence credentials;
- Count, track and visualise your herds;
- Instantly alert you to theft and break outs;
- Detect pests and disease;
- Track animal fertility during breeding periods;
- Gain insight into feeding patterns, consumption and efficiency per animals; and

[343] *Wu W, Dawson D, Fleming-Muñoz D, Schleiger E and Horton J. 2019. The future of Australia's agricultural workforce. CSIRO Data61: Canberra, Australia.*

[344] *ABS, Census of Population and Housing, 2016.*

- Track animal weight, temperatures and productivity.

Supply chain and provenance

Supply chain and provenance technologies can increase consumer confidence, add value to products, and improve information flows. As consumers are increasingly concerned with the sustainability of farming, organic or free range status and the origin of food, the ability to provide this information is increasingly important for producers. Technologies offer tamper-proof, secure end-to-end tracking, and have the capacity to eliminate the need for manually updated, paper-based systems, and offer farmers and consumers the transparency, accountability and traceability they desire.

Supply chain technologies such as blockchain and inventory management software have multiple end-uses, including:

- Accurately capturing data about the provenance, attributes, condition, and location of crops on-farm and throughout the supply chain;
- Reducing the risks and constraints of paper-based systems;
- Improving efficiency getting products to market;
- Facilitating faster payments;

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- Providing food safety assurances that consumers and regulators require;
- Increasing accountability for damaged and tampered goods;
- Exposing counterfeit goods; and
- Improving biosecurity responses.

Emissions reduction technology

Meat and Livestock Australia (MLA) has set an ambitious target for the red meat and livestock industry to be carbon neutral by 2030. To achieve this goal while maintaining or improving long-term productivity and heard numbers, MLA is investing in research and development of technology to:

- Reduce methane emissions from livestock;
- Develop viable grazing supplement delivery technologies that maintain livestock productivity and lower methane emissions;
- Advance soil carbon sequestration method and measurement technology;
- Avoid methane emissions from waste management at processing facilities; and
- Renewable energy technology to reduce carbon emissions from fossil fuel use within the industry.

Packing and product processing

Australian food producers and processors are recognised globally for the innovative and reliable production of high-quality 'clean and green' processed food and agricultural products, services and technology. The Australian processed food and beverage industry is supported by a world-class packaging and logistics network. From two-gram sachets to shelf-stable sterilised retort pouch packaging, the local packaging industry is well developed and highly innovative. –

AusTrade[345]

SUMMARY

Increasing use of robotics and digitalisation are increasing the complexity of production processes and impacting the labour market. The workforce roles and required level of education are increasing, requiring investment in both capital goods and workforce training for producers.

Automation and robotics

Machines are increasingly being used in the food industry to ensure quality and affordability, by reducing costs of keeping the food fresh and increasing productivity. While machines have always had a role within the value chain, technological advancements and the use of AI is allowing more complex tasks to be undertaken by robotic machines such as grading, sorting, food safety compliance, packaging and labelling. TOMRA is a leading sorting and collection solutions provider in Norway that uses X-ray, near infra-red spectroscopy, laser, cameras and machine learning algorithm to analyse different aspects of fruit or vegetables for sorting. In Japan, Kewpie Corporation uses AI to identify anomalies present in foods from farms. Both technologies are used to increase revenue and to improve production yields.

Robotic machines are improving workplace health and safety by eliminating safety issues for dangerous jobs in the food industry, such as butchers. Robots are used to cut more difficult parts of meats that reduces many work injuries.

Novel processing techniques

Novel processing techniques have arisen from consumer demand for fresh and healthy products that are preservative free. As such, milder and more energy efficient processing techniques are being developed to maintain structure, function and product quality.

High-pressure processing technology is used for pasteurising and sterilising products. It is a cold pasteurisation technique where products sealed in their final package are subjected to a high level of isotactic pressure transmitted by water to inactivate bacteria, moulds or parasites present in the food. While pasteurisation technology is widely available and commercially applied, for sterilisation the technology is still emerging and use will be for juices, meat, ready-to-eat meals and spreads.

Pulsed electric fields for food processing technology is an alternative to pasteurising liquid food products such as juices and soups and is used in potato processing. It is a non-thermal method of food preservation that uses short pulses of electricity for microbial inactivation. The processing at low temperatures preserves the nutrients of the food and requires less energy.

Monitors and wearable devices

Wearable devices and monitors including smart watches, smart gloves and smart glasses are an emerging technology field that utilise IoT technologies to improve food safety in food processing facilities. Devices are designed to resolve hygiene issues immediately to prevent contamination of food items, recalls, loss of revenue and damage to brand reputation.

Google Glass is tailoring its offering to work in manufacturing and other similar environments, allowing access to training videos, images annotated with instructions or quality assurance checklists.

Smart gloves, such as ProGlove from Germany, enable manufacturing and logistics staff to work faster, safer and more productively by allowing process steps to be documented hands free

[345] *Processed Food Industry Capability Report.*

APPENDIX F

Health Care and Social Assistance Key Technologies

Technologies specific to Health Care and Social Assistance workforce segments

It is important to realise that the roadmap for technological adoption of different "digital disruptors" will be different across every organisation, and depends on the technologies, timeframes, and sequencing they choose. This means that an organisation's technological roadmap for reform will drive a unique workforce transition process, including the evolution of roles, tasks, processes and workforce design that is associated with that process.

While there will be some similarities, the impact of Health Care technologies will be different for each health occupation or subsector. If thoughtfully planned, strategic decisions will be made based on which tasks, functions or processes could be enhanced by technology, and which remain best done by people.

Several factors will drive these strategic decisions including the relative cost of labour, the skills and capabilities of the workforce, consumer expectations around personal interactions and technology adoption, quality and safety, digital health innovations, fiscal constraints and critical workforce shortages.

Business and Administration

It is predicted that global chatbots in the healthcare sector market will be increasingly adopted, and reach a value of $498 million by 2029, after generating $36.5 million in revenue in 2018. Medical triage chatbots currently hold the largest market share and are expected to replace non-emergency hotline services into the future.

– Fred Pennic [346]

SUMMARY

The business and administration services workforce is broad and covers a range of professional occupations and job families including finance, procurement, administration and human resources functions.

Financial Enterprise Resource Planning (ERP) systems

Contemporary ERP systems are enabling business processes to be automated and provide expanded functionality compared to older platforms. For example, invoicing ERPs allow an invoice to be submitted by the payee into the invoicing platform, which is able to capture the data on the invoice, process and seek approval before payment is then sent to the payee. [347]

Many Health Care and Social Assistance organisations have faced challenges with legacy financial and procurement systems that are over five years old, and use a range of different systems that create inefficiencies and duplication. These organisations can benefit from using an ERP as it significantly reduces processing costs whilst increasing processing speeds and providing greater transparency of transactions through its end-to-end process management. [348]

Despite the potential benefits of ERP systems, they bring a number of challenges in their implementation, such as ensuring data cleansing is complete prior to transition, data migration and transition planning is managed, business reporting requirements are clearly identified and appropriate testing and piloting structures are put in place.

[346] *Pennic, F (2019) Global chatbots in healthcare market to reach $498 million by 2029, HIT Consultant.*
[347] *Business Insider. (2019). Accounts payable automation: the multitrillion dollar accounts payable market is finally digitizing.*
[348] *Business Insider. (2019). Accounts payable automation: the multitrillion dollar accounts payable market is finally digitizing.*

Kiosks

Health Care and Social Assistance organisations are increasingly using kiosks to streamline front office administrative processes, such as booking systems, automated arrival terminals and queue management.

Booking systems such as QLess and InTouch enable a person to book their own appointment and also provide automated reminders to minimise the risk of 'no-shows'. Other systems place the customer in a virtual queue and keep them updated on waiting time. [349]

For example, Queue Manager is being used in outpatient clinics at the Sunshine Coast University Hospital, and ACT Health has also adopted Queue Manage and Electronic Wayfinder kiosks at the Canberra Hospital, University of Canberra Hospital and four Community Health Centres. [350, 351]

Fintech

Fintech is a broad term used to describe technologies that have the ability to disrupt financial services. The Fintech sector has seen a large increase in investment, from USD$53 million in 2012 to over USD $675 million in 2016. [352]

Businesses are able to gather and analyse more information through the combination of integrated digital financial services with smart devices and IoT. [353]

Blockchain

Blockchain transfers information from one point to another in a fully automated and secure manner, whilst creating a unique record and unique history. Blockchain can automate high touch processes within finance and accounting, reducing errors and inefficiency from manual processes. [354]

The technology is particularly applicable to back office functions such as procurement. [355] This means that blockchain is able to execute a 'smart contract' which is able to automatically execute a contract based on programmed parameters, thereby eliminating financial delays and increasing transparency.

Robotic Process Automation

The use of robotic process automation is expected to impact significantly on the administrative services industry over the coming years, although their use is not widespread across the industry at the moment.

The key application of this technology is in providing online customer service, many organisations are now starting to use 'bots' to drive customer service across their websites, such as the Australian Tax Office (ATO) and National Disability Insurance Agency (NDIA). [356]

For example, the ATO created a bot called Alex who logged 950,000 conversations between March and December in 2016. Another example is Nadia a bot created for the NDIA's eMarketplace to improve access to goods and services for NDIS participants. [357] However robotic process automation should be used with care, with examples where errors have been made in the processes and requirements of the automated system, such as with Centrelink's robo-debt system. [358]

Virtual Platforms

Virtual Platforms are being adopted across a range of processes conducted by business services staff such as human resources. There are a range of virtual HR platforms that are able to perform functions such as applicant tracking, performance management, salary administration, scheduling, rosters and online learning. [359]

These platforms provide increased connectivity and faster analysis of data to reduce rework, improve process compliance and strengthen security of personal information. For example, the Queensland Police Service automated its end-to-end recruitment process with Objective ECM, and reported a 15 per cent gain in productivity for each round of recruitment. [360]

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[349] *Hague Australia. (2019). Queue Management. https://hagueaustralia.com.au/services/queue-management/*
[350] *Queensland Government (Sunshine Coast HHS). (2019). Clinical check-in kiosks.*
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[353] *Office of Chief Economist. Australian Industry Report 2016.*
[354] *Conduent. (2018). Blockchain and the back office: why transforming finance & accounting takes a trusted partner action.*
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[360] *Objective ECM (u.d.) Automating recruitment processes at Queensland Police Service.*

Surgery

Technology is already transforming surgery. New technologies are making surgery less invasive, more accurate, with more predictable outcomes, faster recovery times, and a lower risk of harm. Surgery is increasingly focusing on improving quality of life, with operations focused on prevention. –

Royal College of Surgeons. [361]

SUMMARY

Technologies such as 3D printing, robotics, augmented reality and virtual reality and genomics are already changing how surgical care is delivered. Patients are enjoying less invasive surgical techniques, better outcomes and shorter hospital stays.

Continuing advancements in technologies such as genomics and regenerative medicine create further opportunities for evolution of surgery. Though technologies are expected to continue to impact on the surgical occupation, they are not predicted to replace the core human attributes that the surgical occupation requires, of empathy, compassion and leadership. [362]

3D Printing

Three-dimensional (3D) printing has been widely adopted across the health sector, with many hospitals and surgeons having already implemented this technology. [363] There are a range of benefits associated with adopting 3D printing in surgery, such as the ability to create tailor-made medical devices and implants, the ability to respond to urgent patient demands and the ability to rapidly create medical prototypes. 3D printing has a range of applications including the creation of personalised implants, bio-printing of tissue and organs, surgical tool printing, prostheses and preparation and planning tools. [364, 365]

A recent example of the application of 3D printing in a surgery setting comes from researchers at RMIT University who collaborated with a medical device company and neurosurgeon to create a 3D printed titanium vertebral cage for a patient with severe back pain. The implant was printed layer by layer, adding material under computer control to the exact shape and architecture of the patient. Following a successful surgery, the patient is able to resume normal activities without any significant pain.

A more mature version of 3D printing, is bio printing, or bio fabrication. This technique involves layering living cells on top of each other to create an artificial living tissue. The living cells are taken from the patient requiring the transplant and therefore the likelihood of rejection of the artificial tissue is eliminated. Advances in tissue engineering and printing techniques have seen milestones such as the printing of human skin substitutes for clinical use. In 2016, scientists from the University of Lyon devised the use of "bio-ink" which contains various skin cell types to print large skin objects onto a predetermined scaffold or structure, such as an adult-sized ear. [366]

The Wake Forest School of Medicine, partnered with the Armed Forces Institute of Regenerative Medicine, to build and test a bio-ink printer which is designed to print skin cells directly onto burn wounds. [367] The system first scans the burn area to determine the dimensional properties of the burn area and then proceeds to apply skin cells. [368] This technology minimises the need for skin grafts as it requires only 10 percent of the patient's skin sample to "grow" the bio-ink needed for printing onto the burn area. Bio printing has the potential to significantly reduce the long organ transplant wait lists that exist across health sectors globally.

The field of 3D printing is recognised as an area of rapid growth for the health care sector, with the next evolution of printing being expected in more advanced bio printing and bioengineering. Examples include providing organs to patients on transplant lists, restoring function to organs, producing dissolvable scaffolding, and bioprinting mesenchymal tissue which can differentiate into different structures like connective tissue, blood, cartilage and bone. [369]

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[361] *Royal College of Surgeons. (2018). Future of Surgery.*
[362] *Royal College of Surgeons. (2018). Future of Surgery.*
[363] *Royal College of Surgeons. (2018). Future of Surgery.*
[364] *Royal College of Surgeons. (2018). Future of Surgery.*
[365] *Aimar, A, Palermo, A & Innocenti, B. Journal of Healthcare Engineering. Vol 19. (2019) The role of 3D printing in medical applications: a state of the art.*
[366] *Pourchet, L et al. (2016). Human Skin 3D Bioprinting Using Scaffold-Free Approach.*
[367] *Wake Forest School of Medicine. (n.d.). Printing Skin Cells on Burn Wounds.*
[368] *Wake Forest School of Medicine. (n.d.). Printing Skin Cells on Burn Wounds.*
[369] *Royal College of Surgeons. (2018). Future of Surgery.*

Robotics

Robotics is defined by the design, construction, operation and application of intelligent machines, and the adoption of robotic surgery has become common place across many hospitals. [370]

Robotic surgery is often defined as minimally invasive surgery involving the use of a computer to control surgical instruments, with the surgeon controlling the computer system rather than total automation of the surgery.[371] This allows movements that a human cannot perform, access to difficult to reach anatomy, less post-operative pain for patients, less blood loss, less scarring, shorter hospital stays and a faster return to normal activities for patients.

The first widely adopted robotic surgery system is the da Vinci Surgical System, approved by the FDA in 2000. The da Vinci Surgical System uses robotic technology to allow the surgeons hand movements to be translated into movements by small robotic instruments inside the patient's body. The system improves accuracy, vision and precision.

The Wesley Hospital has two of these da Vinci systems which have been used to perform more than 3,000 robot-assisted procedures to treat diseases in the areas of urology, gynaecology, colorectal, thoracic, cardiac, and upper gastro-intestinal and lower gastro-intestinal surgeries.[372]

As technologies continue to advance, it is expected that a new generation of robotic surgery will be significantly less expensive, improving accessibility and uptake of robot-assisted surgery.[373] It is also expected that AI will become integrated with robotic surgery, automating tasks that are repetitive or automating tasks that are beyond human capabilities.[374]

Advanced robotics will bring a range of benefits to the surgical occupation, including:[375]

- Improved access to minimally invasive surgery as devices become smaller and less expensive leading to greater uptake;
- Increased precision and reduced variation of surgical outcomes through the analysis of data gathered through procedures and refinement of techniques;
- Improved patient safety through reduction in human-error and adoption of AI mechanisms, with the possibility of remote support from specialists; and
- Innovative surgical interventions for complex conditions, such as head and neck cancer that provide both good oncological outcomes while reducing functional morbidity issues associated with traditional treatments.[376]

Emerging technological advancements in non-robotics have been identified, where surgeons can utilise miniaturised devices that dramatically increase the accuracy of surgical treatments.[377] Nano-robots less than one millimetre will be able to automatically or manually navigate anatomical systems to deliver drugs to targeted areas or perform surgical interventions at the cellular level.[378] This will raise the standard for minimally invasive surgery and will further reduce or even eliminate patient recovery times.

Augmented Reality and Virtual Reality

Traditional surgery relies on surgeons interpreting 2D images, such as x-rays or ultrasounds, whilst continuing to perform surgery on the patient. This split focus increases the risk for human-error and increases the length of the surgery.[379]

The robotic surgery tool Intuitive's daVinci Xi uses cameras to transmit 3D images, however more advanced imagery can be obtained from augmented reality (AR) or virtual reality (VR). AR allows for the superimposition of digital information on the physical world.[380] For example, a surgeon using an AR headset would be able to see digital images and other data directly overlaid in their field of view – such as vital signs data and the characteristics of the surgical target directly above the surgical field.[381]

An example of this is the HoloLens – a wearable AR system operated with head gestures and Genvoice commands. The HoloLens has been

[370] *NHS. (2019). The Topol Review: Preparing the Healthcare Workforce to Deliver the Digital Future.*
[371] *The Wesley Hospital. 2020. Robotic and Minimally Invasive Surgery. Accessed from https://wesley.com.au/services/surgical-services/robotic-and-minimally-invasive-surgery*
[372] *The Wesley Hospital. 2020. Robotic and Minimally Invasive Surgery. Accessed from https://wesley.com.au/services/surgical-services/robotic-and-minimally-invasive-surgery*
[373] *Royal College of Surgeons. (2018). Future of Surgery.*
[374] *NHS. (2019). The Topol Review: Preparing the Healthcare Workforce to Deliver the Digital Future.*
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[376] *Golusinski, W. frontiers in Oncology. (2019). Functional Organ Preservation Surgery in Head and Nek Cancer: Transoral Robotic Surgery and Beyond.*
[377] *Royal College of Surgeons. (2018). Future of Surgery.*
[378] *Royal College of Surgeons. (2018). Future of Surgery.*
[379] *Tagaytayan, R, Kelemaen, A & Sik-Lanyi, S. (2018). Arch Med Sci 14, 3*
[380] *Murthi, S & Varshney, A. Harvard Business Review. (2018). How augmented reality will make surgery safer.*
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used during reconstructive surgery to allow the surgeon to essentially see inside the leg – the bones, blood vessels, and the target areas to perform a more tailored and precise surgery.[382]

Adoption of image guided surgery through the use of AR or VR is increasing, with patient anatomy such as vasculature and tumours recorded using Magnetic Resonance Imaging (MRI) or Computed Tomography (CT) and can be displayed on a screen in front of the surgeon in order to inform surgeon's actions.[383] This can be significantly enhanced through the use of head mounted displays which provide three dimensional views of the target, overlayed on reality, in turn improving visualisation and precision.[384] The capabilities of image-guided, minimally invasive surgeries are dramatically increasing. They are also preferred due to faster recovery times for the patient.

In addition to improving patient outcomes, augmented reality and virtual reality is being used to complement surgical training and preparation for complex surgical interventions. Where virtual surgical training was previously only accessible through expensive and limited simulations, VR is increasing accessibility, effectiveness and affordability for surgical training. An example of VR surgical training is the Osso VR platform, which allows surgeons, sales teams and hospital staff to train and assess sing advanced VR[385]. A randomised study was performed with participants split between a traditionally trained group and a VR training group, using the Osso VR platform. The VR trained group received significantly higher rating in all categories of assessment compared to the traditional trained group, with an overall improvement of 230 per cent in the total score. VR trained participants were also faster and more accurate in their surgical delivery[386].

Genomics and Preventative Surgery

Advances in genomics will bring new understanding of diseases to surgical practice, with many conditions having at least some genetic predisposition.[387] In 2018 the NHS and Genomics England achieved the 100,000th sequence of the 100,000 Genomes Project, which aimed to sequence 100,000 whole genomes from 85,000 NHS patients. The project had four main aims; to create an ethical and transparent programme based on consent; to bring benefit to patients and set up a genomic medicine service for the NHS; to enable new scientific discovery and medical insights; and to kick start the development of a UK genomics industry.

Genomics will help to predict the likelihood of disease and improve clinical decision making, along with the potential for preventive surgery. For example, the treatment of cancer patients could leverage genomics to better predict inherited disease risks and identify risk-reduction interventions.

As genomics advances, precision medicine will become more widespread, allowing patients and clinicians to choose the most effective treatment based on the genomic data.[388]

There is a risk however that this could lead to overtreatment or overuse of risk reduction surgery for patients who would not have otherwise had surgery, which could lead to cost escalation.[389] It will be important to raise public awareness and knowledge of genetic risks and the benefits of genomic medicine whilst monitor the use of such surgery in the future to ensure overtreatment does not occur.

[382] *Van Wagenen. (2018). Healthcare teams gain edge using VR, AR for surgery, training.*
[383] *Perim, B and Botha, C. Visual Computing for Medicine. Computer-Assisted Surgery*
[384] *Keller, K and Fuchs, H. Journal of Display Technology. Head Mounted Displays for Medical Use.*
[385] *OSSOVR. 2020. Reality Surgical Training and Assessment Platform. Accessed from https://ossovr.com/*
[386] *https://hbr.org/2019/10/research-how-virtual-reality-can-help-train-surgeons*
[387] *Royal College of Surgeons. (2018). Future of Surgery.*
[388] *Royal College of Surgeons. (2018). Future of Surgery.*
[389] *Royal College of Surgeons. (2018). Future of Surgery.*

Primary Health Care

While General Practitioners (GPs) have widely adopted clinical systems and telehealth, the next wave of technologies are expected to disrupt traditional service delivery approaches. Technologies, including applications, smart devices, and wearables, will enable a greater focus on consumer empowerment in the management of their health. –

RACGP. [390]

SUMMARY

Technologies such as telehealth, secure messaging, mobile applications and wearables are already changing how primary health care is delivered. Patients are enjoying increased access to health care services, increased ability to self-manage their care and improved access to information.

Digital technologies have become essential in primary care delivery, through activities such as facilitating clinical support, monitoring quality of care, securely sharing patient information, monitoring the spread of infectious diseases and tracking supplies drugs and vaccines.

Virtual Care / Telehealth

The Australian College of Rural and Remote Medicine defines virtual care / telehealth as 'the use of communication and information technology to provide patient care'.[391] It involves the transmission of images, voice, and data between two or more sites using telecommunications to provide health services, such as clinical advice, consultation, education, and training services.[392]

The use of virtual care in primary health care has traditionally been associated with improving access to care for rural and regional services, however telehealth offers a range of benefits for both patients and GPs irrespective of their location. The widespread useability of telehealth purpose is evident through the success of a number of initiatives implemented throughout Queensland, northern NSW, Western Australia and the Northern Territory.[393, 394, 395]

Virtual Care has undergone a period of rapid adoption in Primary Health Care practices across the country during the recent COVID-19 pandemic, with over three million patients accessing telehealth services by the end of April 2020. Staff at the Sydney Local Health District delivered over 14,000 hours of video conferencing during the Covid-19 pandemic, ensuring that patients remained connected to their health care providers, whilst reducing the need to travel, and reducing air pollution and greenhouse gas emissions.[396]

Secure Messaging

Secure Messaging is a safe, seamless, secure exchange of clinical information between health and care providers. Secure messaging involves the secure point-to-point delivery of messages to a single, intended entity. The message is encrypted by the sender and is decrypted by the receiver.

Primary Health Care providers have traditionally used fax or email to share patient information with other providers. Unlike Secure Messaging, email does not provide the level of manageability, assurance and reliability that is consistent with current industry standards, and can create risks to the privacy and security of personal and sensitive health information. The risks of using unsecured or unencrypted email include that: emails can easily be sent to the wrong recipient; email is often accessed on portable devices, such as smart phones, tablets and laptops, which are easily lost or stolen; emails can be forwarded or changed without the knowledge or consent of the original sender; and email is vulnerable to interception.

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[390] *RACGP. 2020. On demand telehealth services. Accessed from https://www.racgp.org.au/advocacy/position-statements/view-all-position-statements/health-systems-and-environmental/on-demand-telehealth-services*
[391] *Muir J. (2014). Australian Family Physician Volume 43, No. 12, Pages 828-830. Telehealth: the specialist perspective.*
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[393] *Clinical Excellence Queensland. (2019). Telehealth Parenting Education Program.*
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[396] *Sweet, M. 2020. The genie is out of the bottle telehealth points way for Australia post pandemic. Accessed from https://www.theguardian.com/australia-news/2020/may/13/the-genie-is-out-of-the-bottle-telehealth-points-way-for-australia-post-pandemic*

In addition to the enhanced security that Secure Messaging can offer, it also has the potential to significantly reduce overheads for primary health care services. An economic analysis, undertaken as part of the development of the ADHA National Digital Health Strategy, has estimated that the gross economic benefit of secure messaging could be around $2 billion over 4 years and more than $9 billion over 10 years.[397]

Primary Health Networks, like the Western Victoria Primary Health Network (WVPHN), have reported an uptake of clinicians utilising secure messaging resulting in a saving of time, money and effort, with WVPHN sending an average of 16,000 messages per month.

Since the release of the ADHA National Digital Health Strategy in 2016, a number of software providers have developed secure messaging solutions for the primary health care market, creating a range of options for health care providers to choose from. However, the number of secure messaging software providers also creates challenges to achieving a national standardised approach, as more software providers have meant more health service directories and limited interoperability between competing secure messaging providers.

Mobile health and wearables

Chronic diseases impact more than seven million Australians, and cost the health system more than $60 billion per year. Primary health care has a critical role to play in minimising avoidable hospital admissions through effective management of chronic conditions.[398]

Smart devices and wearables are effective interventions to support in the management of chronic conditions through providing a way to monitor the individual's different dimensions of health to build a more accurate patient profile. This allows early identification of risks that previously could only be detected through long-term monitoring.[399]

Seventy nine percent of all Australians own a smartphone, while six out of 10 mobile consumers own multiple mobile devices.[400] This increases the ease of widespread adoption of wearable monitoring devices and use of mobile applications.

There are a growing number of examples demonstrating how these technologies can be used, and deliver benefits, in practice. For example, applications such as Zephyr's Biopatch, can automatically log and upload basic health information such as heart rate and repertory rate, ensuring that a patient's health care provider can remain informed on any risk signs a patient is experiencing.[401]

The Liverpool Clinical Commissioning Group in the UK developed a program to support patients with chronic obstructive pulmonary disease, heart failure and diabetes, using technology to assist them to manage their health.[402] Patients use applications and wireless technology to measure weight, blood pressure and heart rate, and in some instances, blood sugar. Readings are then fed into a managed triage hub where nurses monitor their condition and can selectively target home visits as required.[403] This has led to a reduction in the workload of GPs as well as the provision of greater independence and control to patients.[404]

Locally, NSW Health aims to integrate data from patient biometric monitoring devices with existing health records to improve remote patient monitoring and enhance their telehealth capabilities.[405] The current barriers to adoption include the clinical validity of healthcare applications and whether a commercial application is classified a "lifestyle application" or a medical device. It is understood the Therapeutic Goods Administration is currently reviewing the regulatory framework for software as a medical device in Australia.

[397] *Digital Health. 2020. Secure Messaging. Accessed from https://conversation.digitalhealth.gov.au/secure-messaging*
[398] *RACGP. 2014. Digital technologies and chronic disease management. Accessed from https://www.racgp.org.au/afp/2014/december/digital-technologies-and-chronic-disease-management/*
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[404] *Pozniak, H. (2018). Future Health. Meet the GP of the future.*
[405] *NSW Health. (2016). eHealth Strategy for NSW Health.*

Rehabilitation

The global telerehabilitation market was USD 3.32 billion in 2019 and is projected to reach USD 9.13 billion by 2027, exhibiting a CAGR of 13.4 percent during the forecast period from 2020-2027.

– Fortune Business Insights [406]

SUMMARY

Rehabilitation technology is a new and growing field. As repetitive exercise is a crucial part of rehabilitation for people with impaired mobility, the use of technology to augment rehabilitation programs helps patients to improve adherence to treatment plans, gain more independence and ultimately have a better quality of life. [407]

Telerehabilitation

Telerehabilitation can include a range of activities including video calls, voice calls, emails, sharing of documents and pictures, use of youtube or other electronic games or media. Rehabilitation consumers are able to access Telerehabilitation services for medical consultations, allied health assessments, therapy and nursing consultations. [408]

Telerehabilitation reduces the burden of travel, accommodation costs, waiting times and stress on patients, families and carers.

For example, patients who are recovering from a stroke are able to use telerehabilitation to access speech pathology services. The speech pathologist is able to support the patient from their own home to reduce unnecessary stress and time of travel.

Telerehabilitation is becoming increasingly common across the country with State Health Departments adopting the approach. Most recently SA Health have adopted this approach and offer loaned SA Health iPads for clients who are seeking to access the service. [409]

Assistive Technology

Assistive Technology (AT) is an umbrella term for any device or system that allows individuals to perform tasks they would otherwise be unable to do, or increases the ease and safety with which tasks can be performed. AT is a key enabler in the delivery of outcomes under Australia's National Disability Strategy (NDS), with particular focus on NDS outcome areas one (inclusive and accessible communities), four (personal and community support) and five (learning and skills). [410]

Exoskeleton

Exoskeletons are weight bearing supports that can be used to improve quality of life and independence.

An exoskeleton is a hard shell that provides weight bearing support, which can also be powered allowing the user to move freely. The technology has been found to improve psychological well-being through improved quality of life, decrease in anxiety and depressive symptoms.

The ReWalk is the first powered exoskeleton that gained FDA approval for home use. The skeleton features powered hip and knew motions that enable the user to perform self-initiated standing, walking, and stair ascending and descending. [411]

3D Printing

3D printing is being increasingly used in Occupational Therapy to create assistive technology for disabled people. For example, 3D printing has been used to make a custom wrist orthosis which require scanning technology to obtain a digital copy of a person's hand and arm. [412]

This technology can also be used to create printable assistive devices for people who experience finger pain, weakness or a limited range of motion.

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[406] *Fortune Business Insights. 2020. Telerehabilitation market size, share and COVID-19 Impact Analysis. Accessed from https://www.fortunebusinessinsights.com/telerehabilitation-market-103112*

[407] *The George Institute. 2013. Affordable technology to improve physical activity levels and mobility outcomes in rehabilitation. Accessed from https://www.georgeinstitute.org.au/projects/affordable-technology-to-improve-physical-activity-levels-and-mobility-outcomes-in*

[408] *SA Health. 2020. Benefits of telerehabilitaiton. Accessed from https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/services/hospitals/rehabilitation+services/telerehabilitation/telerehabilitation*

[409] *SA Health. 2020. Accessing Telerehabilitation. Accessed from https://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/services/hospitals/rehabilitation+services/telerehabilitation/accessing+telerehabilitation*

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Radiology

The current radiologist is met with ever increasing demands and higher workloads, and the practice is under pressure to accurately diagnose with little margin for error. Further, some diagnoses are reached through subjective decisions, and reported with inconsistent standards. However, technological advances within the field are solving these problems, and complementing the role of radiologists in delivering efficient and effective care. –

The Royal Australian and New Zealand College of Radiologists. [413, 414]

SUMMARY

Radiology is a core function of modern medicine, helping to guide diagnostics, treatment and prognoses. Transformative technologies, many powered by AI, have the opportunity to significantly impact the practice of radiology, in a way that will improve efficiency, diagnostic accuracy and medical treatment. [415]

AI assisted diagnosis in clinical radiology

Traditional radiology relies on a radiologist to interpret the visual characteristics of scans, based on their medical knowledge and training. AI diagnosis techniques within image-based radiology are undertaken through the assessment of visual characteristics of scans. [416] Hence, the capabilities of image recognition using AI are set to have a significant impact in radiology, specifically in the detection of tumours and other abnormalities in scans.

For example, HeadXNet is an AI tool developed by researchers from Stanford University that assists in the detection of brain aneurysms from computed tomographic angiography (CTA) scans. [417] The AI tool detects the presence of aneurysms at each section of the scan and develops an annotated version of the final scan, therefore complementing the role of the radiologist rather than replacing it. This has been shown to reduce rates of missed detections and increase likelihood of diagnosis agreement between clinicians. [418]

It has just received the European CE Mark approval for use. [419] In addition, AiDOC have released an AI package for the identification and triage of stroke in CT scans, reducing "door to needle" time for patients suffering stroke, in turn improving outcomes for those patients. [420]

AI has high potential in easing the workload in mammography with commercial initiatives including products like ProFound AI by iCAD which use AI to analyse 2D mammography scans to detect and annotate areas where tumours may be present. [421] Mammography primarily involves specific and high volume tasks and AI has shown cancer detection accuracy comparable to an average breast radiologist in recent studies. [422]

A recent study describes an AI system that is able to interpret screening mammograms more accurately than radiologists by a margin of 11.5 per cent. The study also ran a simulation where the AI system participated in the double-reading process and was found to reduce the workload of the second reader by 88 per cent. [423]

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[413] *Dewey, M. The Lancet. (2018). The future of radiology: adding value to clinical care*
[414] *The Royal Australian and New Zealand College of Radiologists (RANCZR). (2018). 2016 Workforce Survey Report Australia*
[415] *Walach, E. 2020. Radiology Redefined: How technology is transforming medical imaging. Accessed from https://www.radiologytoday.net/archive/WebEx0518.shtml*
[416] *Hosny, A et al. (2018). Artificial intelligence in radiology*
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[419] *iCAD. (2019). ProFound AI for 2D Mammography.*
[420] *NueroNews. 2019. Aidoc releases complete AI package to speed identification and treatment of stroke.*
[421] *iCAD. (2019). ProFound AI for 2D Mammography.*
[422] *Rodriguez-Ruiz, A et al. (2019). Journal of the National Cancer Institute. Stand-Alone Artificial Intelligence for Breast Cancer Detection in Mammography: Comparison with 101 Radiologists.*
[423] *McKinney,S., Sieniek, M., Shetty, S. 2020. International evaluation of an AI system for breast cancer screening. Accessed from https://www.nature.com/articles/s41586-019-1799-6*

AR & VR in interventional radiology

Interventional radiology is a specialisation that provides minimally invasive diagnosis and treatment of diseases, relying on angiography techniques (imaging of lymph and blood vessels) that are extremely complex.

Interventional radiologists (IRs) are required to undergo substantial amounts of ongoing training to increase proficiency in specific procedures. [424] AR and VR technologies provide an opportunity to supplement radiology training through helping trainees conceptualise complex anatomy.

For example, VR systems such as the VIST Virtual Patient by Mentice create a simulation of the patient on the display monitors in the angiography suite. [425] The system uses previous case files or is given patient MRI and CT scans to provide real-time feedback to procedure steps to simulate a real procedure. [426] The system can be used to accelerate training for inexperienced IRs and can also be used by experienced clinicians to improve their skills for certain types of cases.

Similar to the application of AR and VR technologies in surgery, AR technology can also be used in IR to overlap diagnostic images of a particular lesion directly onto the patient, helping to visual the fused anatomy and increase accuracy in targeting the lesion. [427]

Big Data in radiation oncology

The increasingly powerful computational hardware and software will have significant benefits within radiation oncology. [428] Increased computational power and cloud computing will enable deep learning solutions to improve existing operations, treatments and discover new opportunities to adapt treatments to individual patients for increased effectiveness. [429]

Upgrades in IT infrastructure, computational advancements, and integration of systems will also enable Big Data capabilities. [430] Big Data can facilitate the integration of databases across radiation oncology sites. Its impacts include the ability to establish 'Virtual Clinical Trials' over a number of sites, accelerating clinical validation of new treatments, and the use of informatics tools that allow for monitoring of the quality of oncology care at the point of delivery.

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[430] *Chetty, I et al. (2015). Technology for Innovation in Radiation Oncology.*

Pathology

Frost & Sullivan found the global digital pathology market to be valued at $440 million. Revenue is expected to reach $709 million by 2021. The future of digital pathology will be built on technologies such as deep learning, machine learning and Big Data analytics.
–

Alliance of Advanced BioMedical Engineering. [431]

SUMMARY

100 percent of cancers are diagnosed by pathology and 70 percent of all medical decisions rely on pathology services. [432] *Increases in capability, accuracy, and time-sensitivity brought about from emerging technologies, and its effective adoption into clinical practice will result in significant benefits for the whole healthcare system.* As technologies evolve and more data becomes available to support the continued learning of AI technologies, it is expected the cost of testing will decrease and more patients will have access to digital pathology solutions.

Clinical digital pathology

Pathology has historically involved slides containing tissue samples prepared by laboratory technicians being examined under microscope by a pathologist. [433] This process is time intensive for both the laboratory technician and the pathologist, whilst creating logistical challenges for transportation of fragile slides between rural sites and larger pathology sites, and given Australia's wide and sparse population this remains a significant challenge. Further, pathology laboratory accreditation requires slides to be retained for a minimum of 10 years, which causes strain on laboratory space. [434]

Considering the significant challenges associated with historical slide based pathology, clinical digital pathology systems are providing advantages in reducing the time to prepare and assess slides. In clinical digital pathology, following preparation and staining by a technician, the slides can be loaded into fully automated scanners that take high quality digital microscopic images at high volumes for analysis by pathologists. [435]

Clinical digital pathology systems are currently being implemented across Australia. Some private pathology services are on track to become fully digitised pathology networks by incorporating commercial scanner solutions at all sites which can assist in challenges associated with servicing rural and remote regions of Australia. [436]

Genomics

Pathology has changed significantly as a result of genomics, allowing rapid disease diagnosis and early intervention and tailoring of treatment plans.

For example, traditional anatomical pathology conducts analysis of tissue morphology to provide a diagnosis. If cancerous cells are found, traditional treatment methods generally involve use of standard chemotherapy and radiotherapy. [437] Integration of genomic medicine with existing morphology techniques increases the quantity and quality of information available to support a diagnosis. Genomic medicine enables increased stratification and subtyping of cell types. The detailed characterisation of cell types enabled by genomics generates information about how subtypes of cancerous cells will respond to different therapies.

This is especially useful in cancer diagnosis and therapies, where stratification of different tumour cell subtypes drives targeted therapies for each subtype, reducing the need to use standard chemotherapy and radiotherapy, both which may have significant side effects. [438]

[431] *Alliance of Advanced BioMedical Engineering. 2020. Innovations and Impact of Digital Pathology. Accessed from https://aabme.asme.org/posts/innovations-and-impact-of-digital-pathology*
[432] *Pathology Awareness Australia. (2016). What is Pathology?*
[433] *Pathology Awareness Australia. (2016). Digital Pathology: Enabling Accurate Diagnosis at a Distance.*
[434] *Pathology Awareness Australia. (2016). Digital Pathology: Enabling Accurate Diagnosis at a Distance.*
[435] *Pathology Awareness Australia. (2016). Digital Pathology: Enabling Accurate Diagnosis at a Distance.*
[436] *Philips. (2019). Digital pathology speeds up collaboration across laboratories.*
[437] *Moorhead, J & Jones, L.NHS. (2019). Genomics in Histopathology.*
[438] *Moorhead, J & Jones, L.NHS. (2019). Genomics in Histopathology.*

In recent years the term genetic pathology has emerged as a sub-speciality of pathology that contribute to the multidisciplinary range of skills required within pathology services to aid in the diagnosis, management and treatment of patients with disorders arising from genomic mutations.[439] Analysis of data is carried out in genetic diagnostic laboratories which produce accurate genomic data and clinically interpret this data.

AI-assisted diagnosis

Research has found that AI has the potential to advance pathology. It has been found that AI technologies can identify regions of interest in histological slides, employing image correction techniques to highlight areas for human analysis.[440]

Further research is also being undertaken to train AI to diagnose based on whole slides, bypassing human interaction until the final stage of analysis, however accuracy of diagnosis from this research remains lower than the accuracy of manual analysis of 99.4 percent.[441] An AI algorithm developed by Google, Lymph Node Assistant (LYNA), reported that the algorithm could successfully detect metastatic breast cancer on slides 99 percent of the time. It was reported that using LYNA resulted in time-saving benefits of 50 per cent[442].

Training of AI requires time and high quantities of good quality data to be fed into the software for it to "learn" and improve its abilities.[443] Good quality data from digital tissue slide images is becoming increasingly available with the widespread use of digital pathology, hence the clinical validity of AI-assisted diagnosis will be achieved at an accelerated rate.

Internet of Things and Cloud technology

IoT technologies, combined with the benefits of cloud technologies, are emerging in pathology to help with point of care diagnostics and reduce the time taken to identify disease.

An example is a voice pathology detection system, which uses local binary pattern recognition and machine learning to detect the pathology.[444] IoT technologies can also be used to remotely detect viral outbreaks that enable early quarantining of the infected. This has been useful where disease is spread in remote areas and is spread by insects.[445]

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[439] Royal College of Pathologists Australasia. 2020. Genetic Pathology. Accessed from https://www.rcpa.edu.au/getattachment/20903e1f-1a2f-41c4-9383-76cfec26d5dc/Genetic-Pathology-Medical-Genomics-Handbook.aspx
[440] Chang, H et al. (2018). Artificial Intelligence in Pathology
[441] Chang, H et al. (2018). Artificial Intelligence in Pathology
[442] Google AI Blog. 2018. Applying Deep Learning to Metastatic Breast Cancer Detection. Accessed from https://ai.googleblog.com/2018/10/applying-deep-learning-to-metastatic.html
[443] Chang, H et al. (2018). Artificial Intelligence in Pathology
[444] Muhammad, G et. al. (2017). Smart health solution integrating IoT and cloud: A case study of voice pathology monitoring. IEEE Communications Magazine. Volume 55, Issue 1
[445] Puri, D. (2016) Using IoT-enabled microscopes to fight epidemic outbreaks.

Dermatology

Although a potentially golden era of intelligent dermatology software and tools, research clearly demonstrates that only the combination of human ingenuity mixed with technology can remain the uncontested ideal for providing optimized patient care. –

DermEngine. [446]

SUMMARY

Dermatology has undergone a range of changes over the last decade due to the impact of new technologies. Skin cancer is estimated to be the fourth most commonly diagnosed cancer with over 15,000 new diagnoses as of August 2019. [447] The mortality rate of skin cancer has also increased from 4.5 deaths per 100,000 in 2016 to 5.6 deaths per 100,000 in 2019. [448] The need to support the dermatology workforce to curb this growth is increasing. Fortunately, emerging technologies are enabling rapid progress toward a more consumer centric model that yields rapid and accurate diagnoses based on data, alongside more effective and tailored treatments. [449]

AI-based skin cancer diagnosis

There is significant progress being made in the use of automated image interpretation using AI to diagnose skin cancers with high levels of accuracy. A recent international surgery of over 1000 dermatologists found that 85 per cent were aware that AI was an emerging technology in their field [450].

A number of research topic focus on the use of AI to distinguish between different types of cancer, such as benign nevi vs melanoma. For example, computer scientists at Stanford University have created an artificially intelligent diagnosis algorithm for skin cancer. [451] The program was developed through machine learning analysis of 130,000 skin disease images to develop the ability to visually recognise potential skin abnormalities. Studies suggest this technology is more accurate than the human assessment. [452] In a non-clinical test between a group of 58 dermatologists and an AI-based system, the AI outperformed the dermatologists by identifying 89 percent of melanomas from a set of dermatoscopy images compared to 86.6 percent by the dermatologists. [453]

FotoFinder, a German company specialising in skin cancer imaging and diagnostics, have created Moleanalyzer Pro. [454] This software enables AI and deep learning powered assessment of dermatoscopy images to provide a highly accurate risk score of skin lesions to support the dermatologist's assessment.

Teledermatology

Seventy nine percent of all Australians own a smartphone, while six out of 10 mobile consumers own multiple mobile devices. [455] A number of software providers such as FirstDerm, Spruce, Direct Dematology and iDoc24 have emerged into the teledermatology space.

These technologies work using the same principles, connecting patients to a dermatologist online for a consultation with the ability for patients to securely send images of skin lesions through a smartphone application through an affordable dermatoscope attachment placed over the phone camera. [456] Coupled with the use of image processing software, the application allows dermatologists to efficiently and effectively diagnose patients remotely and prescribe next steps accordingly. [457] This reduces unnecessary in-clinic visits, and allows more time to deliver quality care for those who need it.

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[446] DermEngine. 2018. How Are Digital Health Technologies Changing The Dynamics Of Human Relationships? Accessed from https://www.dermengine.com/blog/dermatology-digtial-health-technology
[447] Cancer Australia. Australian Government. (2019). Melanoma of the skin statistics.
[448] Cancer Australia. Australian Government. (2019). Melanoma of the skin statistics.
[449] DermEngine. 2018. How Are Digital Health Technologies Changing The Dynamics Of Human Relationships? Accessed from https://www.dermengine.com/blog/dermatology-digtial-health-technology
[450] Frontiers in Medicine. 2020. Artificial Intelligence Applications in Dermatology: Where do we stand? Accessed from https://www.frontiersin.org/articles/10.3389/fmed.2020.00100/full
[451] Kubota, T. Stanford News. (2017). Deep learning algorithm does as well as dermatologists in identifying skin cancer.
[452] Mammoser, G. HealthLine. (2018). AI May Be Better at Detecting Skin Cancer Than Your Derm.
[453] Mammoser, G. HealthLine. (2018). AI May Be Better at Detecting Skin Cancer Than Your Derm.
[454] FotoFinder. (2019). Skin cancer diagnostics intelligent and connected with Moleanalyzer pro.
[455] The Royal Australian College of General Practitioners. (2016). Mobilising healthcare.
[456] The Medical Futurist. 2017. Amazing Technologies Changing the Future of Dermatology. Accessed from https://medicalfuturist.com/future-of-dermatology/
[457] DermEngine. (2019). MoleScope by MetaOptima: Smart dermoscopy made simple.

Genomics

A substantial amount of genetics research has been dedicated to the characterisation of specific genes, their involvement in skin pigmentation pathways, and the pathological effect of their mutation. [458]

Genomics in skin diagnosis is currently in clinical use and has assisted dermatologists in identifying extremely rare skin conditions in patients that have similar symptoms to more common conditions. [459] Recognising its potential in dermatology, the National Health Service (UK) is delivering education in genomics to dermatologists through professional development courses to build capacity. [460]

[458] *Ainger, S et al. (2017). Skin Pigmentation Genetics for the Clinic.*
[459] *Gupta, A et al. Whole-exome sequencing solves diagnostic dilemma in a rare case of sporadic acrokeratosis verruciformis.*
[460] *Genomics Education Program. NHS. (2019). About us.*

Disability

Back in 2016, we doubled down on accessibility and our vision to empower more than 1 billion people around the world with disabilities by providing them with technology. What we have learned since is that it takes a village, an army of passionate, incredibly talented people to drive change –

Microsoft President Brad Smith. [461]

SUMMARY

One in five Australians identify with having a disability and technology has the ability to help people with disabilities improve their quality of life and support increased independence and wellbeing. Technology has been helping people with disabilities for a number of years, through technologies such as motorised scooters and hearing aids, however recent advances in technology have opened up previously unseen opportunities to increase the breadth of support available to people with disabilities.

Mobile Applications

Seventy nine percent of all Australians own a smartphone, while six out of 10 mobile consumers own multiple mobile devices. [462] There are a number of mobile applications that are already supporting people with disabilities. For example, over 100,000 deaf and hard of hearing people have used an app called Ava which allows the user to take part in group conversations in either English or French. The app requires everyone in the conversation to open the app, Ava then listens and converts spoken words into text in real time, rendering each speakers words into different colours to help the reader follow the conversation. [463]

Another example, is an app called Voiceitt which was created to support people with speech impediments by using machine learning to pick up on the users speech patterns, recognise any mispronunciations and adjust their speech before creating an output of audio or text.

Telecare

Telecare is an integrated system of communication devices, personal and environmental sensors that can operate in the home and remotely. Telecare equipment can be programmed to call for help in an emergency or automatically alert when help is needed. This can include sensors on doorways, smoke alarms and door entry systems.

Afford, an Australian disability not-for-profit launched Afford TeleCare as a contract-free and virtual method of delivering disability supports to individuals across Australia who require access to essential care from allied health professionals for overall health and mental wellbeing. This technology was released amidst the Covid-19 pandemic where the disabled population required continued access to care and support from their home. Afford TeleCare connects users to allied health professionals across a range of services such as psychology, occupational therapy, emotional regulators and speech pathology through a virtual platform. [464]

Pupil Centre/Corneal Reflection

Public Centre/Corneal Reflection (PCCR) is the technology that sits behind computers that can be controlled by a person's eye.

An example of this is Eyegaze Edge, a table that is set up in front of the user, with a small video camera underneath. A near-infrared LED light illuminates the user's eye, and the camera then measures the distance between the centre of your pupil and the reflection LED light in your cornea. This distance shifts as the direction of your gaze changes, enabling the computer to identify where on the screen you are looking.

A similar technology tracks the position of the head, HeadMouseNano has a camera that tracks the movements of a reflective dot stuck to the user's forehead and these motions control the computer cursor. This technology requires slightly more motor function from the user but is significantly cheaper. [465]

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[461] Microsoft. 2020. Stories from inside Microsoft's journey to design a more accessible world. Accessed from https://news.microsoft.com/stories/people/jenny-lay-flurrie.html
[462] The Royal Australian College of General Practitioners. (2016). Mobilising healthcare.
[463] PBS. 2019. How people with disabilities are using AI to Improve their lives. Accessed from https://www.pbs.org/wgbh/nova/article/people-with-disabilities-use-ai-to-improve-their-lives/
[464] PRWire. 2020. Afford telecare delivers contact free allied health to the disability sector across Australia in response to covid19. Accessed from https://prwire.com.au/pr/89221/afford-telecare-delivers-contact-free-allied-health-to-the-disability-sector-across-australia-in-response-to-covid-19
[465] BBC. 2016. The tech giving people power to deal with disability. Accessed from https://www.bbc.com/news/business-35427933

3D Printing and Bio-electronics

Advances in 3D printing and bio-electronics have considerably impacted people who experience physical disability through replacing missing limbs with individualised prosthetics providing increased functionality.

For example, Thalmic Labs have developed a technology called Myo which is an armband enabling a person to control computer devices by reading the electricity produced by their skeletal muscles and sending these signals wirelessly via Bluetooth to the device. This armband was adapted by researchers at Johns Hopkins University to enable the control of prosthetic limbs.[466]

Artificial Intelligence & Robotics

Advances in AI have prompted the development of a range of smart devices to help people overcome physical and cognitive disabilities. Smart voice-controlled devices powered by AI such as the Amazon Echo Show, are helping people with disabilities have a greater degree of independence in going about everyday tasks.

For example, AI is being explored to help people navigate the NDIS. The concept of an AI powered virtual assistant, Nadia, was announced by the National Disability Insurance Agency (NDIA) in 2017. Though still in development and testing phases of development, Nadia will use cognitive technology developed by the IBM Watson team to respond to participants' questions, matched with an animated mouth and face.[467]

Organisations across the world are starting to realise the impact that AI can have on supporting people with disabilities. In recognition of this Microsoft created a program called "AI for Accessibility" with $25 million funding with the goal to develop more AI within the firm and allocate grant funding to organisations who are seeking to build tools for disabled communities.[468]

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[466] *BBC. 2016. The tech giving people power to deal with disability. Accessed from https://www.bbc.com/news/business-35427933*

[467] *Centre for Digital Business. 2018. Joint Standing Committee on the National Disability Insurance Scheme Senate Inquiry – NDIS ICT Systems.*

[468] *PBS. 2019. How people with disabilities are using AI to improve their lives. Accessed from https://www.pbs.org/wgbh/nova/article/people-with-disabilities-use-ai-to-improve-their-lives/*

Aged Care

Digital health, clinical informatics and assistive technologies have the potential to significantly improve the aged care system through increased efficiency and coordination of care providers and by supporting healthy ageing –

AMA. [469]

SUMMARY

The aged care sector is in the midst of a period of rapid change, with growing demand for services, large scale aged care reform and rapid advancements in technological interventions. In recognition of this period of change and the role that technology could play, the Aged Care Industry Information Technology Council (ACIITC) commissioned the Technology Roadmap for Aged Care in 2016.

Technology has the potential to improve quality of life for older Australians, and to transform the way in which people interact with services and support.

Smart Homes and Telecare

Almost all older people would prefer to live in their own homes. Smart home technology embeds a range of technologies to produce greater automation, energy efficiencies, convenience, security and self-management.

Smart home technology and telecare can also work together to provide virtual health monitoring. For example, Telstra Health has developed their Virtual Health Monitoring (VHM) solution which connects healthcare providers with patients via a secure digital health platform enabling healthcare professionals to monitor the health and wellbeing of their patients. The VHM technologies allow patients to transmit their symptoms and vital signs when connected to the patient app which includes monitoring pulse, oxygen saturation, temperature, blood glucose, weight and blood pressure. [470] These technologies have the potential to reduce the likelihood for many people entering residential aged care.

ePrescriptions

As discussed in an earlier section, ePrescribing provides an option for prescribers and patients to use an electronic PBS prescription. [471] There are currently two forms of electronic prescriptions; tokens and active script lists. The token form requires the user to have a token sent to their mobile via an app, SMS or email, which is then scanned by the pharmacist to unlock the prescription. The active script list form, which is not yet widely available, allows the pharmacy to have active list of all patient prescriptions in their software, removing the middle step requiring the patient to hold a token.

Telstra Health's prescription software is eRx Script Exchange, which has traditionally allowed doctors to print scripts with an eRx barcode that patients can then take to their pharmacy to fill their script. eRx will soon adopt the token and active script list technologies to allow for electronic prescribing. [472]

During the COVID-19 environment, measures to improve access to medicines and reduce the burden on GP's and support self-isolation protocols were introduced in Queensland. This included continued dispensing arrangement for ongoing supply PBS subsidised medicines and a home delivery services for PBS medicines. [473] Although some of these measures may be reversed as the pandemic's impact eases, these measures are ultimately more beneficial to the aged. There are continued calls by the Pharmacy Guild for the Commonwealth Government to ease dispensing limits for repeat prescriptions to minimise the requirement for individuals to visit the doctor to receive the same prescription. [474]

Artificial Intelligence

AAI is helping patients and families to stay better connected through improving remote monitoring solutions, enhancing smart home technologies and enabling virtual home assistants.

[469] *AMA. 2019. Technological innovations needed for aged care. Accessed from https://ama.com.au/ausmed/technological-innovations-needed-aged-care*
[470] *Telstra Health. 2020. Virtual Health Monitoring. Accessed from https://www.telstrahealth.com/home/products/mycaremanager.html*
[471] *Department of Health. 2020. Electronic Prescribing. Accessed from https://www.health.gov.au/initiatives-and-programs/electronic-prescribing*
[472] *eRx script exchange. 2020. ePrescribing. Accessed from https://www.erx.com.au/eprescribing/*
[473] *Department of Health. (2020) (Minister Greg Hunt Statement) Ensuring continued access to medicines during the COVID-19 pandemic. Accessed from: https://www.health.gov.au/ministers/the-hon-greg-hunt-mp/media/ensuring-continued-access-to-medicines-during-the-covid-19-pandemic.*
[474] *Woodley, M. (2019) Government urged to easy pharmacy dispensing restrictions. Accessed from: https://www1.racgp.org.au/newsgp/professional/government-urged-to-ease-pharmacy-dispensing-restr*

AI enabled smart home technologies such as Amazon Echo are using AI to enable medication adherence and care coordination, whilst a remote monitoring technology called CarePredict is using AI to continuously detect changes in patient behaviour patterns to enable early detection of health issues.

A number of technology providers, such as Catalia Health's Mabu have also developed AI enabled virtual home assistants.[475] Mabu is a conversational robot that can provide tailored conversations by learning about each patient's personality, interests and treatment challenges.

[475] *Catalia Health. 2020. The Catalia Health Platform: How it works. Accessed from http://www.cataliahealth.com/how-it-works/*

Child and Family

Most Australians, even many from vulnerable and disadvantaged groups, now have access to the Internet and are using it regularly and comfortably to communicate, socialise and investigate services and products.

SUMMARY

There is a significant gap in research on the extent to which social assistance currently use digital technologies and the potential opportunities that digital technologies may bring to the child and family area.

Child Family Community Australia have undertaken a series of research activities discussing how technology could add value to service provision for the child, youth and family sector. From both research and consultation it was concluded that there is a significant gap in knowledge regarding how technology could be used to deliver child, youth and family services. [477]

E-counselling

Although significant strides have been made in increasing awareness of the importance of mental health, and normalising the discussion of mental illness, there is still stigma associated with mental health problems and health seeking. Furthermore, access to quality counsellors can be prohibitively expensive and the logistics of finding one that is compatible to the individual's needs and personality can be difficult, especially in regional and rural areas.

E-counselling via virtual platforms, is enabling greater access to the right care for the some of the most vulnerable and disadvantaged groups in the community by bypassing many of the

As access will only continue to increase over time, it is worth considering how harnessing some of the benefits of new technologies can improve and expand services for families that will allow clients and practitioners to connect easily and efficiently, engage and ultimately benefit from improved outcomes –

Child Family Community Australia. [476]

drawbacks that are inherent in traditional counselling services. E-counselling can provide a less expensive and more discrete service. It also allows greater access to a more diverse range of clinicians and experts which would traditionally be unavailable due to geographical barriers. [478]

Programs such as the MoodGYM Cognitive Behaviour Training Program was created by researchers, mental health experts and IT specialists at the Australian National University. MoodGYM provides an effective, anonymously accessible, virtual solution for adults and young people that has been effective in decreasing or preventing depressive symptoms and has approximately 650,000 registered users in 220 countries. [479]

Interoperability

Another advantage of the increased adoption of digitised solutions for counselling is its interoperability with other services and agencies.

One of the key benefits with this is the sharing of data and information about children and families across agencies acknowledging that a whole of family understanding of education, health, child protection, youth justice, housing and homelessness and domestic and family violence provide better insight for children and families requiring complex support.

[476] *Child Family Community Australia. 2013. Using technology in service delivery to families children and young people. Accessed from https://aifs.gov.au/cfca/publications/using-technology-service-delivery-families-children/conclusions*

[477] *Child Family community Australia. 2018. Digital technology use in the child, youth and family sector. Accessed from https://aifs.gov.au/cfca/publications/digital-technology-use-child-youth-and-family-sector*

[478] *Child Family Community Australia. 2013. Using technology in service delivery to families children and young people. Accessed from https://aifs.gov.au/cfca/publications/using-technology-service-delivery-families-children/conclusions*

[479] *Child Family Community Australia. 2013. Using technology in service delivery to families children and young people. Accessed from https://aifs.gov.au/cfca/publications/using-technology-service-delivery-families-children/conclusions*

APPENDIX G

Mining and METS Technologies

Technologies specific to Mining and METS workforce segments

As technologies that are well-embedded within the Mining and METS industry are already delivering cost savings, productivity gains, safety advances and reducing environmental impacts, the future focus will continue to shift to emerging digital technologies that can continue to transform and drive the industry into the future. Emerging technologies, such as AI, robotics and advanced data analytics, represent significant opportunity and are capable of revolutionising the industry once more.

New technologies have the potential to disrupt traditional businesses models, as well as the traditional occupations, roles and tasks that are performed by the workforce within the Mining and METS industry. It will be increasingly important for mining organisations to proactively seek technology solutions that continue to drive efficiencies and ensure that their workforce is suitably skilled during the transformation journey

Mine Planning & Management

Management teams must realise that tech-enabled transformation is a journey unique to every company and mine, not a one-off application of use cases. There are no silver bullets, and no one list of technologies that every company should implement. There will be hundreds, and ultimately thousands, of ideas, improvements, and use cases. A company should start by identifying a use case that will provide a high return on investment –

Shabir Ahmed [480]

SUMMARY

Without end-to-end visibility and integration across the value chain, the planning and management of mine sites and operational variables such as asset health, process performance or geological variance are often reactive and misaligned with downstream activities. Through the use of technologies, more effective planning and management can be done upstream to optimise the processes leading to the best long term outcomes.

Mine planning is requiring a deeper and continuously up to do date understanding of the resource base, where previously this would have been based on historical data, mining companies can now leverage software providers who have offerings in this area that involve better connections between modelling and planning tools based on sensor fed information.

Chemical Analysis & Photo Assay

Due to limitations in ore supply there is an industry wide trend towards mining larger, lower grade ores that result in a higher amount of waste materials. These waste materials can be harmful to the environment as well as incurring costs on the mining company to clean the material. There is increasing pressure to improve methodologies for mining in a way that minimises wastes, in order to protect the environment and reduce liabilities.

For example, Chrysos Corporation have developed a PhotonAssay solution which provides rapid, accurate, safe and non-destructive ore grade analysis. The technology hits samples with X-rays, causing short-lived excitation of atomic nuclei of targeted elements. These excited nuclei then give off a characteristic signature that can be detected and used to calculate metal grade.[481]

Data and Analytics

A holistic approach to mine planning leveraging data analytics can create value and opportunities across the value chain. Data and analytics are helping mine planners and

[480] *Matthew Hall. Mining Technology. 2020. Could COVID-19 spark an autonomous revolution in mining? Available at https://www.mining-technology.com/features/could-covid-19-spark-an-autonomous-revolution-in-mining/*

[481] *Chrisos Corporation. Available at https://chrysos.com.au/*

managers to monitor, collect and analyse information from pieces of mining equipment, creating insight into the health and performance of equipment and infrastructure that would not have previously been possible. This enables mining companies to measure data in real time such as fluid temperatures, pressures and vibrations. The use of data and analytics can help in identifying risks early in order to avoid unexpected downtimes or failures.[482]

Blockchain

Blockchain is changing the operating dynamic of organisations across many sectors including the Mining and METS industry. Blockchain is a decentralised distributed ledger that records transactions between two parties. It moves transactions from a centralised server-based system to a transparent cryptographic network.

As consumer demand for transparency, quality and known providence increase, the use of blockchain has the ability to increase supply chain transparency and tracking for mining organisations. Mining companies most impacted by blockchain technology include those for whom there is a competitive advantage in being able to demonstrate that their metals/minerals are sourced ethically.

This is particularly beneficial to companies legitimately mining and trading precious metals, cobalt and diamonds.

For example, Ford Motor Company, Huayou Cobalt, IBM, LG Chem and RCS Global launched a pilot program in 2019 to address concerns around their mineral supply chain. The project used the IBM Blockchain Platform to create a simulated sourcing scenario. This meant the cobalt products at Huayou's mining operation could be tracked as they travelled from the mine to be smelted at the LG Chem plant in South Korea, and onto the Ford plant in the United States to be turned into cars.[483]

[482] *Mining Global. 2016. Examining the Internet of Things and its impact on the mining industry in 2016. Available at https://www.miningglobal.com/technology/examining-internet-things-and-its-impact-mining-industry-2016*

[483] *IBM News Room. 2019. Ford Motor Company, Huayou Cobalt, IBM, LG Chem and RCS Global Launch Blockchain Pilot to Address Concerns in Strategic Mineral Supply Chains. Available at https://newsroom.ibm.com/2019-01-16-Ford-Motor-Company-Huayou-Cobalt-IBM-LG-Chem-and-RCS-Global-Launch-Blockchain-Pilot-to-Address-Concerns-in-Strategic-Mineral-Supply-Chains*

Mining Exploration

Discovery of the next generation of gold mines requires developing better ways to target and map the gold mineralising systems. Gold Road Resources is utilising the innovative technologies and knowledge advances developed to identify new areas with gold potential and refine understanding of known gold systems, effectively improving the way we go about our exploration. –

Kevin Cassidy,
Chief Geologist Gold Road Resources [484]

SUMMARY

Mining exploration uses historic data to identify potential areas of mineral deposits. Through the use of technologies innovative exploration designs can be created that optimise the targeting and identification of potential sites. This will result in fewer drill operators and traditional surveyors whilst increasing the demand on data analytics.

Geo-Spatial Data and 3D Mapping

Geo-spatial data is data about objects or events that have a location on the earth's surface, the location can be static such as the location of a road or earthquake event, or dynamic such as a moving vehicle or pedestrian. Geo-spatial data combines location information, attribute information and temporal information. [485] 3D Mapping leverages geo-spatial data to profile objects in three dimensions, and map them in the real world.

Geo-spatial data and 3D mapping technology provide the ability to view, compare and evaluate data to build a greater understanding of what is beneath the earth's surface. When used for mineral exploration the use of these technologies can increase geological and metallurgical prediction, providing the organisation with an increased probability in recovery of mineral deposits. The use of these technologies alongside mining databases has the potential to increase resource identification, improve waste classification and drilling efficiency and effectiveness. [486]

Geo-spatial data, 3D mapping and hyperspectral core imaging allow the material drilled to be continuously monitored, while tools such as autonomous drills allow exploration methods to be adapted in response to information gathered. Companies already employing such technology include Rio Tinto and BHP, the former with its 3D mapping technology and the latter with its downhole assay.

Rio Tinto developed a 3D visualisation technology, RTVis, that is being used within Australian mines. This technology is linked to the Mine Automation System (MAS) and evaluates data collected to gain a deeper understanding of deposits located below the surface resulting in improved boundary identification and field task planning. The technology allows workers to make faster and more informed decisions contributing to a boost in productivity and cost savings. [487]

CSIRO has created new underground mapping technology called ExScan, which is a combination of laser scanning and software that creates real time 3D maps of tunnels, walls and cavities underground where GPS does not penetrate. These maps can then be used for locating, steering and navigating equipment and vehicles. The technology is being trialled at five Australian mining companies as well as companies overseas. [488]

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[484] International Mining. 2020. CSIRO uncovers innovative approach to Yilgarn gold exploration. Available at https://im-mining.com/2020/05/28/csiro-uncovers-innovative-approach-gold-exploration/

[485] Science Direct. 2016. Geospatial Reasoning with Open Data. Available at https://www.sciencedirect.com/topics/computer-science/geospatial-data

[486] Ernst & Young. 2019. Future of Work: The economic implications of technology and digital mining. Available at https://minerals.org.au/sites/default/files/190214%20The%20Future%20of%20Work%20The%20economic%20implications%20of%20technology%20and%20digital%20mining.pdf

[487] Rio Tinto wins 'gold medal' at awards for innovative mine technologies, Rio Tinto, 29th May 2017, URL: https://www.riotinto.com/media/media-releases-237_22401.aspx ; Accessed: 20thNovember, 2018

[488] Spatial Source. 2020. CSIRO is mapping the underground. Available at https://www.spatialsource.com.au/3d-bim/mapping-the-underground

Artificial Intelligence

AI is being used to enhance the predictability of mine sites. AI has the ability to analyse large volumes of complex structured and unstructured data. For example, Goldcorp and IBM created a new technology which aims to improve predictability for gold mineralisation using search and query capabilities across exploration datasets collected from GoldCorp's mine in northern Ontario.[489]

Autonomous Drilling

Mining exploration is currently conducted through analysing historical data and assessing material characteristics throughout the drilling exploration process.

The use of autonomous drilling can enhance this process through real-time data capture enabling the continual assessment of the material characteristics during the drilling process, allowing the exploration design to adapt dynamically. Autonomous drills collect live data and are able to respond consistently to the material characteristics identified, providing the opportunity to dynamically adjust the exploration drilling design, resulting in a reduction of drilling costs and improved geological information, providing benefits to downstream mining operations.[490]

For example, BHP has been using downhole assay in their Pilbara mine operations which enables real-time data capture during exploration. The technology minimises drilling waste and is predicted to save BHP more than US$10 million on drilling and assay costs.[491]

It is expected that the number of autonomous drills will increase, leading to a reduction in the requirement for traditional drill operators and shifting the focus of workforce capability from traditional mining to decision support enabled through technology.

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[489] Golgcorpand IBM Develop New AI Technology Solution to Improve Predictability for Gold Mineralization, Goldcorp, URL: https://www.goldcorp.com/English/investors/news-releases/news-release-details/2018/Goldcorp-and-IBM-Develop-New-AI-Technology-Solution-to-Improve-Predictability-for-Gold-Mineralization/default.aspx ; Accessed: 20thNovember, 2018

[490] Ernst & Young. 2019. Future of Work: The economic implications of technology and digital mining. Available at https://minerals.org.au/sites/default/files/190214%20The%20Future%20of%20Work%20The%20economic%20implications%20of%20technology%20and%20digital%20mining.pdf

[491] Downhole data without delay, CSIRO, URL: https://www.csiro.au/en/Research/MRF/Areas/Resourceful-magazine/Issue-10/Downhole-data-without-delay ; Accessed: 20thNovember, 2018

Mining Operations

Safer working conditions through improved underground communication, automation, more sophisticated mineral and metal transportation, and emergency response measures are achieved by integrating technology into mining projects. Technological advancements in mining are also making operations more productive. This can be seen in the use of robotics operating 24 hours a day, real-time monitoring of minerals and metals through mines and processing plants, and using simulations at the mine design stage to test different solutions before implementation. –

Stacy Corneau [492]

SUMMARY

The mining operations component of the value chain includes development, production and processing. Mining operations are benefiting from technology through the improved flow of information and use of autonomous mining solutions that reduce downtime and sub-optimal operations, creating safer environments for workers.

Traditionally mining operations used a drill and blast design with minimal use of geological data. Technology creates the opportunity to tailor extraction processes based on geological information, whilst leveraging autonomous drills to increase efficiency. The adoption of technology within this space will likely lead to a reduction in the requirement for drill operators, whilst increasing the demand for data analytics and technology informed decision support.

Geo-Spatial Data and 3D Mapping

The understanding and accuracy of geological modelling is the key to efficient and effective mining. As noted above, the traditional approach to creating an understanding of the mine's geographical composition and structure used historical data from previous explorations and took point in time samples from exploratory drilling exercises.

The advances in technology have created the ability to understand the mine site through data collection and 3D mapping, creating an opportunity to optimise the mine plan and drill pattern to ensure optimal results. The access to real-time data and the data captured from exploration enables mine operators to customise drill patterns, enabling drills to differentiate between rock types and waste and therefore reduce the total number of holes drilled, explosives consumed and increase the quality of ore extracted.

Autonomous Trucks

The use of autonomous trucks has transformed mining operations over recent years, with companies seeing increased equipment utilisation, optimised fleet performance, increased productivity, reduction in costs and improvements in employee safety.

In addition to these benefits the use of autonomous trucks creates a new rich data source for mine operators on how assets perform through different activities which can then be used to identify the most efficient operating model and reduce process variation.

For example, Rio Tinto have introduced fully automated, driverless haulage trucks across iron ore mines in Western Australia. The trucks are specially built to perform normal tasks associated with driving a vehicle, and respond to GPS directions. The system has already realised benefits including improved employee safety from reduced operator exposure to hazards and risks, a 14 percent improvement in productivity and a 13 percent reduction in operating costs. [493]

Automated Drilling

The use of automated drilling has created an opportunity for mine operators to optimise their extraction results whilst also improving the productivity of downstream operators. Autonomous drills are able to collect real-time data and, using advanced analytics, providing information to operators that enable tailored

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[492] *International Institute for Sustainable Development. 2019. How can technology in mining protect the environment? Available at https://www.iisd.org/blog/how-can-technology-mining-protect-environment*

[493] *Mine of the Future, Rio Tinto, URL: https://www.riotinto.com/australia/pilbara/mine-of-the-future-9603.aspx; Accessed:19thNovember, 2018*

adjustment of drill patterns to suit the mineral characteristics. This results in a significant reduction in explosives used, as well as higher quality extraction of ore which reduces the cost downstream as less investment is required in waste management. Mining organisations are reporting significant efficiency savings such as Anglo American who, after implementing automated drilling, reported a reduction of 25 percent in total drills required, a gain of 18 percent in drill rate and 23 percent in direct operating hours. [494]

For example, Rio Tinto deployed their Autonomous Drilling System in 2014, which saw operators being located in a remote operating centre. The use of autonomous drills meant that a single operator could manage up to four autonomous drill rigs at the same time. This system increased productivity, precision and created a safer working environment for the operator. Rio Tinto reported a 15 percent increase in availability compared to manned drills. [495]

Drones

Drones are being increasingly used in the mining industry, with companies using drones to scan over their mining operations to track waste piles, infrastructure and identify any potential environmental issues. The point of view that a drone can capture is often not possible from the ground and drones are also able to analyse the data collected from the imagery. [496]

Drones are also being used alongside advanced analytics, digital twins and integrated operating centres to optimise mine site operations and support the shift to predictive maintenance strategies. The use of drones alongside this technology enhances productivity whilst reducing total operating costs.

Electrification of Vehicles

Many mining organisations are introducing electric vehicles into their fleet. Due to the volume of equipment and vehicles that are used on mining sites, one of the largest costs for mining organisations is the cost of diesel fuel, and the subsequent ventilation costs that occur from use of diesel powered machinery in underground mines. It is predicted that by 2030, 58 percent of the light vehicles on the road in the United States will be electric, which will be brought on by the ever-decreasing cost of battery and inverter technology. [497]

The use of electric vehicles in mining reduces costs in multiple ways, such as through the elimination of reliance on fossil fuels and the reduction in ventilation costs from the reduction in heat output of vehicles. As well as the comparatively low heat output, electric vehicles have zero emissions and therefore no CO2 or diesel particulate matter is emitted into the underground working environment which is extremely detrimental to employee long term health.

For example, Anglo American has recently partnered with Williams Advanced Engineers to develop a new Fuel Cell Electric Vehicle which will be an ultra-class electrically powered mining haul truck. This truck, once developed, will be the world's largest hydrogen powered mine truck. [498]

Energy Technologies

The Mining and METS industry accounts for roughly 10 percent of Australia's total energy use, with most energy supplied by diesel, natural gas and grid electricity. Optimising points of inefficiencies throughout the value chain has the potential to reduce costs significantly.

[494] *Smarter and safer Kolomelamine through automated drilling, AngloAmerican, Available at https://southafrica.angloamerican.com/our-stories/a-smarter-safer-kolomela-mine.aspx. Accessed: 19th November, 2018,*

[495] *Mine of the Future, Rio Tinto, Available at https://www.riotinto.com/australia/pilbara/mine-of-the-future-9603.aspx; Accessed:19thNovember, 2018*

[496] *Schmelzer, R. Forbes. 2019. AI Helping extract value in the mining industry. Available at https://www.forbes.com/sites/cognitiveworld/2019/08/09/ai-helping-extract-value-in-the-mining-industry/#68590b7b7006roi*

[497] *Austmine. 2019. Electric vehicles in the mining industry. Available at http://www.austmine.com.au/News/electric-vehicles-in-the-mining-industry*

[498] *Electric Vehicles Research. 2020. World's largest electrified mining truck. Available at https://www.electricvehiclesresearch.com/articles/19798/worlds-largest-electrified-mining-truck*

For example, crushing and grinding of material is responsible for at least 40 percent of the total energy use in mining and mineral processing and many organisations have started adopting technologies that can improve flow sheet design to reduce the direct and indirect energy use.[499] The use of appropriate energy technologies can optimise the crushing and grinding mill process, through considering resource characteristics, efficiency of motor systems and indirect energy use.

Through the effective sorting of ore using technology, energy can be saved which can produce up to a 20 percent reduction in processing costs. For example, CSIRO has developed a new ore sorting solution that uses magnetic resonance technology to scan and analyse ore-grade copper material from waste rock. The analyser illuminate sore batches with short-pulse radio waves that can penetrate copper ores, resulting in a more in-depth analysis than previously possible.[500]

Remote Operating Centres

As many Mining and METS organisations adopt the use of technologies such as autonomous vehicles, sensors and drones, more of their workforce is being transitioned from front line to control centre operators working in a remote integrated operating centre.

These centres combine skills, operations processes and technologies from across the sector to deliver remote management of technology and operations for the mine. The creation of these remote operating centres has resulted in significant value improvements from increased productivity to stability across the value chain. The centre can be responsible for activities such as daily scheduling from mine sites to ports support through real-time coordination and execution management and optimising management of infrastructure through use of complex analytics and real time data from autonomous equipment

[499] *Department of Industry, Science, Energy and Resources. 2020. Mining opportunities to save. Available at https://www.energy.gov.au/business/large-businesses/industries/mining/mining-opportunities-save*

[500] *Australian Mining. 2018. CSIRO scanner to significantly reduce copper waste. Available at https://www.australianmining.com.au/news/csiro-scanner-significantly-reduce-copper-waste/*

Outbound Logistics

It's been a challenging journey to automate a rail network of this size and scale in a remote location like the Pilbara, but early results indicate significant potential to improve productivity, providing increased system flexibility and reducing bottlenecks –

Ivan Vella, Rio Tinto **501**

SUMMARY

The outbound logistics segment of the value chain involves the transport of mining products through rail, port and ship. Technology is supporting the integration of autonomous assets into transport planning resulting in improved system efficiency.

Autonomous Rail

Trains are the most common form of long distance haulage in the mining sector, and are used to move materials between mine sites and ports. Due to the huge distance that trains cover, it is important for mining companies to optimise operating time. It has been found that manually operated trains add approximately one hour to the journey due to shift changes and operator breaks. The introduction of autonomous trains eliminates the requirement for breaks during shift changes, reduces operational variability and increases productivity.

Autonomous trains are also able to use advanced analytics and autonomous decision making to enhance both safety and efficiency. This ensures the train is travelling at the optimal speed whilst upholding programmed safety standards.

For example, Rio Tinto have recently adopted autonomous trains in their Pilbara operations and are seeing improvements in safety, reductions in bottlenecks and increases in productivity through reduced cycle time. [502]

Data & Analytics

Outbound logistics is an important segment of the mining value chain, and an area where small inefficiencies can add up to large costs for mining organisations. The use of data and analytics within this space is closely linked to the technologies on the ground such as autonomous trains and sensors, however data and analytics can also be used to develop optimisation models that are able to pinpoint breakdowns in the system and recommendation options for improvement.

For example, AnyLogic have developed a simulation model that is able to represent the supply chain processes and show how different agents interact with each other including sea ports and mines, as well as trucks, trains, and vessels. [503]

[501] *Jones, D. Design Engineering. 2019. Australian mining company rolls out autonomous train system. Available at https://www.design-engineering.com/australian-mining-company-rolls-out-autonomous-train-system-1004032351/*

[502] *Rio Tinto. 2019. Mine of the Future. Available at https://www.riotinto.com/australia/pilbara/mine-of-the-future-9603.aspx*

[503] *Anylogic. Improving mining outbound logistics with agent-based simulation modelling. Available at https://www.anylogic.com/anylogic-agent-based-simulation-modeling-helped-improve-mining-outbound-logistics/*

Maintenance

Predictive analytics has both immediate and long-term benefits for organisations when it comes to reliability and cost savings. When combined with monitoring and asset management systems, PdM can give mining companies better visibility over their assets, greatly reducing previously uncontrollable challenges such as distance and environment. –

Colin Beaney, Asset Intensive Industries [504]

SUMMARY

Maintenance is one of the largest expenses that mining companies incur with costs forecast to increase by nearly 60 per cent over the next five years, and as technology evolves the Mining and METS industry is looking for the most economically optimised maintenance regime for assets to give the greatest amount of up time and minimise costs. [505] Equipment breakdowns are costly on many levels, such as downtime effecting productivity and equipment parts being expensive leading to costs incurred on labour and energy.

Predictive Analytics

The use of predictive analytics has also increased within the Mining and METS industry, with organisations leveraging the technology to manage predictive maintenance and increase the quality of ore supplied downstream.

Traditional mining operations resulted in higher instances of explosives which, due to blast displacement, can cause product dilution. The use of predictive analytics can predict blast displacement which provides an opportunity to reduce dilution. For example, Orica released a digital platform in 2018 designed to integrate data and insights across the drill and blast process to optimise blasting outcomes. The system integrates explosive delivery control systems, blast design and quality management to optimise the process and reduce dilution of ore. [506]

Another source of costs for mining companies are unplanned breakdowns. Traditionally, mining companies have used time based maintenance plans to repair and replace their assets. Predictive analytics has the ability to monitor assets and shift organisations towards a predictive maintenance strategy. This can be achieved through assets being fitted with sensors that transmit data back to the control centre, where predictive analytics can be used to identify when an asset is likely to require maintenance. [507]

Artificial Intelligence and Machine Learning

Mining organisations need careful management and workforce coordination to control maintenance costs and AI is now being investigated as an optimisation tool. AI can be used to determine the best solution through automatically adapting to scenarios using a combination of algorithms. For example, Cubic Transportation systems adopted the use of AI to optimise its processes and found that the Cubic was able to improve its efficiency and increase the availability of working machines by 20 per cent, without recruiting additional staff.

Augmented Reality

The use of augmented reality has been adopted in recent years to support mining organisations in conducting complex maintenance. For example, METS company IFS recently announced a new solution which integrates augmented reality with enterprise data to boost the productivity of industrial engineers. The tool has two parts; an operator station which is a lightweight headset and wearable computer, and a touch screen expert station used off-site. These technologies allow technicians to perform complex maintenance with the support of expert advice provided virtually. The solutions lets technicians visualise software data related to the asset they are servicing and record HS images. [508] This solution has the potential to change the way that companies maintain complex assets.

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504 AusIMM Bulletin. 2017. How predictive analytics is the future of asset optimisation in mining. Available at https://www.ausimmbulletin.com/feature/predictive-analytics-future-asset-optimisation-mining/

505 Ninness, J. Australasian Mine Safety Journal. 2018. How new technology and AI can control rising maintenance costs. Available at https://www.amsj.com.au/mining-maintenance-costs-technology/

506 Optimising drill and blast operations with next generation BlastIQQTMdigital platform, Orica, URL:http://www.orica.com/news---media/optimising-drill-and-blast-operations-with-the-next-generation-blastiq-digital-platform#.XAdOG2gzY2y; Accessed: 19thNovember, 2018

507 Ernst & Young. 2019. Future of Work: The economic implications of technology and digital mining. Available at https://minerals.org.au/sites/default/files/190214%20The%20Future%20of%20Work%20The%20economic%20implications%20of%20technology%20and%20digital%20mining.pdf

508 Ninness, J. Australasian Mine Safety Journal. 2018. How new technology and AI can control rising maintenance costs. Available at https://www.amsj.com.au/mining-maintenance-costs-technology/

Sensors

Sensors are being installed to collect data and determine mine equipment problems before the point of failure, thereby reducing down time and costs. This form of predictive maintenance is possible through condition monitoring using sensors that can track the performance of machine components and show projected issues based on aggregated data. There are a range of sensors such as vibration, gas and thermal sensors.[509]

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For example, METS organisation Mining3 have created, AURA IQ, an acoustic distributed sensing system which can improve safety, accuracy and efficiency in regards to conveyor belt maintenance. The technology uses fibre optic detection and sensing technology alongside advanced signal processing algorithms and data analysis to identify potential failures in long conveyor belts. AURA IQ can reduce the number of belt walks needed to maintain conveyors, significantly improving mine safety and occupational health.

[509] *Roan, A.J. MetalTech News. 2020. Predictive maintenance dodges downtime. Available at https://www.metaltechnews.com/story/2020/04/01/mining-tech/predictive-maintenance-dodges-downtime/194.html*

[510] *CSIRO. 2020. Resourceful Issue 19: Safer Mines - Conveyor monitoring. Available at https://www.csiro.au/en/Research/MRF/Areas/Resourceful-magazine/Issue-19/Conveyor-monitoring*

APPENDIX H

Tourism key technologies

Technologies specific to Tourism workforce segments

With an uptake in the usage of technology in the Tourism industry, the workforce will increasingly require specialised skills and knowledge. Airlines, tour operators, large hotel chains, casinos and restaurants and other retail outlets all require staff to provide their services, such as running tours, taking bookings, cleaning rooms and operating gaming tables. As such, the workforce will be continually required to up-skill its technology capability as these tasks are increasingly automated and completed by intelligent technology driven software and machines.

Accommodation

"Short-term rental platforms such as Airbnb are increasingly displacing hotels and holiday letting agencies as the go-to form of accommodation. The ease of booking it all in seconds on your smartphone adds to the appeal… Some hotel chains and booking sites have adapted their strategies accordingly by providing apartment-style living alongside conventional hotel rooms" –

***Thomas Sigler and Radoslaw Panczak*[511]**

SUMMARY

The accommodation sector has already been significantly disrupted through the adoption of sharing economy platforms that offer alternative, lower cost accommodation options for travellers. From the period June 2013 to June 2018, the accommodation industry within Australia saw a reduction in business counts which is likely attributed to less regulation in the sharing economy. Airbnb allows individuals to list accommodation without registering as a business, excluding these services from business counts. Due to the infrastructure requirements of accommodation, further significant disruption to the sector is unlikely.

Sharing economy platforms

Sharing economy platforms such as Airbnb and Stayz has already disrupted the accommodation sector. However, regional areas have a significantly lower rate of adoption, with only 17 percent of people travelling to regional areas interstate using sharing economy platforms for accommodation. [512]

Smart rooms and in-room technologies

Smart rooms utilise technology to create a connected experience for guests. Smart televisions act as entertainment centres with chrome casting capabilities to enable guests to seamlessly perform work activities or enjoy leisure activities such as accessing online stream services. Smart pads are increasingly being used in rooms to control technology aspect such as keyless entry, menu ordering and bill review and payment.

It is expected that in the short to medium term, accommodation services will increasingly adopt in-room technologies that allow guests to utilise their own devices to create a tailored experience. Additional technology enabled activities are likely to include the ability to select room locations, provide information about in-destination activities, make service requests, and support the check-in and check-out process.

[511] *Ever wondered how many Airbnbs Australia has and where they all are? We have the answers, 13 February 2020, Available at https://theconversation.com/ever-wondered-how-many-airbnbs-australia-has-and-where-they-all-are-we-have-the-answers-129003*

[512] *Tourism Research Australia, Austrade and Deloitte Access Economics. 2019, Technology Disruptors in Tourism.*

Social media

Social media is critical to the success of hotels in a modern environment. As competition has increased and cost pressures are increasingly leading younger generations to shared accommodation through online platforms, social media has the potential to attract new customers.

Social media is often a source of 'travel inspiration' and is used to make holidays easier to plan. A strong social media presence is a free marketing tool that almost 40 percent of guests will seek to review before booking a room. [513]

Robotics

Robotics are expected to cause disruption in the short term to accommodation services segment as they are increasingly used to perform routine tasks. Internationally, robots are utilised to perform concierge functions, [514] deliver room service and handle luggage. [515]

In response to the COVID-19 pandemic, the Beverly Hilton Hotel is utilising robotics to sanitise guest rooms. The hotel invested in hospital-grade technologies that use ultraviolet light robots to sanitise guest rooms, luggage and packages. [516]

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[513] *Fuel Travel, 2019 Leisure Travel Trends Study, 2019.*

[514] *Hilton, Hilton And IBM Pilot "Connie," The World's First Watson-Enabled Hotel Concierge, 2016, Available at https://newsroom.hilton.com/corporate/news/hilton-and-ibm-pilot-connie-the-worlds-first-watsonenabled-hotel-concierge*

[515] *Yotel, Available at https://www.yotel.com/en/hotels/yotel-new-york/your-stay*

[516] *Kaitlyn Folmer and Dr. Jay Bhatt, ABC News, In hotels and beyond, UV light robots and lamps could help protect against coronavirus, Available at https://abcnews.go.com/Health/hotels-uv-light-robots-lamps-protect-coronavirus/story?id=71205829.*

Ground Transport

New types of technology and service delivery model such as Mobility as a Service (MaaS), transport-on-demand, autonomous vehicles, contactless payments, big data and analytics will significantly change how customers experience transport and make their travel choices. Some of these shifts will happen quickly, while some are more likely to occur over a longer period of time. What is clear is that while transformation within the transport sector will be rapid, it will also be unpredictable as new services and paradigms emerge and take-up of these services increases." –

Tourism and Transport Forum [517]

SUMMARY

The ground transport sector has also already been significantly disrupted by technology, through the adoption of ridesharing platforms such as Uber. Regulatory changes requiring ride share drivers to register as a business has seen a strong growth in business numbers across the industry.

The next wave of disruption is expected to affect transport modes, with ridesharing platforms transitioning into boats, helicopters and scooters. Autonomous vehicles are expected to become widely available into the future, however regulatory changes will be required to enable these to become a long term disruptor.

Ride sharing platforms

Ride sharing platforms such as Uber have disrupted the industry significantly. While ride sharing platforms are no longer an emerging technology, there is a substantial increase in the number of platforms that now offer ride sharing. In addition to Uber, platforms including Lyft, Didi, Ola, Shebah and Taxify are all increasing their reach within Queensland.

Autonomous vehicles

Connected and autonomous vehicles (CAVs) have the potential to disrupt all industries connected to transport, including tourism. CAVS will navigate on a fully autonomous software, making driver engagement obsolete. It is predicted that widespread adoption of autonomous vehicles for urban tourism could lead to potential benefits including reduced traffic congestion and emissions, improved car hire processes, reduced parking requirements and cheaper taxi fares.[518]

It is predicted that the visitor economy could be gradually transformed if autonomous vehicles could become fully automated and mainstream, leading to a future where small autonomous vehicles navigate urban attractions and replace traditional 'hop-on hop-off' city tours. However, this is likely a long term impact as there are significant regulatory burdens to navigate in the short to medium term.

Mobility platforms

With increased digital interfaces, private transport companies, such as e-scooter services, will increasingly partner with public mass-transit operators in order to establish intermodal platforms that give end users a seamless travel experience.

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[517] The Future of Mobility, 2017, Available at https://www.ttf.org.au/wp-content/uploads/2017/08/TTF-The-Future-of-Mobility-August-2017.pdf

[518] University of Surrey, Autonomous vehicles could shape the future of urban tourism, 2018.

Retail

"In an increasingly competitive retail environment, being at the forefront of technology has never been more important. Technology is core to any modern retailers' omni-channel operations, with it enabling seamless connectivity between physical stores, online store, supply chains and customers" –

KPMG [519]

SUMMARY

The industry has been disrupted by the introduction of online shopping, meaning people no longer have to travel for specific purchases. However, boutique experiences are increasingly incorporating shopping into travel experiences, as social media influences shopper's purchase decisions and online purchase platforms are enabled by digital wallets and buy now pay later services such as Afterpay that are making it easier for customers to purchase while travelling.

Social media influencers

Social media influencers are increasingly endorsing and shaping attitudes towards tourism through blogs, tweets, pictures posted to Instagram and videos on emerging platforms such as TikTok. In 2018-19, Tourism Australia spent more than half a million dollars on social media influences, including Chinese pop star Hins Cheung who filmed four short videos to promote experiences in Sydney and Port Stephens. [520]

Emerging payment platforms

Digital wallets, Afterpay and crypto currencies that allow consumers to purchase a diverse range of goods and services including clothing, flights and experiences are making purchasing easier while travelling. International tourists have increased abilities to utilise payment methods that suit their requirements and are not limited to cash transactions.

Online retailing

The increase of boutique speciality stores combined with the move to online shopping has seen many retailers, particularly larger retail stores, close their bricks-and-mortar stores. To compete with online stores, retailers have begun moving away from traditional models, and toward providing products aligned with the 'experience economy', in which "the memory itself and enriched experience become the product". [521] Within the Tourism industry, a focus on providing consumers with experiences rather than focusing on product sales will be increasingly important.

[519] KPMG, Technology to support modern retail operations, 2019 Available at https://assets.kpmg/content/dam/kpmg/au/pdf/2019/technology-to-support-modern-retail-operations.pdf
[520] https://www.abc.net.au/news/2019-12-12/tourism-australia-social-media-influencers/11785634

[521] ACS. 2017. Tomorrow's Digitally Enabled Workforce. Available at https://www.acs.org.au/content/dam/acs/acs-documents/16-0026_DATA61_REPORT_TomorrowsDigiallyEnabledWorkforce_WEB_160128.pdf

Food and beverage

Automation and new technologies have the potential to make tourism businesses in Queensland more productive and efficient, enhance the tourism experience and improve the economic contribution of tourism to Queensland. Yet, key challenges include competition for service based workers and training and development of the tourism workforce –

Queensland Tourism Industry Council[522]

SUMMARY

Takeaway food has experienced an increase in demand which has been assisted by the use of online food delivery services. These platforms have changed the way customers seek their meals and have increased the range of delivery options that restaurants provide. Between 2012-13 and 2017-18, Australian consumer spend on restaurants and takeaway meals increased by 27 percent. [523]

The food and beverage sector is heavily influenced by social media trends, with travellers often seeking out Instagram's of locations and food experiences. As such, a positive social media presence is increasingly important for tourism operators within the sector to attract new domestic and international travellers.

Peer-to-peer food delivery services

The increase in food delivery platforms is increasing short term disruption to the sector. Travellers are expected to increasingly utilise these platforms after a long day of sightseeing to accommodate eating outside of normal hours or to reduce language barriers of ordering food directly.

Platforms such as UberEats, Menulog and Deliveroo are all increasing their presence within the market. The platforms offer convenience, delivery, choice and transparency.

Social media

Travellers are increasingly seeking food experiences that can be shared on social media. Additionally, restaurants are increasingly using social media platforms to share meals with diners to attract new visitors and promote their presence or stay connected through sharing trading hours, meal deals and happy hours.

Workforce management automation

Workforce management solutions are increasingly optimising the workforce for hospitality managers. As human resources are required to performance guest services at hotels, restaurants and licenced clubs and venues, the adoption of technology to streamline scheduling shifts and provide staff analytics and forecasting allows manager roles to focus on non-labour related issues, reduce costs and increase staff productivity.

[522] *Queensland Tourism Digital Workforce Development and Training Plan, 2019.*

[523] *Tourism Research Australia, Tourism Businesses in Australia, June 2013 to June 2018.*

Tours and Travel Agents

"Consumers are increasingly planning and booking travel online and then rating their experiences. In the near future, greater use of data combined with machine learning will enable travel companies to predict when and where travellers may want to travel allowing them to better target travel experiences and to generate personalised offers for the travelling public." –

Department of Industry, Science and Technology[524]

SUMMARY

The demand for travel agency and tour operator services has experienced an increase, which is attributed to the sustained growth in inbound and outbound travel. Technology is making is easier to customise travel itineraries and generate social media content to influence destination and tour choices.

The introduction of online bookings giving people the ability to plan and book travel online has significantly disrupted the need for bricks and mortar travel agents. The COVID-19 pandemic has also highlighted the risk associated with the traditional operating model, as Flight Centre with approximately 900 locations across Australia closed 100 locations as early as March 2020 due to the initial impacts of COVID-19.[525] By April, Flight Centre reportedly had closed half of its global stores, 428 stores in Australia and stood down approximately 6,000 support and sales staff.[526]

AR/VR

AR/VR are likely to impact the industry through new travel opportunities and improved tour experiences for tourists.

These technologies are likely to disrupt the industry through offering a competing product, leading to a reduction in actual travel for individuals who consider the technologies as an acceptable substitute for the in-person experience. However, it is expected that this trend is likely to be adopted by cash constrained travellers and would be unlikely to replace tangible experiences for wealthier consumers.

Sharing economy

The sharing economy is an emerging competitor in the touring space, increasingly offering experiences alongside accommodation offerings. Airbnb experiences are unique, curated experiences that are designed and hosted by locals. They differ from tours by offering a 'local experience' that includes special knowledge of a destination and inside access to local places, communities and restaurants that are not widely known. Airbnb experiences focus on personal interactions, meaningful engagement and passionate hosts to differentiate the experience from a typical tour operator.

Social media

Social media is increasingly influencing travel destinations globally. Younger people often use social media to plan travel destination, connect and learn about locations, stay informed regarding travel information and find local restaurants.

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[524] *Australia's Tech Future – Delivering a strong, safe and inclusive digital economy, 2018, Available at https://www.industry.gov.au/sites/default/files/2018-12/australias-tech-future.pdf*

[525] *Jeremy Story Carter, ABC, Flight Centre closes 100 stores across Australia due to business impact from coronavirus fears, 13 March 2020, Available at https://www.abc.net.au/news/2020-03-13/coronavirus-fears-prompt-closure-of-100-flight-centre-stores/12053206*

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APPENDIX I

Enrolments and Completions for VET qualifications in the Greater Whitsunday region

Enrolment and completion data for VET qualifications within the region for each industry to inform the existing workforce capabilities within the region and to identify education and training pathways that are needed to build capabilities between current and future state.

Agriculture, Forestry and Fishing | BOWEN

Enrolments

Qualification	2016	2017	2018
Certificate III in Rural Operations	89	37	48
Certificate II in Rural Operations	10	18	34
Certificate II in Horticulture	6	20	16
Certificate III in Agriculture	28	46	12
Certificate III in Horticulture	27	29	10
Certificate IV in Agriculture	-	-	5
Certificate III in Parks and Gardens	-	8	4
Certificate III in Conservation and Land Management	1	2	3
Certificate II in Agriculture	5	12	3
Certificate III in Landscape Construction	2	-	2

Completions

Qualification	2016	2017	2018* *preliminary
Certificate III in Rural Operations	21	20	5
Certificate II in Rural Operations	8	-	3
Certificate II in Horticulture	-	6	-
Certificate III in Agriculture	2	10	6
Certificate III in Horticulture	-	1	3
Certificate IV in Agriculture	-	-	-
Certificate III in Parks and Gardens	-	5	-
Certificate III in Conservation and Land Management	-	-	-
Certificate II in Agriculture	-	5	-
Certificate III in Landscape Construction	-	-	-

Source: National Centre for Vocational Education Research (NCVER) VOCSTATS data, 2019

Agriculture, Forestry and Fishing | MACKAY

Enrolments

Qualification	2016	2017	2018
Certificate III in Rural Operations	62	43	108
Certificate III in Horticulture	71	71	54
Certificate II in Rural Operations	56	83	46
Certificate I in AgriFood Operations	10	6	24
Certificate II in Horticulture	15	52	22
Certificate III in Agriculture	43	7	9
Certificate III in Conservation and Land Management	2	9	9
Certificate III in Arboriculture	7	10	7
Certificate II in Conservation and Land Management	9	5	6
Certificate III in Landscape Construction	-	-	6

Completions

Qualification	2016	2017	2018* *preliminary
Certificate III in Rural Operations	29	25	11
Certificate III in Horticulture	4	8	4
Certificate II in Rural Operations	16	14	7
Certificate I in AgriFood Operations	2	8	21
Certificate II in Horticulture	2	5	2
Certificate III in Agriculture	-	4	2
Certificate III in Conservation and Land Management	-	7	-
Certificate III in Arboriculture	-	-	-
Certificate II in Conservation and Land Management	2	-	-
Certificate III in Landscape Construction	-	-	5

Source: National Centre for Vocational Education Research (NCVER) VOCSTATS data, 2019

Agriculture, Forestry and Fishing | WHITSUNDAY

Enrolments

Qualification	2016	2017	2018
Certificate I in AgriFood Operations	2	19	32
Certificate II in Rural Operations	15	26	25
Certificate III in Horticulture	15	38	11
Certificate III in Conservation and Land Management	1	2	5
Certificate III in Rural Operations	66	7	4
Certificate II in Horticulture	8	14	4
Certificate III in Agriculture	2	4	4
Certificate III in Irrigation	-	-	2
Certificate III in Landscape Construction	9	1	1
Certificate III in Arboriculture	-	-	-

Completions

Qualification	2016	2017	2018* *preliminary
Certificate I in AgriFood Operations	1	14	25
Certificate II in Rural Operations	4	2	2
Certificate III in Horticulture	2	2	6
Certificate III in Conservation and Land Management	-	-	-
Certificate III in Rural Operations	23	6	3
Certificate II in Horticulture	-	1	-
Certificate III in Agriculture	-	-	-
Certificate III in Irrigation	-	-	-
Certificate III in Landscape Construction	9	-	-
Certificate III in Arboriculture	-	-	-

Source: National Centre for Vocational Education Research (NCVER) VOCSTATS data, 2019

Health and Social Assistance | BOWEN

Enrolments

Qualification	2016	2017	2018
Diploma of Early Childhood Education and Care	125	102	79
Certificate III in Individual Support	25	71	56
Certificate III in Early Childhood Education and Care	62	55	53
Certificate III in Education Support	71	62	39
Certificate III in Community Services	13	33	33
Certificate IV in Allied Health Assistance	19	19	18
Certificate III in Dental Assisting	10	17	12
Diploma of Community Services	12	16	11
Certificate IV in Education Support	14	5	11
Certificate II in Health Support Services	-	17	10

Completions

Qualification	2016	2017	2018* *preliminary
Diploma of Early Childhood Education and Care	7	7	9
Certificate III in Individual Support	1	13	14
Certificate III in Early Childhood Education and Care	8	10	12
Certificate III in Education Support	15	18	10
Certificate III in Community Services	2	7	3
Certificate IV in Allied Health Assistance	-	-	-
Certificate III in Dental Assisting	2	7	4
Diploma of Community Services	-	3	4
Certificate IV in Education Support	6	6	2
Certificate II in Health Support Services	1	-	6

Source: National Centre for Vocational Education Research (NCVER) VOCSTATS data, 2019

Health and Social Assistance | MACKAY

Enrolments

Qualification	2016	2017	2018
Certificate III in Individual Support	209	409	464
Certificate III in Early Childhood Education and Care	383	347	323
Diploma of Early Childhood Education and Care	352	268	266
Certificate III in Community Services	33	128	169
Certificate III in Education Support	239	187	145
Certificate IV in Ageing Support	72	100	133
Diploma of Community Services	86	75	83
Certificate IV in Disability	30	33	42
Diploma of Nursing	-	20	42
Certificate II in Community Services	29	31	37

Completions

Qualification	2016	2017	2018* *preliminary
Certificate III in Individual Support	20	106	113
Certificate III in Early Childhood Education and Care	92	79	99
Diploma of Early Childhood Education and Care	45	39	51
Certificate III in Community Services	-	22	8
Certificate III in Education Support	28	44	22
Certificate IV in Ageing Support	-	44	39
Diploma of Community Services	2	7	24
Certificate IV in Disability	5	7	11
Diploma of Nursing	-	-	11
Certificate II in Community Services	14	20	33

Source: National Centre for Vocational Education Research (NCVER) VOCSTATS data, 2019

Health and Social Assistance | WHITSUNDAY

Enrolments

Qualification	2016	2017	2018
Diploma of Early Childhood Education and Care	49	43	35
Certificate III in Individual Support	14	39	32
Certificate III in Early Childhood Education and Care	54	48	29
Certificate II in Active Volunteering	-	-	27
Certificate III in Education Support	42	48	26
Certificate III in Community Services	14	16	13
Certificate II in Community Services	6	3	13
Certificate II in Health Support Services	-	-	10
Certificate IV in Leisure and Health	-	3	9
Diploma of Nursing	-	-	8

Completions

Qualification	2016	2017	2018* *preliminary
Diploma of Early Childhood Education and Care	4	1	7
Certificate III in Individual Support	3	12	1
Certificate III in Early Childhood Education and Care	12	14	10
Certificate II in Active Volunteering	-	-	-
Certificate III in Education Support	14	13	9
Certificate III in Community Services	-	-	-
Certificate II in Community Services	2	2	6
Certificate II in Health Support Services	-	1	11
Certificate IV in Leisure and Health	-	-	1
Diploma of Nursing	-	-	-

Source: National Centre for Vocational Education Research (NCVER) VOCSTATS data, 2019

Mining and METS | BOWEN

Enrolments

Qualification	2016	2017	2018
Certificate III in Surface Extraction Operations	1,032	1,060	906
Certificate II in Surface Extraction Operations	965	751	832
Certificate III in Mine Emergency Response and Rescue	233	244	152
Certificate IV in Surface Coal Mining (Open Cut Examiner)	92	92	149
Certificate III in Civil Construction Plant Operations	41	78	40
Certificate II in Resources and Infrastructure Work Preparation	43	27	31
Certificate II in Underground Coal Mining	181	43	40

Completions

Qualification	2016	2017	2018* *preliminary
Certificate III in Surface Extraction Operations	249	196	203
Certificate II in Surface Extraction Operations	23	16	44
Certificate III in Mine Emergency Response and Rescue	11	11	20
Certificate IV in Surface Coal Mining (Open Cut Examiner)	-	14	3
Certificate III in Civil Construction Plant Operations	8	7	16
Certificate II in Resources and Infrastructure Work Preparation	26	18	17
Certificate II in Underground Coal Mining	-	4	-

Source: National Centre for Vocational Education Research (NCVER) VOCSTATS data, 2019

Mining and METS | MACKAY

Enrolments

Qualification	2016	2017	2018
Certificate II in Surface Extraction Operations	2,429	2,280	1,665
Certificate III in Surface Extraction Operations	4,239	4,136	1,906
Certificate III in Mine Emergency Response and Rescue	165	475	253
Certificate III in Civil Construction Plant Operations	247	219	157
Certificate III in Civil Construction	4,239	4,136	1,906
Certificate II in Underground Coal Mining	35	10	17
Certificate IV in Surface Coal Mining (Open Cut Examiner)	247	219	157
Certificate II in Underground Metalliferous Mining	159	42	94

Completions

Qualification	2016	2017	2018* *preliminary
Certificate II in Surface Extraction Operations	109	20	23
Certificate III in Surface Extraction Operations	709	447	461
Certificate III in Mine Emergency Response and Rescue	19	22	13
Certificate III in Civil Construction Plant Operations	26	43	35
Certificate III in Civil Construction	19	33	18
Certificate IV in Surface Coal Mining (Open Cut Examiner)	-	15	1
Certificate II in Underground Coal Mining	4	6	-
Certificate II in Underground Metalliferous Mining	-	-	-

Source: National Centre for Vocational Education Research (NCVER) VOCSTATS data, 2019

Mining and METS | WHITSUNDAY

Enrolments			
Qualification	**2016**	**2017**	**2018**
Certificate II in Surface Extraction Operations	271	237	146
Certificate III in Surface Extraction Operations	166	170	111
Certificate III in Mine Emergency Response and Rescue	34	19	24
Certificate IV in Surface Coal Mining (Open Cut Examiner)	24	19	14
Certificate II in Underground Coal Mining	20	6	8
Certificate III in Resource Processing	3	4	4
Certificate III in Civil Construction Plant Operations	33	22	4
Certificate IV in Underground Coal Operations	-	-	4
Certificate II in Resources and Infrastructure Work Preparation	1	-	3
Completions			
Qualification	**2016**	**2017**	**2018*** *preliminary
Certificate II in Surface Extraction Operations	16	2	2
Certificate III in Surface Extraction Operations	45	52	46
Certificate III in Mine Emergency Response and Rescue	1	-	8
Certificate IV in Surface Coal Mining (Open Cut Examiner)	-	-	-
Certificate II in Underground Coal Mining	-	-	-
Certificate III in Resource Processing	-	-	-
Certificate III in Civil Construction Plant Operations	2	9	-
Certificate IV in Underground Coal Operations	-	-	2
Certificate II in Resources and Infrastructure Work Preparation	-	2	-

Source: National Centre for Vocational Education Research (NCVER) VOCSTATS data, 2019

Tourism | BOWEN

Enrolments			
Qualification	**2016**	**2017**	**2018**
Certificate II in Hospitality	76	70	65
Certificate III in Hospitality	54	52	56
Certificate I in Hospitality	29	23	15
Certificate II in Tourism	19	41	11
Certificate III in Commercial Cookery	12	14	14
Diploma of Hospitality Management	-	-	3
Certificate IV in Hospitality	-	4	-
Certificate III in Travel	1	4	1
Certificate IV in Travel and Tourism	-	-	-
Diploma of Event Management	-	-	3

Completions			
Qualification	**2016**	**2017**	**2018*** *preliminary
Certificate II in Hospitality	37	26	40
Certificate III in Hospitality	27	3	7
Certificate I in Hospitality	12	6	13
Certificate II in Tourism	18	21	13
Certificate III in Commercial Cookery	5	3	-
Diploma of Hospitality Management	-	2	-
Certificate IV in Hospitality	-	-	-
Certificate III in Travel	-	-	2
Certificate IV in Travel and Tourism	-	-	-
Diploma of Event Management	-	-	2

Source: National Centre for Vocational Education Research (NCVER) VOCSTATS data, 2019

Tourism | MACKAY

Enrolments

Qualification	2016	2017	2018
Certificate II in Hospitality	277	366	261
Certificate III in Hospitality	260	133	173
Certificate I in Hospitality	247	258	149
Certificate II in Tourism	105	164	93
Certificate III in Commercial Cookery	56	77	45
Diploma of Hospitality Management	-	22	40
Certificate IV in Hospitality	24	37	22
Certificate III in Travel	37	26	22
Certificate IV in Travel and Tourism	12	14	12
Diploma of Event Management	-	8	5

Completions

Qualification	2016	2017	2018* *preliminary
Certificate II in Hospitality	114	95	123
Certificate III in Hospitality	82	31	38
Certificate I in Hospitality	109	85	68
Certificate II in Tourism	20	90	46
Certificate III in Commercial Cookery	4	13	11
Diploma of Hospitality Management	-	-	8
Certificate IV in Hospitality	9	19	16
Certificate III in Travel	15	12	9
Certificate IV in Travel and Tourism	3	2	2
Diploma of Event Management	-	-	5

Source: National Centre for Vocational Education Research (NCVER) VOCSTATS data, 2019

Tourism | WHITSUNDAY

Enrolments

Qualification	2016	2017	2018
Certificate III in Hospitality	55	24	19
Certificate II in Tourism	-	2	13
Certificate III in Commercial Cookery	12	3	4
Certificate III in Travel	10	32	1
Certificate III in Tourism	5	2	-
Certificate II in Kitchen Operations	6	4	-
Diploma of Hospitality Management	-	30	3
Certificate II in Hospitality	46	19	71
Certificate I in Hospitality	-	10	16
Certificate IV in Hospitality	3	4	2
Qualification	**2016**	**2017**	**2018* *preliminary**
Certificate III in Hospitality	41	6	3
Certificate II in Tourism	-	17	13
Certificate III in Commercial Cookery	4	-	7
Certificate III in Travel	4	2	2
Certificate III in Tourism	-	2	3
Certificate II in Kitchen Operations	-	9	1
Diploma of Hospitality Management	5	4	-
Certificate II in Hospitality	28	10	1
Certificate I in Hospitality	-	-	-
Certificate IV in Hospitality	-	-	-

Source: National Centre for Vocational Education Research (NCVER) VOCSTATS data, 2019

APPENDIX J

Enrolments and Completions in university qualifications in the Greater Whitsunday region

Enrolment and completion data for university qualifications within the region for each industry to inform the existing workforce capabilities within the region and to identify education and training pathways that are needed to build capabilities between current and future state.

Agriculture, Forestry and Fishing | MACKAY

	Bachelor				Postgraduate other			
	2015	2016	2017	2018	2015	2016	2017	2018
Bond University	27	30	17	20	26	25	18	23
CQUniversity	186	198	174	172	31	17	5	3
Griffith University	201	209	241	360	98	71	53	78
James Cook University	127	148	160	179	48	21	52	44
Queensland University of Technology	-	-	-	-	-	-	-	-
The University of Queensland	1,154	1,039	997	959	337	357	424	490
University of Southern Queensland	-	-	-	-	-	-	-	-
University of the Sunshine Coast	218	297	397	466	7	-	-	-
Non-University Higher Education Institutions	-	-	-	-	-	-	-	-
Total	**1,913**	**1,921**	**1,986**	**2,156**	**547**	**491**	**552**	**638**

	Postgraduate research				Undergraduate other			
	2015	2016	2017	2018	2015	2016	2017	2018
Bond University	13	13	3	1	12	16	20	23
CQUniversity	30	-	-	13	-	-	-	-
Griffith University	221	210	185	21	-	-	-	-
James Cook University	115	91	78	71	-	-	-	-
Queensland University of Technology	-	-	-	-	-	-	-	-
The University of Queensland	310	305	284	308	12	10	7	3
University of Southern Queensland	-	-	-	-	-	-	-	-
University of the Sunshine Coast	25	33	53	54	-	-	3	-
Non-University Higher Education Institutions	-	-	-	-	-	-	-	-
Total	**714**	**652**	**603**	**468**	**24**	**26**	**30**	**26**

Source: Department of Education, Skills and Employment - Higher Education Statistics Data Cube (uCube) 2018

Health Care and Social Assistance

	Bachelor				Postgraduate other			
	2015	2016	2017	2018	2015	2016	2017	2018
Bond University	593	515	450	453	154	261	394	449
CQUniversity	4,433	5,118	5,371	5,816	248	248	314	441
Griffith University	4,945	4,920	5,397	5,639	1,928	2,152	2,177	2,430
James Cook University	4,870	5,031	4,983	5,003	1,278	1,308	1,434	1,573
Queensland University of Technology	5,837	6,096	6,081	6,279	1,504	1,493	1,363	1,436
The University of Queensland	7,399	6,847	6,300	5,795	2,283	2,809	3,360	3,810
University of Southern Queensland	2,067	2,327	3,104	3,402	287	180	222	226
University of the Sunshine Coast	3,064	3,543	3,811	4,288	111	122	132	206
Non-University Higher Education Institutions	4,660	5,196	5,313	4,699	-	-	-	-
Total	**37,868**	**39,593**	**40,810**	**41,374**	**7,793**	**8,573**	**9,396**	**10,571**

	Postgraduate research				Undergraduate other			
	2015	2016	2017	2018	2015	2016	2017	2018
Bond University	64	69	67	66	-	-	7	4
CQUniversity	37	20	22	46	9	13	22	23
Griffith University	240	256	273	268	-	-	-	-
James Cook University	141	157	149	155	22	4	-	-
Queensland University of Technology	462	468	441	404	-	-	56	236
The University of Queensland	584	619	572	630	-	-	-	-
University of Southern Queensland	-	15	19	25	9	4	10	-
University of the Sunshine Coast	77	97	105	97	-	7	24	23
Non-University Higher Education Institutions	-	-	-	-	286	316	377	396
Total	**1,605**	**1,701**	**1,648**	**1,691**	**326**	**344**	**496**	**682**

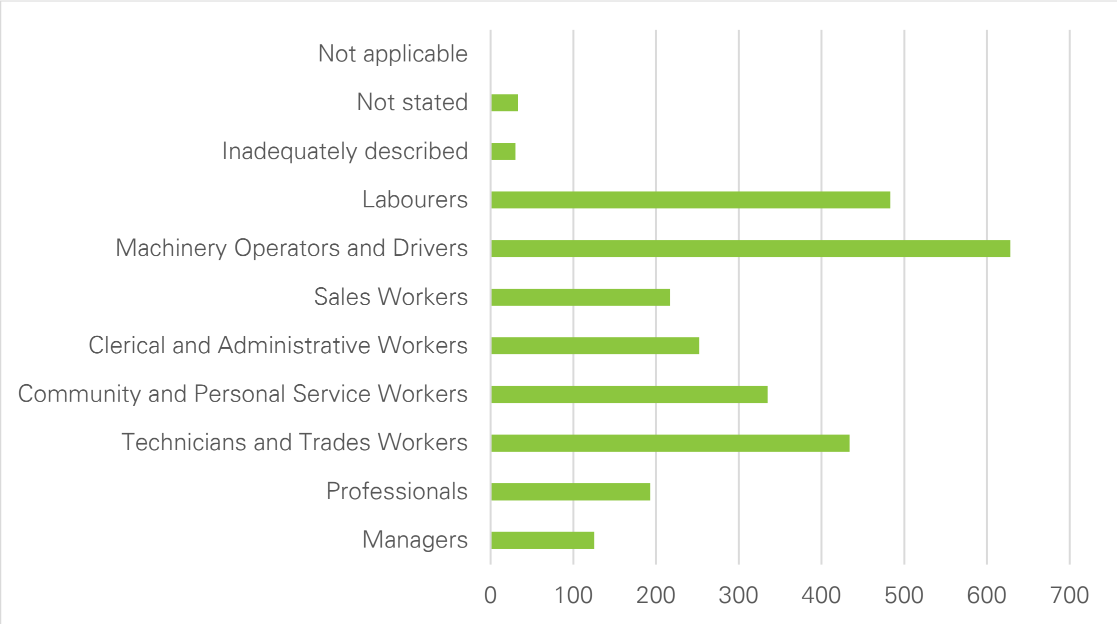
Source: Department of Education, Skills and Employment - Higher Education Statistics Data Cube (uCube) 2018

APPENDIX K

Aboriginal and Torres Strait islander Employment in the Greater Whitsunday region

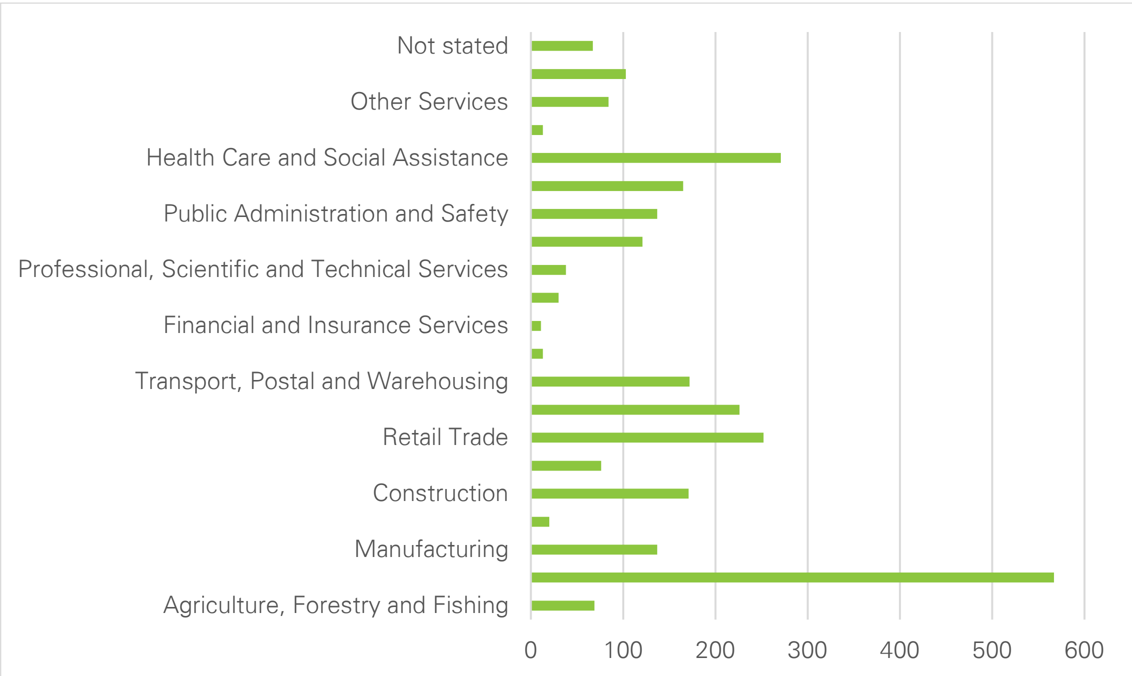
The following graphs show available data provided from the ABS regarding Aboriginal and Torres Strait Islander employment in the region. These were used combined with consultation with experts from within the region to determine the Aboriginal and Torres Strait islander narrative in the Blueprint.

Figure G.1 Aboriginal and Torres Strait Islander employment by role type, Greater Whitsunday region, 2016



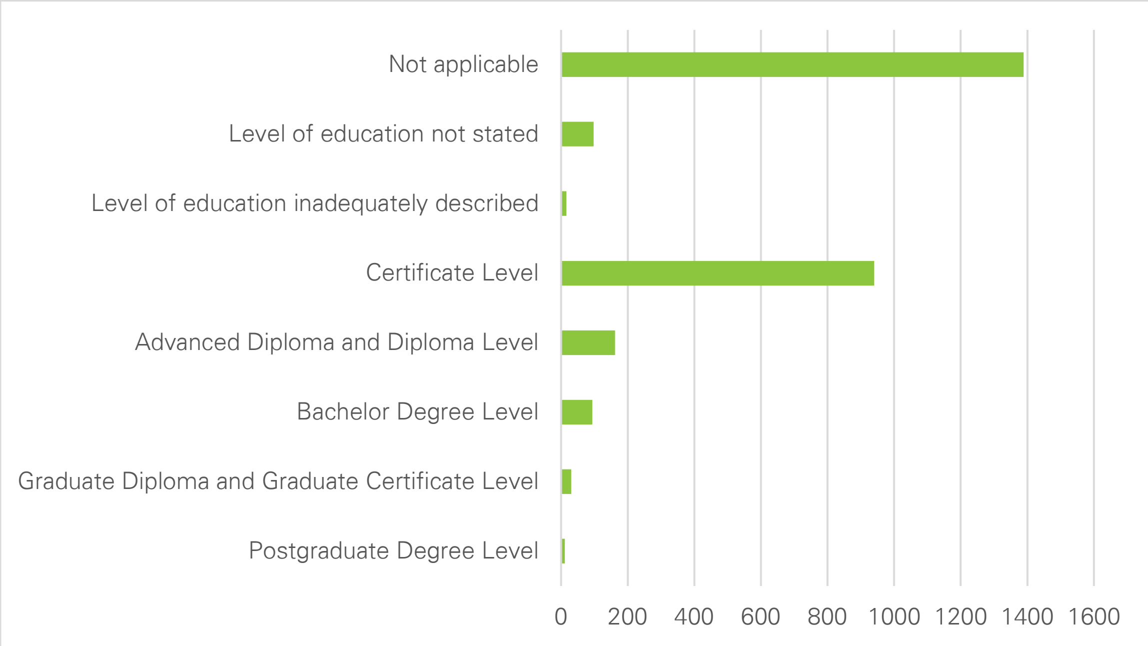
Source: ABS Census 2016

Figure G.2 Aboriginal and Torres Strait Islander employment by industry, Greater Whitsunday region, 2016



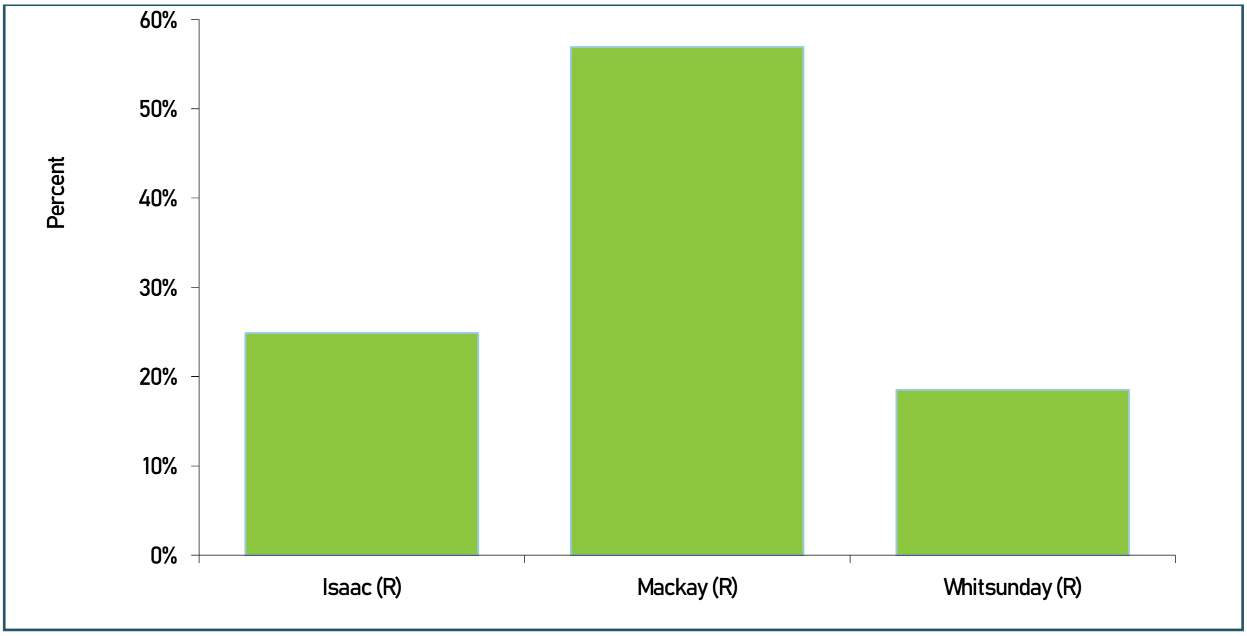
Source: ABS Census 2016

Figure G.3 Aboriginal and Torres Strait Islander educational attainment, Greater Whitsunday region, 2016



Source: ABS Census 2016

Figure G.4 Aboriginal and Torres Strait Islander employment by LGA, Greater Whitsunday region, 2016



Source: ABS Census 2016

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