



Queensland Advanced Manufacturing 10-Year Roadmap and Action Plan

Invested in Queensland manufacturing

Edition 2 – November 2018

First Edition – December 2016

Second Edition – November 2018

Second Edition, Version 2 – November 2018

The Department of State Development, Manufacturing, Infrastructure and Planning

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Foreword from the Premier

My Government is committed to continuing our strong partnership with Queensland's manufacturing industry to grow the diverse sectors that operate and employ across this state.

The manufacturing industry operates in a rapidly changing environment. Embracing new and emerging technologies is vital to improve productivity and global competitiveness.

In this environment, Queensland offers a unique home for manufacturing businesses to grow and evolve into manufacturers of the future, poised for further success.

Our abundance of natural resources, comprehensive transport and infrastructure networks, world-class universities and training institutes, unrivalled proximity to the high-growth markets of the Asia-Pacific, competitive business and living costs, and enviable lifestyle make Queensland an attractive place to operate.

We know manufacturing matters to Queensland. The industry is vital to our state's economy, employing almost 180,000 people, contributing over \$19.2 billion to the economy and driving innovation across a range of growth sectors.

It is timely to revise the roadmap and action plan which will build on achievements to date, implement the findings of the Queensland Productivity Commission inquiry into manufacturing as per the Queensland Government's response issued in April 2018, and also incorporate new commitments.

The revised plan will be delivered through government and industry working closely to drive the transition to advanced manufacturing.

The Roadmap and Action Plan recognises that manufacturing is operating in a highly dynamic global environment and government support needs to remain relevant to the industry's current and emerging needs.

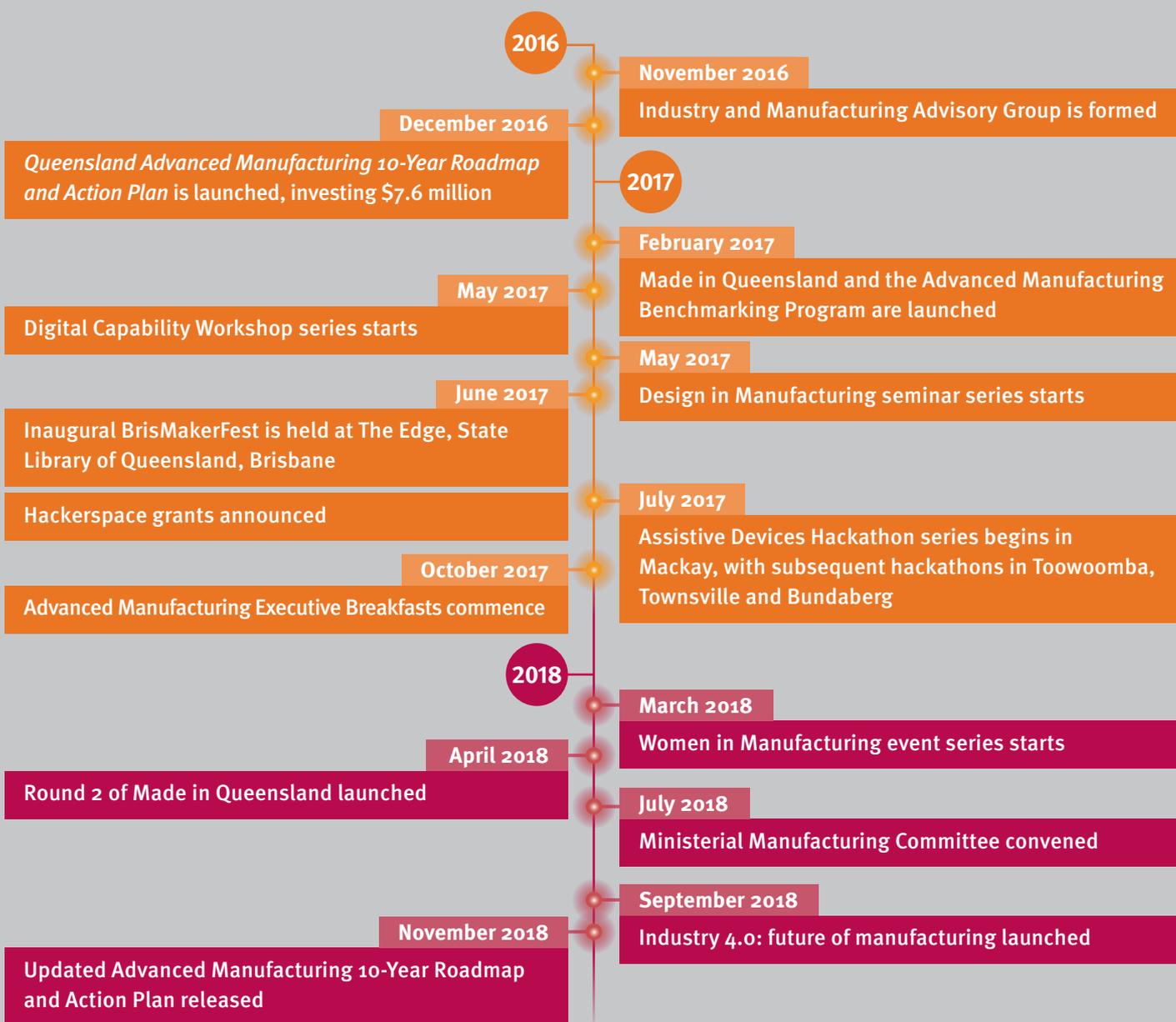
Together with industry, we will continue to deliver tailored initiatives, programs and services that will support Queensland manufacturers on the journey to advanced manufacturing. This transition will enhance the industry's productivity and global competitiveness, generate jobs, attract investment and boost business growth across the state.

The pace of change affecting our manufacturing industry means we need to be agile in responding to the economic and technological changes, whether they are opportunities or challenges. We must embrace new technologies, digital connectivity and global best practice, and we must produce value-added innovative products and deliver innovative services that meet customer demand. Our government is committed to helping Queensland's manufacturing industry achieve this.



The Hon. Anastacia Palaszczuk MP
Premier of Queensland, Minister for Trade

Advanced Manufacturing key achievements



Feedback from participants of the Women in Manufacturing series

"All panellists were intuitive and professional. They gave great advice for future women planning to enter the manufacturing industry."

"Insightful and a valuable opportunity to learn from people directly involved in manufacturing."

"Keep up the great work in delivering those forums. They are a very important format where you can connect personally with industry in an otherwise digital world. It was great to have so many women passionate about manufacturing in one place."

Feedback from participants of the Design in Manufacturing series

"This is a must-do if you are in any way involved in product design and manufacturing."

"The seminar provided a comprehensive introduction to the importance and application of design in improving."

"The DIM was informative and full of real world application of engineering & design."

Foreword from the Minister

Our Government recognises the importance of the advanced manufacturing industry to our economy and we are committed to ensuring our manufacturers remain competitive and relevant on the global stage.

To support our commitment to this industry, we launched the Advanced Manufacturing 10-Year Roadmap and Action Plan in December 2016. There has since been significant progress in implementing this initiative, including the attraction of companies such as Rheinmetall Defence Australia, Oji Fibre Solutions and BrewDog which have been supported by the government to bring new advanced manufacturing jobs, skills, technology, innovation and supply chain opportunities to Queensland.

We also established a Ministerial Manufacturing Committee comprising manufacturing industry leaders to provide expert advice to ensure the Queensland manufacturing industry remains on a strong growth trajectory to become more globally competitive.

Further progress includes:

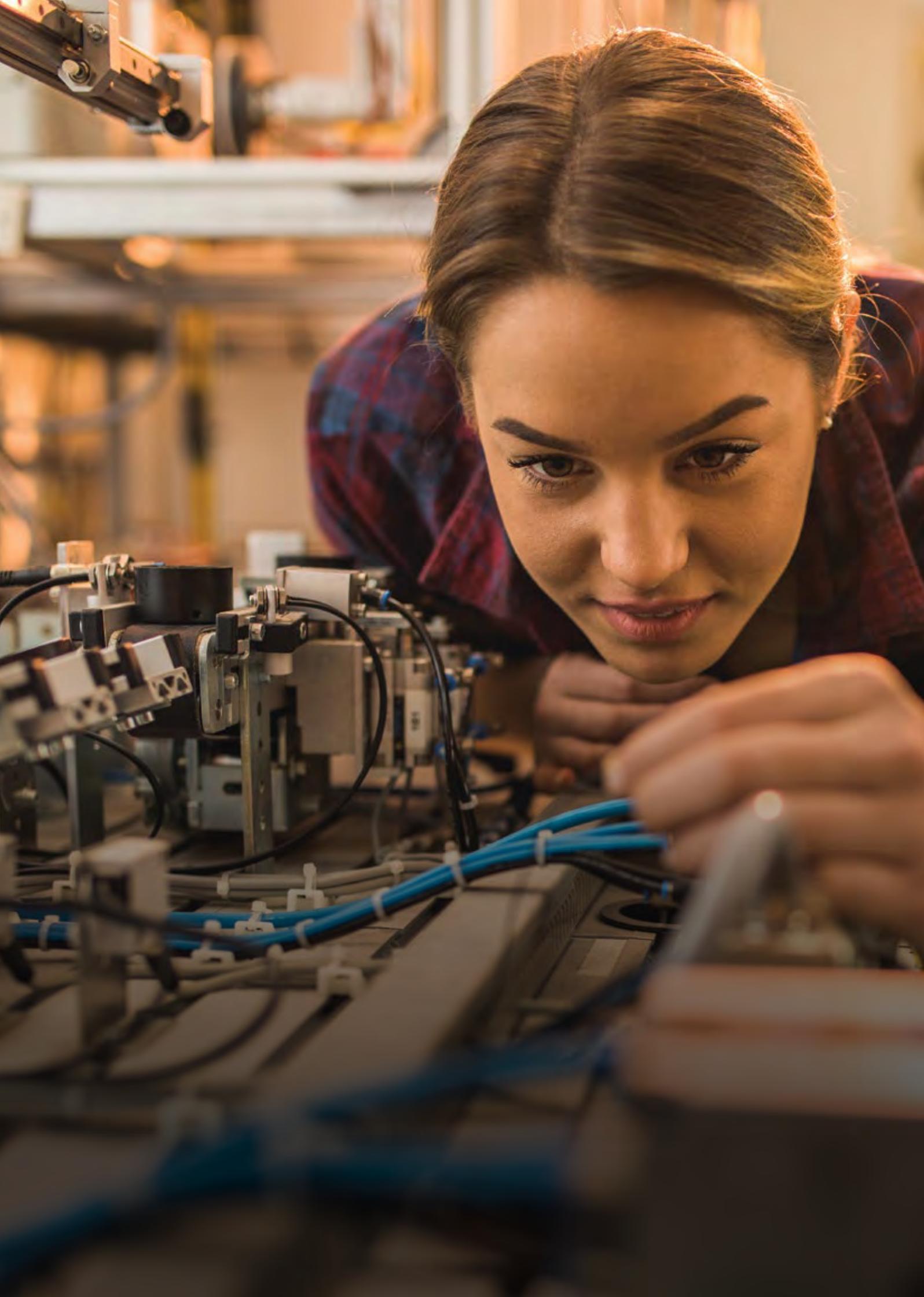
- Launching Jobs Queensland's Advancing Manufacturing Skills – A Skills, Training and Workforce Development Strategy for the Manufacturing Industry in Queensland which will directly inform the development and implementation of a Manufacturing Skills Implementation Plan.
- More than 360 manufacturers across the state have undertaken an industry benchmark assessment, measuring their performance against best practice domestically and internationally and providing recommendations on how to improve performance to facilitate growth and innovation.
- Round 1 of the Made in Queensland program which resulted in 53 projects approved for grants totalling \$18.2 million. These projects will support 2850 existing jobs, create an estimated 532 new high-skill jobs and generate \$47.7 million in project value. Projects funded under the MiQ program cover the state, from Goondiwindi to Cairns.
- Commencing a Design in Manufacturing seminar series which supported more than 100 manufacturers to recognise the importance of design to their future competitiveness.
- The successful completion of the BrisMaker Festival in June 2017, putting a spotlight on advanced manufacturing and connecting makers to manufacturers.

- Delivering Round One of the Queensland Hackerspaces Grant program to support the establishment and expansion of hackerspaces in Queensland. Seven regional hackerspaces received funding of up to \$20,000 each to become established and three already established hackerspaces received up to \$10,000 each to expand.
- Holding Assistive Devices Hackathons in Mackay, Toowoomba, Townsville and Bundaberg, enabling makers to upskill by using advanced manufacturing machinery to develop prototype solutions for people with disabilities.
- A series of Digital Business workshops held through the state supported 40 manufacturers to develop a digital business strategy and action plan.
- A Women in Manufacturing series was also launched to support and promote women in manufacturing and encourage female students to consider a career in manufacturing. Over 370 women and students have attended a breakfast session.
- Manufacturing executive breakfasts, themed around future opportunities including robotics, were held with industry leaders to allow industry to provide input on the future direction of manufacturing initiatives.

The manufacturing sector is vital to growing and diversifying Queensland's economy and creating the jobs of the future, and our government is committed to ensuring it is supported to grow and thrive.



The Hon. Cameron Dick MP
*Minister for State Development, Manufacturing,
Infrastructure and Planning*

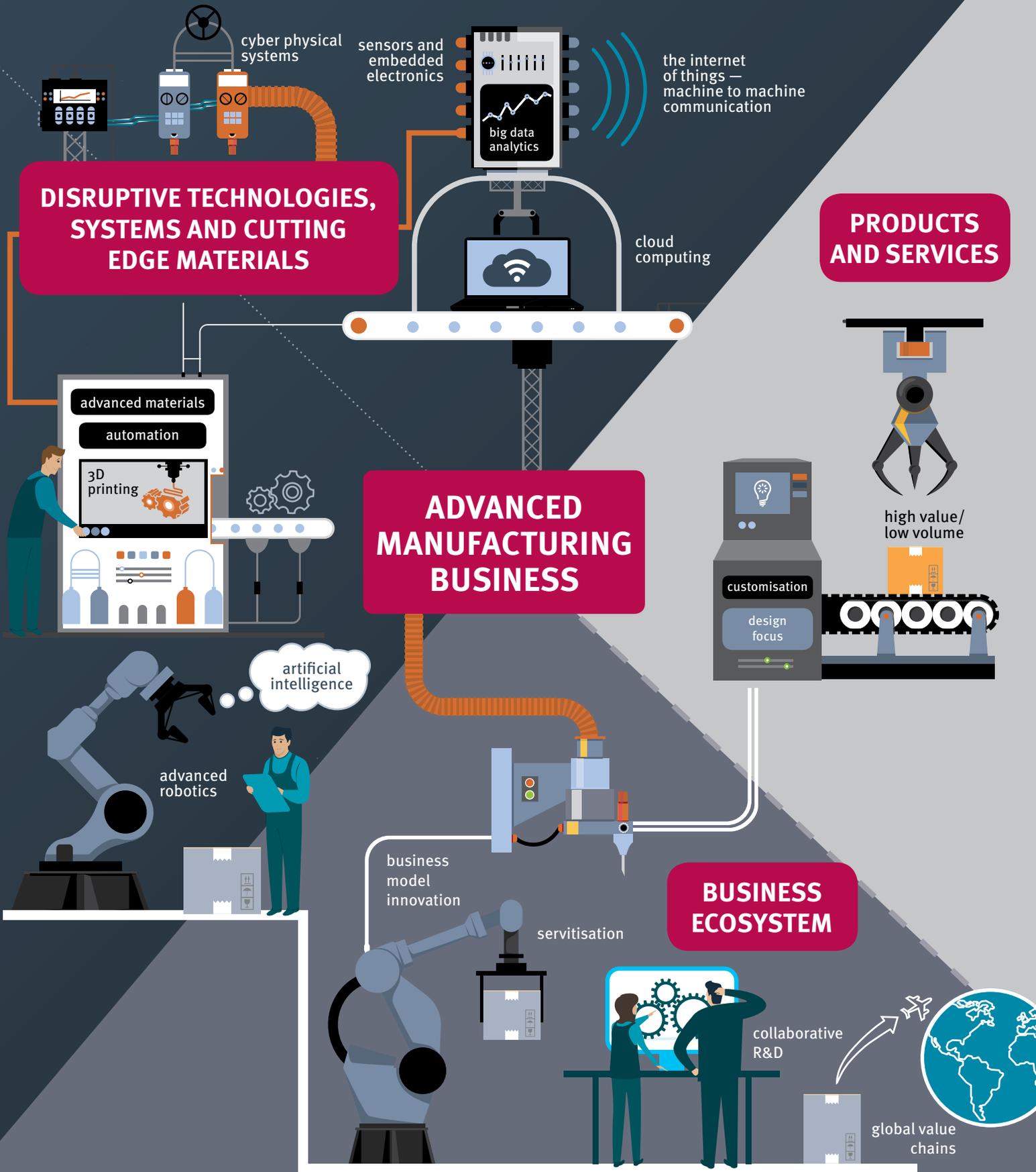




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A 21st Century Advanced Manufacturing Business





Our vision

By 2026, Queensland will be international market leaders in the delivery of advanced manufacturing technologies, systems, products and services that are innovative, sustainable, and embedded in local and global supply chains.

The Queensland Government recognises the contribution of the manufacturing sector to our economy and the future high-skill employment opportunities that will be presented by Industry 4.0, the Fourth Industrial Revolution, which takes the automation of manufacturing processes to a new level by introducing customised and flexible mass production technologies.

By capitalising on Queensland's existing industry capabilities and Queensland's competitive strengths, our 10-year vision for the industry will see traditional manufacturers transition to advanced manufacturing, creating innovative and world-leading businesses.

These businesses will demonstrate strong information and communication technology (ICT) expertise and capacity, operate in global value chains and focus on exporting and adopting sustainable manufacturing practices to reduce inputs, waste and costs. Central to their operations will be the Internet of Things (IoT), where a network of data-gathering sensors and cloud computing enables machine-to-machine communications.¹ Their use of big data analytics will lead to cost reductions and more agile decision-making and they will provide services to support customised products through a process called 'servitisation'.

The Fourth Industrial Revolution will see businesses adopting advanced manufacturing with a strong focus on current and future customers. They will be ready to take advantage of the impact that digital transformation has on their markets. They will find new ways to engage with customers and create value, and in the process, uncover new revenue streams.

This transition will result in an industry comprising internationally competitive businesses that build on disruptive technologies, systems and cutting-edge materials. These include advanced automation, 3D printing, advanced materials, artificial intelligence, sensors and embedded electronics.

More Queensland manufacturing businesses will seize opportunities to supply high-value goods and services into domestic and global supply chains and export markets in growth sectors such as:

- aerospace
- biofutures
- biomedical
- defence industries
- food, beverage and beef processing
- mining equipment, technology and services
- precision agriculture
- rail manufacturing
- renewables and hydrogen
- resource recovery.

What is advanced manufacturing?

*"While there is no universal definition of the term 'advanced manufacturing' there is a consensus that it involves a holistic approach to the way a manufacturing business operates, with a high level of technology and expertise applied throughout every step of a value chain."*²
Brent Balinski, *Manufacturers' Monthly*, November 2016.

Advanced manufacturing incorporates market products and a range of activities from design and research and development (R&D) to production, distribution and after-sales services.³ It includes:

- collaborative R&D and design-led thinking
- innovative business models and effective supply chain capabilities
- the effective use of disruptive technologies, systems and cutting-edge materials
- a focus on customisation and exports
- world-best practices and processes
- new ways to manufacture existing products and the manufacture of new products
- the provision of high-value-added services and innovative solutions.

Advanced manufacturers use and integrate new technologies, design and innovative production and customer engagement systems to produce high-value products and smart services across key industry sectors which, in Queensland, include:

- aerospace
- biofutures
- biomedical
- defence industries
- food, beverage and beef processing
- mining equipment, technology and services
- precision agriculture
- rail manufacturing
- renewables and hydrogen
- resource recovery.

Industry 4.0, otherwise referred to as the Fourth Industrial Revolution, is a key enabler of advanced manufacturers that connects big data and analytics with automation and robotics, cloud computing and system/software integration to create 'smart factories'⁴. The benefits of Industry 4.0 span several areas such as cost, productivity, profitability and operations that manufacturers are actively seeking to control, streamline, optimise or enhance.⁵

Rapid advances and convergences in technology are making it easier for manufacturers to remain competitive and develop new markets through superior customer experiences.⁶

**Industry 4.0 is the next phase in digitalisation and it will transform manufacturing in the 21st century.⁷
It is being driven by four disruptions:⁸**

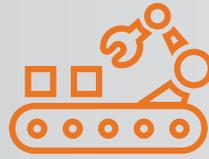
- 1** big data (capturing more data from sensors can lead to increased yields)
- 2** advanced analytics (can be used to improve product development)
- 3** human-machine interfaces (can lead to reduced errors)
- 4** digital-to-physical transfers (e.g. advanced robotics and 3D printing that can minimise the time to market).

Advanced manufacturing powering the Queensland economy



Additive manufacturing

better known as 3D printing, encompasses manufacturing technologies that create objects by addition rather than subtraction.



Advanced robotics

next-generation robots could be mobile and autonomous in their environment, with the ability to interact with their environment and achieve outcomes without programming of all procedures.



Materials by design

materials that endure in extreme temperatures, lightweight composites and new electronic and functional materials enable advances in transportation, electronics and aerospace.



Biomanufacturing

researchers are developing new tools to enable them to readily engineer biological systems, with widespread applications for energy, medicine and electronics.



Nanoelectronics

refers to technology with a nanoscale component. The technology has driven ongoing improvements in price and performance of computers, phones and other communications equipment.



*these sectors have a Roadmap

Queensland manufacturing: an industry snapshot

Queensland's manufacturing industry is primarily comprised of smaller, more flexible and agile manufacturing operations. The industry is well placed to build on its globally recognised capabilities as more companies transition to being advanced manufacturers.



Manufacturing's contribution to Queensland's economy

In the year to September 2018, manufacturing was Queensland's sixth largest employing industry with 179,100 persons, with 86 per cent being employed full-time.⁹ This represents an increase of 15,100 persons over the previous year.

Manufacturing is one of the state's largest contributors to the economy. It has consistently contributed around \$20 billion per year over the last decade to the Queensland economy.¹⁰

Manufacturing in Queensland is diverse. The top five employing subsectors in terms of percentage of jobs are:

- food product manufacturing (26.1 per cent)
- machinery and equipment manufacturing (13.7 per cent)
- transport equipment manufacturing (8.8 per cent)
- fabricated metal product manufacturing (7.7 per cent); and
- furniture and other manufacturing (7.6 per cent).¹¹

The sector comprises around 16,400 manufacturing companies.¹² The majority of manufacturing businesses are small and medium-sized enterprises (SMEs).

Moreover, analysis by the Advanced Manufacturing Growth Centre, part of the of the Australian Government's \$248 million Industry Growth Centres Initiative, has shown that there is a significant cohort of jobs in the economy, supported by manufacturing, but not engaged directly in the production process. The trend for companies to outsource non-core functions means that many workers who might once have been directly employed by manufacturers are now employed in supporting companies. These indirect jobs cater to demand for services related to direct manufacturing activity and include roles such as retail, logistics and professional services.¹³



In more general terms, manufacturing is one of Australia's most innovative sectors of the economy, generating better than average productivity growth, high-skill jobs and high-value exports – moving with the great technological change driven by Industry 4.0.¹⁴

Queensland's manufacturing exports totalled approximately \$15.8 billion in 2017- 18, representing almost one-quarter of total state export value.

The manufacturing sector is vital to growing and diversifying the economy, by strengthening international competitiveness and creating the jobs of the future.

Manufacturing is a key sector for R&D investment in Queensland, with the third highest private expenditure

of \$361 million, behind only mining (\$505 million) and professional and scientific services (\$432 million) in 2015-16.¹⁵ The leading manufacturing sub-sectors for R&D expenditure were food (\$87 million), metal (\$66 million) and transport equipment (\$56 million).

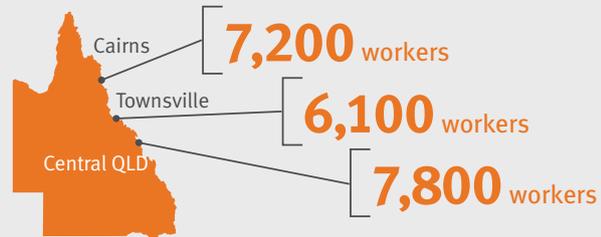
Queensland's manufacturing exports totalled approximately \$15.8 billion in 2017- 18, representing almost one-quarter of total state export value. The key manufacturing sub-sectors in terms of export value for this period were: food product (\$7.1 billion), primary and metal product (\$4.5 billion) and machinery and equipment (\$1.7 billion).¹⁶

As much as 41 per cent of global trade is now in intermediate goods, for example, components and research. As a result, there is a growing market for advanced manufacturers that create finished products and also add value at every stage of, and within, the global supply chain.

Regionally, manufacturing creates a significant amount of employment



of the industry's economic contribution is delivered through regional manufacturing.



As at June 2018, in Cairns, the **manufacturing sector employed around 7,200 workers**. In Townsville³, around **6,100 workers** were employed, and in Central Queensland around **7,800 workers** were employed. In terms of established small to medium manufacturing enterprises, as at June 2017 there were **970 across Cairns, Townsville and Central Queensland SA4 regions**.

Regional manufacturing

The Queensland Plan outlines a 30-year strategic vision for the future growth and prosperity of Queensland. It states that the “Regions are the engine rooms of our state. They drive growth, create employment and draw people to pioneer new lives and new opportunities. They are key population centres and transport, communication and service hubs, critical to Queensland’s economy and future. As Australia’s most decentralised state with the strongest regional network, our regions offer a unique competitive advantage”.

Queensland regions contribute to nearly a third of gross state product, with agriculture, mining and construction accounting for a significant proportion of economic activity.¹⁷

However, approximately 28 per cent of the industry’s economic contribution is delivered through regional manufacturing. Regions with a high manufacturing industry gross value added include Central Queensland (\$1.08 billion), Wide Bay (\$941 million) and Townsville (\$879 million).¹⁸

Regional Queensland employs around 51,500 persons, or 29 per cent of the state’s manufacturing workforce as at September quarter 2018.

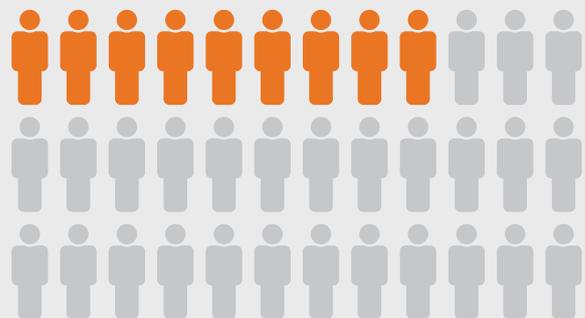
The regions of Cairns, Townsville and Rockhampton have a combined 46 per cent of regional manufacturing employment. As of June 2018, 21,000 people were directly employed in manufacturing in the three regional localities of Cairns, Townsville and Rockhampton as follows:

- 7,200 in Cairns
- 6,100 in Townsville
- 7,800 in Rockhampton.

The other main manufacturing regions are Wide Bay (21 per cent) and Mackay (12 per cent).¹⁹

The top three employing manufacturing sub-sectors in regional Queensland for the September quarter 2018 includes:

- Food Product Manufacturing, accounting for around 36 per cent of total employment within the regions
- Primary Metal and Metal Product Manufacturing (14 per cent)
- Transport Equipment Manufacturing (7 per cent).²⁰



As of the June quarter 2018, the manufacturing sector that accounts for the **highest share of total manufacturing employment** in Queensland is food product manufacturing, **with total employment of around 42,300 people** representing almost one-quarter of total manufacturing jobs in the state.

CASE STUDY

Ballistic Beer Co.

Like many of its peers in Queensland's independent brewing industry, Brisbane-based Ballistic Beer Co. in Salisbury has seen a meteoric rise from humble beginnings. From an idea first conceived by two friends in 2014, Ballistic opened in 2016 as a pilot operation based in a World War II-era shed. Today, it's a multiple-award winning brewery employing more than 15 people and brewing 35,000 litres of beer a month. Most recently, Ballistic has expanded to a second wholly-owned venue to enhance the reach and distribution of their product in a market where access to beer taps is key.

Capitalising on an industry estimated to be worth \$62 million a year and growing to the state economy, the Queensland Craft Beer Strategy is the government's response to independent brewers' calls for support. In founder David Kitchen's view, the strategy has potential to build commonality in planning between the industry and state and local councils, create opportunities for current and would-be brewers to train in the art and to tackle some small but highly beneficial changes that will unlock growth for the industry.



Global trends

Global trends and drivers provide both challenges and new opportunities for advanced manufacturers. These include:

Asia and Indo-Pacific middle class

A joint Telstra and CSIRO report, *Make for Asia*, reported that in 2009, the global middle class held 1.9 billion people with 28 per cent of this total in the Asia Pacific region. This is forecast to grow to a billion people by 2030 with the Asia Pacific share growing to 66 per cent, equating to around 3.2 billion people. This represents a huge market and opportunity for Queensland which has unequalled proximity to Asian markets.²¹

These trends, coupled with the shift in the global economy from West to East, are forecast to generate a 'dining boom' with global demand for food increasing by up to 75 per cent by 2050.²² It is also seeing the growth of other food trends, such as the desire for 'novelty' in food choices which underlies global growth in sectors such as the craft beer.

Increased demand from an ageing population

The ageing population worldwide is creating strong demand for a wide range of products and services particularly in the healthcare, medical and pharmaceutical

industries. It is expected that by 2050 Asia will be home to 24 per cent of those aged over 60 and this trend will have significant implications for health care expenditure with the increasing demand for products such as dental implants and titanium hip replacements to preserve a high quality of life as well as foods to allow them to address the medical issues which are becoming increasingly prevalent as society ages. Foods which tackle diabetes, compromised immune systems, digestive issues, malnourishment, osteoporosis, hypertension and high cholesterol, all of which afflict the elderly, offer considerable growth potential.²³

The ageing population domestically also impacts adversely on the availability of manufacturing skills and expertise in Queensland as skilled manufacturers retire. This roadmap recognises that mature-age workers are a source of highly capable mentors to the younger generation entering the state's manufacturing industry. Advanced manufacturing is also opening up new opportunities for workers to remain in the workforce through the introduction of robotics and automation.





CASE STUDY

UAP

UAP was founded in the 1990s by brothers Matthew and Daniel Tobin and is a global company recognised as a world-leader in public art and architectural design solutions. Its main factory in Northgate produces public art works for a global market. UAP projects include the Wintergarden facade in Brisbane, the Wahat Al Karama monument in the United Arab Emirates and Suzhou Sports Centre in China.

UAP is developing new ways to use robots and vision systems for design-led manufacturing, and it is working collaboratively with the Australian Centre for Robotic Vision at the Queensland University of Technology (QUT), and the Innovative Manufacturing Cooperative Research Centre (IMCRC) to develop a new wave of agile robots that can see what it is working on and make decisions. This is a significant change from pre-programmed robots that perform one repeated task in a highly-controlled environment. One of the robotic arms is being trained at the Northgate workshop to create large-scale, bespoke art pieces, previously impossible to produce economically in Australia.

Focus on increased sustainability

There is a growing international trend for sustainable products and services. This trend provides increased opportunities for the manufacture of sustainably produced and supplied products to both domestic and international markets.

Growth in the popularity and use of renewable energy provides new opportunities for Queensland to manufacture innovative products for use in wind turbines, cooling towers, solar thermal generators and energy storage systems.

While offering opportunities to provide products to address changing demand by customers, this trend also introduces challenges for manufacturers. The International Energy Agency (IEA) reported in December 2017, that Australia's manufacturing sector is the most energy intensive of nineteen advanced economies. In addition, water and waste are significant concerns.

There are also less appreciated effects such as disruption to supply chains caused by extreme weather and other effects on productivity. For example, the University of Chicago's Energy Policy Institute, has

found that sub-optimal environmental conditions do more than simply make workers uncomfortable. They also affect workers' ability to perform tasks, and can influence work intensity and duration, all of which impact overall labour productivity. Extreme high temperatures have the potential to weaken cognitive ability, impose biophysical constraints on work intensity and induce shorter work hours.

Disruptive technology

The increasing pace of change arising from new and emerging technologies is having a disruptive impact on traditional jobs, businesses and industries and enabling countries that have previously competed for low-cost, low-skill jobs to compete for high-skill jobs and produce high-value goods.²⁴

Digitalisation is integral to the technological changes occurring worldwide. Its impact on the product development process leads to a merging of design, production planning, engineering, manufacturing and services into one unit resulting in more efficient production and greater economies of scale and speed to market.²⁵

Strengths and opportunities

Queensland boasts a strong and diverse economy and the competitive advantages to make it the best location for businesses to invest and grow.

The Queensland Government is unashamedly pro-business with a stable and supportive policy and regulatory regime. Queensland offers competitive payroll tax rates, commercial and industrial property costs and low workers compensation premiums.

With an abundance of natural resources, the state has ready access to raw materials supported by comprehensive transport networks and infrastructure.

Queensland's skilled workforce is equipped to sustain emerging technologies, and the support of world-class universities and training institutes will ensure the supply of future workforce needs. Action is being taken under this Roadmap to further strengthen the development of skills for the future of work in the digital economy and advanced manufacturing.

In accelerating the shift to advanced manufacturing over the next decade, the state will capitalise on its competitive advantage to realise significant opportunities. This shift will be underpinned by the technological advances in the state's world-class research universities and institutes.

Queensland's existing manufacturing base

Queensland manufacturers are innovative, customer-focused and seeking ways to address the emerging issues that they face in today's globally competitive environment. The state already has an advanced manufacturing base across the following:

- additive manufacturing techniques (medical prosthetics and dental implants, building and construction, energy storage solutions)
- advanced forming technologies (medical and aerospace)
- advanced materials (medical devices, construction and civil engineering, transport and aerospace)
- biomanufacturing (medicine, energy and electronics)
- electronics manufacture (aerospace, medical devices, ICT and communications, defence and mining)
- heavy engineering (transport)

- high temperature superconducting technologies (energy and defence)
- innovative processing technologies (food and beverage manufacturing including beef processing)
- precision tooling and niche machining (aerospace, medical devices and instruments and mining equipment)
- technologically superior microwave modules and systems (next generation broadband communications and defence).

Queensland's significant and diverse regional manufacturing industry

Regional manufacturing provides a significant contribution to the state and regional economies. Approximately 28 per cent of the manufacturing industry's economic contribution is delivered through Queensland's regions. The diversity of regional manufacturing ranges from Food Product Manufacture to Primary Metal and Metal Product Manufacture to Transport Equipment Manufacture.

Queensland regions have developed specialised sectors over time. For instance:

- the Cairns region is highly specialised in terms of employment in the shipbuilding and repairs sector and the aircraft manufacturing and repair sector and has a strong food product manufacturing base
- the Townsville area has strong capabilities in food product manufacturing, primary metal product manufacturing and fabricated metal manufacturing
- the Rockhampton region's base includes rail manufacture, metal production and food product manufacturing.

The Queensland Government recognises the strengths of our regional manufacturers and is committed to supporting their growth through a suite of support initiatives.

To this end the Queensland Government is investing \$30 million into regional Manufacturing Hubs in Cairns, Townsville and Rockhampton to:

- support local manufacturers to become more productive, increase international competitiveness and access emerging and diversified growth opportunities
- support regional industry partners to accelerate the growth of several existing specialised industries and create a powerful and influential collective of local businesses, governments, economic development agencies and educational institutions to set a path for the strong growth of regional manufacturing
- be a catalyst to deliver world-leading technologies, processes and practices to regional manufacturers, and attract increased private sector investment and jobs in our regions.

Queensland's world-class education and skills training facilities

Queensland's workforce of over 2.5 million is highly skilled, motivated and employment ready. Its diversity and flexibility give potential investors a broad choice of skilled workers owing to world-class education and skills training institutions.

Queensland is home to a large number of internationally recognised universities and research institutions focused on advanced manufacturing. These are listed in **Appendix A**.

Queensland's nine universities include some of the most well recognised, largest and newest universities in the world.

Research conducted at Queensland universities and research institutions has achieved worldwide acclaim and has made a significant contribution to economic growth within the state, bringing more than \$1 billion into the Queensland economy each year.

TAFE Queensland is Australia's most prominent vocational education supplier, with more than 125,000 students enrolled annually in employment and training programs. TAFE Queensland offers education in more than 640 skills areas to students in more than 50 locations across the state.



CASE STUDY

Phibion

Phibion is an advanced environmental technology company that provides process engineering solutions to civil engineering problems. They are a global leader in specialised dewatering technology in mineral processing and land reclamation.

Phibion invented Accelerated Mechanical Consolidation (AMC), a dewatering process using their patented MudMaster® technology. This process rapidly reduces the volume of saturated materials, encouraging rapid water recovery while increasing density and strength. Additionally, this process reduces the operational footprint required while providing enduring economic, environmental and social value. Their technology allows rapid closure of completed operations enabling a wider range of sustainable future land uses to be considered.

AMC has been successfully applied around the world in a range of commodities, climatic conditions and industries. The MudMaster® is designed and manufactured in Queensland utilising many innovative local suppliers. At up to 17.5 tonnes, 9 metres long and 4.5 metres wide this a complex and significant fabrication achievement.

Phibion was the winner of the Environmental Solutions category in the 2018 Queensland Export Awards.

The Queensland Government aims to ensure young Queenslanders are well-positioned to take advantage of the many opportunities a knowledge-based economy offers and become the entrepreneurs of tomorrow. Queensland has a strong focus on science, technology, engineering and mathematics (STEM) in our state school system. STEM skills touch every aspect of today's world and through partnerships with industry, universities and the broader community, Queensland schools provide a world-class STEM learning environment to prepare students for the jobs of the future.

STEM skills touch every aspect of today's world and through partnerships with industry, universities and community

Queensland's Gateway to Industry Schools Program provides industry with the flexibility to develop and implement tailored school engagement approaches and activities. It aims to provide education and career opportunities for school students and an avenue for industries to meet future workforce requirements by increasing the number of students choosing a pathway into their industry sector.

Queensland's smart robotics, automation and design capability

Queensland has been testing robotics for many years. Examples include:

- the Port of Brisbane is Australia's first autonomous port
- the Australian Centre for Robotic Vision at the Queensland University of Technology developed the Crown-of-Thorns Starfish robot to control the spread of reef-eating starfish
- research and development into robotics includes CSIRO's Queensland Centre for Advanced Technologies specialising in field robotics
- the University of Queensland is pioneering innovations in autonomous mining.

Queensland's emerging maker culture provides access to advanced manufacturing equipment which supports the development of technical skills in robotics, automation and design.

In addition, the Queensland Government is investing in future skills through its curriculum and has created a Centre of Excellence in Automation and Robotics at Alexandra Hills State school.



CASE STUDY

Hydrogen

In Queensland, conditions are favourable to capitalise on domestic technological breakthroughs and the global momentum to grow the hydrogen economy. In August 2018, CSIRO demonstrated its world-first technology for re-fuelling hydrogen fuel cell vehicles at the Queensland Centre for Advanced Technologies. This project was supported by Hydrogen Mobility Australia members: BOC, Hyundai and Toyota.

The unique membrane technology enables the production of ultra-high purity hydrogen from ammonia. The membrane breakthrough will allow hydrogen to be safely transported and used as a mass-production energy carrier.

The Queensland Government has committed to fund CSIRO to undertake a pre-feasibility study into establishing an ammonia to hydrogen demonstration plant in Gladstone. The project will be a catalyst in opening up the supply chain of clean hydrogen to the world, including emerging markets in Japan, South Korea and Europe.

Queensland's strong innovation culture

The Queensland Government's Advance Queensland program positions Queensland as a leader in the knowledge economy, creating jobs both now and for the future. It empowers our best entrepreneurs, innovators and researchers and helps translate their ideas into commercial success and social benefits to help Queensland and Queenslanders be the best they can be.

The Advance Queensland five key themes: Inspire, Discover, Connect, Invest and Grow underpin a suite of programs and services to continue building Queensland's innovation base.

Advance Queensland is directly supporting the ongoing growth of the state's manufacturing industry further building the sector's current level of innovation.

Queensland's high-value and emerging manufacturing sectors



Aerospace

The Queensland Aerospace 10-Year Roadmap and Action Plan, launched in June 2018, identifies that the global market

outlook for aerospace presents major opportunities for Queensland companies. These include manufacturing opportunities for the new joint strike fighter global fleet supply, large-scale super alloy casting for jet engine casings brazing, heat treatment for avionics and components and new opportunities for the composites and advanced materials.



Biofutures

The development of the biofutures sector is a priority for the Queensland Government and is supported through the *Queensland Biofutures 10-Year Roadmap and Action Plan*.

This fast growing and high potential sector will focus on the manufacture of products from sustainable organic and/or waste resources into a diverse range of bioproducts such as sustainable chemicals, fuels, synthetic rubber, cosmetics, detergents and textiles. Innovative scientific and industrial technologies create bioproducts which are renewable and provide environmentally beneficial alternatives to existing conventional chemical and fossil fuel refining processes.



Biomedical

Building on the state's recognised expertise and capacity in the biotechnology and bioproducts sector, the *Queensland Biomedical 10-Year Roadmap and Action Plan* identifies the growing demand for personalised medical devices, particularly for the state's growing and aged population, and the assistive technologies to support the infirmed, elderly and disabled with the activities of daily living.

Queensland is also well placed to capitalise on export opportunities in areas of competitive strength such as the manufacture of scientific instruments (largely medical) and medicinal and pharmaceutical products.



Defence industries

The Queensland Defence industries 10-Year Roadmap and Action Plan, launched in June 2018, identifies Queensland as having a strong defence industrial base and world-class capabilities in a range of areas.

The increased investment in the defence sector is creating opportunities for advanced manufacturing in Queensland in areas of significant capability. These include heavy vehicle manufacturing, fibre-reinforced composites and metal-composite hybrid materials development for light weighting of structures and components.

CASE STUDY

Rheinmetall Defence Australia

In March 2018, the Australian Government announced Rheinmetall Defence Australia as the successful tenderer for the \$5.2 billion LAND 400 Phase 2 contract with its Boxer combat reconnaissance vehicle (CRV). A key element of Rheinmetall's bid was its commitment to establish its Australia-New Zealand Headquarters and Military Vehicle Centre of Excellence (MILVEHCOE) in South East Queensland.

LAND 400 is the largest acquisition project in the history of the Australian Army and attracting Rheinmetall and Phase 2 to Queensland is a catalytic outcome that will create unrivalled opportunities for the state's defence and advanced manufacturing industries for decades to come. Rheinmetall expects that over 450 jobs will be created for Queenslanders and \$1 billion will be contributed to the Queensland economy in the first 10 years. Rheinmetall's presence in Queensland will drive continued innovation, boost investment and create increased global export opportunities for local industry.

Rheinmetall's MILVEHCOE will be located in the heart of Australia's largest heavy vehicle manufacturing and sustainment precinct. It will not only manage the delivery and continued development and sustainment of the Boxer CRV, it will also accommodate Rheinmetall's other defence projects. The MILVEHCOE will act as a regional hub with an expected program of continuous design, manufacture and support for up to 5000 military vehicles across Australia and the Asia Pacific.



Opportunities also exist for Queensland businesses with capabilities in the manufacture of technologically superior command and control systems, reconnaissance and surveillance systems, ballistic protection for personnel and equipment and autonomous vehicles and systems.

Drawing together industry, researchers and businesses, Queensland is actively developing capabilities such as robotics, artificial intelligence and trusted autonomous systems. In recognition of the state's depth of technological capability, Queensland has been named as the national headquarters of the first Defence Cooperative Research Centre for Trusted Autonomous Systems (DCRC TAS).



Food and beverage processing

The Asia-Pacific's growing middle class demand for safe, clean and green food together with the state's proximity to this rapidly growing region creates opportunities for Queensland's food processing sector.

Queensland is recognised for its high-quality food, exceptional safety standards and value-adding (through manufacturing technologies and processes) to product development, such as ready-to-eat meals. Upstream processing opportunities in agriculture also exist to produce healthy foods and nutraceuticals which are favoured by the Asian market.

Independent brewing in Queensland is another growing market. Exciting opportunities are available for Queensland's craft brewers, with the sector currently contributing an estimated \$62 million annually to the state economy and new businesses growing rapidly across the state.

Queensland's craft brewing industry is a highly innovative and award-winning sector that offers employment opportunities through increasing its production to capitalise on the significant demand for craft beer products.



Vehicle manufacture

Queensland manufactures a wide range of vehicles and components, producing most vehicle types, with the exception of passenger motor vehicles. Trucks, buses, aftermarket components, performance vehicles and specialist vehicles are produced in Queensland.

The heavy vehicle precinct located in the corridor between Ipswich and Brisbane, is Australia's largest vehicle manufacturing area, currently manufacturing heavy vehicles for commercial, mining and defence customers.

Within this precinct, the Volvo truck assembly plant has operated at Wacol since 1972. Volvo manufactures over 2,500 Mack and Volvo vehicles per year with a workforce of approximately 500 employees. In the context of passenger motor vehicle production plant closures throughout Australia, Volvo truck production has been resilient. It currently has an estimated overall market share of 21.7 per cent of the motor vehicle manufacturing sector in Australia.²⁶

This resilience is evidenced by the opening of its new \$30 million national headquarters, dealership and training centre and the expansion of its assembly plant near Wacol in August 2018. The facility can produce up to 67 tailor-made heavy-duty vehicles per week.

In March 2018, Rheinmetall was announced as the successful tenderer for the \$5 billion Land 400 Phase 2 contract. The contract includes building the Boxer combat reconnaissance vehicle for the Australian Defence Force in Queensland which will bring further heavy vehicle manufacturing and substantial supply chain opportunities to Queensland.



Mining equipment, technology and services (METS)

Building on world leading innovation in automation for the mining industry, Queensland has globally recognised expertise in boosting safety through automation, meeting industrial standards and regulations and easing workflow operation.

The *Queensland METS 10-Year Roadmap and Action Plan* supports the industry in taking advantage of the increasing demand for this expertise as automation becomes more prevalent in the mining sector.



Precision agriculture

The growing demand for smart farming includes precision agriculture (through robotics and automated technologies contributing to more efficient agricultural practices) and telemetry devices (needed to operate farming enterprises remotely)²⁷ and will create robust opportunities for business within Queensland's highly productive agricultural industry.

There are also opportunities in the agriculture sector for the design and manufacture of biodegradable, starch-based plastics and composites through cleaner processes and easier recycling.



CASE STUDY

James Cook University

James Cook University (JCU) is utilising its Townsville city campus, as well as undertaking low-cost repurposing of buildings, to create the Technology Innovation Complex for the research community, industry and the wider community to develop prototypes and turn ideas into reality. In 2017, JCU's Cairns campus began offering 'Electronic Systems and Internet of Things' as a new area of specialisation after completion of a general first year in engineering. This degree combines engineering and business with technology, to train people in creating new internet-connected devices and managing the huge amounts of data they produce.



Rail manufacturing

The rail sector makes a significant direct contribution to the Queensland economy, as a key source of high-value, economic activity.

Total employment in the Queensland rail sector is estimated to be around 21,000 people with a total direct economic contribution of around \$4 billion in 2017-18. Industry revenue is estimated to be almost \$9.4 billion in 2017-18 and Queensland accounts for an estimated 30 per cent of the national industry.

While estimates vary, it is expected there will be approximately \$46 billion in planned investments in rail projects across national governments over the next decade. There are opportunities for Queensland to gain a greater share of this investment pipeline and these opportunities will be promoted under this Roadmap.

The Queensland Government has committed to guaranteeing all future rail rolling stock and associated infrastructure for which Queensland has the manufacturing capacity, to be manufactured and maintained by Queenslanders to support jobs in Maryborough and other regional centres. A rail manufacturing strategy will be developed to capitalise on these opportunities.



Renewables and hydrogen

Growth in the use of renewable energy provides new opportunities for Queensland's advanced manufacturing sector to test and

deploy innovations such as composites for wind turbines, cooling tower design for solar thermal generators, as well as the next generation materials for solar panels and batteries.

The Queensland Government is committed to growing large-scale solar in Queensland through the Solar 150 program—Queensland's large-scale solar investment program which is committed to supporting up to 150 megawatts of aggregate electricity generation capacity (AC) solar power generation in Queensland—to drive significant growth in renewable energy investment.

Queensland recognises the strategic opportunity for a new hydrogen industry to address the need for manufacturers to access competitively-priced energy and create new export opportunities.

To this end, the government is committed to identifying the opportunities, capabilities and capacity to produce and supply hydrogen at a competitive price.



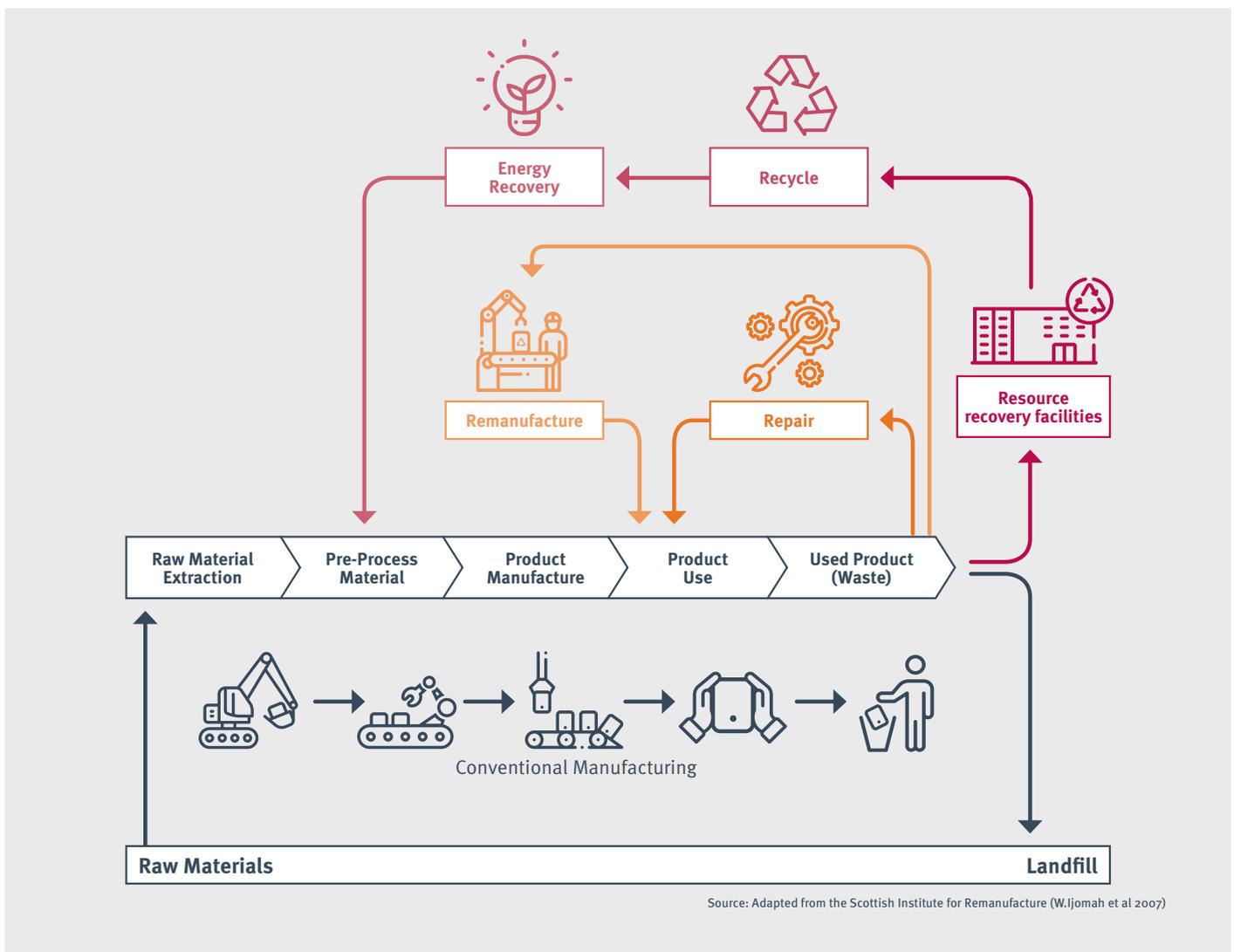
Resource Recovery

We all recognise how important it is to divert waste from landfill, reduce stockpiling and recover resources for more valuable uses. That's why the Queensland Government has established the \$100 million Resource Recovery Industry Development Program.

Our goal is to make Queensland a world leader in resource recovery projects, so we're offering funding and support to local governments, waste recovery businesses, not for profits and consortia looking to employ proven technologies along the entire supply chain, from collection and transfer to sorting, re-manufacturing and waste to energy.

Manufacturers will benefit from learning about the emergence of resource recovery technologies to better manage waste and generate opportunities for re-manufacturing.

In addition to the environmental benefits of resource recovery programs, re-manufacturing provides cost effective opportunities for the creation of skilled jobs, particularly as products are taken apart, repaired and reassembled to their original equipment manufacturer (OEM) specifications. Businesses that re-use core products that are deemed as waste can build these up again into a high-quality, cost effective product, typically using less energy than manufacturing a new product.



The challenge

To increase productivity, innovation and competitiveness while transitioning Queensland's manufacturing industry to advanced manufacturing within a highly competitive and fast-changing global environment

Specific challenges that will continue to be addressed through the Roadmap include:

Increasing adoption of innovative technologies, processes and practices

Effectively addressing the challenge of adopting new technologies, processes and practices is critical in the transition to advanced manufacturing.

However, the manufacturing environment is highly dynamic and keeping up with current trends and technologies can be challenging, particularly for small to medium enterprises. Manufacturing firms would benefit from targeted support to:

- lift awareness of advanced manufacturing technologies (including robotics and automation, digitalisation, virtual and augmented reality, nanotechnology) and world-best practices
- understand the real cost of purchasing new technology
- identify the cost savings achievable through the adoption of world-best practices in areas such as digitalisation, design in manufacturing and sustainable manufacturing
- build the expertise for using new technology to increase productivity and competitiveness
- implement new technologies and practices in a way that aligns with current business capabilities, existing and future required skillsets, and identified goals
- benchmark their performance, pre-and post-advanced manufacturing technology investment, against international best practice
- quantify the value of their investment
- improve information communications and technology literacy.

The 2018 report by Australia's Office of the Chief Economist (OCE) on the nation's innovation system revealed that Australia ranked last out of 27 countries for collaboration on innovation between SMEs and research institutions.²⁸ The need for increased industry and research collaboration and co-location was identified as a major recommendation in a study on advanced manufacturing by the Office of the Queensland Chief Scientist.²⁹

adopting new technologies, processes and practices is critical in the transition to advanced manufacturing.



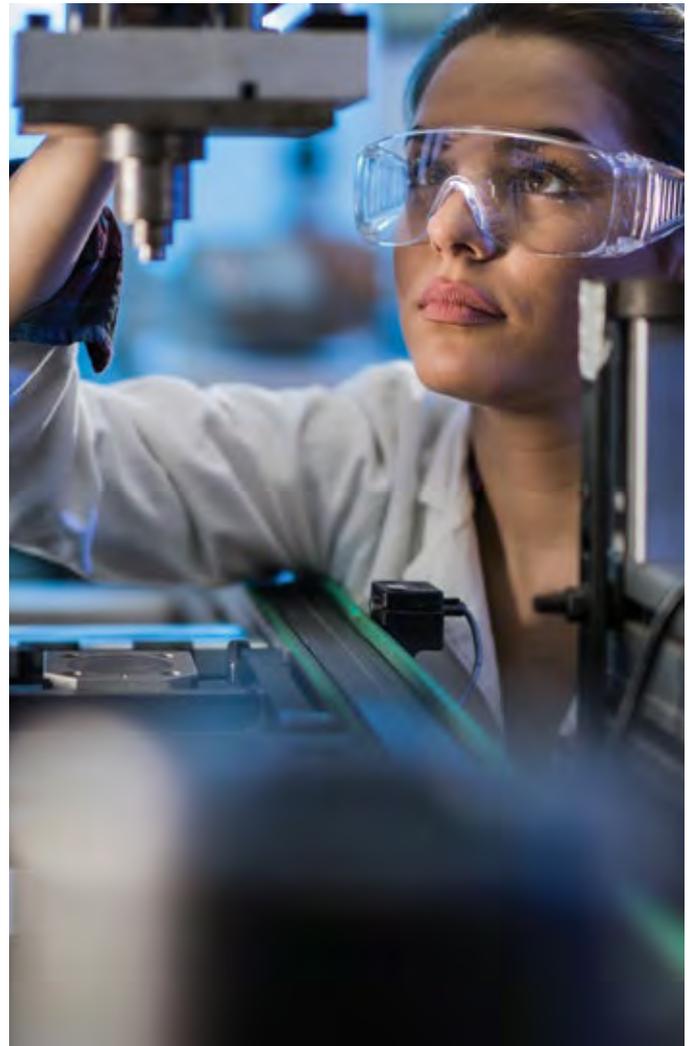
Attracting and retaining a highly-skilled workforce

The Council of Australian Governments has noted that increasing the skills and qualifications of individual workers is critical to support Australian businesses and drive improvements in the productivity of the economy while fostering greater levels of workforce participation.³⁰

New technologies are accelerating the rate of innovation, requiring a greater focus on new business models and access to global supply chains. They are also the catalyst for creating new highly-skilled occupations and attracting highly-skilled workers.

Our changing demography is resulting in changes to the way people work, preferences in relation to work-life balance, and a more diverse workforce. This demographic shift will, over time, help manufacturers to see different opportunities and support agile, responsive and customer focused businesses.

Queensland's advanced manufacturers recognise the importance of continually building leadership and operational enterprise management skills to remain at the forefront of a rapidly changing business environment. However, a recent study by the Centre for Workplace Leadership at the University of Melbourne surveyed almost 8,000 individuals across 2,703 organisations and 2,561 workplaces and concluded that there is a pattern of mediocre leadership in many organisations that will likely impair their capacity to shift to a knowledge economy and impede their efforts to raise productivity.³¹



CASE STUDY

Assistive Technology Makerspace

The Assistive Technology (AT) Makerspace is a newly established hackerspace specialising in the co-design, co-development, and co-deployment of assistive technology solutions in partnership with people with disability. Located in Bundaberg, the hackerspace was started after local disability organisation, Community Lifestyle Support (CLS), realised that they had many clients in need of custom assistive technology, and no local facility capable of developing solutions to meet those needs. They also saw an opportunity with the National Disability Insurance Scheme (NDIS) expanding its scope on funding for assistive devices. With the help of funding through the Advance Queensland Knowledge Transfer Partnership Program and a partnership with Central Queensland University, CLS' AT Makerspace can offer manufacturers and community makers a place to hack, make and experiment with products that can later be commercialised.

AT Makerspace had a soft launch in November 2017 with a TOM Makeathon event, which was supported by the Department of State Development, Manufacturing, Infrastructure and Planning, where teams of makers partnered with someone from the disability community to provide a solution to an everyday challenge they faced. It plans to do several more of these events each year after it formally opens to the public in November 2018.

CASE STUDY

Split Spaces

Split Spaces is a dedicated not-for-profit Innovation Hub located in Mackay designed to assist Intrepreneurs, Entrepreneurs, Futurepreneurs, Startups, Scaleups, Innovators, Inventors, Creatives and Creators. The space offers diversity in programs, facilities, mentoring, coaching and a range of membership levels open to anyone. With the support of a Queensland Hackerspace grant, Split Spaces will further develop its hackerspace, to complement a larger rapid prototyping solution targeted at mining technologies.

The Split Spaces hackerspace will provide opportunities to overcome barriers faced by organisations, particularly those in the mining industry, who wish to innovate whilst reducing associated costs and barriers to rapid prototype in Australia. The space will also enable creatives and innovators to build and prototype when developing new concepts or installations for one-off or unique projects.

To enhance the effectiveness of the hackerspace, Split Spaces intends to work closely with regional organisations to establish a cluster of manufacturing and engineering services, industry organisations and associated operators who are well positioned to assist the development of new technologies, innovative approaches and the willingness to drive innovation in the region.

To build an advanced manufacturing workforce manufacturing firms benefit from:

- university and vocational education and training graduates with skills in areas such as digital expertise, design, coding and virtual and augmented reality
- partnerships with universities and research institutions to generate innovative solutions through research and development
- partnerships with schools to attract new entrants into the manufacturing industry
- implementing enterprise workforce development plans with an emphasis on the importance of management and leadership skills. The Australian Securities and Investments Commission's published insolvency statistics shows that for the past three years (2014-15 to 2016 -17), the leading cause for business failure has been poor strategic management of business
- strategies to retain the knowledge and skills of the industry's ageing workforce and succession planning.

As a key element of the Advanced Manufacturing 10-year Roadmap and Action Plan, Jobs Queensland prepared the *Advanced Manufacturing Skills, A Skills, Training and Workforce Development Strategy for the Manufacturing Industry in Queensland* in 2018.

The strategy provides a holistic approach to skills, training and workforce development for Queensland's manufacturing industry. It identifies the challenges and opportunities for skills within the industry and outlines how the dynamic nature of advanced manufacturing continues to challenge the currency of skills, requiring the workforce to continually adapt and build capability.

Queensland's advanced manufacturers recognise the importance of continually building leadership and operational enterprise management skills to remain at the forefront of a rapidly changing business environment.

The Queensland Government Response to the strategy highlights initiatives to progress the strategy's 10 Priority Action Areas. It provides a framework for government to partner with industry to identify actions to help shape workforce, training and business development strategies for the future of manufacturing in Queensland.

A Manufacturing Skills Working Group has been established with the primary objective of developing and implementing a Manufacturing Skills Implementation Plan, which will be implemented in 2019.

Addressing a negative public perception of manufacturing

The closure of the passenger motor vehicle production in Australia contributed toward a public perception that Australian manufacturing is in decline.

However, this is not the reality for manufacturing in Queensland where, for example:

- manufacturing is Queensland's sixth largest employing industry with 179,100 persons
- Employment has increased by 15,100 persons over the year to September quarter 2017
- 86 per cent of employees are engaged on a full-time basis
- Queensland manufacturing consistently contributes around \$20 billion per year to the economy
- manufacturing in Queensland is a key investor in R&D, with private expenditure of \$361 million
- Exports by Queensland manufacturers totalled approximately \$15.8 billion in 2017-18
- Queensland is home to the largest heavy vehicle manufacture sector in Australia.

The Queensland manufacturing story – the state's capabilities, technologies and achievements - needs to be promoted both domestically and internationally to raise the profile of the industry, attract new entrants and to build investment in Queensland.

86 per cent of manufacturing employees are engaged on a full-time basis

Assisting manufacturers to seize the different distinct opportunities and challenges specific to their location or sector

Regional manufacturers share a range of challenges with South East Queensland and national manufacturers. These challenges are sometimes magnified in regional areas, given the distance to markets and limited access to potential opportunities. Some of these challenges include a skilled labour shortage, global competition, technology disruption and equipping the future workforce with high-quality and relevant skills required for a changing sector.

In recognising the need to strengthen regional manufacturing, funding of \$30 million has been allocated to the regional manufacturing hubs. The hubs will aim to ensure that regional manufacturing's potential is realised to contribute even more significantly to the local and Queensland economies.

In addition to the challenges and opportunities across the entire manufacturing industry and the specific issues facing regional manufacturers, there is a unique suite of issues to be addressed by the various manufacturing subsectors.

To this end, the government is working with regional industry and industry sectors such as Beef Processing, Craft Brewing and Rail Manufacturing to support local manufacturers adopt advanced manufacturing technologies, systems, practices and processes to increase access to global supply chain opportunities. We are also supporting manufacturers to benefit from a diversifying and broadening of their manufacturing base.



CASE STUDY

Northern Oil Refinery

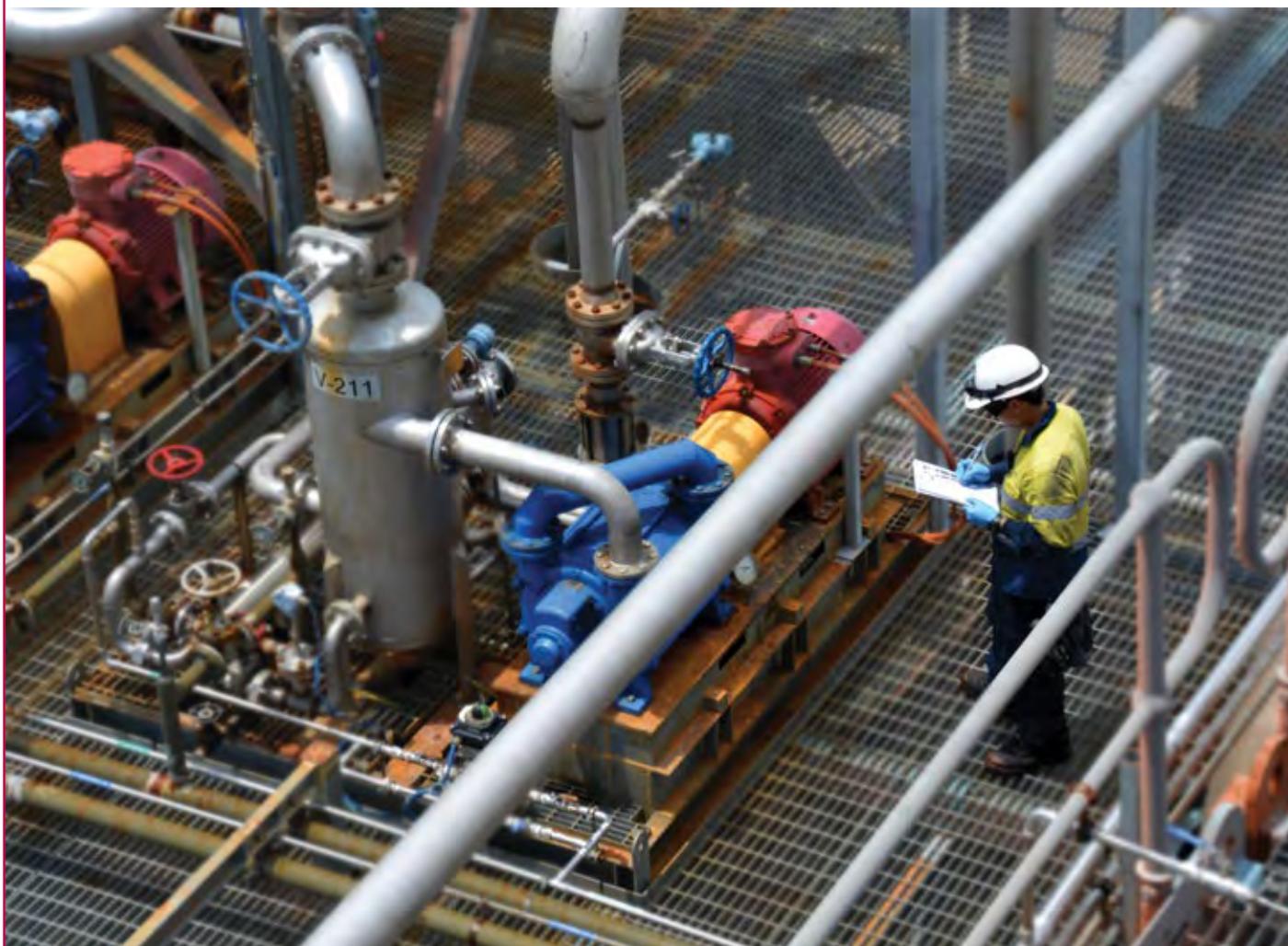
Queensland's first advanced biofuels production plant has successfully refined four waste-based products into fuel and plans to test another seven waste products to see if the same result can be achieved.

The Northern Oil Advanced Biofuels Pilot Plant at Yarwun, near Gladstone, commenced operations in mid-2017 and has since generated renewable crude from used oil residue, softwood plantation waste, blue pine and macadamia nut shells.

This renewable crude is able to be upgraded to quality diesel fuel oil using pilot scale distillation and hydrotreating rigs – which means it can be used to run diesel engines. Laboratory testing has also confirmed the renewable crude can be further refined to make jet fuel and lubricants.

The owners of the \$18 million Pilot Plant now intend to test if they can successfully convert plastic, tyres and an invasive weed into diesel and energy. These investigations will drive Queensland one step closer toward achieving the government's vision for a \$1 billion sustainable and export oriented industrial biotechnology and bioproducts sector in Queensland.

The Northern Oil refinery was the first project attracted to Queensland by the government's \$105 million Advance Queensland Industry Attraction Fund (AQIAF)



Actions

21st century advanced manufacturing competitiveness has fully converged the digital and physical worlds where advanced hardware combined with advanced software, sensors and massive amounts of data and analytics results in smarter products, processes and more closely connected customers, suppliers and manufacturers.³²

Under the revised Advanced Manufacturing 10-Year Roadmap and Action Plan, four strategies have been developed to realise our vision of Queensland becoming internationally recognised for high-value, advanced manufacturing technologies, systems, products and services that are innovative, sustainable and embedded in local and global supply chains by 2026. These strategies will:

- 1 encourage the adoption of advanced manufacturing technologies, systems and practices
- 2 drive the development of a highly skilled workforce
- 3 showcase the opportunities and achievements of Queensland's advanced manufacturing industry
- 4 support regional manufacturing and manufacturing growth sectors across Queensland.

Each strategy includes a range of actions that facilitate the transition to advanced manufacturing.

In implementing the actions, and the applicable initiatives, programs, workshops and services, the Queensland Government will adopt a partnership approach with business and other stakeholders to ensure the initiatives are effectively adopted.

Actions supporting Strategy 1: increasing the adoption of leading-edge design, innovation, technologies, processes and practices

- **An Industry 4.0 – the future of manufacturing** initiative. Embracing Industry 4.0 will require manufacturing businesses to focus on innovation, invest in commercialisation, educate and train a highly skilled workforce and encourage collaboration and the adoption of new technologies. The Queensland Government is committed to delivering several Industry 4.0 initiatives, including:

- » Introductory 4.0 seminars aim to demystify industry 4.0 and encourage its take up by more manufacturers
- » futuremap™ workshops to support manufacturers map business capabilities in relation to Industry 4.0
- » Industry 4.0 masterclasses to provide manufacturers with access to global experts on Industry 4.0 and to build on the results of their futuremap™
- » Inside Advanced Manufacturing is a week-long event held across the state to showcase the use of advanced manufacturing techniques and technologies. During this week, advanced manufacturers and research organisations will showcase their businesses to other manufacturers and students.
- The continued implementation of the **\$40 million Made in Queensland** grant program, with round 2 supporting manufacturing firms to implement leading edge technologies to increase productivity and generate new jobs.
- The **Advanced Manufacturing Benchmarking** program will continue to assist businesses measure their performance and practices and subsequently access a suite of business improvement measures to help them grow and innovate.
- Journey to **Advanced Manufacturing** initiative which provides manufacturers with access to a suite of tailored business improvement opportunities. These include workshops, forums and specific programs across the state including:
 - » robotics and automation
 - » digital business capability
 - » supply chain capability
 - » energy and sustainability
 - » B2B network development.

CASE STUDY

Queensland Productivity Commission — Manufacturing in Queensland Report

In September 2016, the Queensland Government tasked the Queensland Productivity Commission (the Commission) with undertaking an inquiry into Queensland manufacturing, including a review of international reshoring initiatives.

In undertaking the Inquiry, the Commission considered policy options to improve the productivity and competitiveness of the Queensland manufacturing sector, with a focus on opportunities to maximise existing advantages, improve weaknesses and take advantage of emerging domestic and international opportunities.

The Government has accepted 16 of the 17 recommendations including: making it easier for business to locate to Queensland; avoiding further pressure on energy prices; removing impediments to procurement and labour mobility; and ensuring the manufacturing industry can access the right workforce.

- The **Advanced Manufacturing Design** program which will help increase businesses' international competitiveness by accelerating the incorporation of design principles and practices in manufactured products
 - **The Digital Connectivity** program to bring manufacturers closer to their customers and better positioned to manage the whole manufacturing process and product lifecycle through the design production, logistics, supply and services aspects.
 - Support for manufacturers will also be provided through the **sustainable manufacturing practices** initiative to address input costs such as energy and electricity, reduce waste and to meet the increasing customer demand for products that are both affordable and have a light environmental footprint.

Existing programs, such as ecoBiz will be leveraged to support manufacturers to adopt more sustainable models.
- Actions supporting Strategy 2:
driving the ongoing development of a highly-skilled workforce**
- **A Manufacturing Skills Implementation Plan** will be delivered in partnership with industry to support manufacturers respond to emerging industry trends in the transition to advanced manufacturing. This Plan will have a focus on:
 - » encouraging the uptake of manufacturing apprenticeships and traineeships
 - » working with schools, the VET sector and universities to align education, skills development and higher education with emerging industry requirements
 - » strengthening business, leadership and workforce development skills and building supply chain management capability
 - » introducing practical industry learning opportunities to school students
 - » practical learning opportunities in schools as an introduction to advanced manufacturing, including activities such as robotics, design and engineering
 - » regional and priority sector skills development strategies to meet specific industry requirements
 - » foundation and employability skills such as adaptability, resilience, digital literacy and STEM skills
 - » encouraging tradespeople to own and embrace change
 - » providing support to existing workers in industries in transition to advanced manufacturing through access to programs that provide opportunities for upskilling and reskilling to minimise workers being displaced as a result of changes to technologies and work practices.
 - **The Hacker/Makerspaces program** will continue to support the establishment and expansion of makerspaces and other similar initiatives across Queensland.



Actions supporting Strategy 3: showcasing the opportunities and achievements of Queensland's advanced manufacturing industry

- **Promoting Queensland's advanced manufacturing to the world**

- » promoting Queensland's technologies and expertise internationally
- » marketing Queensland's advanced manufacturing achievements
- » promoting Queensland manufacturing's robotics and automation capability
- » promoting manufacturing as a key contributor to Queensland's strong, modern and diversified economy
- » attracting investment and projects to Queensland to build investment in the state's advanced manufacturing industry

- **Promoting Queensland's Advanced Manufacturing to Industry**

- » facilitating tailored events to promote Queensland capabilities and capacity to major project proponents, interstate and international investors and the community
- » organising targeted workshops across Queensland to promote opportunities for local advanced manufacturing businesses.

- » Expanding regional manufacturing networks to showcase manufacturing innovation, assist companies to engage and encourage industry collaboration
- » Promoting opportunities for existing workers to transfer their skills and knowledge into advanced manufacturing

- **Promoting Queensland's Advanced Manufacturing to new entrants**

- » informing students, parents and educators about the exciting career opportunities in the manufacturing industry, especially as a result of the industry entering a new industrial revolution (Industry 4.0)
- » informing university students and academic staff about the highly skilled career opportunities in manufacturing
- » delivering MakerFest 2019, a series of events designed to showcase advanced manufacturing and emerging technologies in Queensland; promote STEM skills and their fundamental importance to advanced manufacturing; encourage the sharing of ideas and techniques between industry and makers; and promote opportunities for attracting younger people into manufacturing
- » delivering the Women in Manufacturing seminar series and promoting career opportunities in the manufacturing industry to women
- » creating a strong nexus between the popular maker movement and career opportunities in advanced manufacturing.



Actions supporting Strategy 4: supporting regional manufacturing and manufacturing growth sectors across Queensland

- The **Manufacturing Ministerial Committee (MMC)**, chaired by the Minister for State Development, Manufacturing, Infrastructure and Planning will continue to provide expert advice to government ensure the Queensland manufacturing sector remains on a strong growth trajectory to become more globally competitive.
- **Manufacturing Hubs** in Cairns, Townsville and Rockhampton. \$30 million will be invested to support the manufacturing industry to further build productivity, increase international competitiveness and access emerging and diversified opportunities. The hubs will bring together an influential collective of local businesses, governments, economic development agencies, and educational institutions, to set a path for the growth of regional manufacturing.

Local businesses will be able to drop into the hubs and access streamlined advice and assistance to targeted programs including business development programs, skills development and training programs and advanced manufacturing programs. The hubs will also support regional industry partners accelerate the growth of several existing specialised industries.

In Cairns, the hub will initially focus on marine, aviation and food manufacturing. In Townsville, advanced metal production and food transformation will be initial key focus areas, whereas Rockhampton will specialise in rail manufacturing and technology, advanced technologies for metal production and food product innovation.

- **Accessing new market opportunities** in priority sectors such as aerospace, biofutures, biomedical, defence and mining equipment, technology and services.
 - » Supporting the development of manufacturing sectors through:
 - a Queensland Craft Brewing Strategy to support the sustainable growth of the Queensland’s world class, dynamic and socially responsible craft brewing industry. Queensland is home to close to 80 independent craft breweries.
 - a Rail Manufacturing Strategy for Queensland to promote the capability and capacity of Queensland manufacturers to deliver on rail projects nationally, increase export opportunities for Queensland rail manufacturers and generate highly skilled job opportunities

CASE STUDY

SuperPro Suspension

SuperPro Suspension is an Australian manufacturer of automotive polyurethane bushings and suspension parts, based in Brisbane, Queensland. Built on a foundation of knowing suspension and wheel alignment concepts, SuperPro has been a market leader globally for 30 years.

The driving force with the organisation has been to innovate and push the boundaries of what is possible. By utilising modern design techniques, rapid prototyping using 3D printing and Finite Element Analysis, SuperPro can respond in a much shorter time frame and bring quality solutions to market. With a research and development team based close to the manufacturing facility, testing of new and improved materials and processes is streamlined.

SuperPro is recognised globally for its premium polyurethane product due to the evolution of the material and design capabilities. With a philosophy of constant improvement, SuperPro will continue to grow and develop cutting edge products.



- a Queensland Beef Processing Strategy to further support a sector which makes a significant contribution to Queensland's economy. Average direct employment alone in the beef processing sector in Queensland is estimated to exceed 10,000 jobs and the industry value-add is approximately \$1 billion annually to the Queensland economy, making it one of the state's largest manufacturing sectors
- a Hydrogen Industry Strategy
The Queensland Government's September 2018 discussion paper *Advancing Queensland's hydrogen industry* identified five focus areas to support growth in the hydrogen industry - supporting innovation, facilitating private sector investment, ensuring an effective policy framework for sustainable development, building community awareness and confidence and facilitating skills development for new technology.
Feedback on the discussion paper will inform the development of a hydrogen industry strategy in 2019
- » Reshoring of manufacturing involves transferring an activity, commonly a production process, from an overseas location back to a country of origin. The Queensland Government is committed to reshoring manufacturing activities and has provided an additional \$20 million to the Advance Queensland Industry Attraction Fund (AQIAF) to deliver on this commitment.
The focus will be on working with manufacturing companies that have taken production processes offshore from Queensland or other Australian States to actively encourage the reshoring of operations to Queensland.
- » Supporting manufacturing ecosystems that bring together companies, schools, researchers, universities, investors, government and stakeholders in the manufacturing supply chain.

CASE STUDY

Evolve Group Pty Ltd

Evolve Group Pty Ltd is an Australian owned plastics manufacturer located in Logan City, that provides a full range of services from plastic injection moulding, design and prototyping assistance, through to tool manufacture, component construction, roll-form machinery manufacturer and finished goods assembly.

With the help of a Made in Queensland grant, the company will upgrade its machinery to transform it from a traditional manufacturing plant into a world leading, advanced automated manufacturing facility. Incorporating automated systems has enabled Evolve Group to bring current offshore manufacturing back to Queensland and retain and retrain employees in high-value, knowledge-based jobs.

Advance Queensland

The actions to be delivered under the Advanced Manufacturing 10-Year Roadmap and Action Plan are supported by a suite of programs delivered under the Queensland Government's Advance Queensland program.

2016-2020 will deliver more innovative and internationally competitive small businesses

The Queensland Government has a clear plan to drive employment and economic growth.

To create a diverse, knowledge-based economy, it is vital that the state's innovation system works seamlessly from the generation of ideas to the generation of jobs.



With funding of \$650 million, the Advance Queensland initiative is building a prosperous future for Queensland, growing our regions, further unlocking the potential of business to innovate, further harnessing our existing strengths and fostering emerging opportunities. There are a number of programs relevant to advanced manufacturers:

- **Advancing Regional Innovation Program** aims to turn Queensland's regions into hubs for innovation and enterprise.
- **Ignite Ideas Fund** supports start-ups and small to medium Queensland businesses to commercialise market ready innovative ideas that will:
 - » generate jobs today and in the future
 - » enhance innovation and skilled job opportunities across regional Queensland
 - » help Queensland businesses compete in global markets
 - » grow Queensland's reputation.
- **Business Development Fund** helps to turn ideas into a reality with co-investment in emerging and high-growth Queensland businesses at the forefront of commercialising innovative research or ideas.
- **Industry Tech Fund**, providing funding to back projects that develop and deploy cross-cutting platform technologies.
- **The Regional Internet of Things (RIoT) Program** to fund local projects helping local business, communities and councils to trial the use of connected devices.
- **Innovation Partnerships** to position Queensland as a global innovation hub with grants of up to \$1.5 million awarded to Queensland research organisations to collaborate on research projects with industry.



- **Innovate Queensland** provides a range of skills-based and collaborative solutions for businesses and early stage innovators seeking to benefit from innovation and technology commercialisation.

Advanced manufacturing is also one of the **Science and Research Priorities** identified by the Queensland Chief Scientist as an important enabler to deliver productivity growth and jobs for the state.

With funding of \$650 million, the Advance Queensland initiative is building a prosperous future for Queensland

Additionally, the Queensland Government is actively delivering a suite of industry attraction and facilitation service with the aim of encouraging the relocation and establishment of new projects, or reinvestment and expansion of existing operations in Queensland.

One of these, the \$105 million **Advance Queensland Industry Attraction Fund (AQIAF)**, targets growth companies in priority industry sectors including advanced manufacturing. AQIAF seeks to bring innovative projects to Queensland and help them grow in order to drive job creation, regional growth, increased innovation and technology and supply chain development.

The **Advancing Small Business Queensland Strategy 2016-2020** will deliver more innovative and internationally competitive small businesses that contribute to the state's economic development. This strategy supports businesses transitioning to advanced manufacturing.

Advancing education: An action plan for education in Queensland includes The Schools of the Future STEM Strategy for Queensland state schools and #codingcounts: A plan for coding and robotics in Queensland state schools. The action plan promotes fast-tracking the digital technologies curriculum including coding and robotics. Skills in these areas will underpin the future growth of the advanced manufacturing sector.

Advanced Manufacturing 10-Year Roadmap and Action Plan

VISION

By 2026, Queensland will be an international market leader in the delivery of advanced manufacturing technologies, systems, products and services that are innovative, sustainable, and embedded in local and global supply chains.

STRENGTHS AND OPPORTUNITIES

- Queensland's existing manufacturing base
- Queensland's significant and diverse regional manufacturing industry
- Queensland's world-class education and skills training facilities

Specific Challenges

Increasing adoption of innovative technologies, processes and practices

Attracting and retaining a highly-skilled workforce

STRATEGIES

Strategy 1

Increasing the adoption of leading-edge design, innovation, technologies, processes and practices

Actions

- **The Industry 4.0 – the future of manufacturing initiative** to assist manufacturers to understand Industry 4.0, prepare a futuremap™, undertake masterclasses and get a first-hand look at practical implementation of Industry 4.0 through the Inside Advanced Manufacturing event
- **The Made in Queensland grant program** will continue to support manufacturers adopt new technologies
- **An Advanced Manufacturing Benchmarking program** will assist businesses measure their performance and practices and inform their ongoing growth and innovation
- **Journey to Advanced Manufacturing initiative** including a suite of tailored workshops, forums and specific programs across the state such as:
 - » manufacturing systems and processes
 - » robotics and automation
 - » digital connectivity and capability
 - » supply chain capability
 - » sustainable manufacturing practices
 - » B2B network development
 - » manufacturing technologies
 - » virtual reality and augmented reality
 - » site visualisation deployment
- **The Design in Manufacturing program** to accelerate the incorporation of design principles and practices.
- **The Digital Connectivity program** to bring manufacturers closer to their customers and better positioned to manage the whole manufacturing process and product lifecycle through the design production, logistics, supply and services aspects.

Strategy 2

Driving the ongoing development of a highly-skilled workforce

Actions

- **A Manufacturing Skills Implementation Plan** will be delivered in partnership with industry to support manufacturers respond to emerging industry trends in the transition to advanced manufacturing. This Plan will have a focus on:
 - » encouraging the uptake of manufacturing apprenticeships and traineeships
 - » working with schools, the VET sector and universities to align education, skills development and higher education with emerging industry requirements
 - » strengthening business, leadership and workforce development skills and building supply chain management capability
 - » introduce practical industry learning opportunities to school students
 - » practical learning opportunities in schools as an introduction to advanced manufacturing, including activities such as robotics, design and engineering
 - » regional and priority sector skills development strategies to meet specific industry requirements
 - » foundation and employability skills such as adaptability, resilience, digital literacy and STEM skills
 - » encouraging tradespeople to own and embrace change
 - » providing support to existing workers in industries in transition to advanced manufacturing through access to programs that provide opportunities for upskilling and reskilling to minimise workers being displaced as a result of changes to technologies and work practices.
- **The Hacker/Makerspaces program** will continue to support the establishment and expansion of makerspaces and other similar initiatives across Queensland.

NITIES

- Queensland's smart robotics, automation and design capability
- Queensland's strong innovation culture

Addressing a negative public perception of manufacturing

Strategy 3

Showcasing the opportunities and achievements of Queensland's Advanced Manufacturing industry

Actions

- **Showcasing to the world** through:
 - » Queensland's technologies and expertise
 - » Queensland's advanced manufacturing achievements
 - » Queensland robotics and automation capability
 - » manufacturing as a key economic contributor
 - » investment and projects opportunities in Queensland
- **Showcasing to Industry** through:
 - » tailored initiatives to promote Queensland capabilities and capacity to major project proponents, interstate and international investors and the community
 - » targeted workshops across Queensland to promote opportunities for local advanced manufacturing businesses
 - » expanding regional manufacturing networks to showcase manufacturing innovation, assist companies to engage and encourage industry collaboration
 - » informing existing employees about opportunities to transfer their skills and knowledge into advanced manufacturing
- **Showcasing to new entrants** by:
 - » informing students, parents and educators about the exciting career opportunities in the manufacturing industry, especially as a result of the industry entering a new industrial revolution (Industry 4.0)
 - » lifting the profile of career opportunities in manufacturing to university students and academic staff
 - » facilitating MakerFest 2019 to showcase advanced manufacturing, promote STEM skills; encourage the sharing of ideas and techniques between industry and makers, and attract younger people into manufacturing.
 - » delivering the **Women in Manufacturing** seminar series and promoting career opportunities in the manufacturing industry to women.
 - » creating a strong nexus between the popular maker movement and career opportunities in advanced manufacturing.

PRIMARY CHALLENGE

To increase productivity, innovation and competitiveness while transitioning Queensland's manufacturing industry to advanced manufacturing within a highly competitive and fast-changing global environment

Assisting manufacturers to seize the different distinct opportunities and challenges specific to their location or sector

Strategy 4

Supporting regional manufacturing and manufacturing growth sectors across Queensland

Actions

- **The Manufacturing Ministerial Committee (MMC)**, chaired by the Honourable Cameron Dick MP, Minister for State Development, Manufacturing, Infrastructure and Planning will provide industry leadership and advice to support continued growth and increased global competitiveness in the industry.
- **Expanding regional networks** by working with regional manufacturers to capitalise on existing strengths and create new opportunities that support the sector in regional Queensland.
- **Manufacturing Hubs** will be established in Cairns, Townsville and Rockhampton to strengthen regional industry and boost the competitiveness, productivity and innovative capacity of Queensland's manufacturing sectors.
- **Strategic sector development** such as:
 - » a Queensland Craft Brewing Strategy
 - » a Rail Manufacturing Strategy for Queensland
 - » a Queensland Beef Processing Strategy
 - » supporting the development of a Queensland Hydrogen industry
- **Facilitate reshoring** of manufacturing activities to further build Queensland's manufacturing base
- **Enhancing existing manufacturing** ecosystems that bring together companies, schools, researchers, universities, investors, government and stakeholders in the manufacturing supply chain will be supported.

Appendix A

List of key Queensland research institutes and universities with a focus on advanced manufacturing

- ARC for Aerospace Automation (QUT, CSIRO and Queensland Government)
- ARC Centre of Excellence for Robotic Vision (QUT-headquarters)
- Australian Institute for Bioengineering and Nanotechnology (UQ)
- Australian National Fabrication Facility (nodes at UQ and GU)
- Automotive Australia 2020 CRC (QUT)
- Centre for Advanced Materials Processing and Manufacturing (UQ)
- Centre for Future Materials (USQ)
- Centre of Excellence in Engineered Fibre Composites (University of South Queensland (USQ))
- Centre for Future Timber Structures (UQ)
- Centre for High Performance Polymers (UQ)
- CRC for Polymers (QUT, UQ, GU- participants)
- Defence Materials Technology Centre (UQ, QUT-participants)
- Dow Centre for Sustainable Engineering Innovation (UQ)
- Innovative Manufacturing CRC (JCU, QUT, GU)
- Institute of Health and Biomedical Innovation (QUT)
- Medical Engineering Research Facility (QUT)
- National Biologics Facility (UQ- node)
- National Centre for Engineering in Agriculture University of Southern Queensland (USQ)
- Nihon Superior Centre for the Manufacture of Electronic Materials (UQ)
- Queensland Centre for Advanced Technologies (CSIRO)
- Railway Manufacturing CRC (Central Queensland University (CQU), QUT, UQ- partners)
- The Australian Synchrotron—Australian Research Centre (ARC) Special Research Initiative in Synchrotron Science. The Queensland node comprises Queensland Government, UQ, QUT, JCU, CQU, USQ and University of Sunshine Coast (USC)
- The Baosteel-Australia Joint Research and Development Centre (UQ)
- Translational Research Institute (UQ, QUT, Mater Research and Queensland Health)

Notes

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