



Advancing Manufacturing Skills

A Skills, Training and Workforce
Development Strategy
for the Manufacturing Industry
in Queensland

February 2018



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A word from the Chair

Manufacturers in Queensland are passionate about their industry and its future. The manufacturing industry has a very positive outlook and is in a state of expansion. It contributes some \$20 billion to the Queensland economy.

Through business capability development and a highly skilled workforce, Queensland manufacturing has the opportunity to go from strength to strength. *Advancing Manufacturing Skills: A Skills, Training and Workforce Development Strategy for the Manufacturing Industry in Queensland* (the Strategy) identifies the opportunities and challenges within Queensland's manufacturing industry. The priorities identified and the accompanying Action Plan will help increase the contribution this industry can provide to the future economic and social prosperity of Queensland.

Manufacturing is proudly represented in Queensland with industries that have embraced the Fourth Industrial Revolution, Industry 4.0, and is in the process of securing its place in a changing and increasingly competitive global market-place embracing mass customisation. Advancing manufacturing is a journey that leads from survival to growth. Around the state, Jobs Queensland has heard inspiring stories of manufacturers who are on this journey. Some of those manufacturers are featured in the Strategy.

Structural adjustment in Queensland manufacturing has been less severe than in other states due to a diverse and geographically dispersed manufacturing industry. With an industry that covers everything from food processing, metal manufacturing and aerospace, to defence and medical technology manufacturing, Queensland's manufacturers are well placed to lead our state to becoming an economic powerhouse.

Innovation is a strength of Queensland manufacturing and increasingly provides opportunities for young entrepreneurial Queenslanders to contribute to future developments and growth. Skills in areas such as robotics, gaming, 3D printing, design and critical thinking offer exciting opportunities for careers in manufacturing for young people.

But this transition is not only about the young. New technology, including robotics, is not only improving productivity for manufacturers, it is supporting the existing workforce to gain new skills and move into new, less physical roles. With much of the new technology taking on more mundane work, there are increasing opportunities for existing workers to contribute ideas and mentor a new generation of workers.

Promoting a modern image of manufacturing is an important recommendation of the Strategy along with strengthening the skills required for growing a sector that embraces digital technology in a culture of, and need for, continuous improvement.

Queensland's advancing manufacturing industry has the potential to take the human and machine interface to new and exciting levels. It will require a collaboration between experienced workers welcoming young, energetic and spirited Queenslanders on a journey into the future. The significant contribution – through the guidance provided by the Advancing Manufacturing Advisory Committee, participation by manufacturers and their employees across the state in surveys and forums and willingness to share knowledge and experiences – underpins and shapes the Strategy and Action Plan.

Advancing manufacturing in Queensland is an exciting journey and one that the Strategy aims to accelerate by ensuring a highly skilled, engaged and adaptable workforce for the future.



Rachel Hunter
Chair, Jobs Queensland

1. Executive summary

Advancing Manufacturing Skills is a skills, training and workforce development strategy (the Strategy) that will assist all Queensland manufacturers to develop the workforce skills they need during a time of significant change.

It is essential to provide the skills and training which will optimise future growth in Queensland manufacturing. This will support the achievement of the vision for the industry outlined in the *Queensland Government Advanced Manufacturing 10-Year Roadmap and Action Plan*.¹

Rather than being a workforce development strategy for a small and very advanced segment of the industry, the Strategy has been developed to support all manufacturers in Queensland to participate in the journey towards advanced manufacturing.

1.1 The outlook for manufacturing in Queensland is positive

Manufacturing in Australia has been expanding for the last two years. November 2017 marked the 14th consecutive month of expansion for the Australian Performance of Manufacturing Index (PMI®) and the longest run of expansion since 2007.²

Manufacturing in Queensland is:

- one of Queensland's top 10 industries and a driver of the state's economy³
- one of the state's largest export industries⁴
- the state's seventh largest employer⁵
- the fifth largest user of the apprenticeship and traineeship system⁶
- contributing \$20 billion a year to the Queensland economy⁷
- exporting \$16 billion in international exports
- accounting for a fifth of the total Queensland business research and development (R&D) spend.⁸

Future growth is forecast. While the Australian Government's Department of Employment projects a decline of 1.9 per cent in Queensland manufacturing jobs in the short-term (2017 to 2022), the Queensland Statistician forecasts a rise in industry employment from 204,230 in 2020–21 to 311,839 in 2040–41 (a 53 per cent increase in employment over 20 years).⁹

1. Department of State Development, *Queensland Advanced Manufacturing 10-Year Roadmap and Action Plan – powering the Queensland Economy, December 2016*.
<https://www.statedevelopment.qld.gov.au/resources/plan/advanced-manufacturing/advanced-manufacturing-roadmap.pdf>.

2. Australian Industry Group, *Australian Industry Group Australian Performance of Manufacturing Index (Australian PMI®), November 2017*
http://cdn.aigroup.com.au/Economic_Indicators/PMI/2017/PMI_Nov_2017_40732j.pdf.

3. Australian Bureau of Statistics, *Labour Force, Australia, Detailed, Quarterly, Aug 2017*, Employed persons by Industry group of main job.

4. Department of State Development, *Queensland Advanced Manufacturing 10-Year Roadmap and Action Plan – powering the Queensland Economy, December 2016*.
<https://www.statedevelopment.qld.gov.au/resources/plan/advanced-manufacturing/advanced-manufacturing-roadmap.pdf>.

5. Australian Bureau of Statistics, *Labour Force, Australia, Detailed, Quarterly, Aug 2017*, Employed persons by Industry group of main job.

6. Department of Education and Training, 2016, Direct Entry-Level Training Administration (DELTA) database, Queensland.

7. Queensland Productivity Commission, 2017, *Draft Report Manufacturing in Queensland*,
https://qpc.blob.core.windows.net/wordpress/2017/07/17_4232-QPC-Manufacturing-Report_21.pdf.

8. Department of State Development, *Queensland Advanced Manufacturing 10-Year Roadmap and Action Plan – powering the Queensland Economy, December 2016*.
<https://www.statedevelopment.qld.gov.au/resources/plan/advanced-manufacturing/advanced-manufacturing-roadmap.pdf>.

9. Australian Government Department of Employment, *Labour Market Information Portal, 2017 Regional projections to 2022 – interactive tool*; Queensland Government Statistician's Office, *Regional employment projections, 2010-11 to 2040-41*
<http://www.qgso.qld.gov.au/products/tables/reg-employment-proj/index.php>.

Manufacturing in Queensland is diverse and is differentiated from other states in two main ways:

- 1. Niche manufacturing** – without large scale manufacturing as part of its industry structure, Queensland manufacturers have focused on niche products, value-adding and customisation to meet client needs. The industry's approach aligns with global manufacturing trends of mass customisation, value-adding and niche opportunities.
- 2. Regional coverage** – Queensland's manufacturing industry is the most geographically dispersed in the country. Regional clusters support global supply chains including agriculture, food processing, resources, defence, aerospace, construction and regional economies.

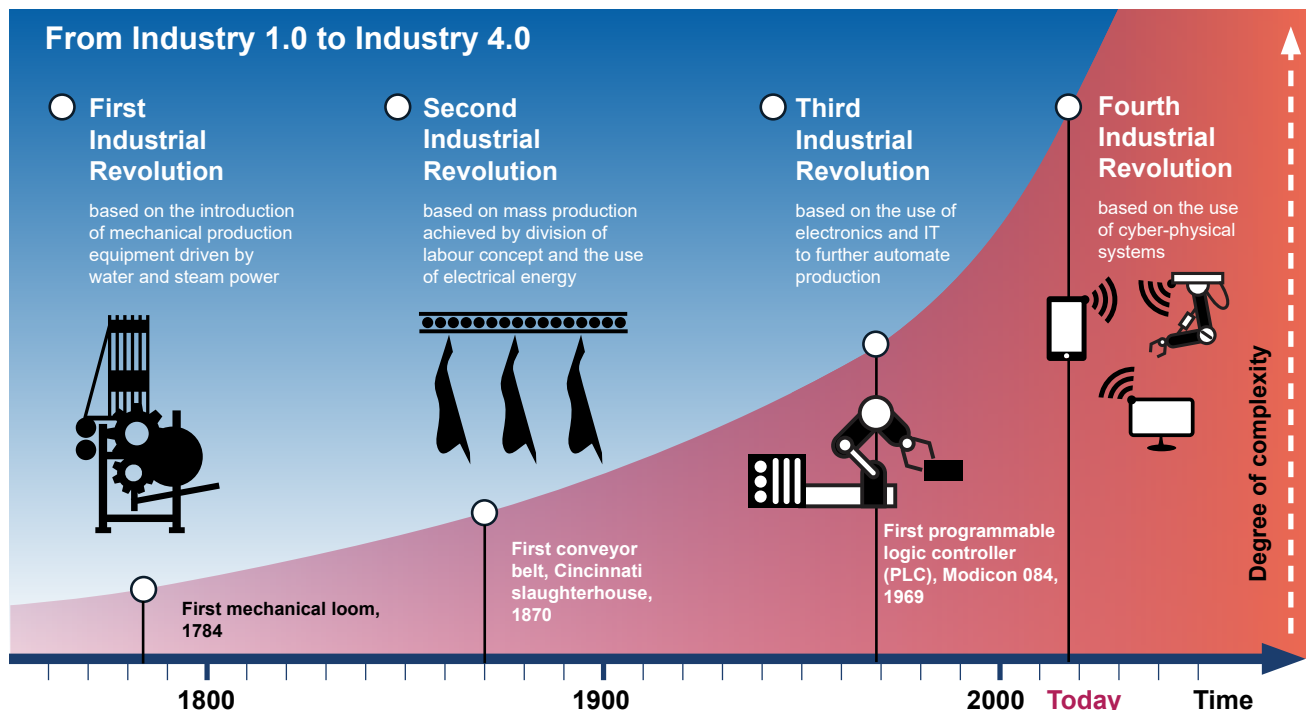
Queensland's manufacturing is highly focused on global opportunities and is well placed to become a leading advanced manufacturing industry globally. Engagement with these global supply chains builds systems, processes and capabilities that improve competitiveness.

1.2 Change is underway

Manufacturing worldwide is being transformed by major disruptive forces that are reshaping the skills and capabilities needed to be competitive. These forces include:

- Increasing globalisation of markets.
- Industry 4.0 – the fourth industrial revolution through the use of cyber physical systems and digitisation of the manufacturing supply chain (see Figure 1 below).
- The trend to mass customisation – focusing on customer driven, high-value products rather than on high-volume, lower value products.

Figure 1



Source: Adapted from [engineersjournal.ie](http://www.engineersjournal.ie) via <http://www.ibaset.com/blog/industry-4-0-heart-european-investment-according-plan/>.

Manufacturers that transform their businesses in response to these drivers are transitioning from traditional or broad-based manufacturing to advanced manufacturing using:

- innovation in product and service design
- new technologies to increase productivity, flexibility, capacity and to reduce production costs
- digital tools across their entire manufacturing supply chain.

While not all manufacturers will actively choose to transform or change their businesses, the reality is that nearly all will be using some of the tools and processes that identify advanced manufacturing.

Queensland manufacturers and their workforces are embracing this change:

- Nine out of 10 manufacturers surveyed by Jobs Queensland reported that the transformation to advanced manufacturing is essential or very important to their business.¹⁰
- Three quarters of manufacturing employees surveyed by Jobs Queensland are prepared to undertake further education and training to gain the required future skills and knowledge.¹¹

It became clear during this project that many manufacturers see 'advanced manufacturing' as a term that excludes them. There is a segment of manufacturers who question the relevance of 'advanced manufacturing' to their business. This is often driven by the belief that 'advanced manufacturing' is all about robotics and automation, rather than process and product improvements, and having a vision for the future.

Almost all manufacturers surveyed see advanced manufacturing as a journey rather than an end goal.¹² The notion of 'advancing manufacturing' is more reflective of the journey that many manufacturers are on. Even self-identifying 'advanced manufacturers' acknowledge that in a world of rapidly advancing technologies and shifting global forces, it may be a journey without end.

The manufacturing workforce is also changing as the industry transitions. As in many industries, the workforce (which in the manufacturing industry is male-dominated) is ageing. A significant shift in the educational profile of the workforce is also underway as the industry transitions from a primarily low-skilled, production-based workforce to a greater reliance on higher-level and more technical skills as a source of competitive advantage.

The highly diversified nature of the manufacturing industry in Queensland has helped to prevent the large-scale workforce impacts of structural adjustment seen in the manufacturing industry in some parts of Australia. Despite this, as the industry transitions to take advantage of new opportunities, the impacts of structural adjustment, which can include job losses and business closures, can have a significant impact at the individual or community level.

Advancing Manufacturing Skills is focused on providing the skills and training to support future growth by supporting all manufacturers and their employees.

10. Jobs Queensland, *Advancing Manufacturing Employer Survey*, 2017.

11. Jobs Queensland, *Advancing Manufacturing Employee Survey*, 2017.

12. Jobs Queensland, *Advancing Manufacturing Employer Survey*, 2017.

1.3 Main findings

The changes underway in the manufacturing industry in Queensland are creating a stronger industry of world-class manufacturers. Advancing manufacturing is a journey that includes everyone — business leaders and managers, employees, customers and suppliers. The journey is one that will create long-term opportunities, higher skilled jobs and stable employment for employees — who are a key partner in this journey.

The transition to advanced manufacturing involves building capability related to business management, innovation and productivity enhancements. The development of these skills is needed at the business level and across the manufacturing workforce more broadly.

Strong manufacturing ecosystems at the sector and regional level can support the transition to advanced manufacturing. Harnessing the benefits of existing ecosystems and supporting the development of new ecosystems will help to cement the important role of industry in driving and leading the change.

A highly skilled manufacturing workforce will be a critical driver of competitiveness for the industry into the future. Increasing demand for higher level skills is changing the profile of the workforce as many of the traditional low-skilled and repetitive tasks are replaced with automation and new technologies. Critical thinking, higher level problem-solving and 'STEM thinking' are increasingly important skills which underpin all roles in an advanced manufacturing workplace.

The Vocational Education and Training (VET) system plays a critical skills development role for the industry. Traditional trade training, including apprenticeships and traineeships, continues to be relevant; however, there are areas in which the VET system is not meeting the needs of the manufacturing industry. Meaningful change is needed to accommodate the new and higher-demand skills. Industry needs to respond to Industry 4.0 and transition to advanced manufacturing. VET and university programs will need to operate in a more flexible manner and blend the skills needed in the physical and virtual manufacturing worlds.

The existing manufacturing workforce will need to continually adapt to respond to this new environment. Employees have demonstrated their willingness to upskill and multi-skill. Continual skills development is becoming the new norm, leading to a need for modularised training offerings. There is a need to support the attainment of skills and capabilities that will best position the industry for competitiveness into the future and create opportunities for Queenslanders.

A range of strategies are needed to be considered and implemented to provide the industry with the future supply of skills and labour needed to be globally competitive. Opportunities exist to further embrace diversity to best harness the available talent and offset the risk associated with an ageing and male-dominated workforce.

The transition to advanced manufacturing is creating an industry that offers stable, diverse and technology-rich careers. This is an important message for current employees, new entrants and the community more broadly. It is an important message that needs to be widely spread to challenge the myths about careers in the manufacturing industry.

Active partnerships are needed between industry, schools, training providers and universities to prepare the workforce of the future for the opportunities available in the industry. These partnerships will better prepare new entrants with Industry 4.0 skills and the soft skills needed for workplace readiness; and build the currency of teacher/trainer skills in contemporary manufacturing.

1.4 Priority Action Areas

Through the development of the Strategy, 10 key areas of priority have been identified for action. These are identified throughout the document as 'Priority Action Areas'.

The 10 Priority Action Areas focus on:

1. Positioning the manufacturing workforce as a key partner in the journey towards advanced manufacturing.
2. Strengthening the business capability of manufacturers.
3. Building the understanding of capability related to business management, innovation and productivity at all levels of the manufacturing industry.
4. Supporting industry-led ecosystems.
5. Fostering continued industry opportunity growth.
6. Strengthening the role of apprenticeships and traineeships and the VET system in supporting skills development.
7. Building a highly skilled, adaptable and capable existing workforce.
8. Increasing the diversity of the manufacturing workforce.
9. Positioning manufacturing as a first choice career.
10. Facilitating enhanced partnerships and engagement to better prepare new entrants.

A more detailed action plan, identifying specific actions underpinning each Priority Action Area, is provided in Section 7 from page 68.

While industry must lead the journey to advanced manufacturing, government and the wider network of industry associations, unions, industry networks, employees, the education and training sector, and research institutes are vital partners in supporting the successful transition.

The Priority Action Areas in the Strategy are not specifically targeted at one key stakeholder within the manufacturing system in isolation. No single stakeholder can solely drive the changes required to advance manufacturing in Queensland; action must be based on partnerships and a shared sense of purpose and priority.

Advancing manufacturing in Queensland is an exciting journey and one that the Strategy aims to accelerate.



Staff member at HE Tech, Underwood. Photo credit: Welcome to the Fold.

2. About the Strategy

Jobs Queensland provides strategic advice to the Queensland Government on skills demand, future workforce planning and development, and apprenticeships and traineeships.

Advancing Manufacturing Skills has been prepared by Jobs Queensland, in association with the Department of State Development, Manufacturing, Infrastructure and Planning (formerly the Department of State Development), as a priority project to support the implementation of the *Queensland Advanced Manufacturing 10-Year Roadmap and Action Plan*.¹³

The Roadmap defines advanced manufacturing as:

“Advanced manufacturing 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.

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.”¹⁴

The manufacturing sector in Queensland is viewed by the Queensland Government as a critical driver of innovation and productivity in the economy. The Roadmap aims to design a plan for the growth of advanced manufacturing, fostering the continued transition of existing manufacturers into world-class advanced manufacturers who will grow the economy and generate future high-value, high-skilled jobs for Queenslanders.

2.1 A strategy for the manufacturing industry

Advancing Manufacturing Skills identifies the priorities and practical actions that can advance manufacturing business and workforce skills in Queensland. It aims to support all manufacturers to participate in the journey to advanced manufacturing.

While some priorities in the Strategy focus on the new skills required to respond to Industry 4.0, the broad focus is to improve the capabilities and workforce skills of all manufacturing businesses in an increasingly competitive market environment.

The Strategy seeks to address the needs of:

- manufacturing enterprises
- managers and leaders in manufacturing companies
- the current and future manufacturing workforce
- new entrants (young people and those from other industry sectors) expected to join the manufacturing industry in the future.

Ten key areas of priority have been identified for action. These are identified throughout the document as 'Priority Action Areas'. A more detailed Action Plan, identifying specific actions underpinning each Priority Action Area, is provided in Section 7 from page 68.

13. Department of State Development, *Queensland Advanced Manufacturing 10-Year Roadmap and Action Plan – powering the Queensland Economy*, December 2016. <https://www.statedevelopment.qld.gov.au/resources/plan/advanced-manufacturing/advanced-manufacturing-roadmap.pdf>.

14. Ibid.

2.2 Consultation undertaken

Extensive industry consultation was undertaken to explore the skills and workforce needs of Queensland manufacturers and collate the evidence needed to support findings and priorities presented in the Strategy. This covered:

- The formation of an industry advisory committee (the Advancing Manufacturing Advisory Committee) comprised of industry associations, a union, employers and the Skills Service Organisation (SSO).
- A Jobs Queensland survey of employers conducted in July 2017 (with 66 respondents).
- A Jobs Queensland survey of employees conducted in October and November 2017 (with 583 respondents).
- Twelve industry workshops coordinated by Jobs Queensland to seek in-depth feedback from industry throughout Queensland. One hundred and six industry representatives and stakeholders attended these workshops which were held in Logan, Gold Coast, Ipswich, North Lakes, Toowoomba, Dalby, Maryborough, Gladstone, Rockhampton, Mackay, Townsville and Cairns. To facilitate industry discussions at these workshops, five themes arising from an environmental scan were explored:

Theme 1 – The Enterprise Transformation Journey – What is the current experience of manufacturers as they work on the transition from traditional or broad-based manufacturing to advanced manufacturing?

Theme 2 – Enterprise Capabilities – What are the skills at organisational level and at leadership team level that manufacturers need to be able to support the transition to advanced manufacturing?

Theme 3 – Workforce Skills – What are the changing workforce skills that are needed now and into the future to respond to the digital transformation of the manufacturing industry?

Theme 4 – Career Paths – Are career paths changing and what is the experience that industry is having in attracting young people and workers from diverse backgrounds to manufacturing careers?

Theme 5 – Ecosystem Support – Who are Queensland manufacturers relying on for help and assistance to build the skills and capabilities they need to support the transition from broad-based to advanced manufacturing?

- Additional in-depth interviews with 30 manufacturers, industry groups and stakeholders covering case studies and in-depth information on manufacturing subsector skills priorities.

The Strategy draws on the findings from direct consultation (survey data and in-depth feedback) as well as referencing a wide range of published reports, articles and programs that address the issues, findings and priorities discussed in *Advancing Manufacturing Skills*.

2.3 Definitions

It is useful to provide definitions for some terms used throughout this report.

Term	Definition
Additive manufacturing	Additive Manufacturing refers to a process by which digital 3D design data is used to build up a component in layers by depositing material. The term '3D printing' is increasingly used as a synonym for additive manufacturing.
Advanced manufacturing	<p><i>"Advanced manufacturing 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.</i></p> <p><i>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."</i>¹⁵</p>
Broad-based manufacturing	Describes traditional manufacturing that has not been impacted by Industry 4.0 changes (see definition on page 15).
Competitive manufacturing	A term used for a wide range of tools that improve the efficiency and productivity of manufacturing processes, factory and work layout, and overall tracking and management of manufacturing.
Design for manufacturing and assembly (DFMA)	Method of design for ease (practicality of manufacture and assembly), efficiency and cost minimisation in manufacture and assembly.



Staff at B&R Enclosures, Heathwood. Photo credit: Welcome to the Fold.

15. Department of State Development, *Queensland Advanced Manufacturing 10-Year Roadmap and Action Plan – powering the Queensland Economy*, December 2016, page 6.
<https://www.statedevelopment.qld.gov.au/resources/plan/advanced-manufacturing/advanced-manufacturing-roadmap.pdf>.

Term	Definition
Ecosystem	<p>The ecosystem for advancing manufacturing is defined as the network of:</p> <ul style="list-style-type: none"> • manufacturers sharing their experiences of innovation and new technology absorption • technical and technology specialists • clients • suppliers of new technology • industry associations, networks and clusters that foster industry development, market engagement, innovation and new technology absorption • unions • research institutes • schools, training providers and universities • information sources including online information • government agencies who can provide information and resources to support business growth, planning, exporting and industry development • sources of investment funding.
Embodied services	<p>Embodied services are services used in the process of manufacturing products e.g. design, technical services, testing and analysis, programming automation.</p> <p>Embedded services are those directly linked to the product e.g. preventative maintenance, calibration, after sales support and training.</p>
Industry 4.0	<p>Industry 4.0, the Fourth Industrial Revolution, aims to leverage differences between the physical, digital and biological spheres. It integrates cyber-physical systems (systems that integrate machine and human processes to achieve greater productivity) and the Internet of Things (IoT), big data and cloud computing, robotics, artificial intelligence (AI) based systems and additive manufacturing.</p> <p>Compared to previous industrial revolutions, the fourth one is evolving at an exponential rather than at a linear pace.</p>
Mass customisation	<p>The ability to take a standard product and customise it to meet specific customer requirements. For example, producing buses with specific gear boxes or engines for central Australia's harsh terrain.</p>
STEM thinking	<p>The ability to analyse information, understand the implications and solve problems.</p>

3. The outlook for manufacturing in Queensland is positive

Queensland's manufacturing industry is resilient and growing with a strong future. Advancing manufacturing will strengthen the industry and support its role as a critical driver of economic growth — generating intrastate and international exports that create wealth and jobs in the Queensland economy.

3.1 Role of manufacturing in Queensland's economy

National growth in manufacturing

The Australian Industry Group's Australian Performance of Manufacturing Index (Australian PMI®) jumped 6.2 points to 57.3 in November, marking a 14th consecutive month of expanding or stable conditions and the longest run of expansion since 2005.¹⁶ Although the growth environment is positive, more can be done to improve productivity in the manufacturing sector.

Multifactor productivity (MFP) is defined as a ratio of a measure of output to a combined input of multiple factors, for example labour and capital. The Australian Bureau of Statistics (ABS) data on an hours worked basis, market sector multifactor productivity (MFP) grew 0.3 per cent in 2014–15 reflecting a 2.2 per cent increase in gross value added and a 1.9 per cent increase in total labour and capital inputs.¹⁷ On gross value added multifactor productivity indices, the manufacturing result was seventh in a field of 16 sectors' results — indicating the potential for improved productivity.

The transition to advanced manufacturing is an opportunity for Queensland manufacturing to improve productivity and, as a result, strengthen its competitiveness.

Queensland manufacturing's role in the economy

Queensland manufacturing is diverse, a high user of R&D, an active adopter of digital technologies and has produced leading, innovative products for global markets.¹⁸

Contributing \$20.3 billion to the Queensland economy in 2014–15 and employing 156,000 people (the seventh largest industry employer in the State), the manufacturing industry plays a key role in the state's economy.¹⁹

In 2015–16, Queensland's manufacturing export earnings totalled around \$16 billion.²⁰ Lead export sectors were food and beverage, metal products, machinery and equipment.

Queensland manufacturing has global leaders, proactive small to medium enterprises (SMEs) targeting new markets and a track record of industry sector collaboration to overcome challenges, build capabilities, encourage new industry investment and target new markets.²¹

Even though many SMEs may not be directly exporting, they are often supplying to lead contractors in major global supply chains which must compete in international markets — a significant proportion of the Australian economy is dominated by major/global supply chains.

16. Australian Industry Group, *Australian Industry Group Australian Performance of Manufacturing Index (Australian PMI®)*, November 2017, <https://www.aigroup.com.au/policy-and-research/mediacentre/releases/PMI-Nov-2017/>.

17. Australian Bureau of Statistics, *5260.0 Estimates of Industry Multifactor Productivity, 2014–15* <http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/5260.0.55.002Main+Features12014-15>.

18. Office of the Queensland Chief Scientist, *Advanced manufacturing – implications and opportunities for Queensland*, February 2016, <http://www.chiefscientist.qld.gov.au/images/documents/chiefscientist/pubs/reports-other/advanced-manufacturing-2016.pdf>.

19. Department of State Development, 2016, *Advanced Manufacturing 10-year Roadmap*, <https://www.statedevelopment.qld.gov.au/resources/plan/advanced-manufacturing/advanced-manufacturing-roadmap.pdf>.

20. Australian Industry Group, *Economics Factsheet, Queensland Manufacturing 2015-16* http://cdn.aigroup.com.au/Economic_Indicators/Fact_Sheets/QLD_Manufacturing_Fact_Sheet.pdf.

21. Department of State Development, 2016, *Advanced Manufacturing 10-year Roadmap*, <https://www.statedevelopment.qld.gov.au/resources/plan/advanced-manufacturing/advanced-manufacturing-roadmap.pdf>.

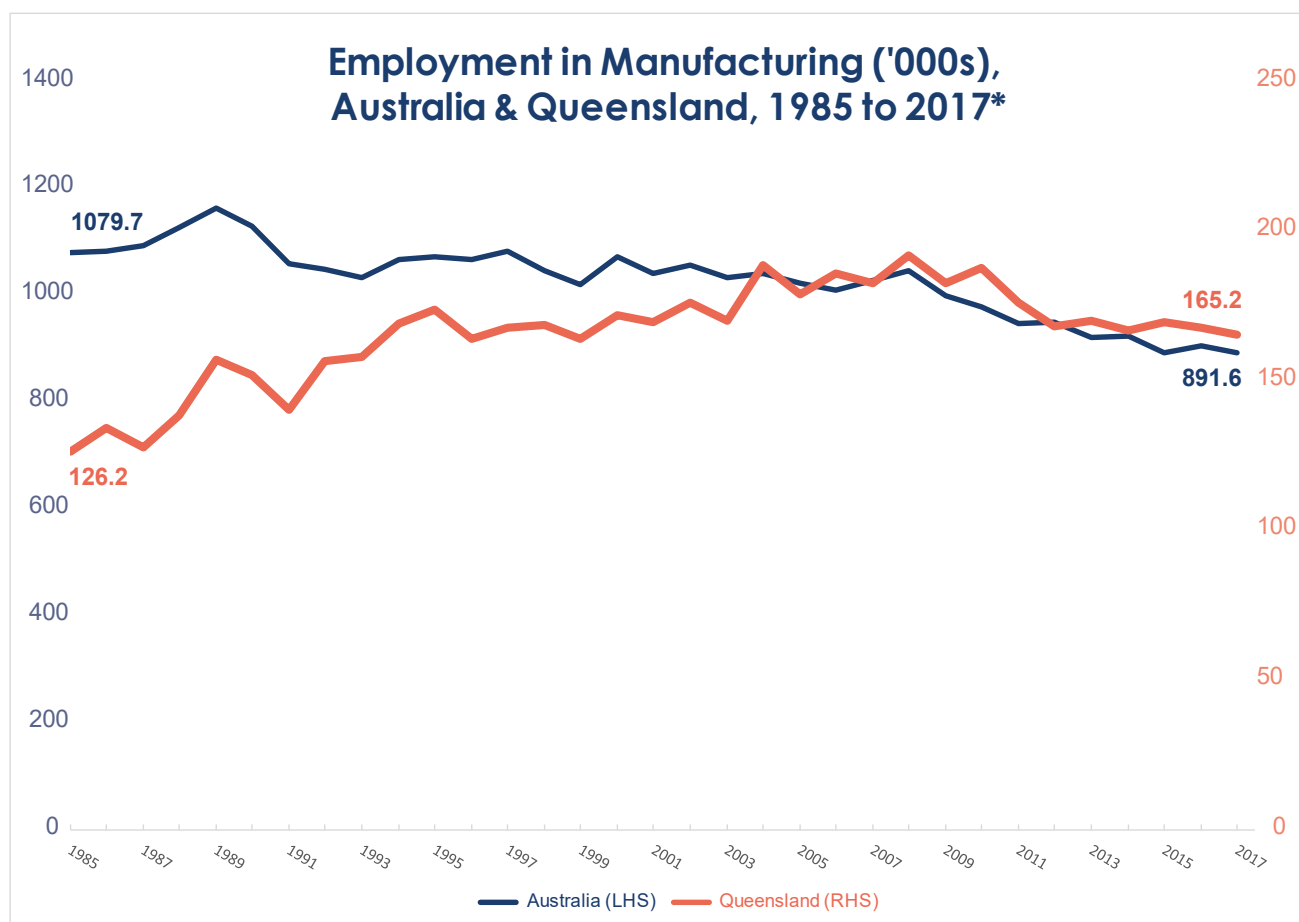
3.2 Profile of Queensland manufacturing

The diversity of Queensland's manufacturing sector is its strength.

While food manufacturing, metal products and machinery and equipment sectors dominate in terms of revenue and employment, the Queensland manufacturing industry is diverse and covers a broad spectrum of capabilities including:

- aerospace
- life sciences
- defence
- new product development using traditional and new materials.

While nationally manufacturing employment has been falling, Queensland's manufacturing employment has seen significant growth in the 30 years since 1985. It was not impacted by the global financial crisis of 2007–08, instead reaching its highest level of 191,800 persons in 2008. While there have been job losses since that peak, the industry has grown by almost 31 per cent in the past 30 years.²²

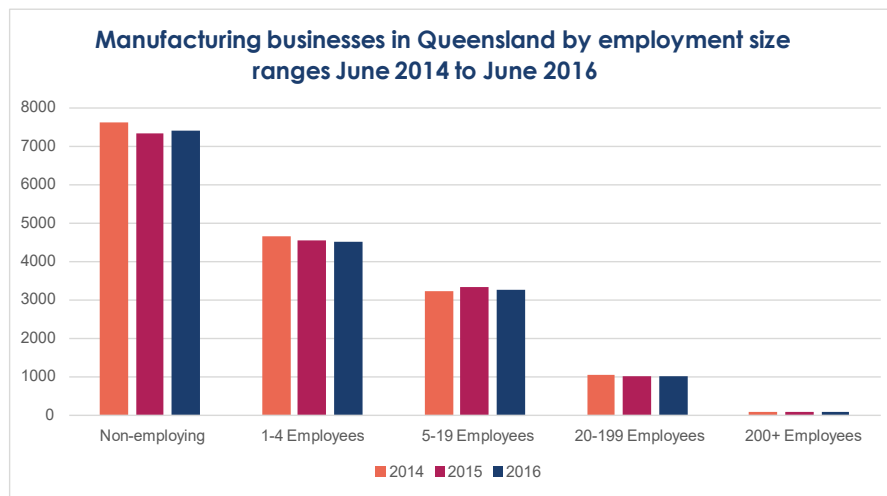


Source: Australian Bureau of Statistics, 2017, 6291.0.55.003 Labour Force, Australia, Detailed, Quarterly, Table 05. Employed persons by State, Territory and Industry division of main job (ANZSIC).

*Four-quarter average

22. Australian Bureau of Statistics, 2017, Labour Force, Australia, Detailed, Quarterly, Table 5.

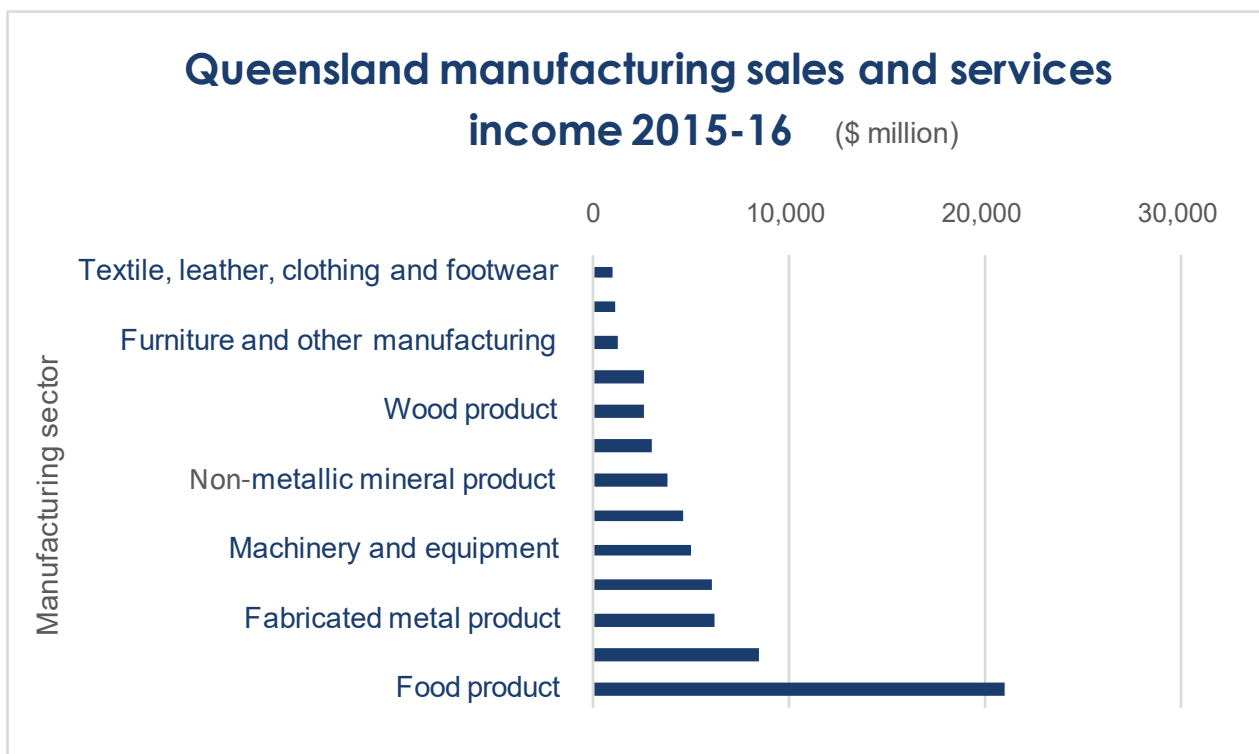
Around 93 per cent of Queensland's manufacturers employed fewer than 20 people in 2015–16, which is similar to the national figure. Queensland also hosts a significant number of large manufacturers — some Queensland-owned and others that are branches of companies headquartered interstate or globally.



Source: Australian Bureau of Statistics, 8165.0 Counts of Australian Businesses, including Entries and Exits June 2014-16.²³

The top four revenue earning sectors accounting for 56 per cent of total manufacturing sales and service revenue in 2015–16 were:

- food products (\$20,974 million)
- primary metal and metal products (\$8,418 million)
- fabricated metal products (\$6,092 million)
- basic chemical and chemical products (\$6,062 million).²⁴



Source: Australian Bureau of Statistics, 8155.0 Australian Industry, 2015-16.

23. The ABS defines 'non-employed' businesses as 'a business without an active Income Tax Withholding (ITW) role or which has not remitted ITW for five consecutive quarters (or three consecutive years for annual remitters) is counted as non-employed'. This would include businesses that are sole traders.

24. Australian Bureau of Statistics, 8155.0 – Australian Industry, 2015–16, Manufacturing Industry.

3.3 Regional manufacturing

The Queensland manufacturing industry is the most geographically dispersed in Australia with 44 per cent of manufacturing employment in August 2017 based outside the Greater Brisbane region.²⁵ Manufacturing clusters operate along the coast and in inland areas of the state to support many other sectors within regional economies including: food production, mining and resources, defence, marine, construction and tourism, creating high-value jobs in these regions.

Regional manufacturers often have a strong focus on engaging with major or global supply chains. This creates opportunities for regional manufacturers to improve their capabilities, systems and capacity to compete at global standards of performance.



Staff at the Geofabrics Plant in Ormeau. Photo credit: Welcome to the Fold.

25. Australian Government Department of Employment, Labour Market Information Portal, 2017 Regional projections to 2022 – interactive tool.

Queensland manufacturing – regional diversity and capability

North and Far North Queensland



Cairns – a manufacturing base supporting marine, aerospace, tourism and construction. Opportunities are growing for international links and new investment in Northern Australia as part of the forecast economic growth in the Tropics.

Townsville – service centre for North Queensland servicing resources, defence, transport, ports and construction activities.

Mount Isa – the largest outback industrial service centre in Queensland.

Central Queensland

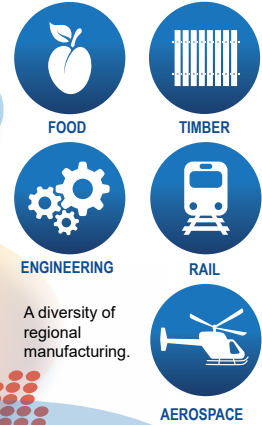


Mackay and Emerald – specialist service centres for mining and resources sector clients.

Rockhampton – a service centre for resources and agriculture.

Gladstone – largest multi-commodity port in the state and a base for industrial processing facilities.

Wide Bay–Burnett



A diversity of regional manufacturing.

Darling Downs and Surat Basin



Major engineering and technical service clusters in **Toowoomba, Dalby and Roma** to support agriculture, broad-based manufacturing, and mining, oil and gas.

South-East Queensland



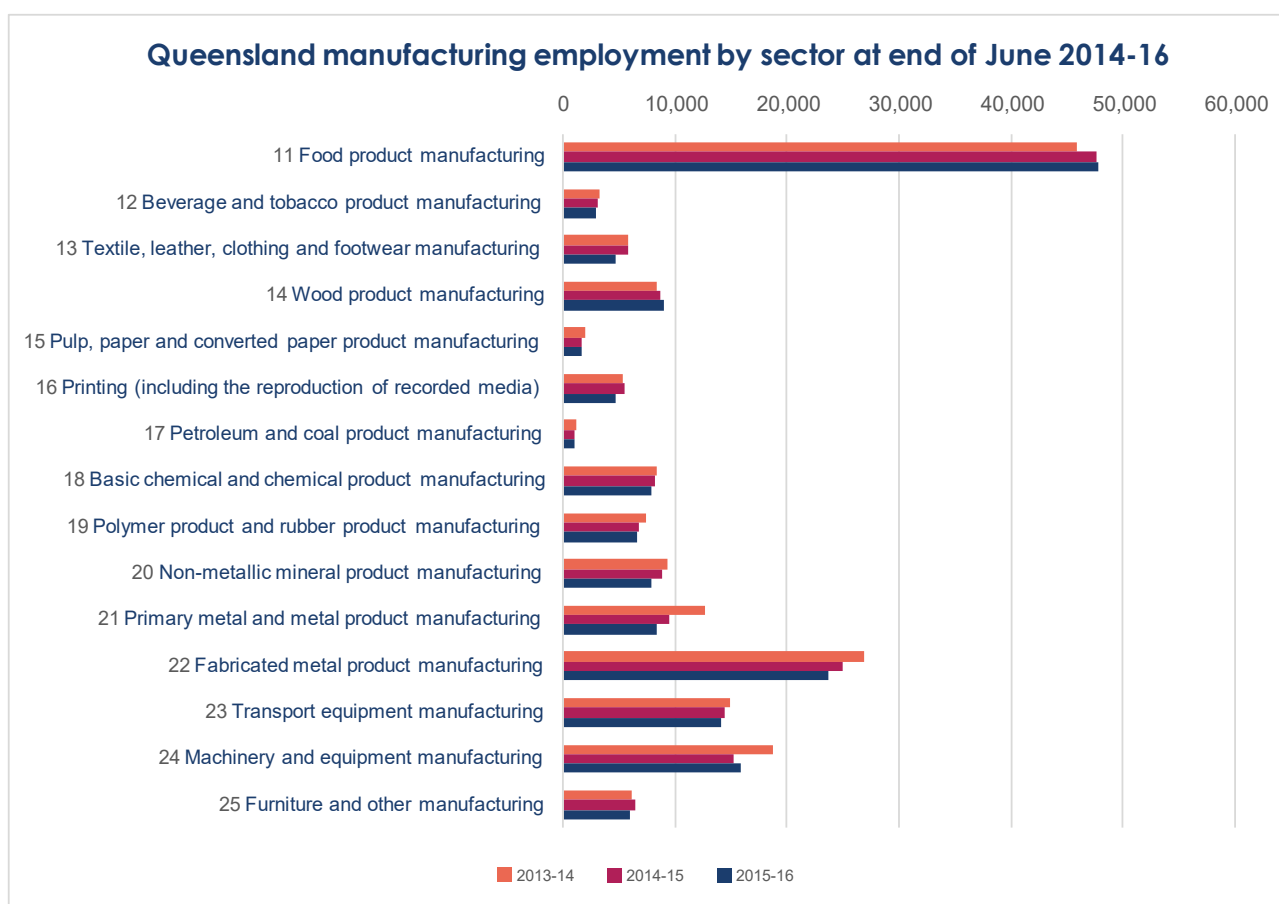
The South-East Queensland economy is the largest regional economy in the state and includes a wide range of manufacturing such as: large scale food processing and beverage manufacturing, leading mining equipment, technology and services (METS) capabilities, advanced life sciences and biotechnology industries, medical products and pharmaceuticals manufacturing, development of bio-products, leather products, geotextile manufacturing, fashion design and clothing manufacturing, chemical production, digital technology capabilities including the Centre for Robotics Vision, extensive metal products and fabricated metal manufacturing, capabilities to support equipment and machinery in rail, transportation, food processing and general engineering industries.

3.4 Manufacturing workforce

The top four employing sectors in manufacturing accounted for 54 per cent of manufacturing employment in August 2017. These were:

- food products (35,000 people)
- machinery and equipment (19,500 people)
- fabricated metal product (15,200 people)
- transport equipment (14,300 people).

Employment in the other manufacturing sectors ranged from less than 1000 employed in pulp, paper and converted paper products to nearly 13,000 employed in furniture and other manufacturing.²⁶ Quarterly data shows that in August 2017 the machinery and equipment manufacturing sector had replaced the fabricated metal product manufacturing sector as the second highest employing sector.²⁷ Annualised figures to June 2017 are not yet available to confirm this change.



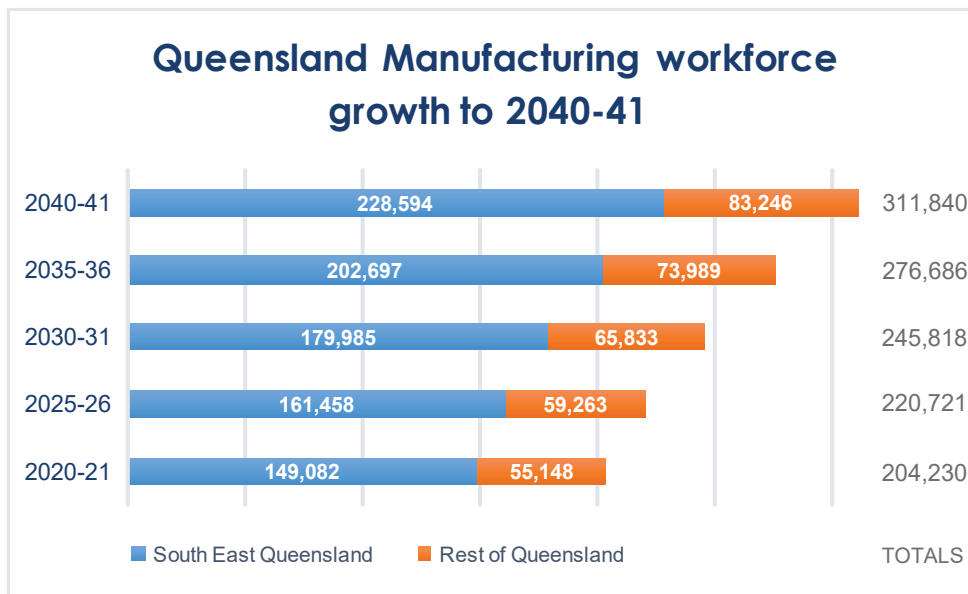
Source: Australian Bureau of Statistics, 8155.0 Australian Industry, 2015–16.

The outlook for manufacturing employment growth is positive — while a decline in growth is predicted in the short-term to 2022, projections to 2040–41 are for a 53 per cent increase.²⁸

26. Australian Bureau of Statistics, 6291.0 Labour Force, Australia, Detailed, Quarterly, Aug 2017, *Employed persons by Industry group of main job* <http://www.abs.gov.au/ausstats/abs@.nsf/mf/6291.0.55.003>.

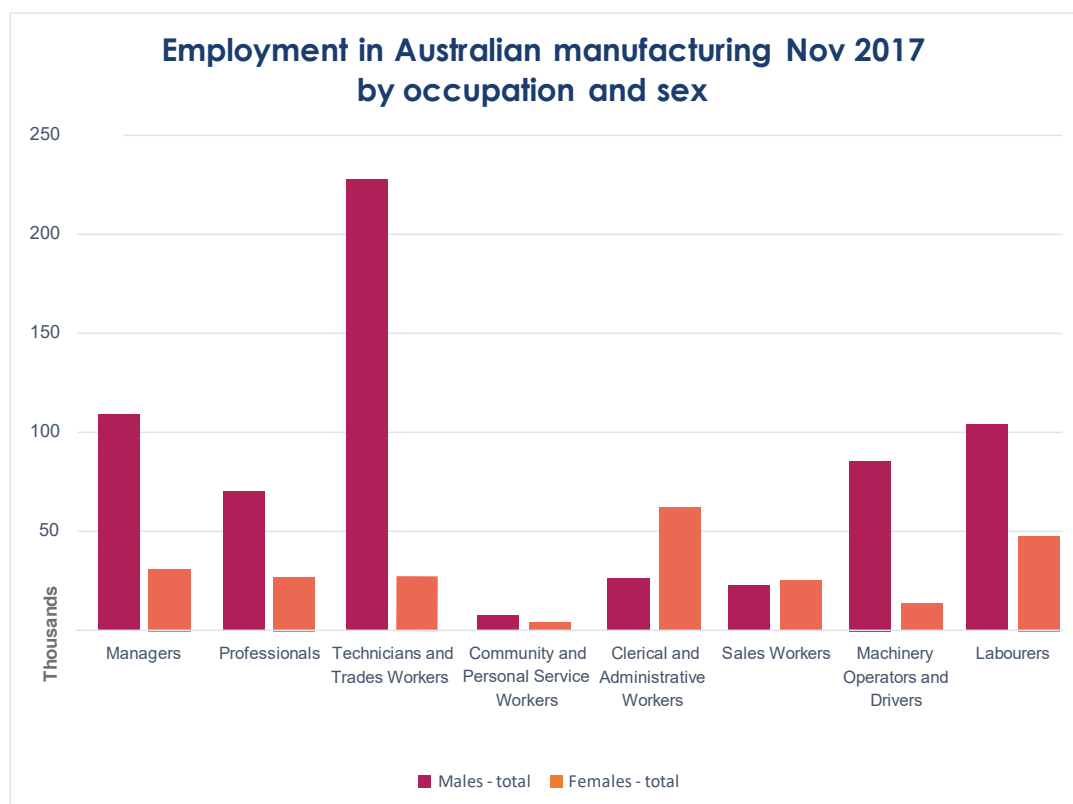
27. Australian Bureau of Statistics, 8155.0 Australian Industry, 2015–16, <http://www.abs.gov.au/ausstats/abs@.nsf/mf/8155.0>.

28. (1) Australian Government Department of Employment, Labour Market Information Portal, 2017 *Regional projections to 2022 – interactive tool*. (2) Queensland Government Statistician's Office, *Regional employment projections, 2010–11 to 2040–41*.



Source: Queensland Government Statistician's Office, Regional employment projections, 2010–11 to 2040–41.

The Queensland manufacturing workforce is predominantly male (72 per cent) and ageing with more than 50 per cent of the workforce aged 40 or older.²⁹ Men are more likely to be employed full-time in trade and technical roles than women, with 92 per cent of men in full-time employment. Women tend to be employed in clerical and administrative roles or as salespeople.³⁰



Source: Australian Bureau of Statistics, 6291.0 Employed persons by Industry division (ANZSIC) and Occupation major group (ANZSCO) of main job and Sex, August 1986 onwards, EQ09.

29. Australian Bureau of Statistics, 2016 Census – Counting Person, Place of Usual Residence, STATE (UR) and AGE5P.

30. Australian Bureau of Statistics, 6291.0 Employed persons by Industry division (ANZSIC) and Occupation major group (ANZSCO) of main job and Sex, August 1986, EQ09.

4. The manufacturing industry in Queensland is changing

4.1 Shifting global landscape

To understand the future skills needs of Queensland manufacturers, it is important to explore the trends impacting on Queensland manufacturers and the ways the industry is responding.

Industry 4.0

Industry 4.0 aims to leverage differences between the physical, digital and biological spheres. It integrates cyber-physical systems and the Internet of Things (IoT), big data and cloud computing, robotics, AI-based systems and additive manufacturing. Compared to previous industrial revolutions, the fourth one is evolving at an exponential rather than at a linear pace.³¹

The European Commission notes that Industry 4.0 has the potential to:

- raise global income levels
- create high-value jobs as lower level or repetitive jobs are undertaken by automated machines and robotics
- improve the quality of life for populations around the world.

This will transform manufacturing driving new and improved capabilities including:

- Creating high-value jobs through increased productivity and competitiveness. This will retain manufacturing jobs and support long-term employment growth.
- Product and service innovation.
- Mass customisation of products to meet customer needs.
- Integration of manufacturing processes and systems to improve control and management.
- Vast increases in data capture and advanced data analytics to inform product, process and business development.
- Absorption of new technologies and the use of new materials to transform manufacturing processes — driving efficiencies and adding value.

To build a vibrant, world-class industry, Queensland manufacturers need to embrace this change.

Not all capabilities will need to be embraced by everyone. The extent of the impact of Industry 4.0 on individual businesses will be dependent on the leadership within the business and market forces. For example, many Queensland manufacturers are already undertaking product and service innovation; although for them it is part of 'business as usual' rather than a transition to 'advanced manufacturing'.

31. European Commission, *The Fourth Industrial Revolution – Digital Single Market*, November 2017, <https://ec.europa.eu/digital-single-market/en/fourth-industrial-revolution>.

Mass customisation

Mass customisation and focusing on niche markets is a strength of the Queensland manufacturing industry. Mass customisation is a production process that combines elements of mass production with those of bespoke tailoring. Manufactured products are adapted and tailored to meet a customer's individual needs, so no two items are the same.³²

Mass customisation is made possible by Industry 4.0 driven cyber-physical capabilities that are utilised by manufacturers to customise products for individualised requirements or customers, at near mass production prices. This customisation creates value and efficiencies for customers as well as niche opportunities for manufacturers. Long run production manufacturers struggle to compete in this customised production market.³³

Globalisation

Queensland manufacturers have long been exposed to global competition. They also participate in global supply chains in a range of sectors including food, mining, oil and gas, marine, defence, aerospace and industrial products.

As global clients and supply chains become increasingly sophisticated, demanding higher levels of services and capabilities from manufacturers, this drives significant changes within the industry. For example, super yacht builders are now issuing detailed digital specifications for refit and repair work to multiple shipyards globally and requiring detailed technical responses to be lodged through online portals. Queensland and Australian marine manufacturers and shipyards must have the capabilities to win this work.

Queensland manufacturers have competitive advantages in three important areas:

1. They are able to provide niche products to a discerning customer base. The ability to undertake small batch runs of high-value products through rapid prototyping, agile manufacturing processes and the ability to be responsive to multiple supply chains places the industry competitively in the global marketplace.
2. Queensland manufacturing industry leaders have excellent quality assurance protocols and a reputation for delivering a high standard of product attributes which are highly exportable.
3. The growing role and value-add of embodied services (services used in the manufacture of the product) in advanced manufacturing, particularly those requiring a high level of technical expertise and quality control, takes advantage of Queensland's highly skilled manufacturing workforce.

Convergence of the digital and physical worlds

Manufacturing is becoming increasingly digitised as the digital and physical worlds converge. This has the effect of reshaping the way products are conceived, designed and manufactured. Manufacturers that absorb digital and new technologies are gaining greater efficiencies in production, better information to manage processes and guide business decisions, improved supply chain management and higher levels of customer support and information.

32. The Economist, 2009, 'Mass Customisation', <http://www.economist.com/node/14299807>.

33. The Conversation, 2013, 'Will mass customisation change Australia's manufacturing future', <https://theconversation.com/will-mass-customisation-change-australias-manufacturing-future-14524>.

While some have concerns about these impacts, Australia's digital future is set to transform the nation³⁴ in very positive ways by:

- driving innovation and global competitiveness
- increasing the use of automation and robotics — removing mundane tasks, improving safety and creating higher value jobs
- creating more opportunities for manufacturers to compete in a global market.

For Queensland manufacturers, this will open up new ways of working and engaging with customers. For employees, there will be increased opportunities to undertake new and challenging roles and new ways of organising work.

Watkins Steel is a leader in the use of digital tools to enhance its structural steel design capabilities.

Using 3D scanners on clients' sites to build a data cloud which maps the construction site or space allows the Watkins Steel design team to accurately design and specify structures that fit into the client's built environment.

A team of young industrial designers and engineers are using augmented reality tools and sophisticated software to finalise designs, create virtual 'walk through' experiences for clients and deliver accurate digital specifications to the manufacturing team.

Significant new investment in information technology, automation and robotics, combined with design-led thinking are delivering advanced manufacturing capabilities to clients, improving quality and accuracy, and maximising cost efficiency of designs.

Watkins Steel is an industry leader in its adaptation of contemporary digital tools and its use of high volume data analytics.



A Watkins Steel staff member in the field with a 3D scanner (left) and an image of an area of the Toowong Bus Depot. Photos courtesy of Watkins Steel.

34. CSIRO, *Enabling Australia's Digital Future: cyber security trends and implications*, <https://www.csiro.au/en/Do-business/Futures/Reports/Enabling-Australias-digital-future>.

4.2 Transition to advanced manufacturing

There are multiple benefits associated with the transition to advanced manufacturing, including the relegation of mundane and repetitive tasks to machines and the creation of more satisfying and high quality, high-value work. The integration of automation and robotics also leads to increased productivity and efficiency. This in turn supports long-term sustainability for both the business and also for the workforce by ensuring that high risk repetitive tasks are undertaken by technology.³⁵ According to CEDA, the transition to advanced manufacturing has the potential to create new jobs which will be higher skilled, higher paying and make a bigger contribution to the economy.³⁶

It became clear during this project that many manufacturers see 'advanced manufacturing' as a term that excludes them. There is a segment of manufacturers who question the relevance of 'advanced manufacturing' to their business. This is often driven by the belief that 'advanced manufacturing' is all about robotics and automation, rather than process and product improvements, and having a vision for the future.

Almost all manufacturers surveyed see advanced manufacturing as a journey rather than an end goal.³⁷ The notion of 'advancing manufacturing' is more reflective of the journey that many manufacturers are on. To survive in today's global marketplace, manufacturers have needed to adopt at least some of the processes, systems and technologies of Industry 4.0. Even self-identifying 'advanced manufacturers' acknowledge that in a world of rapidly advancing technologies and shifting global forces, it may be a journey without end.

Jobs in manufacturing will be retained and transformed — creating jobs that combine the need for critical thinking, the ability to use digital systems, analyse information and work with digital capabilities and automation in the physical world. The value to the Australian economy of these changes is estimated at \$2.2 trillion between 2015 and 2030 from productivity gains — \$1 trillion from accelerating the rate of automation and \$1.2 trillion from transitioning the workforce to new skills, new roles and new ways of working.³⁸

The Advanced Manufacturing Growth Centre's (AMGC) message that “...all manufacturers have the potential to be advanced” is an important one.³⁹

How is the industry in Queensland transitioning to advanced manufacturing?

Much work has been completed and more is underway to advance manufacturing in Queensland. But there is still more work needed to capitalise on Queensland's manufacturing strengths.

Queensland manufacturers have primarily focused on:

- responding to changing and challenging market needs
- finding a niche in the market which is typically shorter run, customised and higher value products
- continuous improvement
- blending service support (e.g. preventative maintenance) with physical products to add value to clients
- problem-solving, innovation and creating new products and value for local and global customers.

35. AlphaBeta, *The Automation Advantage*, 2015. <http://www.alphabeta.com/wp-content/uploads/2017/08/The-Automation-Advantage.pdf>.

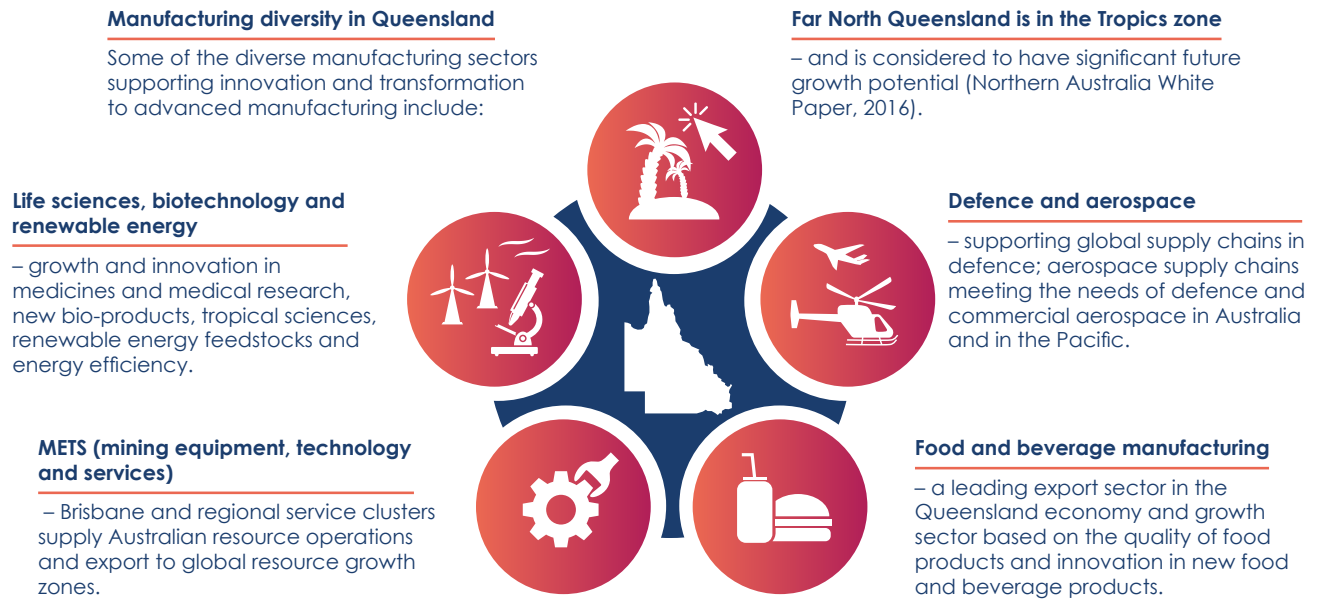
36. Committee for Economic Development of Australia, 2014, *Advanced Manufacturing: Beyond the production line* <https://www.ceda.com.au/CEDA/media/ResearchCatalogueDocuments/PDFs/22092-Advanced-Manufacturing.pdf>.

37. Jobs Queensland, *Advancing Manufacturing Employer Survey*, 2017.

38. AlphaBeta, *The Automation Advantage*, 2015. <http://www.alphabeta.com/wp-content/uploads/2017/08/The-Automation-Advantage.pdf>.

39. Advanced Manufacturing Growth Centre, *Media Release – New AMGC Report Defines Advanced Manufacturing in Australia*, November 2017. https://www.amgc.org.au/Story?Action=View&Story_id=29.

Figure 2: Manufacturing diversity in Queensland

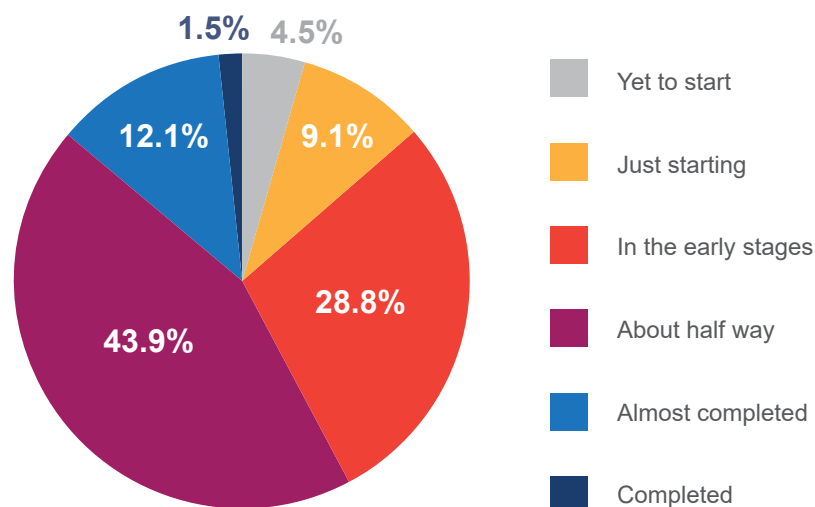


The diversity of the manufacturing industry in Queensland is a major asset during this transition, generating new opportunities and growth (see Figure 2).⁴⁰

Some companies are well advanced on the journey to advanced manufacturing — typically companies with a market led or innovation focus and the resources to support investment in technology and change.

The main findings from the employer survey were that almost 90 per cent of respondents consider the transition to advanced manufacturing was either essential or very important for their business. Only five per cent of manufacturers surveyed had yet to commence the journey.⁴¹

Progress on journey to advanced manufacturing



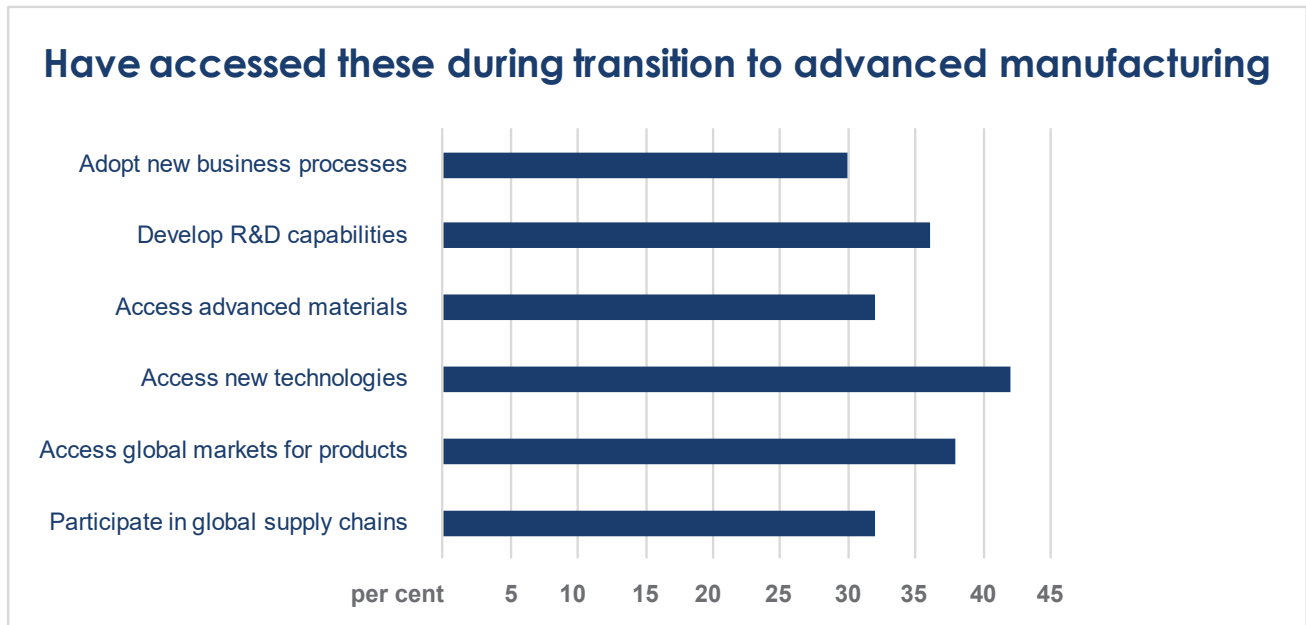
Source: Jobs Queensland, Advancing Manufacturing Employer Survey 2017.
Due to rounding, figures may not add up to 100 per cent.

40. Office of the Queensland Chief Scientist, *Advanced manufacturing – implications and opportunities for Queensland*, February 2016 <http://www.chiefscientist.qld.gov.au/images/documents/chiefscientist/pubs/reports-other/advanced-manufacturing-2016.pdf>.

41. Jobs Queensland, *Advancing Manufacturing Employer Survey 2017*.

Participants in Jobs Queensland workshops and surveys were clear about the positive outcomes they have experienced as they transition to advanced manufacturing.

The transition to advanced manufacturing has led to new opportunities and technologies and driven business improvements. New skills needs in relation to business management, productivity, innovation and supply chain management are being driven by external forces (e.g. technology, increased global competition) and the internal changes that businesses are making to innovate and build competitiveness (e.g. developing new products and implementing new processes and business models).

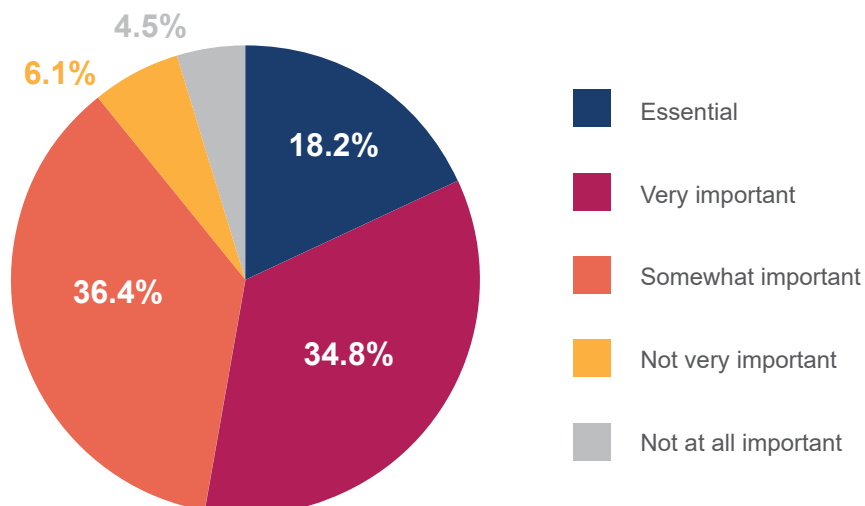


Source: Jobs Queensland, Advancing Manufacturing Employer Survey 2017.

Mentoring is key

Mentoring was considered to have a key role in the successful transition to advanced manufacturing with more than half of those surveyed stating that it was either essential or very important.

Importance of a mentor when transitioning a business to advanced manufacturing

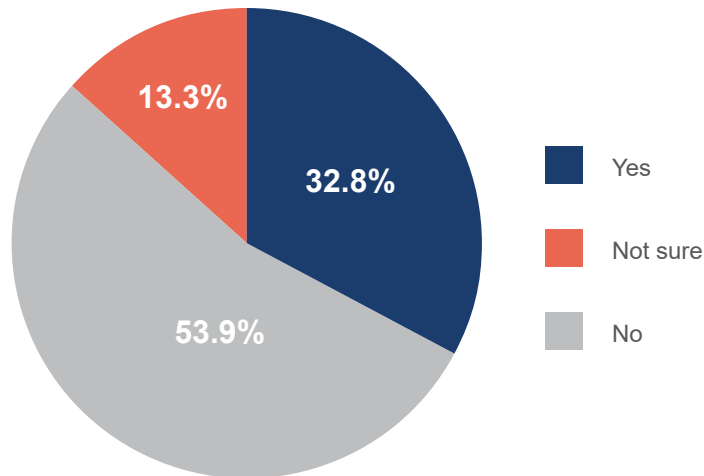


Source: Jobs Queensland, Advancing Manufacturing Employer Survey 2017.

Strong industry feedback was received throughout this process in relation to the importance of a solid partnership between manufacturing employers and employees to succeed on the journey towards advanced manufacturing.

Manufacturing employees in Queensland surveyed by Jobs Queensland were less likely to identify that they were on the advancing manufacturing journey when compared to the employers surveyed. More than 50 per cent of employees surveyed considered that they did not work in an advanced manufacturing workplace.⁴²

Consider place of work to be an “advanced manufacturer”



Source: Jobs Queensland, Advancing Manufacturing Employee Survey 2017.

This finding highlights that there may be a need for greater engagement, cooperation and consultation between employers and employees to ensure that all employees have the information needed about advanced manufacturing, what it means for the workplace and the value it can deliver not just to the business but to employees.

Priority Action Area 1

Position the manufacturing workforce as a key partner in the journey towards advanced manufacturing.

42. Jobs Queensland, Advancing Manufacturing Employee Survey 2017.

4.3 Building business capability

What became clear as Jobs Queensland spoke to industry stakeholders around the state was the need to build business capability within the manufacturing industry.

Advancing manufacturing is a journey and the level of readiness for the transformation to advanced manufacturing varies considerably. While larger and global companies have additional resources and internal networks to support this transition, small and medium-sized enterprises (SMEs) in the manufacturing industry often do not have this benefit.

There are also significant challenges to overcome along the journey to advanced manufacturing. For the industry, a major challenge will be engaging all businesses in the transition to advanced manufacturing. There are many reasons why this may occur, but one that was commonly raised was that many SMEs are focused on working *in* their business and struggle to find the time to work *on* their business.

Business owners with formal management and leadership training are in the minority. Fewer managers and owners have management qualifications in Australia compared with Asian and European manufacturing managers.⁴³ Consequently, some business owners can lack the business management and leadership skills they need to successfully execute the transition to advanced manufacturing.

Building management level skills and capabilities can improve the success rate for transition to advanced manufacturing. This came through strongly from industry stakeholders and is supported through research.⁴⁴ However, this can only occur if the training that is undertaken effectively addresses the specific skills and capabilities required.

Many of the current management qualifications being delivered through VET and higher education are not viewed by industry as meeting the needs of the manufacturing industry. Stakeholders identified a range of areas in which they need to build capability — this includes supply chain management, marketing to new and diverse markets, skills to identify the right technology investments and to absorb that technology into their business processes to planning and managing innovation.

Within the VET sector, training packages do not yet include the units of competency to address some of these skill needs. The Australian Industry and Skills Committee is currently working to address this through nine cross-sector projects.⁴⁵ The introduction of new training products will assist in building business capability. During consultations stakeholders identified the need for future training to be delivered using a 'just-in-time' approach i.e. when, where and how the industry needs it.

While some training products and services already exist to meet this need, there is scope for government to consider how it may be able to facilitate greater access to take-up these forms of training for the manufacturing industry in Queensland — especially for owners and managers of firms. A range of new management and leadership programs (or amendments to existing programs) that focus specifically on advanced manufacturing — through university, VET and executive development programs — also need to be considered.

The need for improved business capability is not limited only to owners and managers. Manufacturing businesses need to embrace a culture of continuous improvement across the whole organisation. Opportunities for improvement and innovation may present from both within the business as well as outside of the business and even outside of the industry. They may come from employees or from customers or suppliers. Employees need to be supported and encouraged to contribute to improvement and innovation initiatives.

43. The Australian Council of Learned Academics, *Maintaining Australia's advantage: Management & Skills (July 2014)* <http://acola.org.au/wp/PDF/SAF01/10.%20Management%20and%20Skills.pdf>.

44. Australian Workforce and Productivity Agency, *Manufacturing workforce study 2014*, <https://docs.education.gov.au/system/files/doc/other/manufacturing-workforce-study-2014.pdf>; Manufacturing Skills Australia, Environmental Scan 2015, <http://mskills.org.au/industry-intelligence/info/environmental-scan>.

45. Australian Industry and Skills Committee, *Cross sector projects*, <https://www.aisc.net.au/content/cross-sector-projects>.

Industry stakeholders highlighted the need for businesses to adopt a culture and mindset that supported successful employee engagement on the journey towards advanced manufacturing. It was a recurring theme across all industry consultations that employee engagement with the process of transition was vital for success and some of the most innovative and successful ideas for improvement have been generated on the shop floor.

Business capabilities can be strengthened by adding principles related to the business environment, Industry 4.0 and competitive systems and practices to manufacturing training and education programs in schools, VET and universities. Similarly, an increased understanding of cutting edge advanced manufacturing principles and business principles can be promoted through building these elements into existing training mechanisms for the manufacturing industry.

A strong message received from industry is that training in business process improvements (including Lean, 5S, Six Sigma, Kaizen, etc.) was a key component of the journey to advanced manufacturing. In 2016, 1056 people in Queensland undertook a qualification in Competitive Systems and Practices (which is one method for undertaking business process improvement training). The majority of this training was at Certificate III and IV levels and provided by private providers.⁴⁶ It is important to note that industry views this form of training as complementary to and building upon, as opposed to replacing, the existing trade and technical qualifications of employees.

GMG is a leading supplier of metal products and components to the mining, rail, road transport, marine, construction and infrastructure markets. With operations in Maryborough and Gladstone, GMG is one of the early adopters and leading proponents of Lean manufacturing in Queensland.

GMG has invested in staff engagement and training, process improvement and an in-house developed Inventory Tracking and Management System (ITMS) that tracks and manages all manufacturing operations — giving real time data on all current jobs and a vast data library of past jobs to inform work analytics and estimating.

GMG's culture of continuous improvement, its data analytics capability and investment in 'right fit' automation for its job types, delivers effective costing, tight control of processes and high levels of quality and delivery performance.

GMG continues to be a leader and a benchmark for the value that the transition to advanced manufacturing can deliver to manufacturing businesses.

46. NCVER, 2017, *TVA program enrolments 2014–2016*.

Priority Action Area 2

Strengthen the capabilities of manufacturing businesses and their leadership teams to successfully transform to advanced manufacturing in areas including:

- business management and leadership
- market engagement including exporting
- new product and service development
- innovation management
- new technology identification and absorption
- change management and workforce skills development.

Priority Action Area 3

Build the understanding of and capability related to business management, innovation and productivity enhancement at all levels of the manufacturing industry.



Staff member at Allmet Engineering, Wacol. Photo credit: Michael Marston ePixel Images.

4.4 Impact of structural adjustment

Some elements of media and popular commentary in recent years have painted a bleak picture for the future of manufacturing in Australia. Overwhelmingly, this project has shown that for Queensland, while structural changes are certainly occurring, the manufacturing industry is evolving to take advantage of new and significant opportunities.

Structural change can occur:

- within firms, as they respond to changes in the relative price of inputs and implement new production processes through the adoption of new technology and management practices
- within industries, as competitive pressures favour one firm over another
- across sectors of the economy, as domestic or global consumption patterns change or industries lose their comparative advantage.⁴⁷

The causes and impacts of structural change vary across the manufacturing industry. For example, there has been a global trend for the transition of large scale, long production run manufacturing (such as automotive, steel production and textile clothing and footwear) to lower cost manufacturing countries. The impact on the mining equipment, technology and services (METS) sector is more cyclical stemming from changes in commodity prices and the transition between construction and production activity in the resources sector.

The impacts of structural adjustment can include job losses and business closures, and can therefore have a significant impact at the individual or community level. Despite this, fluctuations brought about through the expansion of certain industries (often coinciding with firm expansion and creation) and the decline of less competitive industries are important for long-term economic growth.⁴⁸

What is the impact of structural adjustment in Queensland?

The Queensland Productivity Commission notes that it is “*difficult to forecast with any degree of certainty the potential nature and extent of future structural change in Queensland's manufacturing sector. Nonetheless, it is likely that:*

- *Technology, such as advanced manufacturing, will have an impact on established firms, in terms of the level of capital investment, the manner in which they produce, the amount of labour they employ and their ability to compete with domestic and international rivals*
- *Higher electricity and gas prices will erode the commercial sustainability of energy-intensive industries.*⁴⁹

Research by the Australian Workforce and Productivity Agency identified that labourer, manual operator and driver occupations “*have experienced strong declines over the past five years, a trend which is expected to continue in the medium and long term. Conversely, it also implies that high-skilled occupations are the least likely to be impacted by structural adjustment of the (manufacturing) sector.*”⁵⁰

The transition to advanced manufacturing is likely to create higher level jobs and much more worker engagement requiring the use of critical thinking and problem solving in the workplace. The need for upskilling to support the transition to advancing manufacturing jobs will provide workers with a wider set of skills — improving their capacity to secure new jobs if they experience a job loss.

47. Downes and Stoeckel, *Drivers of structural change in the Australian economy*, Centre for International Economics, December 2006. <http://www.thecie.com.au/wp-content/uploads/2014/06/MASTER-DITR-26-Feb.pdf>.

48. Office of the Chief Economist, *Australian Industry Report 2014, Chapter 2*, Australian Government, Canberra. <https://industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/Australian-Industry-Report.pdf>.



49. Queensland Productivity Commission, 2017, *Draft Report Manufacturing in Queensland*, page 152, https://qpc.blob.core.windows.net/wordpress/2017/07/17_4232-QPC-Manufacturing-Report_21.pdf.

50. Australian Workforce and Productivity Agency, *Manufacturing Workforce Study, April 2014*. <https://docs.education.gov.au/system/files/doc/other/manufacturing-workforce-study-2014.pdf>.

While the loss of larger manufacturing operations through structural adjustment is not common in Queensland, it can occur. When large job losses occur, they have a significant effect on the regional economies in which operations are based. Recent examples include the closure of Queensland Nickel with the loss of 800 jobs in Townsville in 2016⁵¹ and the closure of several meat processing plants in Ipswich in late 2017.

The loss of small traditional manufacturing businesses, due to the retirement of business owners or the uptake of new technologies, can drive organic structural change within the industry.⁵² This structural change can be a positive direction for the industry, increasing productivity, changing jobs and increasing employment opportunities in new areas.⁵³ An increased focus is required on succession planning to ensure that businesses can continue to operate when an owner retires. This is especially important in regional areas in order to maintain employment.

The long-term outlook for jobs growth in manufacturing in Queensland is positive. While the Australian Government's Department of Employment projects a decline of 1.9 per cent in Queensland manufacturing jobs in the short-term (2017 to 2022)⁵⁴, the Queensland Statistician forecasts a rise in industry employment from 204,230 in 2020–21 to 311,839 in 2040–41 (a 53 per cent increase in employment over 20 years).⁵⁵

 **An increased focus is required on succession planning to ensure that businesses can continue to operate when an owner retires.** 

51. Queensland Government Media Statements, *QNI exit medicals to begin as tenderer announced*, September 08, 2016, <http://statements.qld.gov.au/Statement/2016/9/8/qni-exit-medicals-to-begin-as-tenderer-named>.

52. Queensland Productivity Commission, *Draft Report Manufacturing in Queensland, 2017*, page 146, https://qpc.blob.core.windows.net/wordpress/2017/07/17_4232-QPC-Manufacturing-Report_21.pdf.

53. Australian Government Department of Employment, *Labour Market Information Portal, 2017 Regional projections to 2022 – interactive tool*, accessed December 2017.

54. Queensland Productivity Commission, *Draft Report, Manufacturing in Queensland, 2017*, page 153, https://qpc.blob.core.windows.net/wordpress/2017/07/17_4232-QPC-Manufacturing-Report_21.pdf.

55. Queensland Government Statistician's Office, *Regional employment projections, 2010–11 to 2040–41* <http://www.qgso.qld.gov.au/products/tables/reg-employment-proj/index.php>.

What is the potential for an influx of displaced workers from other jurisdictions?

The impact of structural adjustment on the Queensland manufacturing industry has been less severe and more gradual compared with structural adjustment in other parts of Australia. Examples of significant job losses in other parts of Australia over the last three years include:

- the closures of major automotive manufacturing plants in South Australia and Victoria⁵⁶
- Arrium moving into voluntary administration which had impacts across several states⁵⁷
- the restructure of Caterpillar worldwide which led to the closure of Caterpillar Underground Mining in Tasmania⁵⁸
- Electrolux, New South Wales
- the curtailment of operations at Rio Tinto's Gove Alumina refinery, Northern Territory⁵⁹
- Alcoa, Victoria.

When job losses occur, lower skilled workers tend to seek new employment in their local region while higher skilled workers are more likely to consider relocating to obtain new employment.⁶⁰ Workers displaced from car manufacturing plants may present a source of skilled labour in areas where the industry has advised of shortages, particularly in areas such as automation, robotics, sensors and instrumentation. Despite this, of the South Australian and Victorian automotive manufacturing workers that moved to other employment, almost one-third remained in the local manufacturing industry.⁶¹

Significant investment in industry development strategies and structural adjustment support, nationally and in southern states, have focused on retaining workers in the regions where they are already living.^{62, 63, 64}

Across both South Australia and Victoria, the impact that the contraction of automotive manufacturing employment had on employment in regional labour markets was relatively limited. While the automotive industry in Australia contracted by almost one quarter in this period, even in the worst affected regions (with a net 7100 automotive jobs lost), the impact as a proportion of total employment was less than three percentage points.⁶⁵ This indicates that regional economies have been largely able to absorb the workers displaced by the contraction.

As a consequence, it is unlikely that there will be movement of significant numbers of displaced workers to Queensland. It is likely, however, to create a separate challenge for the manufacturing industry in Queensland. As competitors in southern states reposition their businesses and actively seek new market opportunities, Queensland manufacturers can expect to face greater competition.

56. Department of Industry, Innovation and Science, *Review of South Australian and Victorian Economies*, <https://industry.gov.au/AboutUs/CorporatePublications/ReviewofSouthAustralianandVictorianEconomies/Pages/default.aspx>.

57. Australian Industry Group, *Arrium voluntary administration*, <https://www.aigroup.com.au/policy-and-research/mediacentre/releases/f0980fba-8506-e611-80cd-0050568067c2/>.

58. Department of State Growth, *Caterpillar Transition Taskforce report released*, <https://www.stategrowth.tas.gov.au/?a=135631>.

59. Rio Tinto, *Gove Operations Bauxite Mine Alumina Refinery*, <http://www.riotinto.com/aluminium/gove-operations-bauxite-mine-alumina-refinery-9091.aspx>.

60. Department of Industry, Innovation and Science, *Review of South Australian and Victorian Economies*, <https://industry.gov.au/AboutUs/CorporatePublications/ReviewofSouthAustralianandVictorianEconomies/Pages/Worker-redeployment-and-skills-development.aspx>.

61. Ibid.

62. Economic Development, Jobs, Transport and Resources, *Victoria's Automotive Transition Plan*, <https://economicdevelopment.vic.gov.au/victorias-automotive-transition-plan>.

63. Australian Government, Business, *Growth Fund*, <https://www.business.gov.au/assistance/growth-fund>.

64. Department of Industry, Innovation and Science, *Automotive*, <https://industry.gov.au/industry/IndustrySectors/automotive/Pages/default.aspx>.

65. Department of Industry, Innovation and Science, *Review of South Australian and Victorian Economies*, <https://industry.gov.au/AboutUs/CorporatePublications/ReviewofSouthAustralianandVictorianEconomies/Pages/Worker-redeployment-and-skills-development.aspx>.

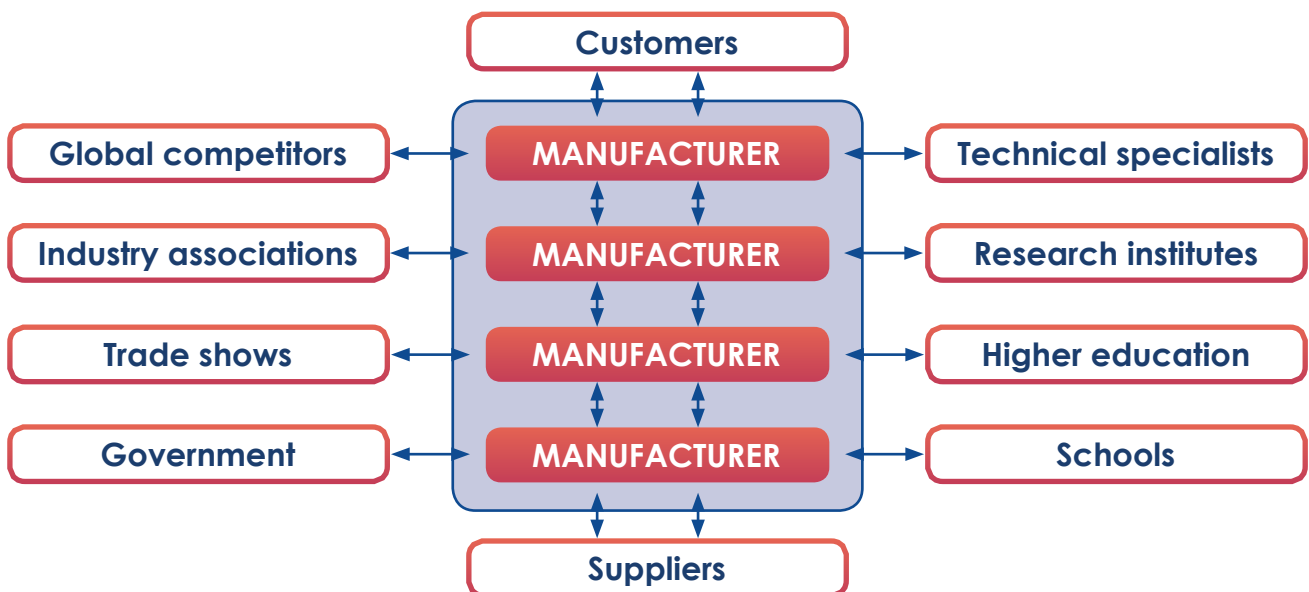
How can the impacts of structural adjustment be minimised?

It is important to ensure that when workers are impacted by structural adjustment, effective support mechanisms are put in place to assist them to transition to new and meaningful employment. The Queensland Productivity Commission identified the following strategies that can help to identify, manage and minimise job losses from structural adjustment. These include:

- Proactive consultation with industry sectors at risk of structural adjustment and unions to prepare for and assist with re-skilling and re-employment strategies.
- Establishing workforce data and analytics reporting that provides advice on workforce trends and demand for skills to identify potential structural changes early on and inform employment and training assistance for displaced workers on a sector and regional basis.
- Working with regional manufacturing 'ecosystems' and industry networks to maximise industry response efforts and minimise net job losses.
- Continuing to provide structural adjustment program support through federal and state governments.⁶⁶

Jobs Queensland, through a separate project, is currently undertaking an analysis to identify effective mechanisms for responding to the workforce impacts of structural change in the economy. This will provide additional evidence to underpin the development and implementation of future interventions.

Figure 4 Ecosystem to support advanced manufacturing



66. Queensland Productivity Commission, *Draft Report, Manufacturing in Queensland, 2017*, page 155. https://qpc.blob.core.windows.net/wordpress/2017/07/17_4232-QPC-Manufacturing-Report_21.pdf.

4.5 Driving competitiveness through collaboration

A range of benefits can be derived from effective industry cooperation and collaboration across the manufacturing industry and the associated value chain. This collaboration is supported through the establishment of concentrated business ecosystems (clusters), generally at the manufacturing sub-sector⁶⁷ or regional level, which create a competitive advantage for participants within the ecosystem.⁶⁸

Ecosystems can be made up of a diverse range of industry participants, including individual manufacturers; industry associations; unions; customers; suppliers; technical and technology specialists; schools, training organisations and universities; government agencies; and research institutes. Each ecosystem participant plays a different but important role in supporting the manufacturing industry, by making specialist resources available and providing a range of varied benefits which may include:

- access to sources of information on industry markets
- new technologies and trends through trade shows
- online information and resources
- information on sources of investment funding.

Industry stakeholders at Jobs Queensland workshops regularly stated that “*industry learns from industry.*” Effective ecosystems support manufacturers transitioning to advanced manufacturing through the sharing of lessons learned and success stories which will help minimise duplication of effort and reduce wasteful or unproductive endeavours. Ecosystems can also facilitate links to research organisations that support R&D, product innovation and commercialisation, creating a competitive advantage for Queensland manufacturers.

Sharing information and capabilities through regional ecosystems will provide access to specialist skills and knowledge to support the transition to advanced manufacturing. For example in the regions outside of Greater Brisbane, access to specialist IT and automation/robotics support services is limited with stakeholders at one regional workshop describing how not having access locally to expertise on system integration is limiting the adoption of new technologies.

Ecosystems can present manufacturers with opportunities to pool resources and collaborate in relation to professional development opportunities for staff, including apprentices and trainees, which can make training more financially viable in regions or niche markets. Partnerships need to be developed that encourage collaboration between key stakeholders (industry-schools-VET-higher education) to ensure the skilling and training needs of niche sectors/thin markets and non-metropolitan regions are met.

Regional ecosystems can also support greater collaboration within the local area, offering opportunities to participate in collaborative tendering processes to improve market access including export markets. Collaborative tendering and improved market access will ensure that Queensland made products and services are globally competitive, and involvement in global supply chains and export markets will also encourage the development of improved business management process and systems.

Ecosystems can play a key role in equipping the manufacturing industry in Queensland with a global mindset, through facilitation of opportunities to build international links and relationships. This can include through: trade missions and international site tours; exchanges (at business, manager or worker level); and export market development at a regional or sectoral level.

67. The term 'Industry sub-sectors' in this context refers to the structural relationships between related businesses established through the Australian and New Zealand Standard Industrial Classification (ANZSIC) subdivisions.

68. Slaper, T and Ortuzar, G, 2015 'Industry Clusters and Economic Development', <http://www.ibrc.indiana.edu/ibr/2015/spring/article2.html>.

Ecosystems also provide industry with the opportunity to share information on new and emerging technologies and the return on investment that these technologies offer. Raising the awareness of the diverse, high-quality digital information and other resources that are available can support manufacturers on their transition as well as profiling the value that suppliers, research organisations and technical specialists can provide.

Many businesses are innovative and entrepreneurial; however they face challenges in implementing business improvements due to lack of access to information and assistance. As one stakeholder put it “*they don't know what they don't know.*” Gaining access to funds for new investment in technologies and innovation has been identified as a challenge. Similarly, capability development for businesses (and key staff within them) in relation to exporting and tendering were commonly identified as critical for growth and competitiveness — especially within regions.

Making information, success stories and relevant resources available to company leadership teams will improve their capabilities and reduce unproductive duplication of effort among SMEs who are all trying to solve the same challenges.

While these activities require strong industry leadership and input to be successful, there is a key role for governments (at all levels) in supporting and facilitating these activities.

Resource Industry Network (RIN) is part of a proactive industry ecosystem in the Mackay and Bowen Basin region, actively working with the mining equipment, technology and services (METS) sector to build their competitiveness and expand their market reach in domestic and international markets.

RIN assists local businesses to connect within the resource sector, develop practical pathways for business success and promote a region of excellence in the resource services sector and the innovation and capability of members and industry.

METS Ignited is an industry-led, government-funded, Growth Centre for the METS sector.

METS Ignited is working with companies in the region through a METS pilot accelerator program covering financial, marketing, commercial and technical advice to commercialise their products and services. METS Ignited is also helping suppliers improve business data analytics, product and services business case development, targeting global markets and building high-level problem-solving and critical thinking in their workforces.

The work that RIN and METS Ignited are undertaking will build resilience, helping industry to access larger international markets and lessen the impact of mining activity cycles.

Priority Action Area 4

Support an industry-led 'ecosystem' that provides:

- networking and information sharing opportunities for 'industry to learn from industry' and support sectoral and regional industry development
- links with research institutes and specialists, suppliers, training providers and the resources available from industry networks and governments to support industry growth and transformation
- access to benchmark services
- opportunities for manufacturers to partner and collaborate to target major contracts and export opportunities
- opportunities for manufacturers to participate in collaborative approaches to skilling and capability development.

Priority Action Area 5

Foster continued industry opportunity growth that will flow through to increased opportunities for Queenslanders in the manufacturing industry, including through:

- development of international market links and export market development
- capability development for manufacturers.



Staff supervising the production process at Geofabrics, Ormeau. Photo credit: Welcome to the Fold.



Staff member with an 81X Chain Wear Gauge. Photo courtesy of Hyne Timber.

5. Advancing manufacturing skills for the future

Human capital is a critical foundation for the future prosperity of the manufacturing industry in Queensland.

"... ultimately it is people that create the competitive edge."

Innes Willox, Australian Industry Group, 2016.⁶⁹

Recent CSIRO reports highlight that a highly skilled workforce is a vital component for economic advantage. CSIRO's Advanced Manufacturing report (2016) stated that *"High education levels (vocational and higher education) and access to world-class research institutions are becoming increasingly important as advances in manufacturing techniques and processes require a more skilled and educated workforce."*⁷⁰

However the report's authors also warned that Australian manufacturers do not capitalise on the full value of staff development. The transition towards advanced manufacturing is evolving manufacturing business models and introducing technologies and processes that are rapidly impacting required skills within the industry. This transition is driving a need for industry to value the upskilling, reskilling and multi-skilling of the existing manufacturing workforce.

5.1 Future skills needs

The results from the Jobs Queensland surveys of employers and employees give a comparison of the skills that businesses and employees currently use, and the skills they believe they will need in the future.

While employers and employees are well aligned on the need for skills related to traditional manufacturing, critical thinking and sustainability, they are not well aligned on the need for other skills.

Employers are placing greater emphasis on these skills in comparison to employees:

- greater market engagement
- innovation
- advanced manufacturing processes
- effective business and supply chain management.⁷¹

A mix of traditional and new skills will be needed as well as flexibility in how skills are developed. Industry and employers need to better engage and communicate with their workforce and other parts of the skills ecosystem to build a shared vision about the skills needed for the future.

69. CEDA, 2014, *Advanced Manufacturing – Beyond the Production Line*, p. 78, <http://www.ceda.com.au/CEDA/media/ResearchCatalogueDocuments/PDFs/22092-Advanced-Manufacturing.pdf>.

70. CSIRO, 2017, *Opportunities for growth: Driving forces creating economic opportunities for Queensland companies over the coming decade*. Brisbane, Australia: CSIRO; 2017. <http://qldfutures.com.au/wp-content/uploads/2017/01/QFIs-Opportunities-for-Growth-Report.pdf>; CSIRO, 2016, *Advanced Manufacturing: A Roadmap for unlocking future growth opportunities for Australia*, <https://www.csiro.au/en/Do-business/Futures/Reports/Advanced-manufacturing-roadmap>.

71. Jobs Queensland, *Advancing Manufacturing Employer Survey 2017*.

Skills being used currently and needed for the transition to Advanced Manufacturing

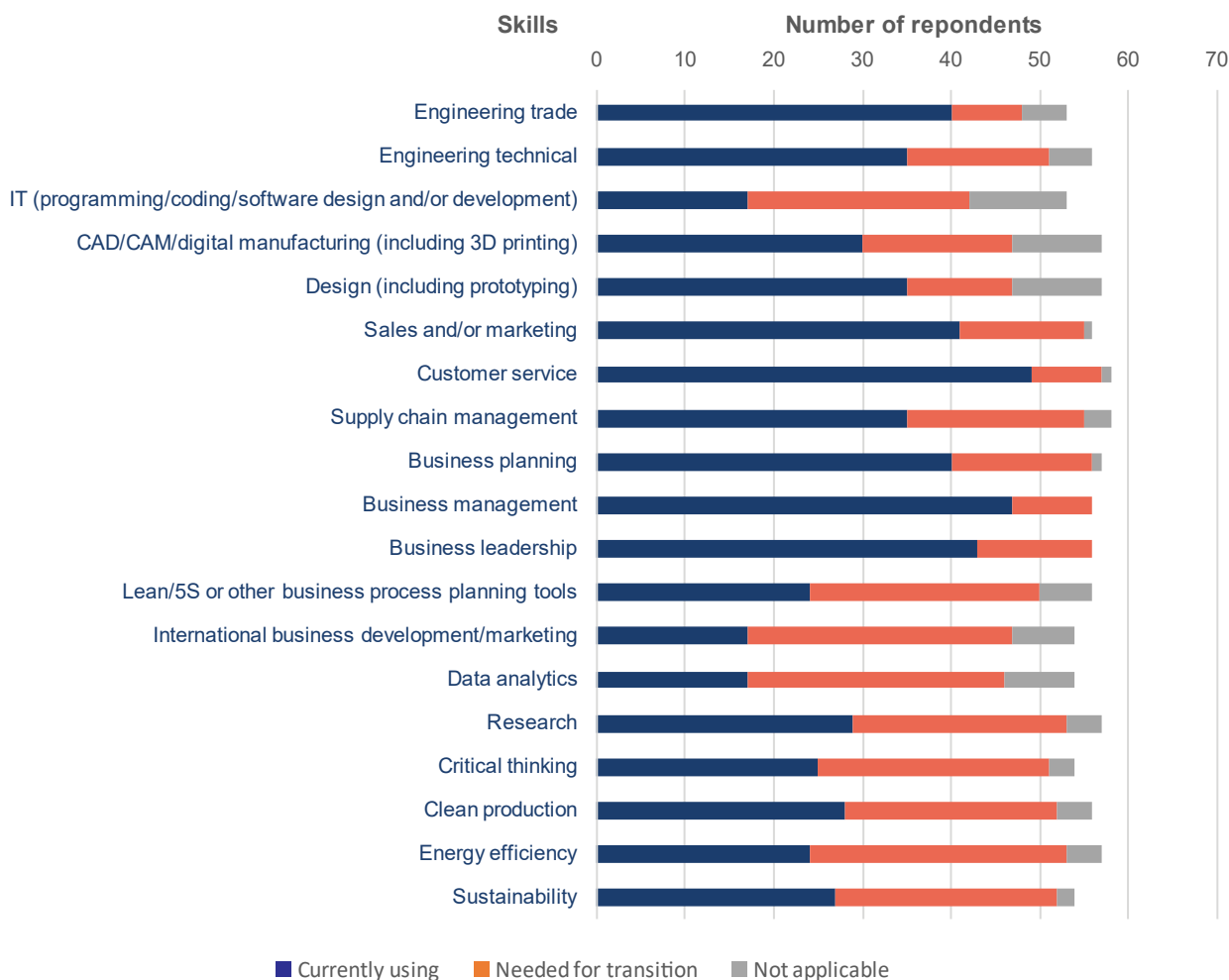
Employers and employees generally in agreement on these skills	More employers report these skills in current use and needed for the transition compared to employees
<p>Engineering and trades</p> <ul style="list-style-type: none"> • Engineering trades • Engineering technical skills <p>STEM skills</p> <ul style="list-style-type: none"> • Critical thinking <p>Sustainability</p> <ul style="list-style-type: none"> • Clean production • Energy efficiency • Sustainability 	<p>Design</p> <ul style="list-style-type: none"> • Design (including prototyping) <p>Market and product</p> <ul style="list-style-type: none"> • Sales and/or marketing • Customer service • International business development/marketing • Research <p>Digital skills</p> <ul style="list-style-type: none"> • IT (programming/coding/software design and/or development) • Computer-aided design (CAD) and manufacturing (CAM) • Digital manufacturing (including 3D printing) <p>Productivity and process management</p> <ul style="list-style-type: none"> • Lean/5S or other business process planning tools • Data analytics <p>Business management</p> <ul style="list-style-type: none"> • Supply chain management • Business planning • Business management • Business leadership

Source: Jobs Queensland, Advancing Manufacturing Employer Survey, 2017; Jobs Queensland, Advancing Manufacturing Employee Survey, 2017.

Critical thinking, higher level problem-solving and 'STEM thinking' (the ability to analyse information, understand the implications and solve problems) are increasingly important skills which underpin all roles in an advanced manufacturing workplace. Respondents to the Jobs Queensland employer survey identified these skills among their top five skills needed to transition to advanced manufacturing.

Digital literacy (the ability to problem solve in a technology-rich environment) and digital skills such as programming and coding are increasingly important. These skills underpin the way automated processes are planned, managed, designed and monitored. Understanding and applying manufacturing systems and information — including through work management systems, real time data on processes, digital integration of machines and management tools — are all part of the suite of digital capabilities that an advancing manufacturing workforce needs now and in the future.

Skills currently in use and needed for transition



Source: Jobs Queensland, Advancing Manufacturing Employer Survey 2017.

Demand for higher level technical skills within the industry is increasing — this covers engineering, laboratory technicians, analytical chemists, designers, IT professionals and technical specialists. In some manufacturing sectors, industry reported that attracting applicants from overseas is a common and first choice approach due to the lack of some highly specialist technical skills in Australia. STEM qualifications have become less popular options creating undersupply of engineering and specialised technical skills for manufacturing.⁷²

Design skills and design-led thinking is increasingly important for innovation and advancing manufacturing. Design-led thinking describes a customer-centred, iterative design process employed by organisations to simulate how a product will be utilised and experienced by a customer.⁷³ Its key steps involve organisations conducting research to emphasise and experience the customer's needs, and prototyping and testing product solutions in collaboration with the customer.⁷⁴

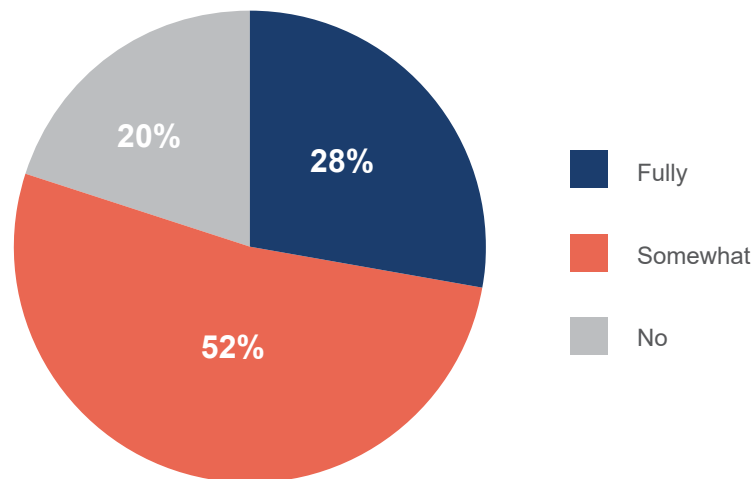
Nearly three in 10 manufacturers have fully incorporated design, design skills and design-led thinking into their business as part of the advanced manufacturing journey, and a further 52 per cent have started this process.

72. Mack, J and Wilson, R, 2015, Trends in Mathematics and Science subject combinations in the NSW HSC 2001 – 2014 by gender, <http://www.maths.usyd.edu.au/u/SMS/MMW2015.pdf>.

73. Harvard Business Review, 2015 'Design Thinking Comes of Age', <https://hbr.org/2015/09/design-thinking-comes-of-age>.

74. Gibbons, S, 2016 'Design Thinking 101', <https://www.nngroup.com/articles/design-thinking/>.

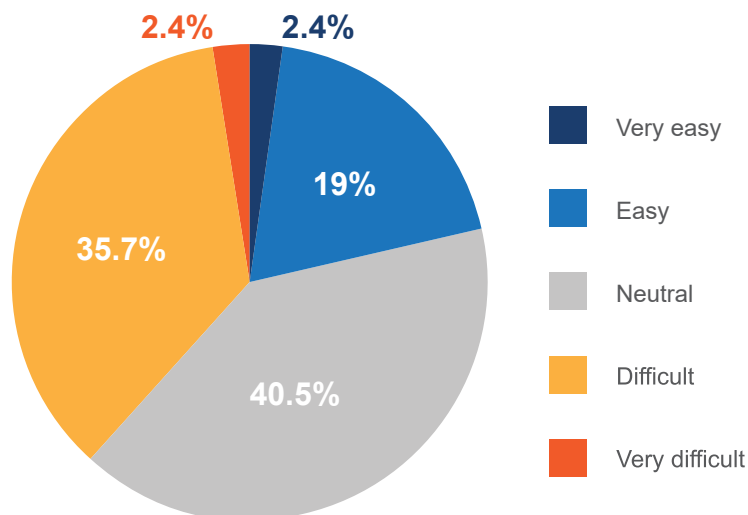
Incorporation of design skills and thinking



Source: Jobs Queensland, Advancing Manufacturing Employer Survey 2017.

An important result is that only 21 per cent of manufacturers found these design skills easy or very easy to access.

Ease of accessing design skills



Source: Jobs Queensland, Advancing Manufacturing Employer Survey 2017.
Due to rounding, figures may not add up to 100 per cent.

Street + Garden specialises in the design and manufacture of furniture for public spaces and private clients. Street + Garden has created a market-leading position through its design-led product development and design-led thinking. A team of five tertiary qualified industrial designers create high quality, bespoke designs for clients and ensure that the resulting products are 'designed for manufacturing and assembly' — ensuring that the manufacturing process is efficient and cost effective.

The company's commitment to innovative design, its investment in its people and culture, its use of 3D printing for models and its commitment to the use of sustainable materials supports its strong position in the market. Street + Garden is an active collaborator with its manufacturing supply chain where open communication has led to new investment in equipment by suppliers and a collaborative approach to forward planning of manufacturing capacity to meet end clients' timelines.

5.2 Educational profile

The change in the skills in demand within the manufacturing industry as it transitions to advanced manufacturing has resulted in a significant shift in the educational profile of the workforce.

The increasing adoption of technology and automation (including robotics) is changing the skills level required in manufacturing. Many of the repetitive, low-value tasks associated with the manufacturing industry in the past have now been automated leading to improved productivity and higher safety standards. As a result, higher level skills are needed to design and manage automated processes.

Analysis of Census data from 2006 and 2016 shows there has been a decline in the use of Certificate level qualifications across all occupations, alongside growth in tertiary level qualifications. The chart below shows the change in qualification levels since 2006 within the industry.

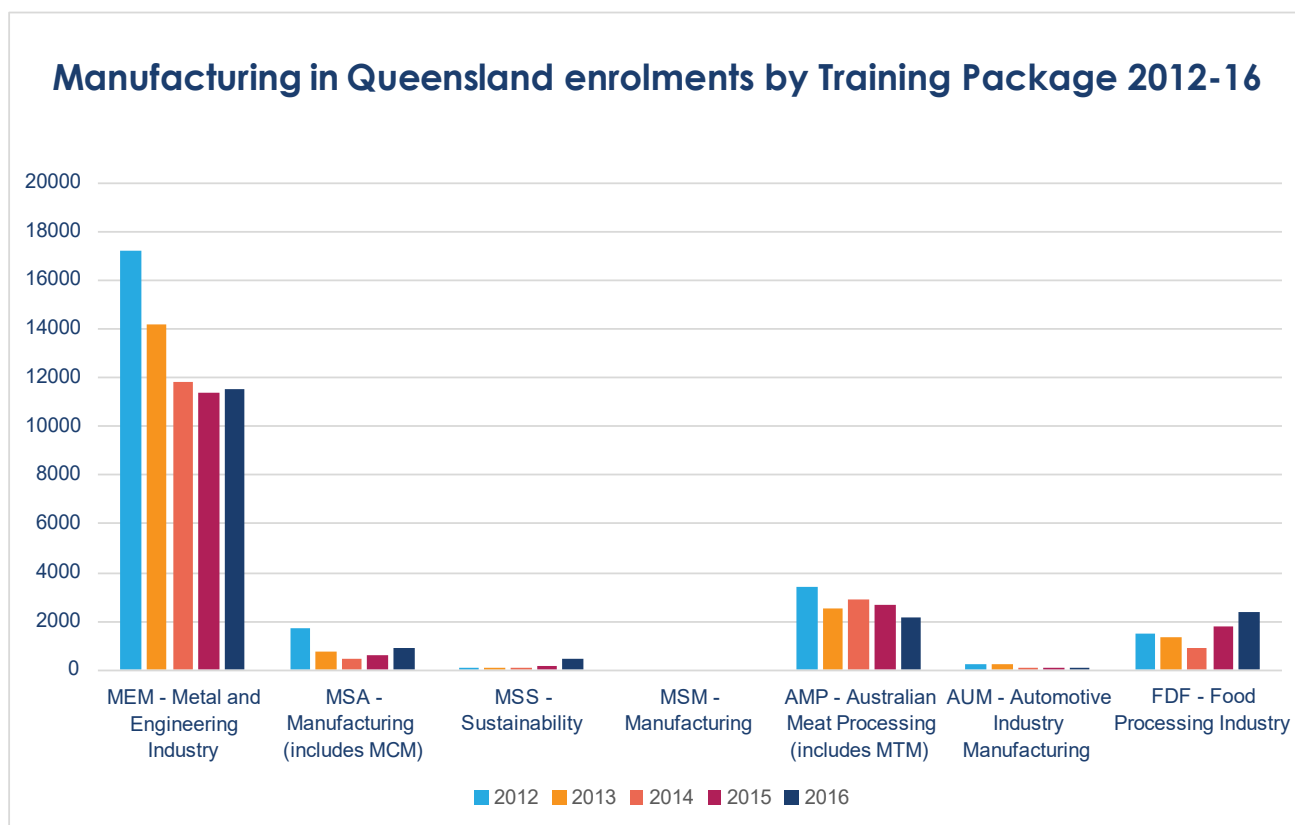
The significant increase in the use of postgraduate degree level qualifications by community and personal services workers reflects the growing importance of work, health and environmental monitoring and safety within the industry.

Occupation		Certificate Level	Advanced Diploma & Diploma Level	Bachelor Degree Level	Graduate Diploma & Certificate Level	Postgraduate Degree Level
Managers	2006	6,458	2,132	2,862	294	750
	2016	5,553	2,357	2,961	348	1,017
	% change	-14.0	10.6	3.5	18.4	35.6
Professionals	2006	2,029	1,446	3,813	233	602
	2016	1,446	1,281	3,451	261	930
	% change	-28.7	-11.4	-9.5	12.0	54.5
Technicians and Trades Workers	2006	29,533	1,951	968	111	103
	2016	23,090	2,093	1,206	108	202
	% change	-21.8	7.3	24.6	-2.7	96.1
Community and Personal Service Workers	2006	336	138	42	5	3
	2016	336	234	122	8	20
	% change	0.0	69.6	190.5	60.0	566.7
Clerical and Administrative Workers	2006	3,511	1,483	1,076	83	133
	2016	3,381	1,629	1,181	94	249
	% change	-3.7	9.8	9.8	13.3	87.2
Sales Workers	2006	1,895	545	493	29	46
	2016	1,685	642	556	28	67
	% change	-11.1	17.8	12.8	-3.4	45.7
Machinery Operators and Drivers	2006	5,266	564	321	30	19
	2016	5,291	703	455	24	51
	% change	0.5	24.6	41.7	-20.0	168.4
Labourers	2006	6,103	918	743	39	55
	2016	5,861	1,172	1,162	48	241
	% change	-4.0	27.7	56.4	23.1	338.2

Source: Australian Bureau of Statistics, Census of Population and Housing 2006 and 2016.

5.3 Use of the National Training System

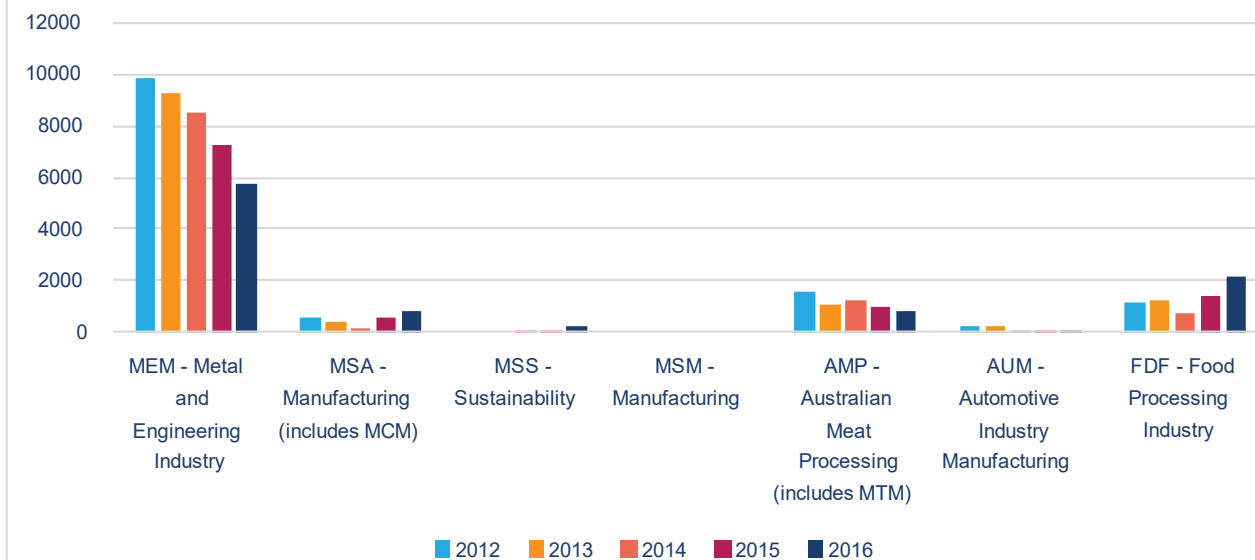
Within the VET system, the pattern of enrolments in publicly-funded training in manufacturing qualifications has seen a downward trend across most of the major Training Packages relevant to the manufacturing industry.



Source: NCVER, National VET Provider Collection, VET program enrolments 2003–2016.

Enrolments in Certificate III qualifications (which are the qualifications most used for apprenticeships and traineeships) decreased across all Training Packages except the Food Processing Industry Training Package and the Sustainability Training Package. Enrolments in the Food Processing Industry Training Package grew by more than 50 per cent which may be reflective of the growth of the food processing sector in Queensland. However, as the largest employing sector, engagement by food processing employers with the nationally accredited training package is comparatively low.

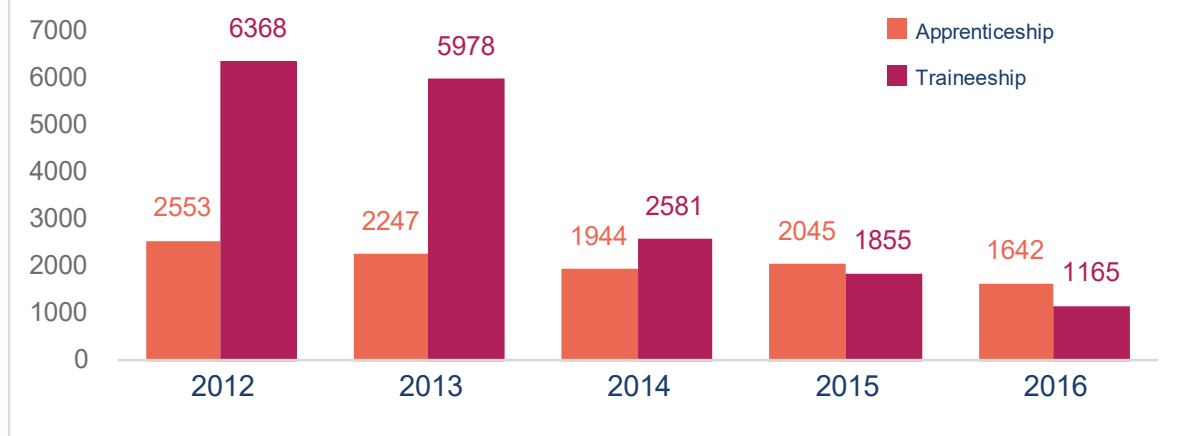
Manufacturing in Queensland Enrolments at Certificate III by Training Package 2012-16



Source: NCVET, National VET Provider Collection, VET program enrolments 2003–2016.

Over the five years to the end of 2016, apprenticeship and traineeship commencements for manufacturing fell by almost 70 per cent. However, much of this fall was driven by a fall in traineeships which fell by 82 per cent. This fall in traineeship numbers coincides with the removal of employer incentives for existing worker traineeships in 2012.⁷⁵

Apprenticeships and traineeships commencements, manufacturing, Queensland, five years to 2016



Source: Department of Education and Training 2016, Direct Entry-Level Training Administration (DELTA) database, Queensland.

The industry needs access to data around apprenticeships and traineeships that is up-to-date and robust. The accuracy of the available completion rate data was identified by stakeholders as an area of concern. The introduction of the Unique Student Identifier (USI) has been identified as potentially improving the quality of data available.

75. Mitchell Institute, 2017, *Finding the Truth in the Apprenticeships Debate*, http://www.mitchellinstitute.org.au/wp-content/uploads/2017/08/Finding-the-truth-in-the-apprenticeships-debate_Final.pdf.

5.4 The importance of the vocational training system

Despite the shifting educational profile of the manufacturing workforce, the importance of the VET system to Queensland manufacturers continues to be significant.

Respondents to the surveys and stakeholders participating in the industry workshops stressed the importance of the VET system (apprenticeships and traineeships in particular) in providing the foundational skills and knowledge needed to work in the industry. Workshop participants further noted that most manufacturing business leaders, managers and owners had come through the trade pathway.

Demand for trade and technical skills will continue

While new skills are needed to advance manufacturing, industry stakeholders strongly emphasised the continued demand for traditional trade and technical skills — these core capabilities are and will still be needed and in demand in the manufacturing industry of the future, for example:

- Without an understanding of the physical world and how materials can be shaped, moulded, cut, welded, transformed and fabricated, computer numerical control (CNC) machine operators will not understand the requirements to program a job on CNC equipment or robotics.
- Product designers need to understand the physical world of manufacturing to efficiently design products for manufacture and assembly (DFMA).

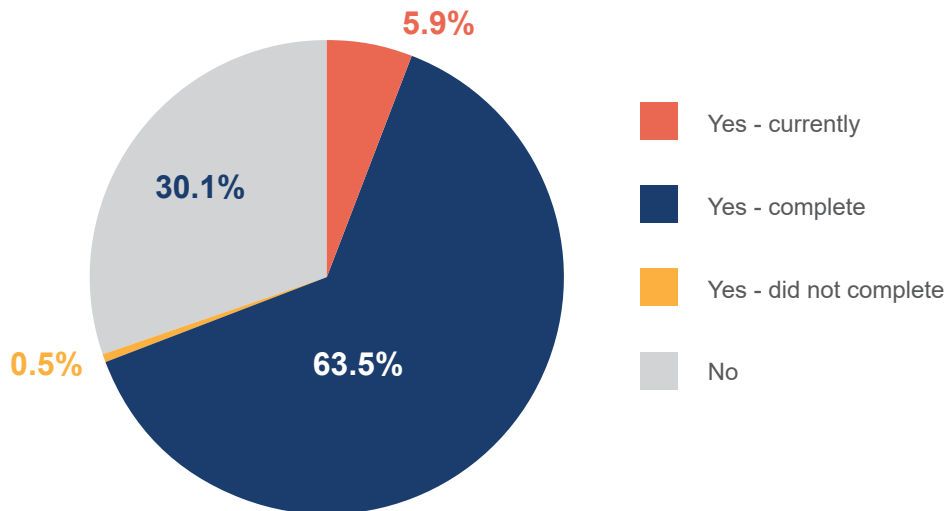
Stakeholders overwhelmingly agree that the VET system will continue to provide the 'backbone' of skills development for the manufacturing industry. In many cases, higher level and more technical skills are required as an addition to, as opposed to in place of, traditional trade training.

In decades past, a trade qualification was considered the end point of the training required for a career in the manufacturing industry. A trade qualification remains the entry point (or entry pathway) for many roles within the industry, but is often considered as merely the beginning of the skills development journey for manufacturing employees as they continually update and further their skills in response to technology advancements and to enable specialisation.

Feedback from employers was that employees who hold both a trade qualification and a relevant tertiary qualification are in very high demand within the industry as they bring a unique and valuable combination of practical, technical and theoretical knowledge and skills.

More than 80 per cent of respondents to the employee survey had undertaken a Certificate III or trade qualification. Seventy per cent of employees surveyed had undertaken apprenticeship or traineeship training. These results highlight the importance of industry training for employees working in advanced (or advancing) manufacturing workplaces.

Are or have undertaken an apprenticeship or traineeship



Source: Jobs Queensland Advancing Manufacturing Employee Survey 2017.

Employee views about the value of their apprenticeship or traineeship training were positive. Sixty-two per cent felt that this training had prepared them well or extremely well for their current role. The remainder reported that the preparation was average (16 per cent) or did not prepare them well (12 per cent).

One recurring theme was the difficulty experienced by many small employers in providing apprenticeship and traineeship opportunities. Increasing specialisation by SMEs and the outsourcing by large employers of some functions is resulting in increasing difficulty for some employers to meet all of the requirements associated with employing an apprentice or trainee.

Effective screening to ensure that businesses can provide the range of experience and skills training required for the occupation is important. Industry also needs support to better engage with the apprenticeship system, including collaborating with other manufacturers to provide opportunities for apprentices to gain the full range of skills. Group Training Organisations can play a role in this area.

Trade and technical skill development in the future

Traditional trade training in manufacturing continues to be relevant. However, change is needed to accommodate the new and higher demand skills industry needs to respond to Industry 4.0 and transition to advanced manufacturing. VET and university programs need to blend the skills needed in the physical and virtual manufacturing worlds. Some stakeholders advocated for the development of new professional pathways into the industry (e.g. at Bachelor level), specifically focused on manufacturing business needs to respond to the increasing 'professionalisation' of the industry.

The apprenticeship training model has stood the test of time. However, it is important to ensure that it can provide the levels of flexibility needed for combined trades and multi-skilling using existing trade qualifications. Current training packages for apprenticeships and traineeships may need to be updated to include digital and new technology skills, and blend the skills needed in the physical and virtual manufacturing worlds. Work is already underway at national level to identify and codify these skills to update national training products.⁷⁶

76. Australian Industry and Skills Committee, 2017, *Cross sector projects*, <https://www.aisc.net.au/content/cross-sector-projects>.

There may also be scope to provide work-based training pathways that blend training and tertiary studies and provide practical pathways to professional careers within the industry. In some cases, new qualifications and changes to existing qualifications may be required to meet this need. There are also a range of existing flexibilities and opportunities for training content customisation available within training packages that it is important for the industry to engage with and understand. If change is to occur to qualifications and training packages, this must be driven by industry and take place within the existing formal mechanisms.

Today's manufacturing trade careers require people who are both 'academically minded' and enjoy working on practical projects. As manufacturing advances and jobs are transformed as part of the digitisation of the industry, mathematics, digital literacy, coding skills, STEM skills and STEM thinking are increasingly important. The increasing complexity of modern manufacturing requires higher levels of academic aptitude compared with what may have been required for many roles in the industry in the past.

The Siemens Industry 4.0 apprenticeship is an example of a new training model designed to meet the needs of the modern manufacturing industry.

Siemens, in a collaboration with Swinburne University, the Australian Government and Australian Industry Group, has developed and is piloting the **Industry 4.0 Higher Apprenticeship program**. The program is the first of its kind in Australia to develop the workplace skills anticipated for Industry 4.0 — the fourth industrial revolution which involves using cyber physical systems and the digitisation of manufacturing processes into digital ecosystems and value chains.

The program is supported by Siemens's global leadership in responding to Industry 4.0's transformational change in manufacturing.

Providing places for school leavers and career changers, the two-year program results in an Associate Degree of Applied Technologies, with an embedded higher education Diploma. A vocational education training package has also been developed in conjunction with the program.

The pilot program of 20 students has combined applied learning and industry placements to create the skill sets and capabilities needed in an advanced manufacturing environment. Reaction to the program from students and employers has been extremely positive — it is delivering the future skills expected to enable the transition to Industry 4.0 for advanced manufacturers in Australia.

Siemens in Australia is also providing hi-tech Siemens PLM industrial software grants to select universities across Australia. The grants are designed to engage students and university researchers to participate in the transition to Industry 4.0. PLM software tools are used in everything from Ben Ainslie Racing in the America's Cup, Firewire surfboard design, Red Bull Racing F1 and even the Mars Rover.

Challenges to the take-up of VET training

Despite the strong level of support for apprenticeships and traineeships as the 'backbone' of the industry, there are a number of barriers to the take-up of VET within the industry.

Manufacturers are looking for the education and training sector to respond to their needs as customers in much the same way that they (manufacturers) are responding to the needs of their customers — through innovation and customisation. The slow pace at which the education and training sector (and VET in particular) is responding to the changing skill needs of manufacturing was commonly raised during the industry workshops as a source of considerable frustration for both employers and employees. Consequently, the industry is often looking outside of the national training system for solutions to its training needs.

Industry participants at Jobs Queensland workshops expressed dissatisfaction with current training packages. Overwhelmingly, participants stated that there was a disconnect between the technology and processes being used in the industry and the skills and knowledge encompassed in the training packages. This was commonly cited as a primary factor leading the industry to look outside of the national training system to meet their training needs.

Many manufacturers consulted believe that the training system currently only caters for those manufacturers who are still undertaking traditional broad-based manufacturing. Their perception is that much of the training within VET lags behind the needs of those manufacturers that are at the forefront of change within the industry.

Industry stakeholders also expressed dissatisfaction with the delivery of training, especially in trade areas. Some advanced manufacturing stakeholders perceive the lack of access to state-of-the-art technology within some training organisations as a barrier to developing a highly skilled technical workforce. This is coupled with a need for trainers to update and maintain their skills and knowledge around the modern technology and processes used in manufacturing.

There is an important role for the industry itself to play in working with training providers to ensure high-quality outcomes and driving change that is required to the training system through established mechanisms.

A common theme that emerged strongly during the consultation undertaken for this project is the need for a focus on high levels of skill acquisition in order for the industry to be globally competitive. While competency is the foundation upon which proficiency is developed, industry stakeholders consider that the training and assessment focus within VET should change from base level competency to a greater focus on proficiency to meet the industry's need for highly skilled workers. This message is consistent with recent commentary on this issue from the Productivity Commission.⁷⁷

Priority Action Area 6

Strengthen the role of apprenticeships and traineeships, and the VET system more broadly, as providing the foundation of skills development to support the advancement of the manufacturing industry.

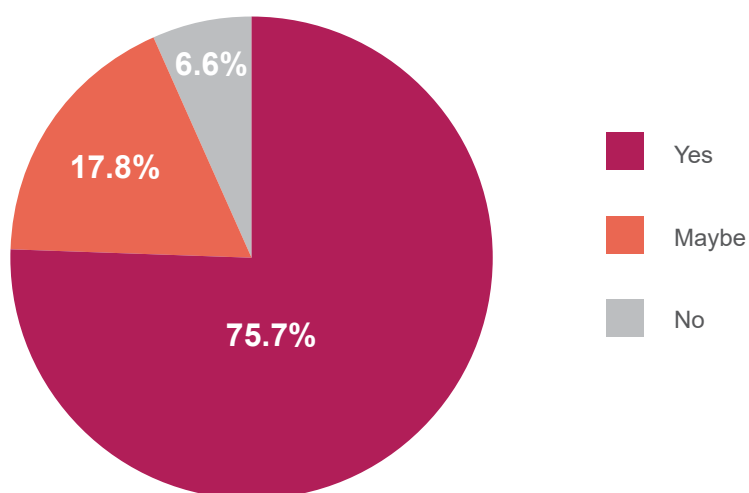
77. Productivity Commission, 2017, *Shifting the Dial: 5 year productivity review, Chapter 3: Future skills and work*, <https://www.pc.gov.au/inquiries/completed/productivity-review/report/3-future-skills-work>.

5.5 Building a highly-skilled manufacturing workforce

The manufacturing workforce needs to continually build and grow their skill set to meet the ever-changing needs of, and opportunities within, the industry. This requires workers who are resilient, adaptable and flexible. The willingness and ability to continuously learn, update existing skills and knowledge, and acquire new skills and knowledge is a key individual capability that was identified by participants in Jobs Queensland industry workshops.

Employees surveyed by Jobs Queensland are in favour of adding new skills to their existing manufacturing skills. Three quarters of employees surveyed (76 per cent) would be prepared to undertake further education and training to gain the required future skills and knowledge.⁷⁸

Would be prepared to undertake further education and training to gain the required future skills and knowledge



Source: Jobs Queensland Advancing Manufacturing Employee Survey 2017.
Due to rounding, figures may not add up to 100 per cent.

A supportive environment in which employees can build these new skills is important. Manufacturers, their employees, unions and where relevant other organisations such as training providers all play a part in creating this environment. This includes through:

- educating the workforce about Industry 4.0 and the positive opportunities from the transition to advanced manufacturing
- addressing the fear of the unknown and the concern that employees may have about job security
- providing clear information on the skills development initiatives that employers will implement and/or access to support upskilling and reskilling of the workforce
- employers and employees partnering on the journey — including through consultation, cooperation, communication and change management.

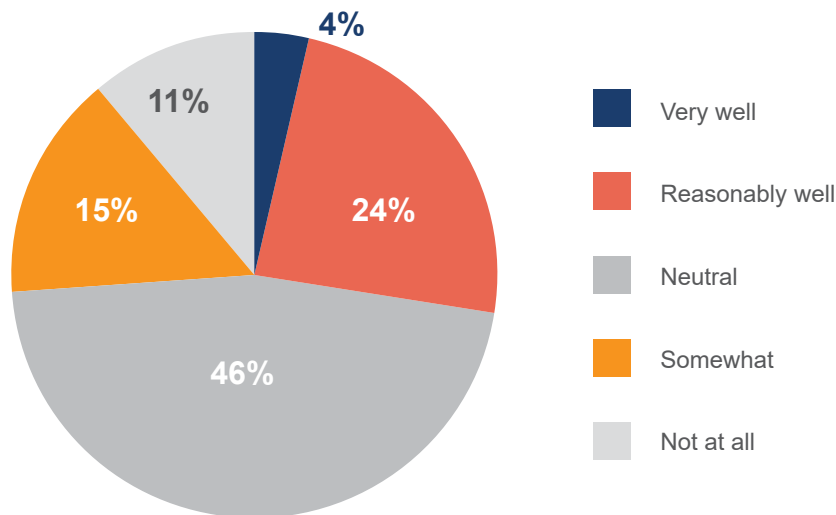
Flexibility and adaptability will be essential as the skills required within manufacturing firms constantly evolve. The ability of employees to respond quickly to these changes and develop any additional skills and capabilities that may be required will be a key source of competitive advantage for firms.⁷⁹ There is already a trend towards multi-skilling within the industry and the feedback from industry received through this project indicates that this trend is likely to continue.

78. Jobs Queensland, *Advancing Manufacturing Employee Survey*, 2017.

79. Office for Learning and Teaching, 2016, *Reskilling the manufacturing workforce and developing capabilities for the future*, <http://www.olt.gov.au/project-reskilling-manufacturing-workforce-and-developing-capabilities-future-2014>.

Less than three in 10 employers (28 per cent) surveyed felt that current training systems accommodated the transitional skills requirements needed very well or well.

How well have current training systems accommodated the transition skills for business/workforce?

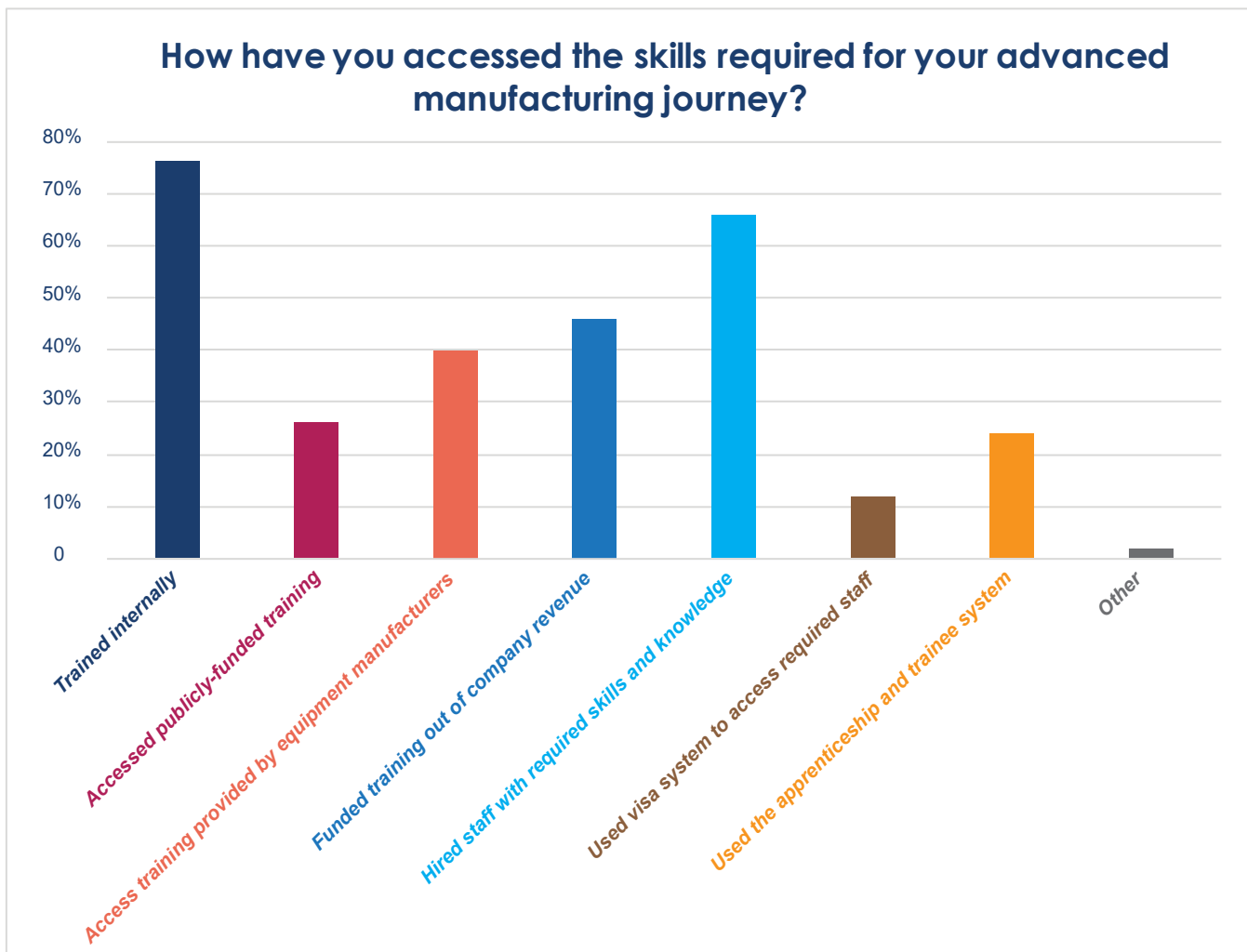


Source: Jobs Queensland Advancing Manufacturing Employer Survey 2017.

Stakeholders consulted consider that the education and training system, with its focus on qualification attainment, is limiting the opportunity for multi-skilling and restricting the development of a flexible and adaptable workforce that is able to respond to a rapidly changing working environment.

In many cases, if the person being trained already holds a full qualification, a further full qualification may not be required to provide the skills and capability for a specific business need. Increased access to and funding for more modularised training (including skill sets) that supports the needs of the business and the employee is needed.

To meet current skill needs employers are using a range of training options. More than three quarters of those surveyed train internally, often using non-accredited training offerings. This was supported by respondents to the employee survey with more than 90 per cent reporting that some form of training was provided in their workplaces. Toolbox sessions (63 per cent) and on-the-job training (57 per cent) were the most frequently used modes.



Source: Jobs Queensland Advancing Manufacturing Employer Survey 2017.

The industry is calling for the development of bespoke and customised specialist programs that can be delivered where and when they are required. These offerings may be available ‘off the shelf’ or may also blend industry experience, hands on skills and higher-level education. On-the-job training is the preferred training delivery method for many manufacturers as it reduces lost productivity caused by employees being away from the workplace.

In a rapidly changing industry environment, new skills that are developed need to be transferable to allow the employee to move easily between roles and employers. There is evidence to suggest that employers are more likely to be able to recognise the transferable skills of workers if they have participated in nationally accredited training.⁸⁰ It should, however, be noted that there are numerous forms of training that, while not nationally accredited, are highly recognised and valued (and therefore transferrable) within the industry.

Government has an important role to play in facilitating the training of a highly skilled workforce that is a key driver of competitiveness for the manufacturing industry in Queensland. Government investment should naturally be targeted at those forms of training that provide the greatest public benefit.

80. Wibrow, B and Circelli, M, 2016, *When one door closes: VET's role in helping displaced workers find jobs*, NCVER, Adelaide, https://www.ncver.edu.au/__data/assets/file/0035/55889/whenonedoorcloses-2861.pdf.

Consideration should be given to ways in which funding structures for training and skills development can provide further public benefit through supporting the advancement of the manufacturing industry, including through:

- supporting skills development in emerging or highly niche technologies that will provide the industry with a global competitive edge
- supporting forms of training that, while not nationally accredited, are highly reputable, valued and transferrable within the industry
- further exploring potential mechanisms to increase the recognition, portability and transferability of skills within the industry, including skills gained through mechanisms other than nationally-recognised training.

Priority Action Area 7

Drive the advancement of the industry in Queensland through enabling the existing manufacturing workforce to develop high levels of skills, adaptability and capability by:

- building the new skills profile across the industry needed to advance manufacturing
- fostering a supportive culture of continuous skill development throughout the industry
- facilitating the training of a highly skilled workforce that is a key driver of competitiveness.



Staff member at B&R Enclosures, Heathwood. Photo: Welcome to the Fold.

6. A strong manufacturing workforce for the future

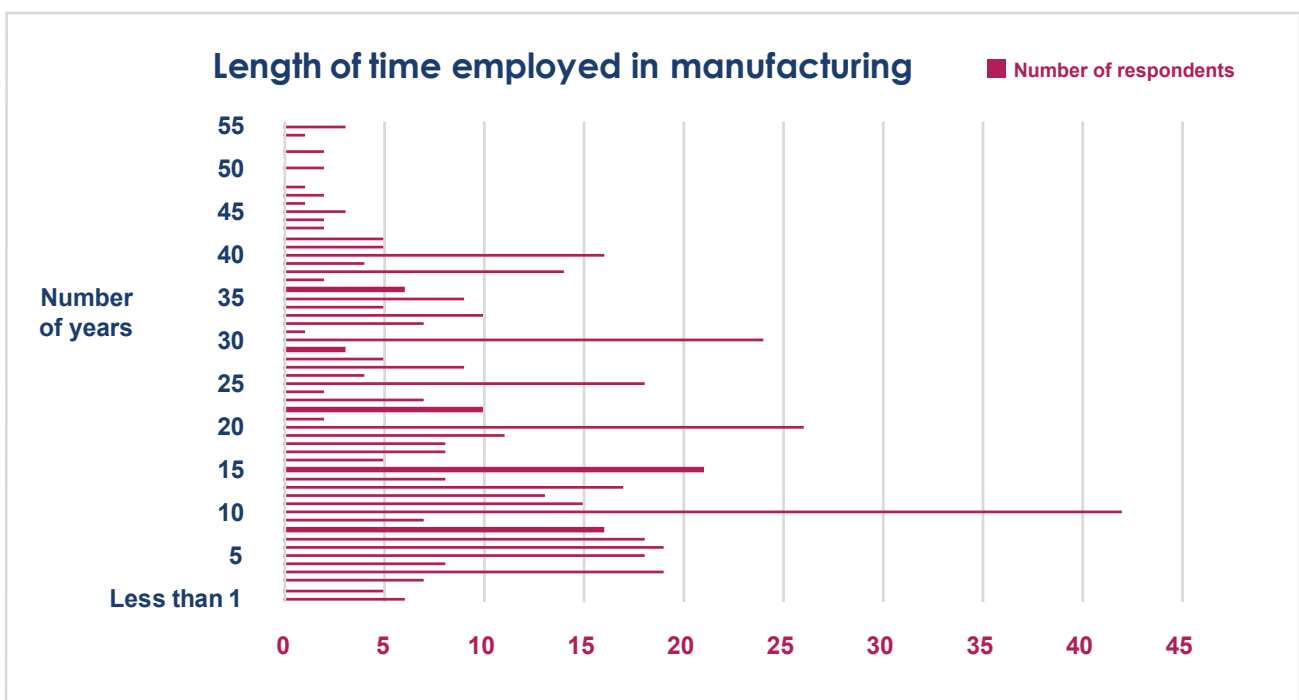
The employment outlook for the manufacturing industry in Queensland is strong. While the Australian Government Department of Employment projects a decline of 1.9 per cent in Queensland manufacturing jobs from 2017 to 2022, the Queensland Statistician forecasts a rise in industry employment from 204,230 in 2020–21 to 311,839 in 2040–41 (a 53 per cent increase in employment over 20 years).⁸¹

Upskilling of the existing workforce alone will not provide the industry with the workforce it requires for future growth and to meet replacement demand from an ageing workforce. There is a need to consider and implement a range of strategies to provide the industry with the future supply of skills and labour needed to be globally competitive.

6.1 Embracing diversity

The manufacturing industry in Queensland needs to increase the diversity of its workforce to best position itself for the future. Research shows that increasing diversity in workplaces improves company profits and increases innovation and productivity.^{82, 83, 84}

As noted in section 4.3, the manufacturing workforce in Queensland is ageing. The Jobs Queensland survey of manufacturing employees showed that the majority of respondents had been employed in the industry for a significant period, many for more than 20 years.



Source: Jobs Queensland Advancing Manufacturing Employee Survey 2017.

81. Australian Government Department of Employment, *Labour Market Information Portal, 2017 Regional projections to 2022 – interactive tool*; Queensland Government Statistician's Office, *Regional employment projections, 2010–11 to 2040–41*, <http://www.qgso.qld.gov.au/products/tables/reg-employment-proj/index.php>.

82. McKinsey & Company, 2015, *Diversity Matters*, <https://www.mckinsey.com/business-functions/organization/our-insights/why-diversity-matters>.

83. Hays, *The Balancing Act Creating a Diverse Workforce*, https://www.hays.com.au/cs/groups/hays_common/@au/@content/documents/digitalasset/hays_154080.pdf.

84. Deloitte Access Economics, 2017, *Westpac Diversity Dividend Report*, <https://www2.deloitte.com/au/en/pages/economics/articles/diversity-dividend-westpac.html>.

The length of experience of those employees surveyed presents a significant strength for the industry. However, the profile of an older, male workforce also creates risk for the industry in that there is loss of skills and knowledge as older workers retire and increased risk of business closures due to a lack of effective succession planning. The impact of this is more significant in regional areas where manufacturing enterprises are often deeply integrated into the local supply chain.⁸⁵ Without a robust supply of younger people and more people from diverse backgrounds entering the industry, there is limited capacity for workforce renewal and candidates for business succession.

It also presents the industry with the challenge of how best to engage with and utilise the skills and knowledge that these workers have. One of the strategies commonly identified during industry workshops was the use of older workers, who are considered 'oracles', as mentors for younger and less experienced employees in the industry, including apprentices and trainees. Mentoring for new entrants has been shown to assist in maximising retention rates in training and employment.⁸⁶ Providing opportunities for mentoring programs in Queensland manufacturing businesses is a strategy that will assist in developing strong partnerships internally.

Part of creating a flexible workforce is the need for employers to be open to recruiting employees with skills and experience outside of the 'traditional' manufacturing skills set. There are now a wide variety of roles in the industry for which the skills and experience required can be transferrable from other sectors. This includes areas such as market engagement, service, design and delivery, logistics and customer support.

Failure to attract women into what are often considered 'non-traditional' roles, such as trade and technical roles, means that the industry is not fully capitalising on a talent pool that accounts for nearly 50 per cent of the labour force. Industry stakeholders reported that the transition to advanced manufacturing and increasing adoption of automation and robotics is beginning to result in increased numbers of women entering the sector. For example, stakeholders in central Queensland reported that women are entering operator roles in resource processing companies in increasing numbers.

People with disability are also a valuable source of talent for the manufacturing industry. The increased use of automation and robotics is raising safety standards throughout the industry and opening up increased opportunities for people with disability. These are committed workers who are suited to a wide range of tasks across the manufacturing value chain. These workers can and do make a valued contribution to the manufacturing industry in Queensland.

The workforce profile within manufacturing firms should seek to capitalise on the diverse experiences and backgrounds of people within the community in which they are located. The proportion of Queenslanders who have both parents born overseas has increased by almost five per cent to 26 per cent since 2006. At the same time, the proportion of Aboriginal and Torres Strait Islander Queenslanders has increased.⁸⁷ Fully capitalising on this diversity will assist to successfully advance manufacturing.

Priority Action Area 8

Increase the diversity of the manufacturing workforce to best harness the available skills and talent in the labour market and build a more resilient workforce.

85. Queensland Productivity Commission, 2017, *Draft Report Manufacturing in Queensland*, https://qpc.blob.core.windows.net/wordpress/2017/07/17_4232-QPC-Manufacturing-Report_21.pdf.

86. Buchanan, J, Raffaele, C, Glozier, N and Kanagaratnam, A, 2016, *Beyond mentoring: social support structures for young Australian apprentices*, NCVET, Adelaide.

87. Queensland Government Statistician's Office, *A changing Queensland, Census 2016 Snapshot*, <http://www.qgso.qld.gov.au/products/reports/changing-qld-c16/changing-qld-c16.pdf>.

Help Industries, a social enterprise providing employment for people with disability and disadvantaged groups, gives workers a grounding in manufacturing processes from warehousing and goods receipt, production processes through to dispatch and customer support.

People with disability have the opportunity to participate and are included in the broader workforce, receiving mentoring and support.

Introducing Lean principles has broken down work processes to task level (basic through to more complex) to give workers with disability the types of work they prefer.

Increased investment in automation, sometimes seen as taking away jobs, has increased the amount of people with disability who work in the business.

Through a supported working environment, the task of feeding and unloading of machines offers people with disability a unique opportunity to be employed in a manufacturing setting.

This approach has significantly improved capacity, productivity, quality, access to a broader talent pool and worker satisfaction, and has reduced workforce turnover.



Photo courtesy of Help Industries.

6.2 Attracting new entrants to the industry

The manufacturing industry offers careers of the future that are secure, diverse and technology-rich. Career paths in manufacturing are varied and offer flexibility for workers in the industry, and opportunities for new entrants to join the industry at different job levels and through different pathways.

A wide range of other sectors are all competing for new entrants and the industry needs a 'strong offer' in the market. Positioning manufacturing as a first choice career option is a priority for ensuring a strong manufacturing workforce.

Competition for new entrants

Queensland manufacturing needs to be more competitive in attracting young people (from school, VET and university) to the industry. The industry needs to update community understanding of the contemporary manufacturing industry and the opportunities it offers through its emphasis on digital and new technology roles. Strategies proposed by industry stakeholders during consultations included:

- Targeted programs focusing on technology to create positive impressions of manufacturing careers.
- Greater industry engagement in marketing the careers that manufacturing can offer.
- Direct engagement programs to inform universities, schools, career advisers, parents and students about the range of diverse, quality career paths in the industry.

The reputation of manufacturing among some as a dirty, dangerous and dying industry can place the industry low on the career choices of people entering the workforce or looking for a new career. Some of these commonly held myths are 'debunked' in Section 6.4 on page 66.

Changing work and career expectations

As well as the transition occurring within manufacturing, employers also need to understand the wider changes in the community that may impact on their future workforce.

The Millennial generation (people born between mid-1980 to mid-2000) is projected to be 50 per cent of the global workforce by 2020. Understanding their views of work, careers and work/life balance is important for the manufacturing industry.⁸⁸

Despite the hype, Millennials are not unique nor should they be considered a homogenous cohort.⁸⁹ Job security and financial stability is important. As employees, they want to be challenged and are willing to work hard. Access to development opportunities including large, highly visible projects and assignments that will allow them to learn and grow will generally assist in attracting and retaining this generation. Flexible work arrangements that empower them to organise their work and personal lives in a way that satisfies all of their priorities is also important in many cases.

88. Catalyst, *Revealing the Real Millennials*, February 2015, <http://www.catalyst.org/knowledge/revealing-real-millennials>.

89. Deloitte, *The Deloitte Millennial Survey 2017*, <https://www2.deloitte.com/global/en/pages/about-deloitte/articles/millennialsurvey.html>.

Attracting experienced and skilled workers

Increasingly, people can expect to have around five careers in their lifetime.⁹⁰ A potential source of skilled workers to support an advancing manufacturing industry are 'career changers'. Strong industry feedback was received during this project that 'second, third or fourth' career people are a valuable source of skills for the manufacturing industry.

The wide range of professions and skills needed in advanced manufacturing is creating new opportunities and new roles. Pathways are needed to support experienced and skilled workers' entry into manufacturing jobs from other industries. This can include people with skills in IT, digital and design, marketing, warehousing and logistics, and business.

Pathways are also needed to attract skilled and experienced individuals made redundant through structural changes in other sectors of the economy e.g. mining, marine, construction and agriculture sectors. This can serve as a valuable source of skilled and experienced employees for the manufacturing industry that should not be overlooked.

More flexible pathways from university, VET and from other industries and professions are needed to facilitate the entry of career changers and other skilled and experienced workers into manufacturing. This includes the provision of flexible mechanisms for formally recognising the skills and experience brought to the industry by these employees. These pathways need to be supported with transition training in traditional manufacturing skills and the new digital, data and analysis skills needed in the Industry 4.0 manufacturing environment.

What can the manufacturing industry offer its workforce?

While there is competition for skills and labour across industries, Queensland manufacturing has a highly competitive offer for its current and future workforce.

Feedback from industry through Jobs Queensland workshops and broader research⁹¹ shows manufacturing jobs can offer a range of important benefits compared with other similar sectors including:

- Manufacturing employees make products that are essential to everyday life and employees can see the outcomes from their work.
- There are constantly evolving opportunities for work, creating opportunities for upskilling and career progression.
- Manufacturing jobs are less subject to boom/bust cycles compared other industries, creating stable employment.
- Work that offers more opportunities and greater likelihood of remaining in the same region.
- Security of tenure, particularly if skills are transferable across different manufacturing sectors.
- Technological changes in the industry are creating increasingly high safety standards.
- Manufacturing is a highly diverse sector — electronics, aerospace, automotive, pharmaceuticals, chemicals, medical, construction, robotics and civil engineering, food and drink, and energy etc. — creating almost endless opportunities.
- There are varied roles available in manufacturing — R&D, logistics, design, engineering, operations, customer engagement and support.
- Manufacturing embraces a culture of continuous improvement — there are always new challenges and new problems to solve.
- Manufacturing is on the cutting edge of technology — Internet of Things, drones, 3D printing and new technologies are constantly emerging.

90. Foundation for Young Australians, 2015, *The New Work Order*, <https://www.fya.org.au/report/new-work-order/>.

91. Stanford, J and Swann, T, 2017, *Manufacturing: A Moment of Opportunity*, The Australian Institute, http://www.futurework.org.au/manufacturing_a_moment_of_opportunity.

Priority Action Area 9

Position manufacturing as a first-choice career for new entrants and experienced and skilled workers that offers a diverse range of technical, business and professional careers which are technology-rich and stable.

PepsiCo manufactures leading global brands in the snack food and beverage market. PepsiCo's Brisbane site is its largest in Australia and is one where significant investment in technology has helped to improve productivity, contain costs to compete on global cost structures and create innovative approaches.

While technology is important, human capital is just as vital to the business. PepsiCo partners with Corinda State High School through the Gateway Schools Program to provide work experience to students and training on site for teachers — an important strategy in getting the message to the community about quality career opportunities in high technology manufacturing workplaces, and creating a pipeline of new entrants for manufacturing jobs.

PepsiCo also helps students understand the real-world value of science, technology, engineering and maths (STEM) skills by providing manufacturing and resource management content for classroom problem solving.



Photo courtesy of PepsiCo.

Debunking some myths

Manufacturing is a dying industry

Media coverage about the demise of car manufacturing in Australia and the outsourcing of manufacturing to lower labour cost countries has given the impression to many that manufacturing is a dying industry.

However, manufacturers who are responding to market changes and opportunities are creating new products and services, new employment opportunities and making a dynamic contribution to the economy.

In Queensland, the diversity of manufacturing and competing in a globalised market has led to greater stability for the industry, creating increased opportunities for an industry already attuned to competing in a global marketplace.

Manufacturing jobs are dirty, low tech jobs

Manufacturing is one of the industries that is creating new opportunities for young people and existing staff to use higher level thinking, problem-solving and flexible approaches in their daily work.

While undoubtedly there can be challenging conditions in manufacturing environments, the manufacturing industry is one of the largest investors in new technology in the economy. Employees have an opportunity to participate in the innovation and transformation that this technology brings as part of the shift from broad-based to advanced manufacturing.

Greater communication of success stories and showcasing the industry's value and opportunities will be important in countering these views.

'Robots will take my job'

There is little doubt that automation and robotics will inevitably take over many repetitive and lower value tasks in manufacturing. As a result, jobs will be transformed and need higher level skills, providing new opportunities for employees.⁹³

For some workers in the industry, these changes can seem challenging — particularly for those that did not grow up with computers and tablets as everyday tools. Support for upskilling of existing workers and reshaping traditional roles and jobs is needed. For young people the manufacturing industry offers an opportunity to link the digital worlds of gaming and advanced digital and graphics software and programs with the physical transformation inherent in manufacturing.

Technology will create opportunities, improve productivity, improve growth and create new technology-focused jobs in manufacturing.

You don't need good maths or grades to work in manufacturing

This view is not true of the modern manufacturing environment. The ability to bring 'STEM thinking' to the workplace is vital — being able to analyse information, understand the implications, problem-solve and plan for change and flexibility are vital skills in manufacturing. Many entry level manufacturing roles require skills and academic aptitude equal to that required for university entry.

93. McKinsey Global Institute, 2017, *A Future that Works: Automation, Employment and Productivity*, <https://www.mckinsey.com/mgi/overview/2017-in-review/automation-and-the-future-of-work/a-future-that-works-automation-employment-and-productivity>

6.3 Strong and effective partnerships

Effective preparation of new entrants was a recurring theme during industry consultation.⁹² Providing school leaders, teachers, career advisers and parents with opportunities to understand the quality and technology-rich careers available in manufacturing will assist in building these pathways.

Manufacturers at industry workshops reported that the pool of potential new entrants was also limited by the challenge of finding school leavers with the understanding, attitude, preparation and aptitude to effectively join the manufacturing workforce.

While embedding the concepts and skills needed for Industry 4.0 into manufacturing education and training programs across the education sector will assist in creating a manufacturing workforce for the future, the industry itself needs to play a greater role in preparing graduates for work in manufacturing. Working with schools, training providers and universities to provide advice on the right mix of soft skills required in the industry can support the successful transitions for new entrants.

The development of hard or technical skills needs to be with industry guidance and involve structured industry placements, work experience or cadetships. Engagement through schools with innovation hubs and competitions can create an interest by students in STEM skills because they emphasise the digital and new technology tools needed in the transition to advanced manufacturing.

School teachers, careers advisers, VET trainers and university teaching staff need opportunities to update their knowledge of industry technologies, work practices and careers. Strong industry partnerships between the manufacturing industry and the education and training sector can assist. Industry virtual and physical site tours, immersion experiences, 'train the trainer' programs and capability development in advanced manufacturing skills, new technologies, current industry work practices and industry careers can raise the profile of the industry; increase awareness of what advanced manufacturing has to offer for new entrants; and prepare new entrants for the industry.

Industry engagement programs, such as that developed by PepsiCo and the Dalby Trade Training Centre, play a vital role and need to be expanded and supported by all stakeholders.

Dalby Trade Training Centre networks with 23 employers in Dalby to provide school students with a sound understanding of the modern manufacturing workplace and the soft skills they need to successfully transition from school into manufacturing jobs. Students spend about 30 days in industry per year.

Although the Trade Training Centre provides training on basic manual skills and exposes students to new technologies (e.g. 3D printing), industry places highest value on the work preparation and work readiness training that the Trade Training Centre delivers.

In a small regional community, the Centre, its feeder schools and local employers are working closely to achieve high quality workplace preparation and successful job outcomes for young people entering manufacturing and trade careers.

92. Jobs Queensland, *Summary of Main Themes from the 12 Jobs Queensland Workshops*.

The Gateway to Industry Schools Program (GISP) and school-based apprenticeships and traineeships (SATs) are very well regarded in the manufacturing industry in Queensland.

Currently, 44 Queensland secondary schools participate in the Manufacturing and Engineering GISP. These schools engage collaboratively with local manufacturing and engineering enterprises, training providers and universities to raise the profile of careers in manufacturing and engineering.

They also provide professional development for teachers in the context of manufacturing and engineering; support the development and implementation of a range of manufacturing and engineering-related activities across industrial technology and design, science, mathematics and English; and other key learning curriculum areas.

For students, participation in the GISP creates opportunities for work experience, structured work placements, take-up of SATs, full-time apprenticeships and provide pathways to university in preparation for trade, paraprofessional and professional careers.

There are opportunities for industry to work collaboratively with universities to inform and boost the number of high-level technical workers entering manufacturing via university pathways. A focus on engineering rather than manufacturing (encompassing design, leadership and management) at university level is seen by some as a barrier to attracting new graduates.

An increased focus on cadetship opportunities within industry can also provide experience and exposure for students and graduates, and prepare them for successful careers in the industry.

Priority Action Area 10

Facilitate enhanced partnerships and engagement between the manufacturing industry and schools, VET providers and universities to better prepare new entrants for successful careers in the industry.

The Manufacturing and Engineering Gateway to Industry Schools Program

is a partnership between industry and schools to raise the profile of careers in manufacturing and engineering and covers:

- Professional development for teachers in industry including STEM connections.
- Manufacturing and engineering-related activities including industrial technology and design, STEM and advanced manufacturing.
- Structured Learning Workplace Programs including meaningful work experience.
- Pathways into school-based apprenticeships and traineeships, and employment.
- Development of 'best practice' industry-endorsed models of delivery and resources.

These Gateway collaborative regional hubs and successful Gateway Day events are helping to reposition manufacturing careers as technology-rich and diverse, and update young people's and parents' understanding of advanced manufacturing workplaces.

Recent Gateway Days supported by industry champions provided immersion experiences to:

- Showcase engineering in real world applications and learning how Science, Technology, Engineering, Arts/Design and Mathematics (STEAM) applies in real world manufacturing settings.
- Gateway Day in industry with teachers, government and trainers visiting leading businesses like Watkins Steel, Euclidean and Ferra Engineering who are transitioning to advanced manufacturing, and the opportunities it brings.
- Experience how Food Processing and STEM applies in real world settings during a 'behind the scenes' tour of the Homestyle Bakeries' Toowoomba baking facility.



Marc Cleave, from industry partner Bustech, shows Kelvin Grove State College students the connections between their studies and the industry as part of the Gateway to Industry Hub for Engineering. Photo courtesy of QMI Solutions.

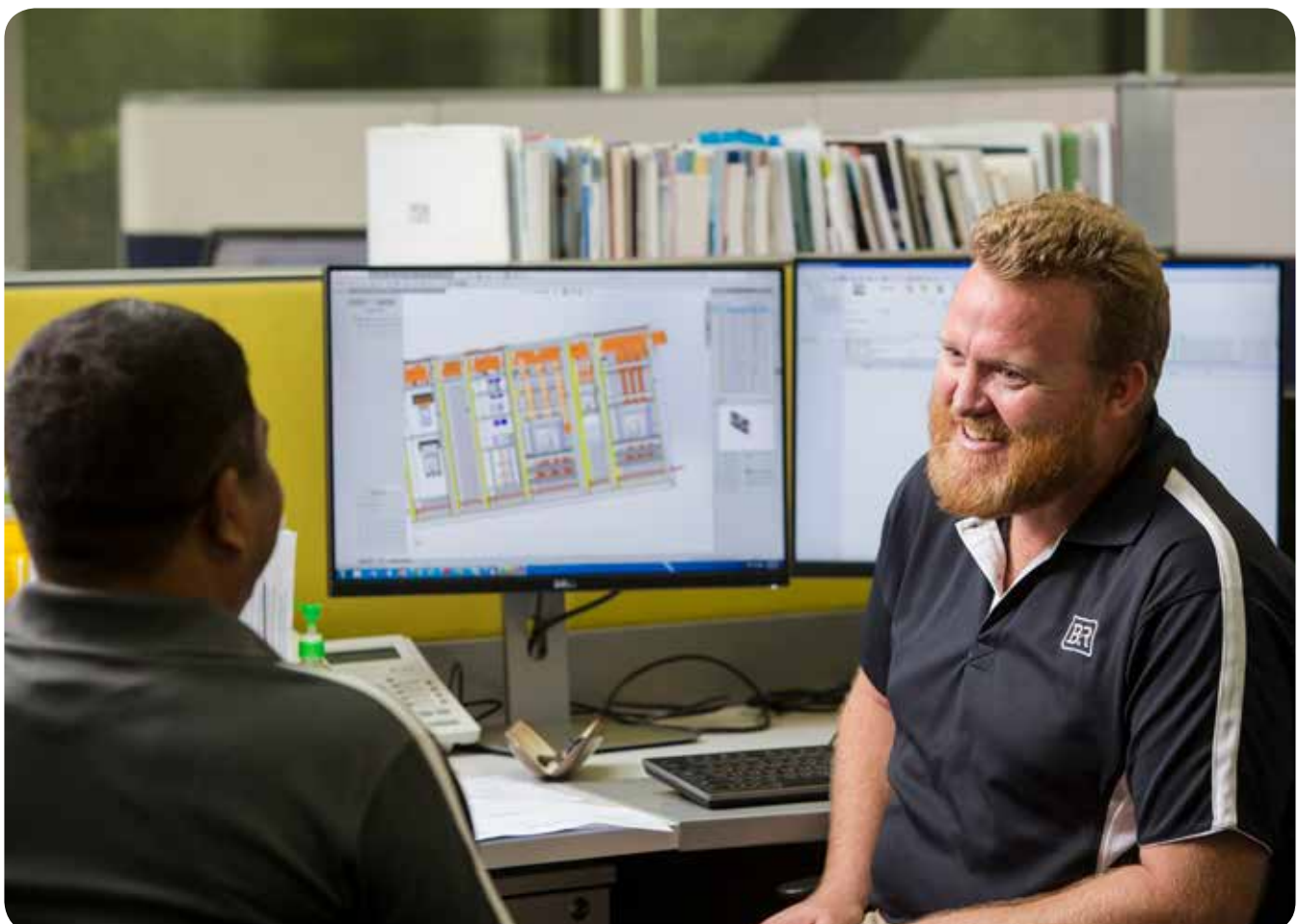


7. Action Plan

The Priority Action Areas outlined below are not specifically targeted at one key stakeholder within the manufacturing system in isolation. No single stakeholder can solely drive the changes required to advance manufacturing in Queensland. Action must be based on partnerships and a shared sense of purpose and priority amongst stakeholders.

Priority Action Area	Actions	Stakeholders
<p>1. Position the manufacturing workforce as a key partner in the journey towards advanced manufacturing.</p>	<ul style="list-style-type: none"> • Improve communication from employers, industry associations and unions about Industry 4.0, the positive benefits it can provide to workers and the role that workers play in the transition to advanced manufacturing. • Upgrade workplace skills and capabilities (employer and employee) in leadership and change management to support the transition to advanced manufacturing. • Promote mechanisms to enhance consultation between employers and employees in order to identify business changes and skills and training needs as the industry transitions. 	<p>Stakeholders – Employers, industry associations, unions, training providers and employees.</p>
<p>2. Strengthen the capabilities of manufacturing businesses and their leadership teams to successfully transform to advanced manufacturing in areas including:</p> <ul style="list-style-type: none"> • business management and leadership • market engagement including exporting • new product and service development • innovation management • new technology identification and absorption • change management and workforce skills development. 	<ul style="list-style-type: none"> • Increase awareness of manufacturing management and leadership training offerings for owners and leadership teams. • Establish and promote leading university and executive programs that support leader and manager skills development in advanced manufacturing and provide clear, professional pathways into the industry in accordance with local needs. • Work with universities, VET providers and other training institutions to develop short and focused skills development programs to provide a modular training approach where a full qualification may not be suitable or necessary. • Explore funding options available to support the up skilling and capability development of owners, managers and leaders within manufacturing businesses (who may already be highly skilled) and for this training to be undertaken in a manner that is flexible, tailored to the manufacturing industry and incorporates mentoring where relevant. • Provide access to industry-relevant mentoring for manufacturers to support the transition to advanced manufacturing. 	<p>Stakeholders – Employers, industry associations, government, employees, education and training sector and regional networks.</p>

Priority Action Area	Actions	Stakeholders
<p>3. Build the understanding of and capability related to business management, innovation and productivity enhancement at all levels of the manufacturing industry.</p>	<ul style="list-style-type: none"> • Explore opportunities to incorporate principles related to the business environment and advanced manufacturing in school, VET and university programs related to the manufacturing industry. • Facilitate the take-up of training programs in competitive manufacturing principles and processes across the industry, including by those who may already possess prior qualifications. • Through the current formal mechanisms, seek the development of units of competency and resources on enterprise management and innovation skills that can be added to training programs serving the industry. 	<p>Stakeholders – Industry, training providers and universities, government, Skills Service Organisations and employees.</p>



Staff at B&R Enclosures, Heathwood. Photo credit: Welcome to the Fold.

Priority Action Area	Actions	Stakeholders
<p>4. Support an industry led 'ecosystem' that provides:</p> <ul style="list-style-type: none"> networking and information sharing opportunities for 'industry to learn from industry' and support sectoral and regional industry development links with research institutes and specialists, suppliers, training providers and the resources available from industry networks and governments to support industry growth and transformation access to benchmark services opportunities for manufacturers to partner and collaborate to target major contracts and export opportunities opportunities for manufacturers to participate in collaborative approaches to skilling and capability development. 	<ul style="list-style-type: none"> Support and build upon the range of existing industry sector and regional networks and ecosystems to assist manufacturers as they transition to advanced manufacturing. Develop new sector and regional ecosystems that cover businesses, industry associations and networks, unions, suppliers, technical specialists, research institutes, training providers and government. Provide mechanisms for manufacturers to access benchmarking services and to partner and collaborate on major contracts and export opportunities. Provide mechanisms for manufacturers to collaborate in relation to skilling and capability development at both the business and workforce level, particularly where niche training markets or geographic location may present barriers to access training. 	<p>Stakeholders – Businesses, industry associations, regional networks and government.</p>

Priority Action Area	Actions	Stakeholders
<p>5. Foster continued industry opportunity growth that will flow through to increased opportunities for Queenslanders in the manufacturing industry, including through:</p> <ul style="list-style-type: none"> • development of international market links and export market development • capability development for manufacturers. 	<ul style="list-style-type: none"> • Given the global focus on manufacturing now and in the future, explore opportunities to build international links (sector or regional) that support exchanges at business, individual and worker level. • Provide access to international study/ site tours and manager exchanges in countries providing potential markets for Queensland manufacturing. • Provide access to capability development for businesses and their workforce in areas including (but not limited to) exporting, tendering and succession planning. 	<p>Stakeholders – Employers, industry associations, ecosystems and government.</p>
<p>6. Strengthen the role of apprenticeships and traineeships, and the VET system more broadly, as providing the foundation of skills development to support the advancement of the manufacturing industry.</p>	<ul style="list-style-type: none"> • Through existing formal mechanisms, develop new qualifications and adjust existing qualifications to meet Industry 4.0 requirements and provide work-based training pathways to a broad range of professional and technical roles within the industry. • Develop increased multiskilling opportunities and pathways – combining traditional manufacturing skills and Industry 4.0 skills to meet future industry needs. • Explore the feasibility of adopting proficiency and high-performance skill attainment levels in manufacturing training rather than the current competency standard to meet advanced manufacturing requirements. • Support opportunities for direct workplace experience and industry visits for students undertaking training around new and emerging skills to foster a quicker take-up of those skills required for their future. • Undertake further analysis of relevant training mechanisms that consider matters including enrolment numbers, industry employment outcomes and relevance to Industry 4.0. 	<p>Stakeholders – Employers, industry associations, Group Training Organisations, Skills Service Organisations, schools, training providers, universities, unions and government.</p>

Priority Action Area	Actions	Stakeholders
<p>7. Drive the advancement of the industry in Queensland through enabling the existing manufacturing workforce to develop high levels of skills, adaptability and capability by:</p> <ul style="list-style-type: none"> • building the new skills profile across the industry needed to advance manufacturing • fostering a supportive culture of continuous skill development throughout the industry • facilitating the training of a highly skilled workforce that is a key driver of competitiveness. 	<ul style="list-style-type: none"> • Provide greater transparency to industry on the options available for flexibility in accessing existing training to support adaptability and multi-skilling. • Promote access to and explore funding options for upskilling and reskilling avenues to support changing skill requirements within the industry, including through modularised training offerings and skill sets. • Explore opportunities to increase flexibility for skills and qualifications to be achieved outside the traditional VET and university environments and support the acquisition of these non-accredited skills where a clear public benefit exists. • Promote the take-up of nationally-recognised qualifications across the manufacturing workforce as a mechanism to increase the transferability of skills across the industry and minimise the impacts of structural adjustment. • Support the development of the range of foundational skills and 'soft skills' required to support the transition to advanced manufacturing, including adaptability, resilience, digital literacy and STEM. • Further explore opportunities to increase the recognition and transferability of skills and capabilities. 	<p>Stakeholders – Employers, industry associations, training providers and universities, unions and government.</p>
<p>8. Increase the diversity of the manufacturing workforce to best harness the available skills and talent in the labour market and build a more resilient workforce.</p>	<ul style="list-style-type: none"> • Actively promote and support the employment of women in non-traditional roles within the sector, including in management and leadership positions. • Provide information to manufacturers in relation to the benefits of employing people with disability in the industry and the range of existing supports available. • Retain older workers as mentors for new and existing workers (including apprentices and trainees). 	<p>Stakeholders – Employers, industry associations, unions, organisations supporting employment pathways and diversity.</p>

Priority Action Area	Actions	Stakeholders
<p>9. Position manufacturing as a first-choice career for new entrants and experienced and skilled workers that offers a diverse range of technical, business and professional careers which are technology-rich and stable.</p>	<ul style="list-style-type: none"> • Update the views of the community, teachers, careers advisers and students about: <ul style="list-style-type: none"> - the diverse range of careers in manufacturing - digital and technology changes in manufacturing jobs that are creating some of the most interesting, technology-rich careers of the future - the stability of jobs in manufacturing. • Implement a proactive careers marketing campaign profiling industry innovation and technology-rich careers, providing visual promotion of manufacturing and the current and future skills required. • Provide work experience/immersion placements for school, VET and university trainers and teachers to update their knowledge of industry technologies, work practices and careers. • Facilitate direct engagement between industry and universities, schools, careers advisers, parents and students about diverse, quality career paths to raise the profile of the industry and its careers including through high profile events and competitions focused on technology and innovation. • Map and promote the diverse career paths in manufacturing including the various entry points and pathways from new entrant to business owners/managers. • Provide transition pathways, training and placement assistance for skilled workers from other sectors (including those impacted by structural change) seeking work in the manufacturing industry. 	<p>Stakeholders – Employers, industry associations, universities, schools, VET providers, and regional networks, unions and government.</p>

Priority Action Area	Actions	Stakeholders
<p>10. Facilitate enhanced partnerships and engagement between the manufacturing industry and schools, VET providers and universities to better prepare new entrants for successful careers in the industry.</p>	<ul style="list-style-type: none"> • Strengthen and expand Gateway Schools and existing successful university/school/industry programs. • Promote increased collaboration between industry, schools, VET and university sectors to develop and expand programs and initiatives that provide a better understanding of workplace requirements and develop Industry 4.0 skills and essential soft skills within the industry. • Upskill VET teachers to develop their skills and knowledge of new technologies and mindsets in the manufacturing industry. • Provide industry virtual and physical site tours, immersion experiences and training in advanced manufacturing skills, new technologies, current industry work practices and industry careers for school teachers, careers advisers, VET trainers, and university teaching staff. • Implement 'train the trainer' programs with VET trainers to rapidly expand the skills take-up required to 'get ahead of the curve' with where advanced manufacturing is going for their students. 	<p>Stakeholders – Employers, industry associations, education and training sector, regional networks, unions and government.</p>



Staff member at HE Tech, Underwood. Photo credit: Welcome to the Fold.

8. Appendix 1

Summary of consultations and the Advancing Manufacturing Committee membership

The Advancing Manufacturing Committee comprised representatives from:

- Group training organisation (Chair)
- Australian Industry Group (AI Group)
- Chamber of Commerce and Industry Queensland (CCIQ)/Registered Training Organisation
- Australian Manufacturing Workers Union (AMWU)
- IBSA Manufacturing
- Boeing Defence Australia
- Sunny Queen Farms
- B&R Enclosures
- Hyne Timber
- QMI Solutions.

Who we consulted with

Stakeholder consultations by Australian and New Zealand Standard Industrial Classification (ANZSIC)

ANZSIC subdivision

11 Food product manufacturing
12 Beverage and tobacco product manufacturing
13 Textile, clothing, leather and footwear manufacturing
14 Wood product manufacturing
15 Pulp, paper and converted paper product manufacturing
18 Basic chemical and chemical product manufacturing
19 Polymer product and rubber product manufacturing
20 Non-metallic mineral product manufacturing
21 Primary metal and metal product manufacturing
22 Fabricated metal product manufacturing
23 Transport equipment manufacturing
24 Machinery and equipment manufacturing
25 Furniture and other manufacturing

Other

10	Exploration and other mining support services
31	Heavy and civil engineering construction
59	Internet service providers, web search portals and data processing services
69	Professional, scientific and technical services
72	Administrative services
81	Tertiary education
82	Adult, community and other education
95	Personal and other services

Public sector

Australian Government
Local Government
State Government

How we consulted

Total number of unique individuals participating in engagement activities — 801.

- Advancing Manufacturing Committee – 10
- Jobs Queensland Manufacturing Employer Survey 2017 – 79
- Jobs Queensland Manufacturing Employee Survey 2017 – 581
- Industry forums – 106
- Individual consultations – 25
- Interagency working group – 8 (not included in above total).

9. Glossary

AI – Artificial Intelligence

AMCG – Advanced Manufacturing Growth Centre

CAD – Computer aided design

CAM – Computer aided manufacturing

CEDA – Committee for Economic Development of Australia

CNC – Computer numerical control

DFMA – Design products for manufacture and assembly

GISP – Gateway to Industry Schools Program

IoT – Internet of Things

METS – Mining equipment, technology and services

MFP – Multifactor productivity

R&D – Research and development

RIN – Resource Industry Network

SATs – School-based apprenticeships and traineeships

SMEs – Small to medium-sized enterprises

SSOs – Service Skills Organisations

STEAM – Science, Technology, Engineering, Arts/Design and Mathematics

STEM – Science, Technology, Engineering and Mathematics

USI – Unique student identifier

VET – Vocational education and training



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