MANUFACTURING SKILLS QUEENSLAND

FUTURE OF TRADES IN MANUFACTURING

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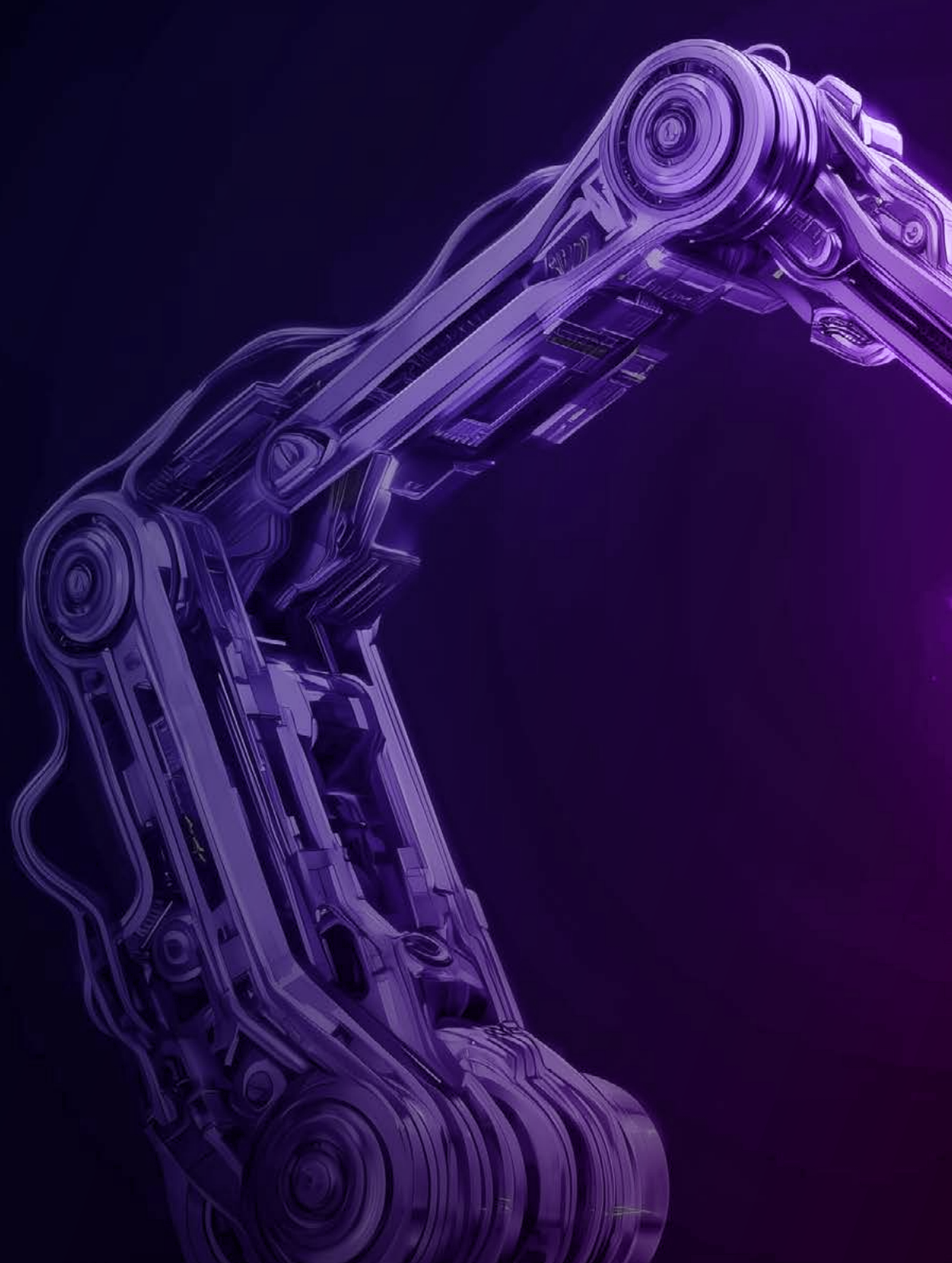

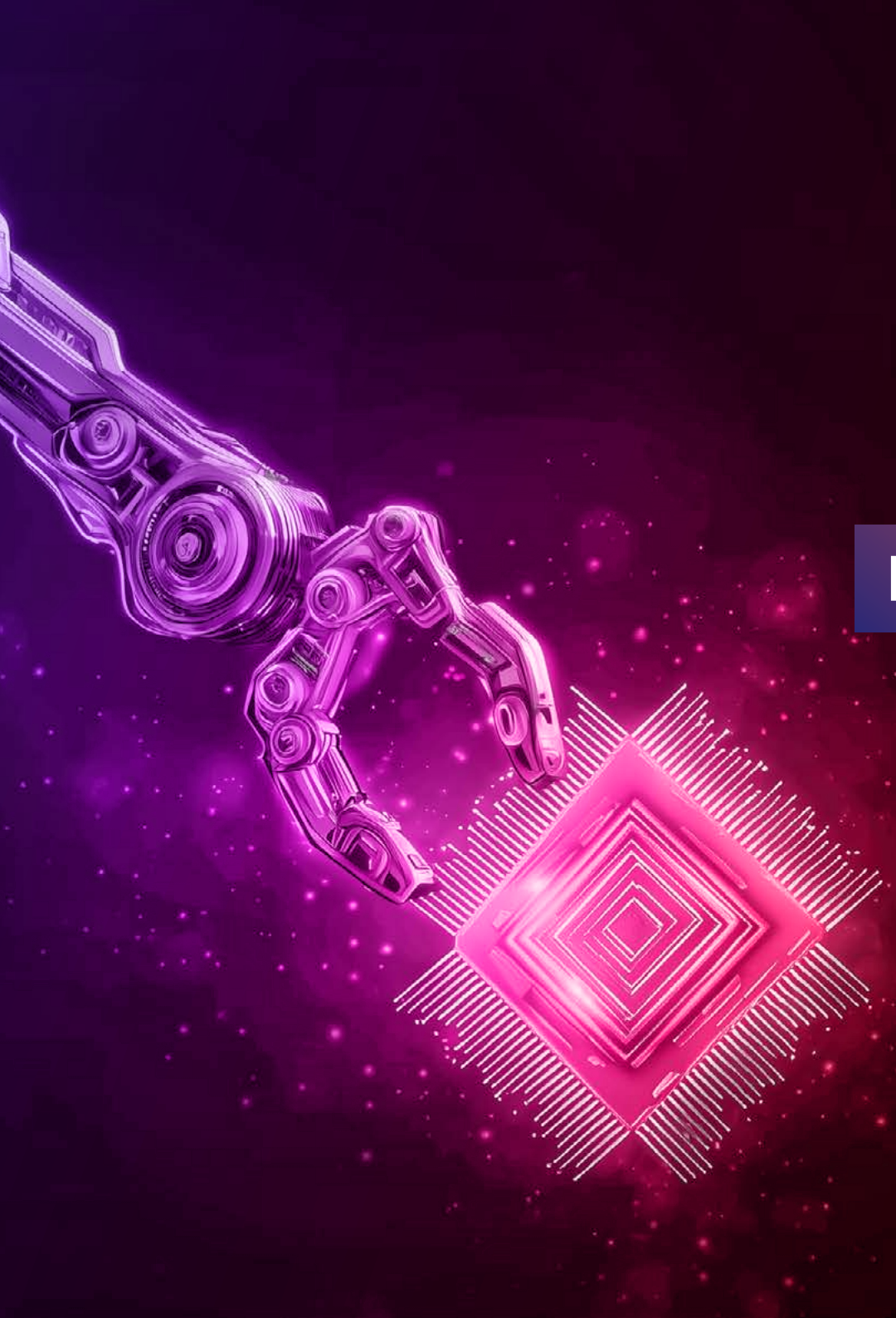

FOREWORD

Manufacturing transformation moves at different speeds: our approach must balance support for early Industry 4.0 adopters while respecting businesses that thrive with traditional methods.


EGR

Queensland's manufacturing sector continues to grow and diversify, building on its deep regional roots and close connection to the state's energy, resource, and infrastructure industries. As technology and sustainability reshape how products are designed, made, and maintained, the trades that support this vital industry are also changing—and fast.

This report examines the future of trades in manufacturing through a workforce lens. It responds directly to the signals we're hearing from employers across the state – that today's qualifications and training pathways are struggling to keep pace with industry transformation. There's a growing urgency to ensure that our system can equip both new entrants and existing workers with the skills they need to thrive.

Digital capability, automation, data fluency, and sustainable practices are no longer niche – they are becoming core requirements across trade roles. While foundational trade skills remain essential, we must now embed new layers of technical, digital, and cross-disciplinary expertise into our vocational training.

This means rethinking how we structure qualifications, what we prioritise in curriculum, and how we support continuous learning across a worker's career.

Importantly, this is not a call for wholesale disruption. It's about practical and achievable reform by updating training products, investing in programs, and creating clearer, more flexible career pathways into and through trades. By taking coordinated action now, we can make sure that today's apprentices and trainees are ready for tomorrow's manufacturing workplaces.

There are real opportunities across Queensland to lead this change. Many of our most innovative manufacturers are based in the regions, developing smart solutions for defence, renewables, transport, and more. By aligning training delivery with these emerging specialisations, and leveraging the local knowledge training organisations, schools, and employers have, we can ensure that trade careers remain a strong and accessible option no matter where a person lives.

This work will only succeed through deep collaboration. Government, industry, educators, and communities all have a role to play. If we align our efforts and focus on outcomes, we can build a training system that keeps pace with industry and unlocks rewarding careers for Queenslanders across generations.

Above all, this report is about people. It's about making sure that welders, machinists, and bakers, alongside the next generation of digital tradespeople, have the tools, training, and opportunities they need to shape a strong future for Queensland. The future of trades is already being built, and we're proud to help lead the way.

02

INTRODUCTION

Equipping Queensland's manufacturing workforce for tomorrow: our blueprint for a competitive, future-ready trades sector in a rapidly evolving global landscape.

Queensland's manufacturing sector is at a pivotal juncture. While pockets of innovation are already embracing elements of Industry 4.0 and 5.0 – such as automation, digital integration, and data-driven decision-making – full adoption across the sector remains limited. Most manufacturers are still navigating the early stages of this transformation, with a few advanced systems, machines, or skilled individuals leading the way. The challenge now lies in translating these successes into broader, system-wide capability that supports the entire manufacturing ecosystem.

Industry 4.0 refers to the use of cyber-physical systems, automation, and data exchange in manufacturing—bringing together Artificial Intelligence (AI), robotics, and the Industrial Internet of Things (IIoT).

Industry 5.0 builds on this by emphasising human–machine collaboration, sustainability, and resilience. Together, they represent the future of advanced manufacturing.

This report has been developed to understand how these shifts are affecting Queensland's manufacturing trades – and what must change in training, systems, and support to ensure the workforce is ready.

At its core, the report:

- analyses how the nature of trade roles is shifting across fundamental, emerging, and support occupations.
- maps current training products to future capability needs across five critical domains.
- identifies where gaps exist – and what steps stakeholders can take to close them.
- showcases national and international innovation to inform Queensland's next move.
- provides a clear blueprint for coordinated, strategic action.

Five key messages emerge from this analysis:

- **Trades are transforming, not disappearing.** Traditional roles are being reshaped by digital tools, automation, and sustainability imperatives. This evolution is gradual but inevitable and must be recognised and supported.
- **The training system is misaligned with industry needs.** Many qualifications still prioritise legacy skills, leaving critical capability gaps – particularly in data, automation, and AI integration.
- **Cross-cutting human capabilities are essential.** Adaptability, collaboration, and critical thinking are just as important as technical skills in the era of smart, human-centric manufacturing.
- **There are practical opportunities for training system innovation that would deliver real impact.** Adjustments to qualification packaging, short bridging programs, and modular upskilling pathways offer practical ways to modernise training and respond to emerging needs.
- **Coordination and leadership are essential.** Queensland's progress will depend on strong leadership and alignment between government, training providers and industry. Sustainable change will require collective effort and a shared vision.

This report outlines how Queensland can continue to evolve its manufacturing trades to remain competitive, future-ready and resilient in the decades ahead.


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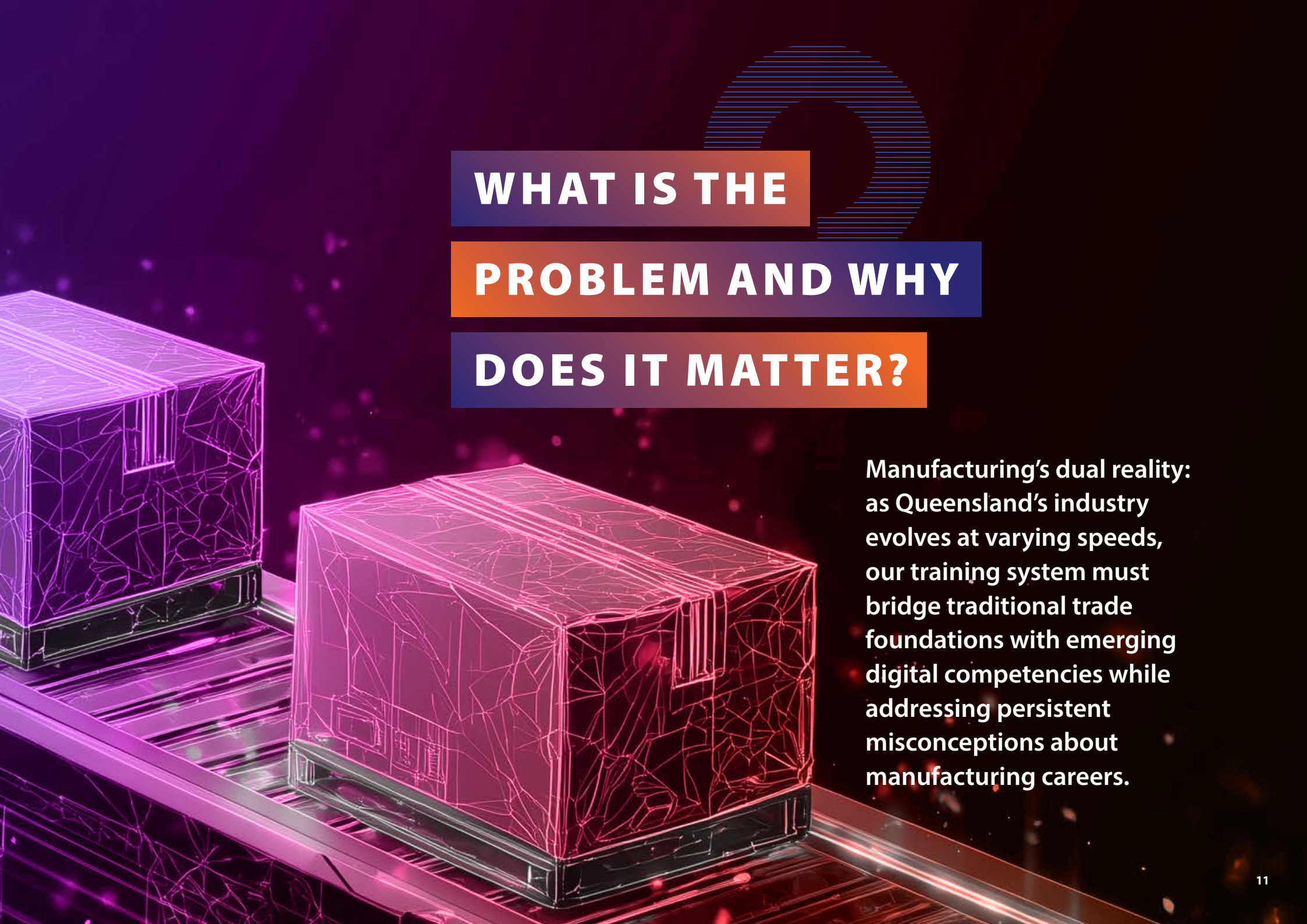


WHAT IS THE PROBLEM AND WHY DOES IT MATTER?

Manufacturing's dual reality: as Queensland's industry evolves at varying speeds, our training system must bridge traditional trade foundations with emerging digital competencies while addressing persistent misconceptions about manufacturing careers.

Manufacturing is a cornerstone of Queensland's economy and state-wide prosperity

Queensland is a manufacturing powerhouse within Australia, distinguished by its increasing share of national manufacturing output, significant presence across regional and metropolitan areas, and recent strategic advancements in high-value sectors.

Manufacturing is integral to Queensland's economic landscape, contributing $29 billion to the state's economy in the 2024/25 financial year, or 5.8% of total Gross State Product (GSP). The state's share of national manufacturing value-added has increased steadily from 16.6% in 2005 to 19.5% in 2025, reflecting sustained growth and resilience.[1]

The manufacturing sector is a major source of employment in Queensland. In 2025, the state's manufacturing sector employed 171,100 people, accounting for 5.7% of the state's total workforce and 19.8% of Australia's manufacturing workforce, with 82.6% in full-time roles. Notably, 50.3% of Queensland's manufacturing workforce operates outside of Brisbane, Gold Coast and the Sunshine Coast, underscoring the sector's significance for employment and economic prosperity in regional areas.[1]

[1] ABS, Labour Force, Australia, detailed, Job Vacancies, Australian National Accounts: State Accounts, 2025.

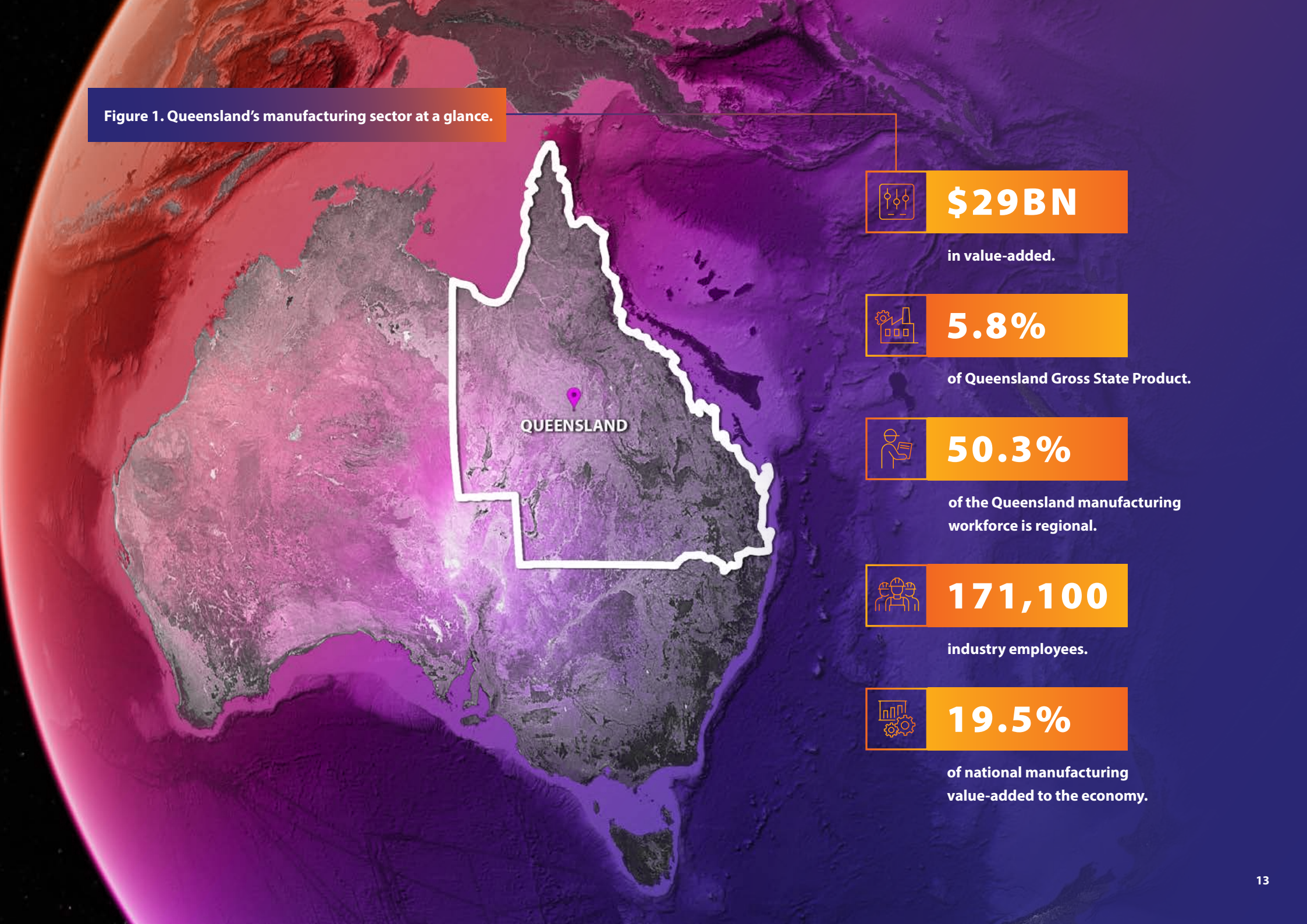


Figure 1. Queensland's manufacturing sector at a glance.

$29BN

in value-added.

5.8%

of Queensland Gross State Product.

50.3%

of the Queensland manufacturing workforce is regional.

171,100

industry employees.

19.5%

of national manufacturing value-added to the economy.


Allweld
MANUFACTURING

A strong manufacturing sector delivers further benefits, supporting innovation and strategic capability for Queensland

The contribution of Queensland's manufacturing sector can be measured in more than just economic output and employment figures. It plays a significant role in accelerating innovation and strengthening sovereign capability.

In 2023–24, the sector accounted for 20.6% of the state's total business research and development (R&D) expenditure, making it the second largest contributor behind professional, scientific and technical services. The $622 million spent on R&D in Queensland is 12.3% of all expenditure in manufacturing across Australia.[2] This underscores manufacturing's role in driving innovation – advancing new technologies, processes, and products that benefit the broader economy.

Queensland is making strategic strides in advanced manufacturing through both public and private investment. In 2024, the state secured Australia's largest-ever defence export deal – a public-private partnership worth more than $1 billion. The agreement will see a fleet of strategically important Boxer-class heavy weapon carrier vehicles built in Queensland over a five-year period, combining traditional fabrication and precision engineering skills with modern systems integration and defence technologies.[3] In the private sector, Vecco Group is constructing Australia's first commercial-scale vanadium battery electrolyte manufacturing facility in Townsville, positioning Queensland as a national leader in clean energy technology and advanced materials processing.[4]

These examples reflect the state's evolving industrial base — one that increasingly straddles both traditional and advanced manufacturing skillsets to deliver complex, strategically significant outputs. As Queensland seeks to build a more resilient and inclusive economy, manufacturing offers a strategic platform. It supports local supply chains, stimulates innovation, and strengthens sovereign capability — all while driving prosperity across both metropolitan and regional communities.

[2] ABS, Research and Experimental Development, Businesses, Australia, 2023-24.

[3] Australian Department of Defence, Landmark production contract signed for Boxer Heavy Weapon Carrier vehicle export to Germany, 10 April 2024. Available at: https://www.defence.gov.au/news-events/releases/2024-04-10/landmark-production-contract-signed-boxer-heavy-weapon-carrier-vehicle-export-germany.

[4] Renew Economy, Townsville to be home of vanadium flow battery manufacturing, 22 May 2024. Available at: https://reneweconomy.com.au/townsville-to-be-home-of-vanadium-flow-battery-manufacturing/

Are trade qualifications keeping pace with the evolving needs of industry?

Queensland's manufacturers are steadily evolving as new technologies — including automation, digital tools, and advanced materials — begin to shape production processes. This shift is uneven and often incremental, with most businesses integrating specific technologies or practices rather than transforming entire operations. Traditional trades continue to underpin the sector, but the skill requirements within those trades are broadening and shifting. Increasingly, manufacturers need workers who can combine practical trade expertise with emerging digital and technical competencies. Yet employers frequently report difficulty finding people with this hybrid capability, particularly in areas such as robotics, digital systems, and composite materials.

The training system has not kept pace with these evolving needs. Apprenticeships remain concentrated in traditional trades (e.g. fabrication and mechanical fitting), with limited formal pathways for new technical roles (e.g. robotics technicians and industrial automation specialists) or opportunities to develop cross-cutting 'human capabilities'.

This misalignment is compounded by persistent misconceptions about manufacturing careers, which continue to shape young people's choices. In 2024, MSQ published the Perceptions of Manufacturing report, which highlighted that young Queenslanders still associate manufacturing with hard, physically demanding and repetitive work, or perceive vocational pathways as less desirable than university pathways. These perceptions deter potential entrants and shrink the pipeline of skilled workers.

In ongoing dialogue with the Queensland manufacturing sector, MSQ has heard that both industry and government stakeholders emphasised that current qualifications are not meeting the needs of modern manufacturers, particularly in relation to digital fluency, adaptability, and evolving technical expectations.

[5] Manufacturing Skills Queensland, Perceptions of Manufacturing Research, December 2024. Available at: https://msq.org.au/wp-content/uploads/2024/12/Perceptions-of-Manufacturing-Research_Web_Single.pdf

Figure 2. Insights from recent MSQ consultations with industry and government stakeholders

Apprentices need to have some form of production or business training to understand why things are done.

Industry Reference Group member

New technologies and equipment improve processes, but there is limited training for onboarding or maintenance.

Regional manufacturer

A decent percentage of the available and untapped workforce, particularly youth, are either unaware of opportunities or view manufacturing as outdated.

Department of Manufacturing

Technology is coming into play in the workplace but there are no qualifications (and no training) to support this.

Regional manufacturer

The perception of manufacturing is that it is still Industry 2.0, not Industry 4.0 or Industry 5.0.

Regional manufacturer

Programs need to meet the needs of modern generation and business.

Regional manufacturer


intellidesign

Inaction on skills development risks economic growth, innovation and sovereign capability

Without targeted investment in skills and training to deliver a strong pipeline of future workers, Queensland risks stalling its manufacturing growth and undermining national resilience. A growing skills mismatch is already affecting productivity, with employers reporting difficulty filling technical roles due to a "lack of applicants" or a shortage of up-to-date skills and capabilities among existing employees.[6]

This mismatch also erodes competitiveness on two fronts. Domestically, manufacturers struggle to attract talent against other industries with clearer upskilling pathways, such as Queensland's mining and resources sector. This makes it harder for manufacturing to compete for the next generation of skilled workers, especially in areas requiring digital or cross-disciplinary capabilities. Without a clear and modernised vocational training offer, the sector risks falling behind other industries that are evolving more rapidly.

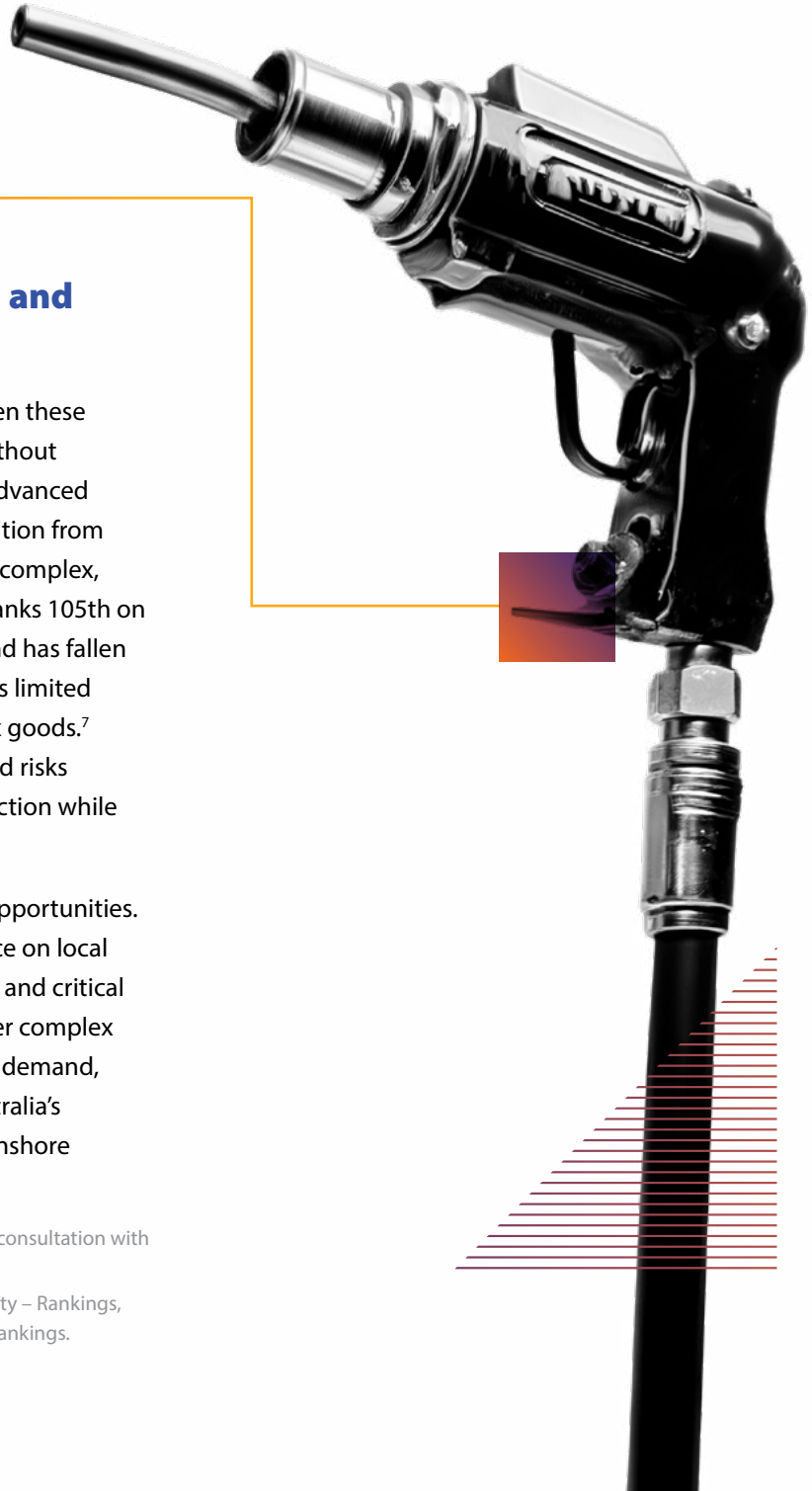
Globally, Queensland's ability to compete in higher-value manufacturing is limited by workforce capability and the ability to effectively leverage new technology.

Meaningful productivity gains occur when these two factors work together in synergy. Without the technical skills required to support advanced production, the state is less able to transition from basic manufacturing to producing more complex, high-margin goods. Australia currently ranks 105th on Harvard's Economic Complexity Index and has fallen steadily over the last 5 years, reflecting its limited capacity to produce high-value, complex goods.[7] Without workforce evolution, Queensland risks being locked into low-complexity production while competitor's advance.

These challenges translate into missed opportunities. High-growth sectors with a heavy reliance on local manufacturing like defence, renewables, and critical minerals require advanced skills to deliver complex outputs. If Queensland cannot meet this demand, investment will flow elsewhere, and Australia's ability to manufacture essential goods onshore will be weakened.

[6] Insights from Manufacturing Skills Queensland's consultation with its Industry Reference Group, 2025.

[7] Harvard Growth Lab, Atlas of Economic Complexity – Rankings, 2025. Available at: https://atlas.hks.harvard.edu/rankings.




04

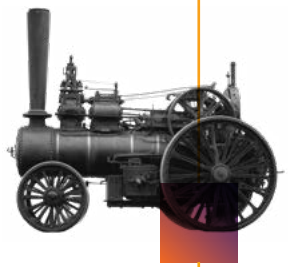
MANUFACTURING TRADES FROM INDUSTRY 1.0 TO 5.0

From the first machines that augmented human labour to today's digital revolution, each industrial era has transformed not just how we make things, but the very nature of trades themselves—requiring our workforce and training systems to adapt.

More than 250 years ago, the invention of the steam engine and other pioneering technological innovations triggered the Industrial Revolution. This period of advancement marked the moment when human labour was first augmented by machines, giving rise to the factory and the trades that underpin industrial production. Since then, manufacturing has evolved through a series of step-changes – each driven by new technologies, each reshaping how goods are made and how workers engage with the process.

These shifts have come to be commonly understood as five distinct industrial eras. While the early revolutions unfolded over the course of centuries, recent transitions have occurred at an ever-accelerating pace. The pace of change creates growing pressure for workers, employers and training systems to adapt. The following section defines each era and outlines how it has shaped the nature of trades in Queensland and beyond.

Figure 3. Timeline of industrial eras and defining innovations



Late 1700s - 1800s

Industry 1.0

The steam engine

Late 1800s - Early 1900s

Industry 2.0

Electric power

1970s - 2000s

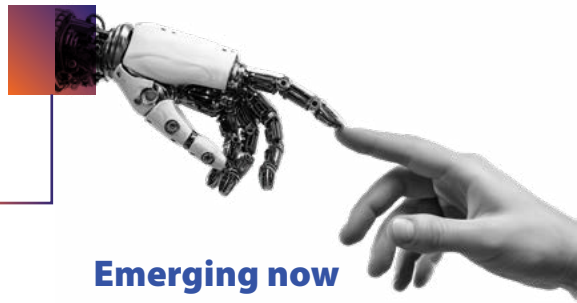
Industry 3.0

Computers

2010s - Present

Industry 4.0

AI and IIoT



Emerging now

Industry 5.0

Human-machine collaboration

The early industrial eras transformed manufacturing over the course of 200 years

INDUSTRY 1.0 – MECHANISATION AND STEAM (LATE 1700s – 1800s)

Defining innovation: The steam engine

The First Industrial Revolution marked the transition from an agrarian, low-density economy to one centred around mechanised production in high-density factory settings. Driven by the advent of steam power, this era saw human and animal labour increasingly replaced by machines, dramatically increasing output per person and giving birth to modern manufacturing. Traditional trades such as blacksmithing and carpentry evolved into more specialised roles like machinists, boilermakers, and engine operators – occupations required to build, operate and maintain the new machinery.

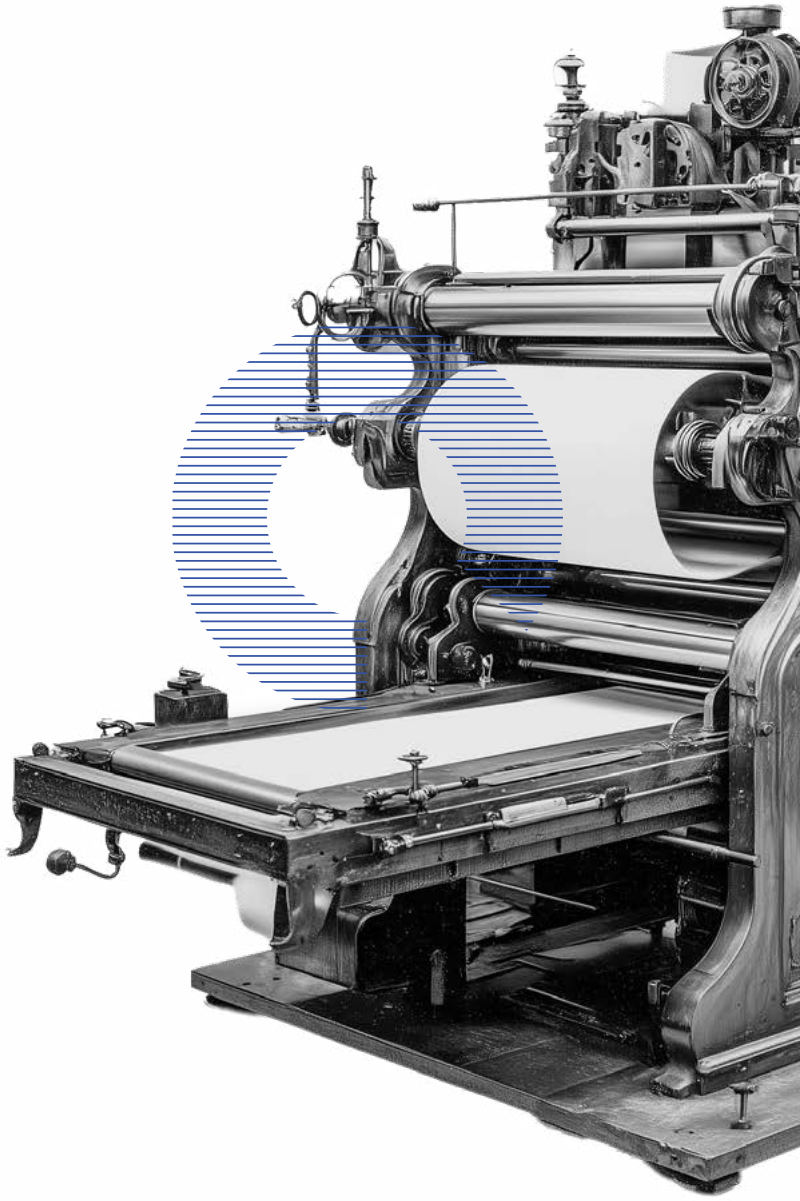
In Queensland, steam-powered machinery drove the development of early mining operations in central Queensland and transformed agricultural processing in regions like the Wide Bay–Burnett, especially through sugar milling. These early industrial hubs laid the foundation for Queensland's manufacturing capability and created demand for emerging trade skills in engine maintenance, metalwork and mechanical repair.

INDUSTRY 2.0 – ELECTRIFICATION AND MASS PRODUCTION (LATE 1800s – EARLY 1900s)

Defining innovation: Electric power

Industry 2.0 was defined by the widespread adoption of electric power, which enabled greater flexibility in factory design and significantly improved safety and efficiency. The introduction of the assembly line and interchangeable parts revolutionised production processes, allowing goods to be manufactured at scale and at lower cost. Manufacturing moved from small workshops to large-scale, standardised production environments, where repetitive tasks could be performed quickly and consistently. This era saw the rise of new trades linked to emerging technologies – fitters, mechanics, and assembly line technicians became essential roles as factories expanded and systems grew more complex.

In Queensland, electrified production lines and processing facilities emerged in cities like Brisbane and Ipswich, expanding manufacturing capacity across metalworks, textiles and transport equipment. The rise of rail manufacturing and urban power systems created new demand for electricians, toolmakers and machine operators across the southeast.



INDUSTRY 3.0 – AUTOMATION AND DIGITISATION (1970s – 2000s)

Defining innovation: Computers and microprocessors

This era introduced computing technology and automation into manufacturing, significantly reducing the need for manual labour in production processes. Key features of Industry 3.0 included the proliferation of electronics and IT for controlling machines, the rise of industrial robotics, and the shift from analog and mechanical technology to digital control systems. New skills emerged in electronics, control systems, instrumentation, and IT support. Technicians were needed to install, program, maintain, and troubleshoot the growing array of digital systems. Multiskilling became more common as workers were expected to operate both mechanical equipment and digital interfaces.

In Queensland, digital control systems were adopted by major processing industries in Gladstone, Townsville and Brisbane—particularly in food, beverage, and resource manufacturing. The demand for technicians trained in Programmable Logic Controllers (PLCs), industrial electronics and computer-integrated manufacturing increased steadily through the 1980s and 1990s.

Industrial transformation has accelerated significantly in the 21st century

INDUSTRY 4.0 – SMART, CONNECTED MANUFACTURING (2010s – PRESENT)

Defining innovation: AI and Industrial Internet of Things (IIoT)

Industry 4.0 merges the physical and digital worlds. Leveraging the digitisation of manufacturing, the last decade has seen rapid integration of cyber-physical systems, IIoT, data analytics and AI into modern 'smart systems'. It marks a shift from isolated, automated machines to interconnected, intelligent systems. In an Industry 4.0 "smart factory", machines, storage systems and products communicate and autonomously exchange information to coordinate actions in real-time. Traditional mechanical skills are now often augmented (or even overtaken) by digital competencies. Tradespeople on the factory floor might find themselves working alongside collaborative robots (cobots) or using tablet interfaces to monitor production. The demand for roles like data analysts, automation engineers, IIoT specialists, and robotics technicians has surged. Paraprofessional roles require a mix of technical knowledge and management acumen.

In Queensland, the uptake of Industry 4.0 technologies is being driven by a combination of government investment and industry innovation. Collaborative initiatives involving training providers, research institutions and manufacturers are helping businesses trial advanced technologies and build the workforce capabilities needed for the next generation of manufacturing.

INDUSTRY 5.0 – HUMAN-CENTRIC AND SUSTAINABLE MANUFACTURING (EMERGING NOW)

Defining innovation: Human-machine collaboration

Industry 5.0 is an emerging concept that builds on Industry 4.0 but places human beings back at the centre of production. Industry 5.0 is less about a specific new technology but focuses on how humans will use the technology that is now available to us. The European Union formally introduced the Industry 5.0 concept in 2021 with a focus on human-centric innovation.[8] There is a growing view that modern manufacturing will require structured collaboration between humans and machines (rather than pure automation) and an alignment of manufacturing with broader societal values like sustainability and well-being. It emphasises a "people-centric" approach. Advanced technology is used to empower workers instead of replacing them, aiming for ergonomic, creative, and meaningful roles for people in manufacturing. Industry 5.0 highlights sustainability and resilience: using green energy, recycling materials, and designing processes that are environmentally friendly and robust against disruptions. Industry 5.0's human-centric ethos means cross-cutting human capabilities will be as valued as technical skills.

Queensland's industrial sector is expected to increasingly incorporate elements of Industry 5.0, with sustainable manufacturing and workforce diversity initiatives leading the way.

[8] European Commission: Directorate-General for Research and Innovation, Industry 5.0, a transformative vision for Europe – Governing systemic transformations towards a sustainable industry, by A. Renda, S. Schwaag Serger, D. Tataj, A. Morlet et al., 2021. Available at: https://data.europa.eu/doi/10.2777/17322

Case Study: Industry 4.0 in action – All Industries Group (Rockhampton)

All Industries Group (AIG), a Rockhampton-based manufacturer, is modernising its fabrication operations to meet demand in advanced sectors such as rail, defence and renewable energy. AIG invested in advanced manufacturing equipment including a plasma cutter, enabling higher precision and greater operational efficiency.

This investment is also enhancing hands-on training opportunities. Apprentices and junior workers are gaining experience with digitally controlled equipment, helping address the company's internal skills gap – where only 6% of required skills were previously fully met. These technologies are supporting upskilling in areas such as specialised welding, which is essential for defence and rail contracts, and have been integrated with AIG's internal skills matrix to track workforce capability.

The company's approach demonstrates how modern equipment can create new development pathways for tradespeople, with emerging expectations around operating, maintaining, and learning on advanced systems.

Case Study: Industry 4.0 in action – Priestley's Gourmet Delights

At its new Acacia Ridge facility, Priestley's Gourmet Delights is applying Industry 4.0 technologies to improve quality, consistency and efficiency in high-volume food production. The company has invested in automation, artificial intelligence, and machine learning to modernise its operations and expand capacity.

The introduction of these technologies is helping Priestley's automate processes such as batching, portioning and temperature control – key for maintaining high standards and boosting productivity. Operators and line technicians are increasingly expected to interpret digital diagnostics, support automation, and contribute to process improvement using live system data.

This transformation highlights how Industry 4.0 enables food manufacturers to combine large-scale production with greater precision and flexibility – backed by a workforce with both trade expertise and digital literacy.

05

SKILLS, CAPABILITIES & QUALIFICATIONS FOR THE FUTURE

As fundamental trades provide the essential foundation, emerging technical specialisations and strategic support roles are becoming increasingly vital to navigate the complex intersection of traditional craftsmanship and advanced digital systems.

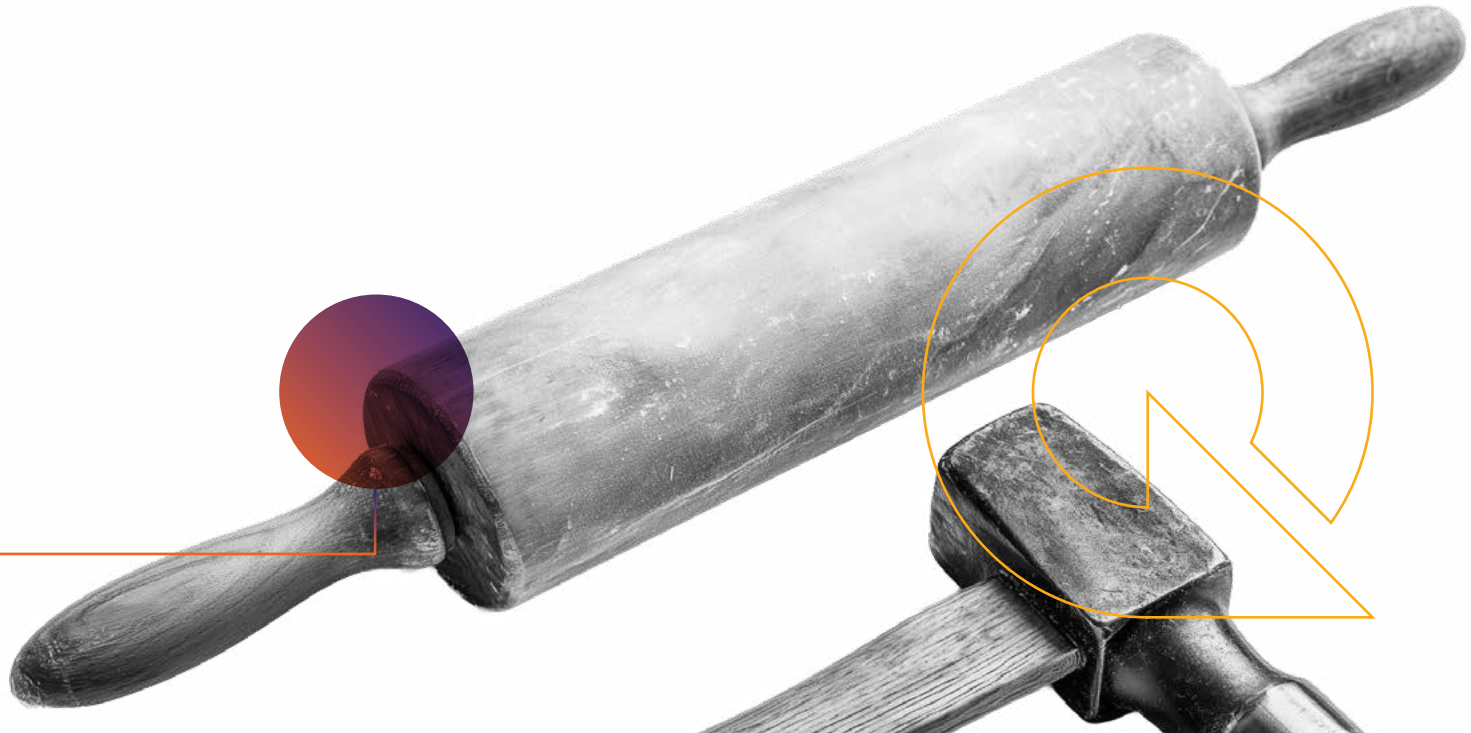
As Queensland's manufacturing sector adapts to the opportunities of Industry 4.0 and 5.0, the workforce is being reshaped by the accelerating adoption of automation, AI, and digital systems – as well as rising expectations for sustainability, customisation and ethical technology use. This is driving a shift in the skills and capabilities required across all trade roles. These trade roles can be grouped into three archetypes that span the manufacturing workforce:

- **Fundamental trades:** Reflect the core skills and occupations long embedded in manufacturing practice.
- **Emerging trades:** Represent the new technical specialisations required to design, install and maintain smart, connected systems.
- **Support roles:** Oversee operations, monitor performance and integrate with digital systems to ensure production runs smoothly and safely.

To understand the changing capability requirements, we undertook a deep dive on the 12 occupations that will play a key role in the present and future of manufacturing. Fundamental trades were selected through data on current workforce, occupations in shortage and level of engagement with qualifications. These eight trades have consistently high enrolment numbers and are crucial to Queensland's largest manufacturing sub-industries. Support roles were selected to provide insight into roles that will continue to increase in importance as Industry 4.0 and 5.0 adoption increases. Emerging trades are a small sample of the jobs or future trades, that will come to the fore in manufacturing organisations.

Table 1. Key manufacturing roles and archetypes

Fundamental trades		Emerging trades	Support roles
Baker	Boilermaker	Mechatronics engineer	Assembly worker
Butcher	Cabinet maker		
Fitter & turner	Machinist	Robotics technician	Process plant operator
Meat process worker	Welder		



The nature of trade roles is evolving with Industry 4.0 and 5.0

As Queensland's manufacturing sector continues to integrate digital technologies, automation, and data-driven operations, traditional trade roles are gradually being redefined. Over time, these roles will require a balanced combination of mechanical expertise, digital literacy, and the capacity to work alongside increasingly smart and connected systems. The table below illustrates how core trade functions are beginning to evolve, highlighting the Industry 4.0 and 5.0 skills that are expected to become central to success as adoption continues to progress across the sector.

Table 2. Summary of capability requirements by role in Industry 4.0 and 5.0

	Core function	Industry 4.0 and 5.0 skills
Fundamental trades		
Baker	Prepares and bakes breads and pastries by measuring, mixing, shaping and cooking ingredients.	Manages smart equipment, using digital controls, programmable logic, and sensor feedback to ensure consistency, efficiency and product quality at scale.
Boilermaker	Fabricates and repairs metal structures by cutting, assembling and welding components.	Works with robotic welding systems and simulation tools, requiring automation fluency, digital layout interpretation, and sustainable fabrication practices.
Butcher	Breaks down carcasses and portions meat products to meet safety and quality standards.	Operates automated cutting and packaging tools while using traceability systems, hygiene monitoring, and compliance-focused data handling.
Cabinet maker	Builds custom joinery and furniture by cutting, assembling and finishing timber products.	Combines craftsmanship with CNC (Computer Numerical Control) programming, 3D parametric modelling, and sustainable material selection in digitally driven workflows.
Fitter & turner	Assembles and maintains machinery by fitting, aligning and repairing mechanical components.	Installs and maintains machinery using CNC systems, sensor diagnostics, and predictive maintenance tools to maximise uptime and precision.
Machinist	Produces precision metal parts using lathes, mills and other machine tools.	Delivers precision parts using Computer-Aided Design (CAD) software, CNC machining, and real-time monitoring of cyber-physical systems.
Meat process worker	Performs cutting, trimming, packing and inspection tasks in meat processing facilities.	Operates in high-throughput environments using sensor-driven lines, live data interpretation, and automated compliance systems.
Welder	Joins metal parts using welding techniques to meet strength and design specifications.	Joins components manually or robotically, using weld sensor data, robotic programming, and digital quality assurance tools to meet tight standards.

	Core function	Industry 4.0 and 5.0 skills
Emerging trades		
Mechatronics engineer	Designs and integrates mechanical and electrical systems for engineered products.	Integrates intelligent systems using robotics, AI deployment, IIoT connectivity, and data analytics to enable smart, flexible manufacturing.
Robotics technician	Installs, tests and maintains robotic systems in manufacturing environments.	Configures and maintains robotic systems using Programmable Logic Controller (PLC) programming, AI-assisted fault diagnostics, and safe human–robot interaction protocols.
Support roles		
Assembly worker	Puts together components or products by following instructions and performing checks.	Collaborates with cobots and follows digital work instructions, using real-time feedback systems and workflow data to maintain production flow and quality.
Process plant operator	Controls machinery and monitors production to maintain safe and efficient operations.	Oversees production using AI-enabled dashboards, IIoT data streams, and sustainability metrics to make real-time operational decisions.

The capability requirements across trade roles in Industry 4.0 and 5.0 align to five key capability domains that reflect the most critical areas of capability development required to keep pace with digital transformation, automation and sustainability imperatives across the sector.[9]

Table 3. Key capability domains in Industry 4.0 and 5.0

Digital Tools	Robotics & Automation	Data Interpretation	AI Integration	Sustainability Practices
The ability to operate computer-controlled machinery and use digital design or production tools (e.g. CAD, CAM, CNC routers, digital dashboards).	Skills to interact with, monitor, or program robotic systems and automated production equipment, including cobots.	The capacity to read, understand and act on production data, diagnostics, or digital instructions to improve safety, quality or efficiency.	Familiarity with the rise in artificial intelligence tools and how they are used to drive efficiency and precision manufacturing.	Knowledge and application of sustainable practices, such as waste reduction, energy efficiency, and material selection.

[9] World Economic Forum, The Future of Jobs Report 2020, October 2020. Available at: https://www3.weforum.org/docs/WEF_Future_of_Jobs_2020.pdf

Expectations are rising across key capability domains among all trade roles

To assess how Industry 4.0 and 5.0 capabilities apply across different trade roles, we developed a qualitative rating system based on relevance – that is, how critical each capability is to perform the job effectively now and into the foreseeable future. For each of the 12 trades, we considered the typical tasks and work environments associated with the role and evaluated how directly each capability domain contributes to job performance. The assessment was informed by current job profiles and task requirements under modern manufacturing conditions, and alignment with emerging technologies and production systems.

Table 4. Capability requirements in Industry 4.0 and 5.0 by occupation

	Digital Tools	Robotics & Automation	Data Interpretation	AI Integration	Sustainability Practices
Fundamental trades					
Baker					
Boilermaker					
Butcher					
Cabinet maker					
Fitter & turner					
Machinist					
Meat process worker					
Welder					

Key: Not required · Low relevance · Moderate relevance · High relevance · Very high relevance

	Digital Tools	Robotics & Automation	Data Interpretation	AI Integration	Sustainability Practices
Emerging trades					
Mechatronics engineer	◔	●	●	●	◔
Robotics technician	◔	●	◔	◔	◑
Support roles					
Assembly worker	◑	●	◑	◔	◑
Process plant operator	◔	◔	●	◔	●

Key: ○ Not required ◔ Low relevance ◑ Moderate relevance ◕ High relevance ● Very high relevance

While emerging roles such as mechatronics engineer and robotics technician are designed around high levels of digital and data capability, this shift is not limited to new occupations. Fundamental trades and support roles are also seeing a marked rise in capability expectations as they interact more frequently with advanced technologies and processes.

Fundamental trades and support roles are increasingly required to work with digital tools, automated equipment, and sustainability protocols. While the core tasks may remain grounded in hands-on expertise, these roles now demand a blend of traditional skill and modern adaptability to operate effectively in smart, connected manufacturing environments.

The distinctions between fundamental, emerging and support roles are blurring, with all roles requiring a blend of technical, digital and adaptive capabilities. This reinforces the need for training pathways that combine hands-on expertise with exposure to modern technologies – preparing all workers to operate confidently in smart, connected manufacturing environments.

Cross-cutting 'human capabilities' are critical for a future-ready manufacturing workforce

In addition to technical and digital competencies, Industry 4.0 and 5.0 demand a renewed focus on human capabilities that enable workers to adapt, collaborate and lead through rapid transformation. These five cross-cutting capabilities are relevant to all manufacturing occupations and are increasingly seen as the defining feature of high-performing manufacturing teams.

These capabilities draw on leading global frameworks and feedback from Queensland manufacturing industry stakeholders.[9]

Key cross-cutting capabilities include:

- **Adaptability and learning agility:** As technologies evolve, so must workers. Whether learning to operate a new robotic interface or adapting to sustainability standards, the ability to continuously acquire and apply knowledge is fundamental to every role.
- **Collaboration and communication:** Industry 5.0 emphasises human–machine collaboration, but also human–human coordination. Teams must work across functions – technicians, operators, designers – to solve problems and maintain performance. Clear communication and strong team dynamics are central to success.
- **Creative problem-solving and innovation:** In modern manufacturing, workers must not only identify issues and make decisions under pressure but also imagine and trial new approaches. This combination of critical analysis and creative thinking supports process improvement, product customisation and operational resilience.
- **Systems thinking:** Increasing interdependence across roles, machines, and processes requires workers to see beyond their immediate task. Understanding how one process affects the next supports proactive problem-solving, waste reduction, and higher quality outcomes.
- **Emotional intelligence and leadership:** Particularly in supervisory or high-change environments, self-awareness, empathy and the ability to guide others through transition are critical. These skills help maintain morale, reduce resistance to change and foster inclusive, safe workplaces.

Developing these capabilities requires more than formal training – it depends on a culture that encourages learning, experimentation, and collaboration. Embedding them into apprenticeships, vocational programs, and on-the-job development will ensure that Queensland's workforce can adapt as technologies and business models evolve. For Queensland's manufacturing sector, fostering these human capabilities across foundational, emerging, and support roles will be just as critical as technical upskilling in preparing for the ongoing transition toward Industry 4.0 and 5.0.


06

MAPPING THE FUTURE: OCCUPATIONS, SKILLS AND TRAINING PRODUCTS

Industry 4.0 and 5.0 technologies have the power to reshaping manufacturing occupations, demanding new workforce capabilities that existing training products must evolve to address.

As Industry 4.0 and 5.0 reshape the capabilities required across the workforce, it is essential to understand how existing training products align with those needs. While the nature of manufacturing work itself is evolving — with new technologies, digital systems, and sustainability practices becoming increasingly central — many qualifications remain anchored in older models of production.

Feedback from MSQ's ongoing consultation with Queensland's manufacturing sector indicates that capability levels are not keeping pace with the demands of modern production environments. While the industry and technology are evolving towards a greater alignment to Industry 4.0 and 5.0, many of the core units of competency underpinning relevant training products have not changed significantly in the last 20 years. Key digital and data capabilities are either missing or insufficiently embedded. Where new capabilities are included in training, they are often siloed as electives, inconsistently delivered, or not well-aligned to the day-to-day reality of modern manufacturing workplaces.

Figure 4. Insights from MSQ's recent consultations with industry stakeholders

Many workers still lack basic digital skills needed to operate modern equipment and keep pace with increasingly automated processes.

Industry Reference Group member

Roles are changing, some roles are emerging based on new technology.

Regional manufacturer

Create training and credentials to allow for movement across the sector or help train entry level skills.

Regional manufacturer

Programs to see skill enhancement in the application of digital and AI tools in manufacturing should be prioritised.

Industry Reference Group member

A need for clear training pathways that are linked to career outcomes in the industry.

Department of Manufacturing

We need to look at training a lot differently, and look at better training options in regional Queensland.

MSQ IRG member

This section presents a forward-looking view that links occupations to relevant qualifications, assesses how well those qualifications develop key capabilities, and identifies urgent capability gaps requiring attention.

Development of Industry 4.0 and 5.0 capabilities is uneven across relevant qualifications

To understand where capability gaps exist, we began by mapping the qualifications currently associated with each of the 12 priority occupations. We then assessed how effectively those qualifications develop five key Industry 4.0 and 5.0 capabilities: CNC/digital tools, robotics and automation, data interpretation, AI integration, and sustainability practices. This analysis enabled us to identify where the training system is not yet keeping pace with industry needs. The full mapping and capability assessments are included in the appendix (Table 8 and Table 9), with the most urgent gaps summarised in Table 5.

Development of the key Industry 4.0 and 5.0 capabilities remain uneven across qualifications. While some qualifications – such as the Certificate IV in Engineering, Diploma of Engineering or Bachelor of Engineering (Mechatronics) – offer strong exposure to digital tools and automation, many others, especially at the Certificate III level, show limited integration of AI, data analytics, or sustainability. The analysis highlights the importance of updating qualification structures to reflect the technologies and practices now shaping modern manufacturing. Embedding these capabilities across trade pathways will be essential to build a workforce that is both technically proficient and future ready.

Urgent and at-risk capability gaps require targeted action

Across the 12 occupations, there are persistent gaps between the capabilities required for Industry 4.0 and 5.0 and those currently developed through existing qualifications. These gaps reflect a broader structural misalignment between training products and the evolving demands of manufacturing and technology-enabled work.

Table 5 highlights where these capability gaps are most significant. Gaps are categorised into two tiers to reflect both the magnitude of the shortfall and its practical implications:

- **Urgent gaps** (⚠) indicate major shortfalls in essential capabilities required for immediate job readiness, requiring priority action.
- **At-risk gaps** (!) point to important but less time-sensitive capability gaps that will still require targeted action to address.

Table 5. Urgent and at-risk capability gaps by occupation

	Digital Tools	Robotics & Automation	Data Interpretation	AI Integration	Sustainability Practices
Fundamental trades					
Baker				!	
Boilermaker	!	⚠		!	!
Butcher	!	⚠		!	
Cabinet maker	⚠			!	
Fitter & turner	!	⚠	⚠	⚠	!
Machinist	!		⚠		!
Meat process worker	!	⚠		!	⚠
Welder	!			⚠	!
Mechatronics engineer					⚠
Robotics technician					!
Assembly worker		⚠	!		!
Process plant operator					⚠

Key: ⚠ Urgent gaps ! At-risk gaps

These gaps indicate areas where current qualifications may be underpreparing learners for emerging workforce requirements. Addressing them will require a combination of short-term curriculum improvements and long-term structural redesign of qualifications. In the short term, this means integrating relevant units into existing packaging rules and promoting greater uptake of future-focused electives. Over time, it may involve the creating of new specialisations, redesigning core content, or developing micro credentials that respond more rapidly to technological change — particularly in areas such as AI integration, robotics, and digital tool proficiency.

Naming matters: Future-facing titles for a future-ready workforce

Modernising workforce capability must also include modernising the way we talk about jobs. Occupational titles are more than administrative labels – they shape public perceptions, influence career decisions, and signal whether a role belongs to the past or the future. In a world of AI, automation and advanced manufacturing, some traditional titles no longer reflect the complexity or technological depth of the work.

Trades like fitter and turner and boilermaker are increasingly embedded in digital workflows, robotics-enabled processes, and high-specification manufacturing environments, yet their titles evoke a more limited and manual past.

A shift toward future-facing occupational names would better reflect the evolving skill sets and help to attract the next generation of talent. For example, mechanical systems technician or fabrication specialist / fabricator may offer more contemporary signals of value and relevance.

Updated job titles can support clearer career pathways. Where once the title Boilermaker may have applied across all levels of seniority, a progression such as Fabricator → Fabrication Specialist → Senior Fabricator → Fabrication Manager can better signal development opportunities and advancement within the trade. When a job is described in modern, scalable terms, it not only reflects the realities of the role but helps workers see a future in it.

07

THE CHANGING LANDSCAPE OF TRADE QUALIFICATIONS

Trade qualifications require comprehensive modernisation to integrate emerging technologies while preserving the core strengths of apprenticeship models, ensuring they deliver the precise mix of traditional craftsmanship and digital fluency demanded by today's rapidly evolving industries.

The landscape for trade qualifications is gradually evolving as technological change reshapes how skills are developed and applied. Traditional apprenticeship models remain central but are beginning to adapt to meet the needs of a modern workforce. Greater flexibility, modular learning, and ongoing upskilling will be essential to ensure workers can continue to build capability throughout their careers, without the need for complete retraining as technologies evolve. This chapter explores practical opportunities for training system innovation, industry-led skilling pathways, and international benchmarks to guide the future of trade training in Queensland.

Practical opportunities for training system innovation

Queensland has an opportunity to implement practical, near-term innovations that strengthen the relevance and responsiveness of trade training. These include targeted adjustments to qualifications and the adoption of new delivery models to close urgent capability gaps.

1. Adjust how existing units of competency are packaged

Incremental adjustments to how units of competency are packaged can deliver meaningful impact while broader qualification redesigns are underway.

High-value units can be reclassified from elective to core to ensure critical skills are universally taught, and relevant existing units can be embedded into additional qualifications to close capability gaps where similar skills are required. These targeted changes offer a practical and cost-effective way to strengthen digital fluency, automation, and sustainability knowledge within trade training – addressing the capability gaps highlighted in Chapter 6. Some units already developed directly support Industry 4.0 and 5.0 capabilities and have cross-application to multiple trades, providing a foundation on which more can be built. An indicative range of suggested unit transfers is presented in Table 6.

Training providers have a critical role to play in accelerating this evolution. Reviewing the elective units currently offered within manufacturing apprenticeships presents an immediate opportunity to embed existing units that better align with emerging Industry 4.0 and 5.0 skills. However, this shift will require more than provider initiative alone – supportive policy settings, funding incentives, and guidance from government and industry will be essential to enable broader adoption. Current data indicates that most Registered Training Organisations (RTOs) offer only a narrow band of electives, suggesting significant scope to diversify training options and align delivery more closely with the future needs of Queensland's manufacturing workforce.

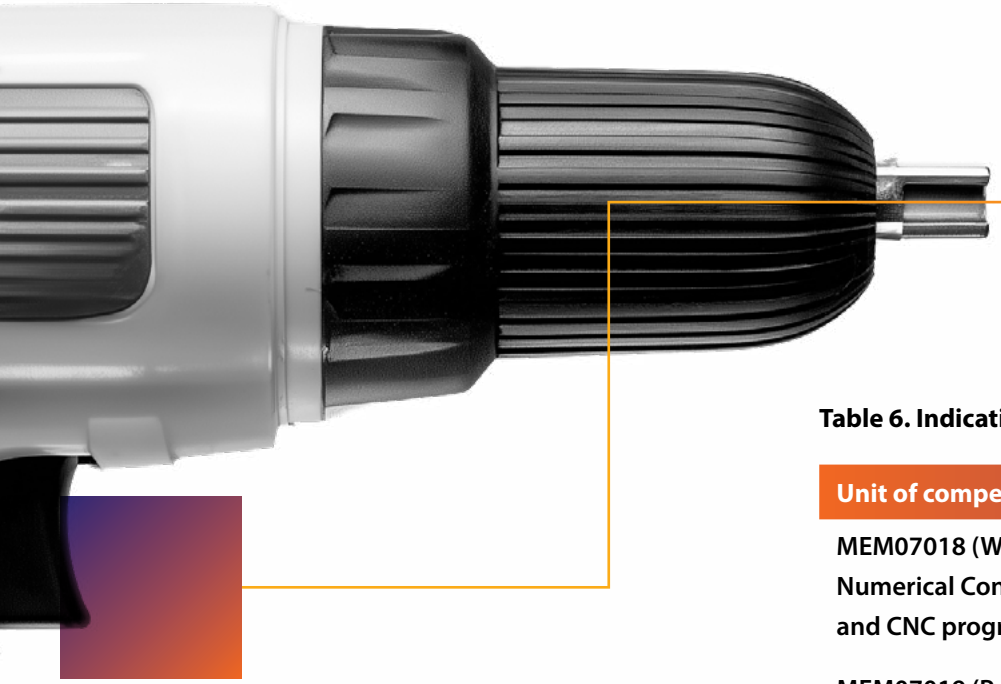


Table 6. Indicative adjustments to how units of competency are packaged to address capability gaps

Unit of competency	Opportunities to deploy into more qualifications
MEM07018 (Write basic Numerical Control (NC) and CNC programs) **MEM07019 (Program NC and CNC machining centre)**	Package in qualifications for trade roles with capability gaps in Digital Tools (see Table 5) to ensure consistent exposure to CNC programming and automated machining techniques applicable across high-specification manufacturing environments.
MEM234014 (Design a robotic system)	Package in qualifications for trade roles with capability gaps in Robotics & Automation (see Table 5) to provide foundational exposure to robotic system design, supporting greater fluency in working with automated and collaborative production technologies.
MSFFDM4002 (Collect and interpret information to support production processes)	Package in qualifications for trade roles with capability gaps in Data Interpretation (see Table 4) to build capability in reading, analysing and applying production data to improve process quality, efficiency and decision-making.
MEM29004 (Analyse and problem solve a PLC based industrial control system)	Package in qualifications for trade roles with capability gaps in Robotics & Automation (see Table 4) to build foundational skills in analysing and troubleshooting PLCs that underpin automated and robotic manufacturing systems.

2. Deepen employer and industry partnerships

When training is co-designed and co-delivered with industry, it is more relevant, responsive, and effective. Industry partnerships bring cutting-edge tools, expert knowledge, and clear employment pathways to training programs – ensuring qualifications evolve with technology and reflect real workplace needs. Germany's dual vocational system provides a global benchmark for how deep and sustained industry engagement can shape successful training outcomes.

Germany's dual system – Co-designed training at scale

Germany's dual vocational training system exemplifies deep employer–education collaboration. Trainees split time between classroom learning and company-based training, with curriculum jointly developed by industry and educators. This model has delivered strong workforce alignment, high employment rates, and a steady supply of skilled manufacturing technicians.

3. Embed immersive and hybrid delivery models

New technologies and flexible delivery methods can enhance engagement, simulate real-world scenarios, and improve training accessibility. Hybrid delivery blends online theory with hands-on practice – useful in regional settings – while augmented reality and virtual reality (AR/VR) allows learners to safely train in complex or high-risk environments. These delivery innovations help accelerate learning and reduce resource constraints on providers and employers. A standout example is SAGE Automation's immersive training centre, which demonstrates the potential of simulation-based learning to prepare workers for Industry 4.0 environments.

SAGE Automation – Immersive simulation for Industry 4.0 workforce training

SAGE Automation, a South Australian advanced manufacturing and control systems company, has developed a purpose-built, immersive training facility known as the Skills Lab. This environment simulates a fully functioning smart factory floor, allowing learners to interact with digital systems, PLCs, robotics, and IIoT in a safe, real-world setting. SAGE delivers accredited and non-accredited training using a blended model – combining online learning, virtual troubleshooting and physical simulation. The centre is used by apprentices, technicians and engineers, and has been recognised as a national leader in preparing workers for Industry 4.0 environments.

4. Develop short bridging programs

Short bridging programs allow workers with existing qualifications to shift into adjacent, high-demand trades by completing only the units they don't already hold. This approach promotes career mobility and helps industry fill skill shortages in growth areas such as robotics, CNC operation or industrial automation – especially when full apprenticeships would be too time-consuming or redundant for experienced workers. One example of this approach in action is Victoria's Skills First accelerated apprenticeship model, which supports cross-trade mobility through targeted, competency-based pathways.

Skills First – Accelerated apprenticeships for cross-trade mobility in Victoria

The Victorian Government's Skills First initiative includes accelerated apprenticeships and bridging programs that allow qualified workers to gain a second trade faster by recognising prior learning. In sectors like engineering and electrotechnology, apprentices with overlapping core competencies can complete condensed pathways by focusing only on new or specialised skill areas. This model has supported rapid workforce redeployment into high-demand areas such as renewable energy, demonstrating how bridging programs can fast-track capability development while maintaining training quality.

5. Promote modular and stackable learning through micro-credentials

Micro-credentials offer a flexible and efficient way for workers to upskill in specific areas like robotics, data analytics, or sustainability. These short-form credentials can be completed quickly, used to upskill existing workers, and stacked into larger qualifications over time. They allow both individuals and employers to respond rapidly to technological shifts and evolving capability needs without the cost or delay of full course enrolments. Singapore's national micro-credential framework offers a leading international model of how this can be done at scale.

SkillsFuture Singapore – A national model for micro-credentials

Singapore's SkillsFuture program enables workers to build modular, stackable learning pathways aligned to national workforce needs. Participants can use government-funded credits to take short courses in advanced manufacturing and emerging technology, with credentials accumulated over time to build full career portfolios. The model supports agility and lifelong learning in a fast-changing industrial economy.

08

RECOMMENDATIONS AND SYSTEM ACTIONS

Queensland's manufacturing future requires coordinated action from policymakers, training providers, and industry leaders to implement change before the opportunity is lost.

This section sets out a targeted set of nine recommendations for three key stakeholder groups in Queensland's manufacturing workforce ecosystem: policymakers (including the Queensland and Commonwealth Governments and Jobs and Skills Councils), training providers (including TAFEs, universities and other registered training organisations), and industry and employers (including large and small-to-medium manufacturers, and peak bodies).

Each recommendation includes a series of tangible actions, grouped by an indicative time horizon of implementation. Priority actions refer to those that can be initiated quickly and should be a priority within the next 12–18 months, while long term actions are those that require systemic change, sustained investment, or alignment across multiple actors and are likely to unfold over a two- to five-year horizon.

Table 7. Summary of recommendations by stakeholder group

Policymakers	Training providers	Industry / employers
1. Increase support for manufacturing workforce development	4. Build deep and sustained engagement with industry	7. Build workforce capability to meet future manufacturing needs
2. Promote a modern and strategic understanding of manufacturing	5. Align training content with Industry 4.0 and 5.0 expectations	8. Communicate clear career pathways to boost attraction and retention of talent
3. Improve the relevance and responsiveness of training packages	6. Strengthen trainer capability, infrastructure, and innovation systems	9. Invest in partnerships and early talent engagement

Policymakers

Including the Queensland Government, the Commonwealth Government, and Jobs and Skills Councils (JSCs).

1. Increase support for manufacturing workforce development.

Queensland's manufacturing sector requires a well-supported pipeline of skilled workers to meet growing technical demands and support future productivity. The Queensland Government plays a leading role in enabling this workforce pipeline, particularly through grant programs and employer incentives.

The Made in Queensland grants program has committed $121.5 million in matched co-investment since 2017 to help small-to-medium enterprises (SME) modernise operations, adopt advanced equipment, and improve systems and productivity.[10] While supporting the acquisition of new technology is vital, equipment that cannot be effectively adopted, maintained, or leveraged by the workforce risks under-delivering on its promise. Incentive structures should therefore emphasise not only the purchase of technology, but also the upskilling, training, and capacity building of existing workers.

By rewarding investment in human capital, especially training that enables proper utilisation, servicing, and integration of new systems, programs and grants can drive stronger returns, higher uptake, and more sustainable impact across Queensland's manufacturing sector.

Priority actions:

- The Queensland Government expands funding programs to support training and workforce development in priority skill areas.

Long term actions:

- The Queensland Government reviews and improves incentives for employers taking on apprentices and trainees, ensuring flexibility based on regionality, business size, and industry context.

[10] Queensland Government, Made in Queensland – Grant Programs, 2025. Available at: https://www.business.qld.gov.au/industries/manufacturing-retail/manufacturing/grant-programs/made-in-queensland

2. Promote a modern and strategic understanding of manufacturing.

Queensland's manufacturing industry is evolving. It contributes to sovereign capability, advanced exports, innovation, and technology leadership – not just employment numbers.

Public messaging and policy signals need to reflect this strategic role. Governments are key actors in shaping how young people, career-changers, and investors perceive the industry.

Effective campaigns can counter misleading "decline" narratives and showcase diverse, high-value career paths. Promotion of digital, clean-tech, and advanced manufacturing jobs will help address misperceptions and increase workforce attraction.

Priority actions:

- The Queensland and Commonwealth Governments promote modern manufacturing careers through targeted outreach that highlights technology, sustainability, and advanced skills.
- The Queensland and Commonwealth Governments promote the overall value of manufacturing beyond job numbers — including its role in sovereign capability, productivity, export competitiveness, and innovation — and counter misleading "decline" narratives.

3. Improve the relevance and responsiveness of training packages.

As technology evolves, so too must training systems. Jobs and Skills Councils (JSCs) play a critical role in ensuring national training packages remain aligned with future skills needs. This includes developing new qualifications for emerging occupations and embedding digital capabilities into the core of traditional trade training.

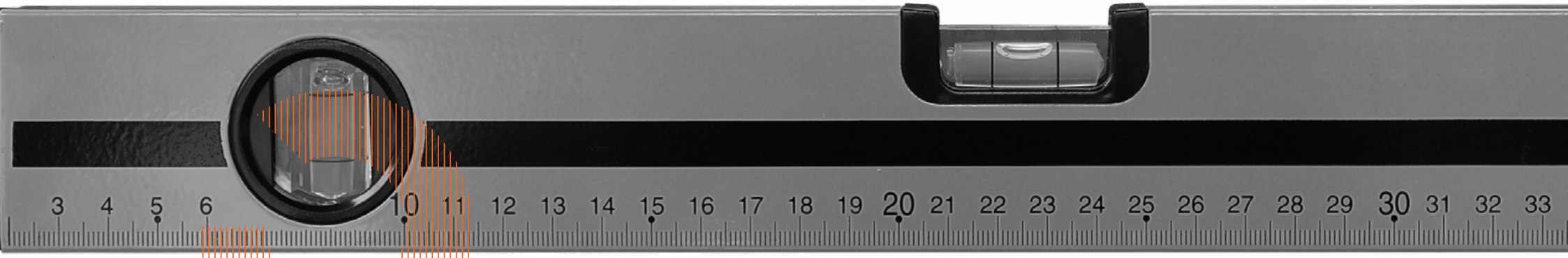
Currently, progression pathways within existing trade qualifications remain uneven. For example, within the MEM Training Package, the Certificate III in Engineering offers more than ten specialisations across mechanical, fabrication, and machining streams.

Yet these pathways converge into a single Certificate IV in Engineering. This creates a structural bottleneck, limiting targeted upskilling, career progression, and alignment with evolving industry requirements.

A nationally recognised skill set such as "Digital Foundations for Trades" could help bridge this gap by embedding foundational digital competencies within core trade qualifications. This proposed model would formalise emerging digital capabilities as standard learning outcomes, not electives, and better prepare learners for smart, connected, and automated workplaces. Addressing these structural and content gaps will make the training system more responsive, modern, and attractive to both learners and employers.

Long term actions:

- JSCs support the development of new qualifications and training pathways aligned to emerging roles.
- JSCs embed foundational digital skills in all publicly funded trade qualifications and develop nationally recognised skill sets.
- JSCs develop and formalise Certificate IV-level qualifications or progression pathways for key fundamental trades where they are currently lacking, such as machinists, boilermakers, and welders.



Training providers

Including TAFEs, universities and other registered training organisations (RTOs).

4. Build deep and sustained engagement with industry.

Strong collaboration between training providers and industry is essential to ensure learning content and delivery are relevant, applied, and future-focused. TAFEs, universities and other RTOs must invest in meaningful partnerships with manufacturers, including through co-designed projects and trainer exposure to new technologies.

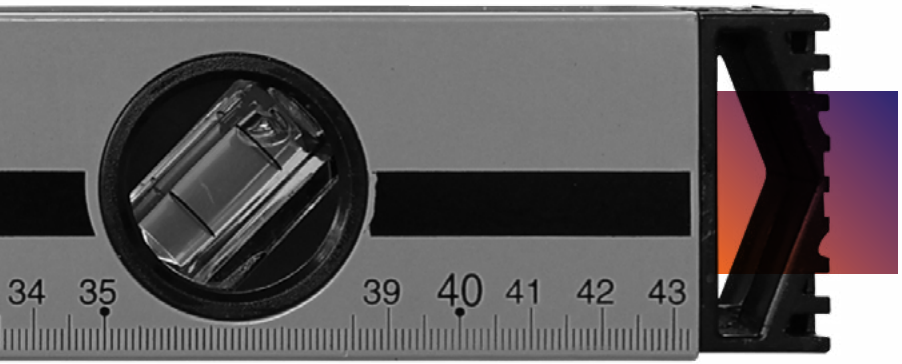
'Lite secondments' – short-term, low-disruption observational placements in industry – provide a practical way for trainers to stay up to date with current practices without requiring long absences from teaching. Larger providers can also look internationally, establishing partnerships with global manufacturers with a Queensland presence – such as Siemens or BOSCH – to embed global standards into local training delivery.

Priority actions:

- All providers partner with local manufacturers to co-design applied training projects.
- All providers enable structured placements or observational experiences for trainers in industry settings, including 'lite' secondments.

Long term actions:

- Larger RTOs and universities create joint ventures with leading global partners to support curriculum innovation and alignment with global standards.



5. Align training content with Industry 4.0 and 5.0 expectations.

To prepare learners for a digitised and human-centred manufacturing future, training content must evolve. Providers have an opportunity to modernise existing trade qualifications to reflect the competencies required in Industry 4.0 and 5.0. This would not involve adding new units or lengthening apprenticeships, but rather introducing blended delivery models, incorporating emerging technology, and developing modular or hybrid qualifications that reflect evolving industry practice.

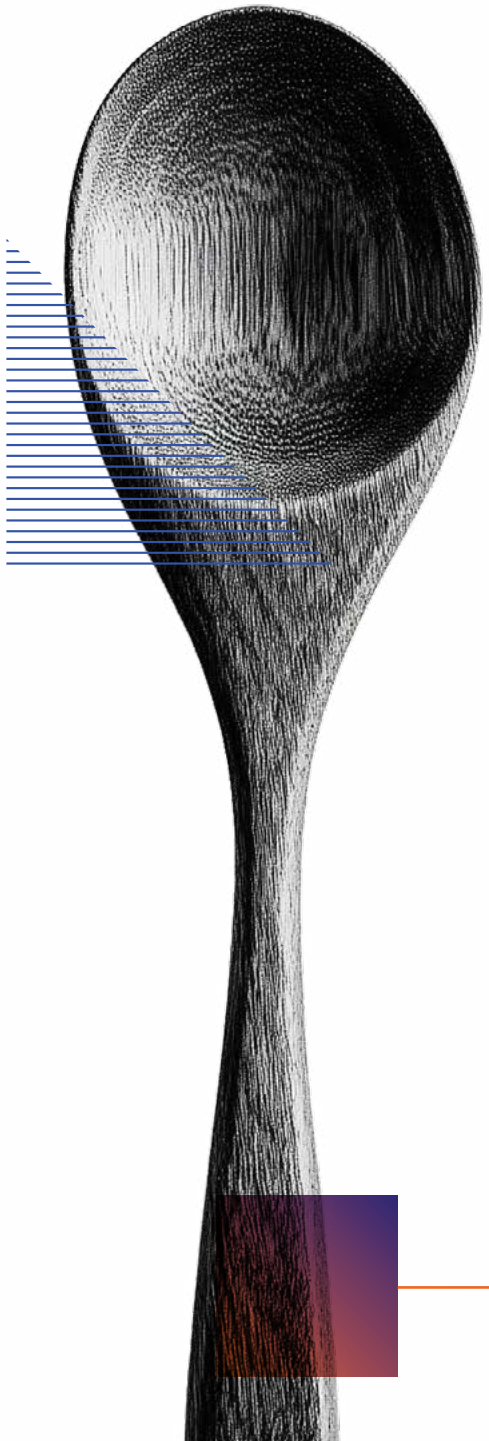
VR-enabled factory floor simulations can immerse learners in real-world manufacturing environments without leaving the classroom, allowing them to safely interact with virtual equipment and processes. A hybrid qualification in 'trades and applied data' could involve training in core trade competencies alongside data collection, visualisation and analytics using digital tools, preparing learners to operate and troubleshoot smart, connected systems in modern manufacturing settings. Modular qualifications offer flexibility – for instance, a qualified welder could complete stackable micro-units in areas like additive manufacturing or AI-assisted fabrication, enabling upskilling without repeating core trade training. These models are key to supporting lifelong learning and enabling workers to adapt as industry needs evolve.

Priority actions:

- TAFEs and RTOs introduce simulated and blended learning environments into trade delivery (e.g. VR-enabled factory floor simulations).

Long term actions:

- All providers (in conjunction with JSCs) should develop hybrid qualifications that combine traditional trades with technical specialisations (e.g. trades and applied data).
- All providers offer modular, flexible qualifications that support lifelong learning and upskilling for advanced technologies.



6. Strengthen trainer capability, infrastructure, and innovation systems.

Well-equipped, well-prepared trainers are central to the quality of vocational education. As the manufacturing landscape changes, trainers need opportunities to deepen their technical skills, particularly in digital and automation technologies. In parallel, RTOs need to update training infrastructure and delivery environments to reflect real-world tools and systems, such as CNC, robotics and IIoT-enabled systems.

Emerging technologies like augmented reality (AR) can play a critical role in overcoming Queensland's geographic and workforce challenges. For regional and SME-based employers, AR allows trainers to deliver high-quality, hands-on instruction remotely, reducing travel requirements, minimising downtime, and enabling consistent access to expertise. Trainers can guide apprentices or employees in real time, using AR to demonstrate complex training, maintenance or servicing procedures directly on site. This approach not only supports equitable access to training across the state but enhances problem-solving and operational efficiency within businesses.

Training providers can build on models like MSQ's Industry Trainer Program, which supports industry professionals to transition into training roles by providing practical upskilling and mentoring. Providers can also test and scale new approaches through dedicated 'training sandboxes' – controlled, low-risk environments where new content, technologies, or teaching methods can be trialled, evaluated, and refined before broader implementation. These sandboxes provide a practical platform to experiment with blended learning, VR/AR integration, and collaborative teaching models that prepare both trainers and learners for the future of manufacturing work.

Priority actions:

- Deliver targeted upskilling programs for trainers in emerging technologies.
- Invest in updated training equipment and infrastructure aligned to modern industry practices.

Long term actions:

- Establish 'training sandboxes' to trial, refine and scale innovative approaches to vocational education delivery.

Industry / employers

Including large manufacturers, small-to-medium manufacturers and industry peak bodies.

7. Build workforce capability to meet future manufacturing needs.

Employers are uniquely placed to lead skills development for the technologies and processes they are adopting. Building workforce capability means ensuring current employees are equipped with the technical skills and confidence to operate in increasingly digital and automated environments. Conducting internal capability assessments helps businesses understand readiness and shape effective upskilling strategies. Using an industry capability assessment tool can further help businesses identify their current level of digital maturity and highlight practical steps, training options, and support available to advance along the Industry 4.0 and 5.0 spectrum.

Supporting staff to participate in short courses and targeted upskilling in Industry 4.0 and 5.0 capabilities helps employees gain the digital competencies needed to work with emerging technologies.

Businesses can trial automation tools in a controlled way and build staff confidence in new operating models by piloting small-scale technology implementation projects, such as deploying cobots in repetitive or low-risk production tasks. Findings and lessons from these pilots could be shared across the manufacturing community, creating a culture of collaboration and continuous improvement that helps SMEs learn from one another's experiences.

Priority actions:

- Manufacturers conduct internal capability assessments to identify current and future skill gaps in relation to Industry 4.0 and 5.0 technologies — with support from MSQ.
- Manufacturers support trades staff to participate in accredited short courses and targeted upskilling.
- Large manufacturers pilot small-scale technology implementation projects involving trades staff.

8. Communicate clear career pathways to boost attraction and retention of talent.

Attracting and retaining talent in manufacturing relies on clear, credible career progression and a culture of development. This includes visible and appealing entry points for young people, career changers and underrepresented groups, as well as progression opportunities for existing workers. Peak bodies and larger employers have a key role in promoting these pathways and challenging misconceptions that manufacturing offers limited long-term prospects. The manufacturing workforce needs to understand that the sector provides enduring career opportunities – with skills that are transferable across sub-industries, pathways into leadership or management, and even routes to business ownership or entrepreneurship. At its heart, manufacturing is about designing and making solutions to real-world problems – a foundation that can support both professional growth and innovation.

Highlighting real-world career journeys via platforms like Manufacturing Matters improve the perception of careers in manufacturing.

Manufacturing Matters is a Queensland-based initiative that showcases modern manufacturing careers through case studies, career profiles, and digital media, helping to reshape public perceptions of the sector. Within businesses, practical tools such as skills passports, dual-skilling programs (performing across multiple roles or skillsets), and visual career maps or organisational charts can help employees see how to advance to the next level. These mechanisms make development opportunities transparent and reinforce that manufacturing offers long-term, evolving, and rewarding career paths.

Priority actions:

- Peak bodies and large manufacturers communicate engaging and realistic career pathways to attract and retain talent, and challenge assumptions that upskilling leads to attrition.

Long term actions:

- Manufacturers establish structured internal learning pathways, supported by investment in employee development and succession planning.

9. Invest in partnerships and early talent engagement.

Early engagement is critical to building Queensland's manufacturing talent pipeline. School-aged students, parents and teachers often have limited visibility of the career opportunities available in advanced manufacturing. Technician-in-residence roles, where experienced industry professionals are embedded within training organisations to share practical expertise and co-deliver training, offer another way to bridge the gap between industry and education.

Employers and peak bodies can learn from successful Queensland programs such as the Queensland Minerals and Energy Academy (QMEA), which operates in over 100 schools delivering workshops, site visits, and camps.[11] Similarly, Construction Skills Queensland runs Construction Pathways events that use VR, live-site tours and pre-trade programs to engage students.[12]

With Manufacturing Skills Queensland (MSQ) holding the Advanced Manufacturing Gateway to Industry Schools Program (AMGISP), the organisation is well positioned to build on these models. By expanding regionally relevant experiences, such as industry visits, VR demonstrations, curriculum resources, teacher professional development, and pre-vocational learning, MSQ can inspire the next generation of skilled workers. MSQ's ongoing initiatives, including work experience guides, the School to Work Transition project, and Structured Workplace Learning opportunities, further strengthen these connections between schools and industry.

Priority actions:

- Peak bodies and large manufacturers promote manufacturing careers through targeted campaigns modelled on proven industry initiatives.

Long term actions:

- Manufacturers invest in long term partnerships with training providers, including through embedded models such as 'technician-in-residence' roles.
- Peak bodies and large manufacturers build strong links with schools and pre-vocational programs to develop the future manufacturing workforce and improve public perception of the sector.

[11] Queensland Resources Council, Hands-on STEM and trade program cracks 100 schools in QLD, 2 May 2024. Available at: https://www.qrc.org.au/hands-on-stem-and-trade-program-cracks-100-schools-in-qld/

[12] Construction Pathways (Construction Skills Queensland), Programs – Construction Pathways, 2025. Available at: https://constructionpathways.com.au/programs/

09

CONCLUSION

Queensland manufacturing stands at a decisive crossroads where our collective response to automation, digitalisation, and sustainability imperatives will determine whether we capitalise on emerging opportunities or fall behind in the global manufacturing revolution.

Queensland's manufacturing trades are undergoing significant evolution. The integration of automation, digital systems and sustainability imperatives is redefining the skills and capabilities required across traditional, emerging, and support occupations. This transition presents both a challenge and a critical opportunity: to ensure the state's skilling systems, training products and industry partnerships remain fit for purpose in an increasingly complex and competitive manufacturing environment.

The actions outlined in this report provide a practical and strategic blueprint for that evolution. Immediate priorities – such as refining training package structures, embedding core digital and sustainability capabilities, and scaling modular upskilling – can begin to close urgent gaps. Longer-term reform will depend on sustained collaboration to build new qualifications, modernise delivery models, and strengthen workforce capability across the industry.

Realising this opportunity will depend on shared commitment:

- **Policymakers** must create the conditions for reform by modernising incentives, updating qualifications, and supporting innovation across the VET system.
- **Training providers** must design and deliver learning that reflects the realities of Industry 4.0 and 5.0 -applied, adaptive and co-designed with industry.
- **Employers** must help shape the future workforce by investing in capability development, trialling new technologies, and promoting clear, credible career pathways.

Queensland has the industrial base, institutional strength and strategic intent to lead this next phase of manufacturing development. The task now is to translate insight into action – ensuring that manufacturing trades remain central to the state's economic resilience, in regional and metropolitan areas, and a cornerstone for its future prosperity.

APPENDIX

Table 8 establishes that each of the 12 key occupations is supported by one or more nationally recognised qualification.

Table 8. Relevant qualifications by occupation

Occupation	Qualification
Fundamental trades	
Baker	Certificate III in Baking [FBP30521] Certificate IV in Baking [FBP40221]
Boilermaker	Certificate III in Engineering – Fabrication Trade (Boilermaking) [MEM30319]
Butcher	Certificate III in Meat Processing (Retail Butcher) [AMP30815]
Cabinet maker	Certificate III in Cabinet Making and Timber Technology [MSF30322]
Fitter & turner	Certificate III in Engineering – Mechanical Trade (Fitting) [MEM30219]
Machinist	Certificate III in Engineering – Mechanical Trade (Machining) [MEM30219]
Meat process worker	Certificate II in Meat Processing (Abattoirs) [AMP20316] Certificate III in Meat Processing (Slaughtering) [AMP30516]
Welder	Certificate III in Engineering – Fabrication Trade (Welding) [MEM30319]
Emerging trades	
Mechatronics engineer	Certificate IV in Engineering [MEM40119] Diploma of Applied Technologies [MEM50822] Advanced Diploma of Engineering Technology – Electrical [UEE62122] Bachelor of Engineering (Mechatronics)
Robotics technician	Certificate IV in Engineering [MEM40119] Certificate IV in Industrial Automation and Control [UEE43220] Diploma of Engineering - Advanced Trade [MEM50119]
Support roles	
Assembly worker	Certificate II in Engineering [MEM20105]
Process plant operator	Certificate II in Process Plant Operations [PMA20116] Certificate III in Process Plant Operations [PMA30120] Certificate IV in Process Plant Technology [PMA40116]

To assess how well each qualification supports development of the five core capabilities, we applied a qualitative scale ranging from "None" to "Very high." This scale considered both the depth and structure of content coverage – for example, whether a capability was merely introduced or embedded through multiple units and explicitly linked to current technologies.

Ratings were informed by a close review of training package content, including the presence of relevant units of competency (such as MEM07015 for CNC programming), typical elective groupings (e.g. automation streams in MEM40119 or MSM40116), and the overall level of qualification (with higher-level qualifications like Certificate IVs or Advanced Diplomas typically offering deeper technical content).

Table 9. Capability development for Industry 4.0 and 5.0 by qualification

Qualification	Digital Tools	Robotics & Automation	Data Interpretation	AI Integration	Sustainability Practices
Certificate III in Baking [FBP30521]	Low relevance	Low relevance	Low relevance	Not required	Moderate relevance
Certificate IV in Baking [FBP40221]	Moderate relevance	Low relevance	Moderate relevance	Low relevance	High relevance
Certificate III in Engineering – Fabrication Trade (Boilermaking) [MEM30319]	Low relevance	Moderate relevance	Low relevance	Low relevance	Moderate relevance
Certificate III in Meat Processing (Retail Butcher) [AMP30815]	Low relevance	Low relevance	Low relevance	Not required	Moderate relevance
Certificate III in Cabinet Making and Timber Technology [MSF30322]	Moderate relevance	Low relevance	Low relevance	Not required	Moderate relevance
Certificate III in Engineering – Mechanical Trade (Fitting) [MEM30219]	Moderate relevance	Low relevance	Low relevance	Not required	Moderate relevance
Certificate III in Engineering – Mechanical Trade (Machining) [MEM30219]	High relevance	Moderate relevance	Low relevance	Low relevance	Low relevance
Certificate II in Meat Processing (Abattoirs) [AMP20316]	Not required	Low relevance	Not required	Not required	Low relevance

Key: Not required · Low relevance · Moderate relevance · High relevance · Very high relevance

Qualification	Digital Tools	Robotics & Automation	Data Interpretation	AI Integration	Sustainability Practices
Certificate III in Meat Processing (Slaughtering) [AMP30516]					
Certificate III in Engineering – Fabrication Trade (Welding) [MEM30319]					
Certificate IV in Engineering [MEM40119]					
Diploma of Applied Technologies [MEM50822]					
Advanced Diploma of Engineering Technology – Electrical [UEE62122]					
Bachelor of Engineering (Mechatronics)					
Certificate IV in Industrial Automation and Control [UEE43220]					
Certificate II in Engineering [MEM20105]					
Certificate II in Process Plant Operations [PMA20116]					
Certificate III in Process Plant Operations [PMA30120]					
Certificate IV in Process Plant Technology [PMA40116]					

Key: Not required | Low relevance | Moderate relevance | High relevance | Very high relevance

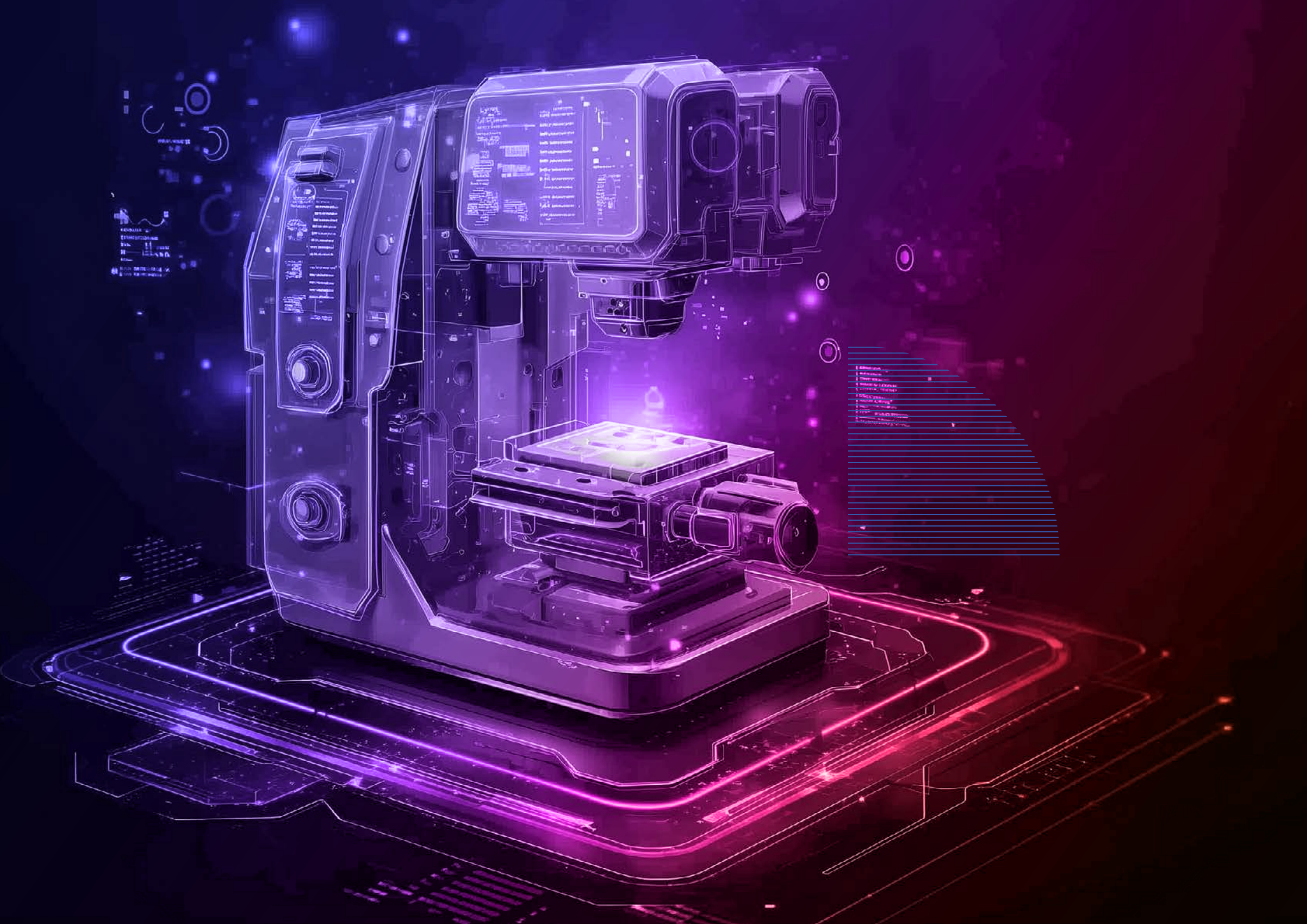
Table 10. Role description and capability requirements in Industry 4.0 and 5.0 by occupation

	Digital Tools	Robotics & Automation	Data Interpretation	AI Integration	Sustainability Practices
Fundamental trades					
Baker Mix, bake and package products using a blend of artisanal and technology enabled methods.					
Boilermaker Cut, shape and weld metal structures using digital simulation and robotic assistance.					
Butcher Prepare and portion meat products using traditional knife skills alongside automated cutting and packaging tools.					
Cabinet maker Design and construct custom furniture using traditional methods and digital design tools.					
Fitter & turner Build, install and maintain machinery using traditional fitting skills and digital diagnostics.					
Machinist Produce precision components using manual and CNC tools; operate in cyber-physical environments.					

Key: Not required | Low relevance | Moderate relevance | High relevance | Very high relevance

	Digital Tools	Robotics & Automation	Data Interpretation	AI Integration	Sustainability Practices
Fundamental trades					
Meat process worker Perform animal processing tasks in high-throughput, sensor-monitored environments with strict hygiene protocols.					
Welder Join metal parts using manual and automated tools; interpret data and operate robotic welders.					
Emerging trades					
Mechatronics engineer Design integrated systems that connect mechanical, electrical, and digital technologies for smart factories.					
Robotics technician Maintain robotic systems, fix faults, and ensure effective collaboration between people and machines.					
Support roles					
Assembly worker Assemble components using hand tools and smart technologies, working alongside collaborative robotics.					
Process plant operator Safely operate and monitor machinery for efficient production, guided by real-time digital systems.					

Key: Not required · Low relevance · Moderate relevance · High relevance · Very high relevance




MANUFACTURING
SKILLS
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