MAKE GREAT HAPPEN

tafe
Queensland
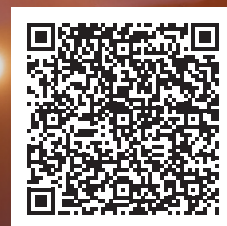
Innovate in the
SMART FACTORY LAB

Welcome to the Smart Factory Lab
at the Ipswich campus

Introducing you to the Smart Factory Lab, a cutting-edge facility designed to support the local manufacturing industry by providing a training facility for manufacturing industry workers for years to come.

TAFE Queensland is dedicated to adapting its training delivery methods to meet the evolving needs of the local industry. With rapid technological advancements and changing industry demands, this commitment is reflected in the integration of innovative technologies, the provision of remote learning options, and the development of specialised programs in advanced manufacturing.

Queensland's manufacturing workforce has maintained growth in recent years, despite cycles of expansion and contraction, the workforce remains 8% larger than pre-pandemic levels and continues to grow, increasing its share of the national workforce from 18.5% pre-pandemic to around 20% today. This shift highlights Queensland's role in driving national manufacturing growth, supported by strong links to resource producers.

TAFE Queensland leads Vocational Education and Training (VET) in the state, collaborating with government and industry to develop essential training for future workforces and the economy.

By analysing and addressing skills gaps, TAFE Queensland efficiently upskills and reskills workers to meet industry needs by developing a combination of accredited and non-accredited training resources for the industry.

The Smart Factory Lab offers a range of training options, from nationally recognised certificates and diplomas to skill sets, micro-credentials, and trade tasters for high school students as part of the TAFE at School program. The Technology and automation micro-credentials are a collection of courses designed to equip participants with the skills needed to navigate the world of new and emerging technologies. This collection includes courses on autonomous technologies, network fundamentals, cybersecurity, and digital transformation.

We look forward to your support and collaboration in advancing the capabilities of our local manufacturing workforce.

Kate Venables
General Manager,
South West Region
TAFE Queensland

The interconnected system is focused on:
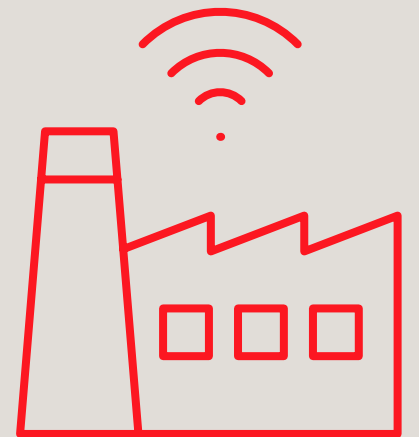
Taking a product from raw material to finished goods - hands free

Providing training and upskilling opportunities for technicians on industry standard cyber physical systems

Digital training tailored from an introductory level to diploma level

State-wide access through remote delivery

Hands-on experience with a range of advanced manufacturing technologies:

- Robotics
- Machine Vision
- Computer Numerical Control (CNC)
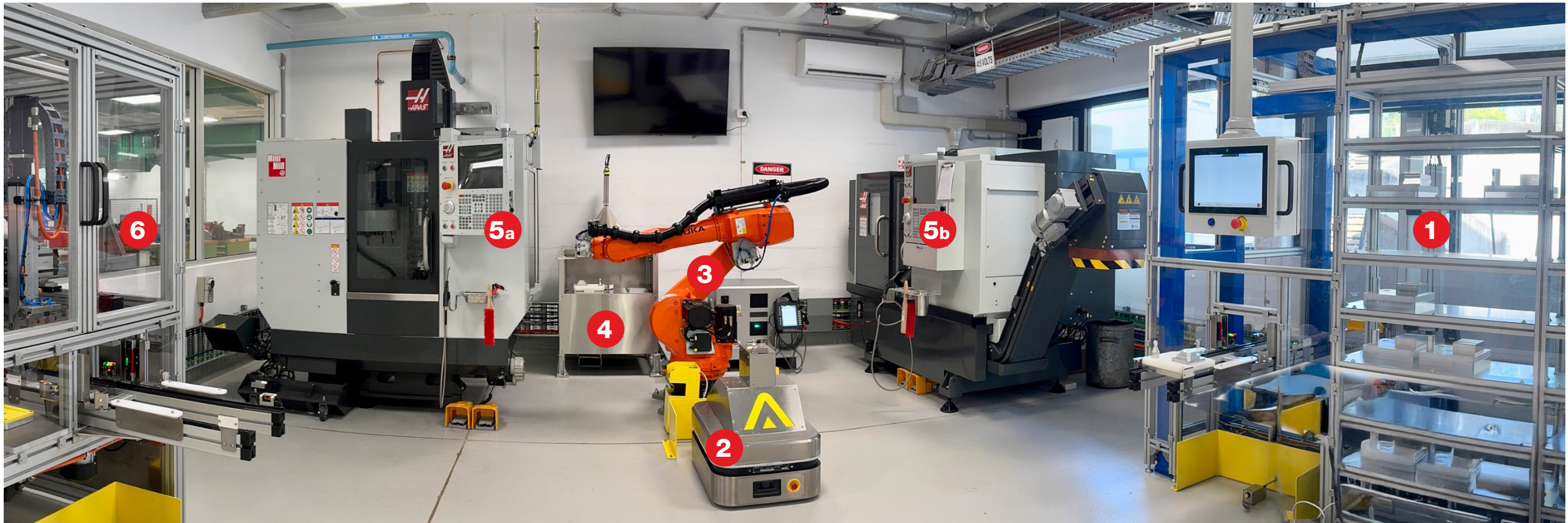- Intralogistics
- Control Systems

Smart Factory Lab features

1	The Smart Storage Shelf
2	OTTO Autonomous Mobile Robot (AMR)
3	Kuka Tending Robot
4	Machine Vision Station
5a	Haas Mini Mill
5b	ST-10 Turning Centre
6	Assembly Cell

(Haas Mini Mill and Haas ST-10 Turning Centre Education Package)

Features within the Smart Factory Lab

1 The Smart Storage Shelf

The Smart Storage Shelf is an advanced, automated storage solution designed to manage and track manufacturing trays within the smart factory environment. It receives trays either directly from an operator or via an Autonomous Mobile Robot (AMR) and uses a motorised 3-axis electric gantry system to pick and place trays into one of forty-eight designated storage locations. Each tray is serialised using an integrated Radio-Frequency Identification (RFID) scanner, allowing for precise tracking of components and seamless inventory management. Trays can be requested through a 12-inch Human-Machine Interface (HMI) located on the front of the unit, or automatically by the Line PLC for AMR retrieval. The system also includes AS4024-compliant fixed safety guarding, and comes with an operator and maintenance training package, offering a realistic, hands-on learning experience in smart warehousing and intralogistics.

Key benefits include:

✓ **Automated efficiency**: Your workforce can learn to manage inventory efficiently using automated systems, reducing manual errors and improving accuracy. The shelf provides real-time data on stock levels and usage patterns, helping make informed decisions and understand inventory dynamics.
✓ **Efficiency**: By automating routine tasks, the Smart Storage Shelf allows your workforce to focus on more complex aspects of their roles, improving overall productivity.
✓ **Hands-on skills**: Develop skills using advanced technologies and systems, preparing your team for modern manufacturing environments.
✓ **Safety training**: The shelf can help train in safe handling and storage practices, reducing the risk of accidents and improving workplace safety.

2 The OTTO Autonomous Mobile Robot (AMR)

The AMR is an advanced industrial automation solution designed to transport manufacturing trays between modular manufacturing units within the smart factory environment. Equipped with Light Detection and Ranging (LiDAR) mapping, job scheduling, and a conveyor top, the OTTO AMR enables us to program new travel paths, respond dynamically to obstructions—including people—and seamlessly integrate with each unit in the factory space. With the ability to pass through standard width doors and a payload capacity of seventy kilograms, it can also be loaded with materials like billets from external locations beyond the lab education space. By working with OTTO Motors' cutting-edge AMR technology, your workforce can gain hands-on experience with real-world automation systems that are increasingly vital to productivity in modern manufacturing.

Key benefits include:

✓ **Automated efficiency**: These robots provide immediate feedback and data analytics, helping your workforce to understand their performance and areas for improvement.
✓ **Efficiency**: OTTO AMR's automate material handling tasks, allowing your workforce to focus on more complex aspects of production and problem-solving.
✓ **Hands-on skills**: Your workforce can gain hands-on experience with automated mobile robotics, enhancing their technical skills in material handling, product movement, and familiarity with automated system.
✓ **Safety training**: Operate AMRs safely in a controlled environment, reducing the risk of accidents and improving overall workplace safety.

3 The Kuka Tending Robot

The Kuka Tending Robot will perform hands free loading and unloading of CNC machines in conjunction with the Kuka Sim (see Kuka Sim: Simulation Software page 9)

4 Machine Vision Station

Machine Vision in the smart factory environment is used to verify the accuracy and completeness of automated assembly processes. In this system, a vision station confirms that each component has been correctly picked and assembled before the manufacturing tray is ejected. Using a combination of pattern matching, shape recognition, and specification-based search algorithms, the vision system ensures consistent quality control. Beyond inspection, machine vision helps solve complex manufacturing problems and enhances production efficiency by reducing errors, supporting process automation, and enabling real-time validation of assembly tasks.

Key benefits include:

✓ **Automated efficiency**: Use machine vision systems for precise and consistent quality inspections, reducing errors and improving product standards. The system provides immediate feedback and data analytics, helping to understand performance metrics and make informed decisions.
✓ **Efficiency**: Machine vision automates repetitive tasks, allowing your workforce to focus on more complex aspects of production, thereby increasing overall efficiency.
✓ **Hands-on skills**: Develop skills in advanced Artificial Intelligence (AI) and machine learning technologies, preparing your workforce for modern manufacturing environments.
✓ **Adaptability**: Machine vision technology can be applied to various manufacturing processes, making it a versatile tool for training in different industry scenarios.
✓ **Safety training**: Machine vision systems can identify potential hazards and ensuring compliance with safety standards.

5 Haas CNC Mini Milling Machine and the Haas ST-10 Turning Centre Education Package

The Haas mini mill education package is a compact, high-performance CNC milling solution specifically designed for training environments and space-limited workshops. Featuring newly engineered base and column castings optimised through Finite Element Analysis (FEA), the updated mini mill offers larger axis travels, faster spindle speeds, and quicker rapids to boost production efficiency. Enhanced with a new Y-axis washdown nozzle for improved chip management and a 45-gallon (170 litre) external coolant tank for simplified maintenance, the mini mill provides a practical and reliable platform for us to learn modern machining techniques. Its compatibility with Haas robot packages and the compact Automatic Parts Loader (APL) also enables seamless integration into automated manufacturing workflows.

The Haas ST-10 turning centre is a compact, high-performance CNC lathe designed to deliver exceptional precision and reliability in industrial machining. Part of the Haas ST series, it offers a smaller footprint without compromising on rigidity, thermal stability, or setup flexibility. Equipped with a 6.5-inch chuck, the ST-10 is ideal for machining smaller components with high accuracy. It features Haas's industry-leading CNC controller for intuitive operation and supports seamless integration with robotic systems, making it well-suited for both manual and automated manufacturing environments.

Key benefits include:

✓ **Efficiency**: Advanced features include faster spindle speeds and larger travels, help with understanding and optimising production workflows.
✓ **Hands-on skills**: Your workforce can learn essential CNC programming and operation skills, which are critical for modern manufacturing processes.
✓ **Adaptability**: Program on the simulator and transfer files to Haas machines for real-world application. The education package includes instructional materials and real-world machine shop scenarios creating a great learning environment. A highlight of the Haas CNC Control Simulator, featuring a fully functional, upgradable control panel ideal for training or on-site demos. It offers simulated dry runs, tool length measurement, Direct Numerical Control (DNC) functionality, and USB support.
✓ **Safety training**: Learn and practice safety protocols in a controlled environment and reduce the risk of accidents.

6 The Assembly Cell

The Assembly Cell receives a manufacturing tray from either an operator or the autonomous mobile vehicle. Functionality including a dual push button is available for safe manual operating mode, as the tray enters the cell the RFID provides the PLC the build recipe for the components that are present on the tray. The vision system confirms the presence and quality of each of the components with a simple shape search vision program. The chain conveyor indexes the tray beneath the pneumatic assembly gantry which will pick and place each component into the finished assembly. The gantry has a rotating gripper allowing the reorientation of parts, basic twist assembly and press lock assembly functionalities. The vision system then confirms that each piece has been picked and assembled, and the manufacturing tray is ejected.

Key benefits include:

✓ **Automated efficiency**: These systems provide immediate feedback and data analytics, helping your workforce understand their performance and areas for improvement.

✓ **Efficiency**: Assembly cells can streamline training by automating repetitive tasks, allowing your workforce to focus on more complex aspects of production and problem-solving.

✓ **Hands-on skills**: Your team members can gain practical experience with advanced machinery and automation systems, improving technical skills and familiarity with modern manufacturing processes.

✓ **Adaptability**: Assembly cells can be reconfigured for different training scenarios, making them versatile tools for teaching various manufacturing techniques and technologies.

✓ **Safety training**: Learn to operate machinery safely in a controlled environment, reducing the risk of accidents and improving overall workplace safety.

Associated software used in the Smart Factory Lab

Emulate3D

Emulate3D is a powerful digital twin technology that plays a vital role in advancing smart manufacturing, equipping your workforce with the skills and knowledge needed to thrive in modern, technology-driven production environments.

This software can emulate a manufacturing process. Emulate3D is a powerful digital twin software platform that enables to simulate and visualise industrial automation systems in a virtual environment.

Within the controls and intralogistics subjects, your workforce can use Emulate3D to train on a digital replica of the assembly cell and smart shelf, including simulated operations of CNC machines, AMRs, and robotic and vision systems.

This simulation environment accurately mirrors the Smart Factory Lab located at the Ipswich campus, allowing your workforce to complete machine-level training in a safe, isolated setting. Emulate3D also supports the testing and refinement of system designs without the risks and costs of physical modifications, providing hands-on experience that closely reflects real-world factory operations.

Key benefits include:

✓ **Virtual prototyping**: Design, test, and refine virtual prototypes before physical implementation, significantly reducing costs and risks associated with real-world testing.

✓ **Realistic simulations**: Emulate3D delivers physics-based, highly realistic simulations of automated systems, enabling workers to safely explore and understand complex manufacturing processes in a controlled environment.

✓ **Improved efficiency**: By identifying potential control issues and optimising system designs early in the project lifecycle, Emulate3D streamlines both training and operational workflows.

✓ **Enhanced safety**: Your workforce can train using virtual models, minimising the risk of accidents and enhancing safety protocols without interrupting actual production.

✓ **Adaptability**: Supports a wide range of robots and machinery, making it suitable for diverse training scenarios and industry applications.

Kuka Sim (simulation software)

Kuka Sim is a simulation software suite designed for offline programming and virtual testing of Kuka robotic systems (robotic arm in the lab). Kuka Sim can be packaged and installed directly to PCs, providing the ability to learn how to write code for the Kuka Robot arm in a simulated fashion.

Key benefits include:

✓ **Virtual prototyping**: Design, test, and refine virtual prototypes before physical implementation, reducing costs and risks associated with real-world testing.

✓ **Realistic simulations**: The software provides realistic, physics-based simulations of automated systems, allowing practice to understand complex processes in a safe, controlled environment.

✓ **Improved efficiency**: By identifying potential issues and optimising designs early in the project lifecycle, kuka Sim helps streamline training and operational processes.

✓ **Enhanced safety**: Learn to operate machinery safely through virtual models, minimising the risk of accidents and improving safety protocols.

✓ **Adaptability**: This software supports a wide range of robots and machinery, making it versatile for various training scenarios and industry needs.

Computer Numerical Control (CNC) simulation station

The CNC Station features a vertical mill and turning simulation machine provided by Haas. Both stations are serviced by a KR50 (2100mm reach) Kuka robot that can move into the park position for operator access and training. When the operators are within the room the robot shall have safe move functionality enabled which can be reset to full speed operation from the safe access viewing area near the entrance of the room. The AMR will deliver billets from storage to the machine tending robot. The machine tending robot will interface with both machines placing parts onto buffer storage locations which features an RFID scanner for serialisation of the storage trays.

Key benefits include:

✓ **Realistic simulations**: Learn to read technical drawings, program CNC lathes and mills, and use CAD/CAM software, equipping your workforce with a comprehensive skill set.

✓ **Improved efficiency**: CNC technology automates complex tasks, enabling your workforce to focus on optimising production processes, integration with tending robotics and improving workflow efficiency.

✓ **Enhanced safety**: CNC machines provide a controlled environment for learning, reducing the risk of accidents and enhancing safety protocols.

✓ **Adaptability**: CNC training programs can be tailored to different levels of expertise, from entry-level operators to advanced specialists, making your workforce versatile for various training needs in campus based or remote access learning.
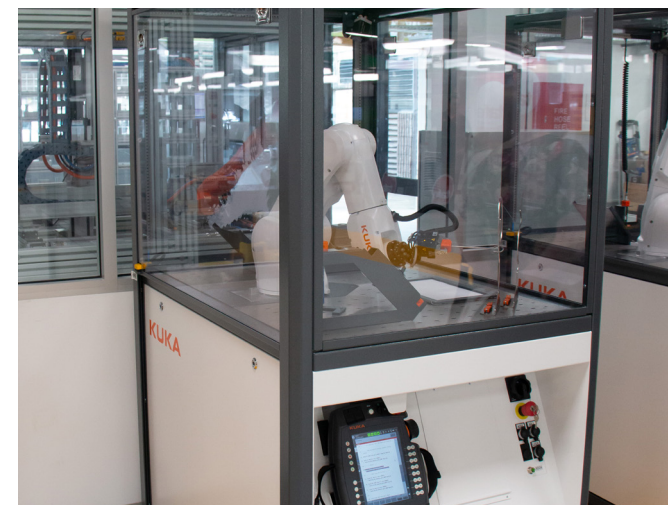
KUKA simulation software

Computer Numerical Control (CNC) simulation station

Meet the team

Col Batzloff

Col Batzloff has been a dedicated member of the TAFE Queensland team since 2007. With a wealth of experience in the education and manufacturing sectors, Col has significantly contributed to the organisation's growth and success. Before his current role as Faculty Projects Director, he served as the Faculty Director of Manufacturing for the Darling Downs and South West Region of TAFE Queensland.

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By integrating innovative technologies, offering remote learning options, and developing specialised programs in advanced manufacturing, TAFE Queensland is ensuring that employers and their workforce are well-prepared for the future. Industry professionals, and students can learn and explore Industry 4.0 in a new, vibrant and inspiring environment.

Col Batzloff

Kingsley Wright

Kingsley Wright is an engineering educator with 14 years' experience in training and education. His career in industry has taken Kingsley all over the world. Kingsley is teaching at TAFE Queensland's Metal Trades, Manufacturing, and Robotics Centre at the Ipswich campus, with a focus on executing advanced manufacturing techniques.

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TAFE Queensland has invested in manufacturing training resources in a big way – we're not just using general technology; we're using cutting-edge technology – TAFE Queensland have got everything!

Kingsley Wright

Aaron Nobbs

Aaron Nobbs is a TAFE Queensland educator, a seasoned boilermaker and fitter and turner in industry for roughly 20 years prior to joining TAFE Queensland. Aaron teaches the Certificate II, III, IV and Diploma offered in the advanced manufacturing faculty. His field of expertise is Computer Numerical Control (CNC) and robotics.

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The Smart Factory Lab will provide opportunities for students everywhere, not only are they going to be learning the fundamentals of robotics, electrotechnology and CNC, they're going to be able to remotely access this facility — wherever they are.

Aaron Nobbs

Training solutions with the Smart Factory Lab

The Smart Factory Lab will offer a range of training options, from nationally recognised certificates and diplomas to skill sets, micro-credentials, and trade tasters for high school students as part of the TAFE at School program.

Key Courses		Career Outcomes	Ways to study
10935NAT	Certificate II in Autonomous Technologies	✓ Junior Technician ✓ Junior Engineering Technician ✓ Junior Information Technology Technician	TAFE at School
MEM20422	Certificate II Engineering Pathways	✓ Engineering Apprentice	TAFE at School
MEM30219	Certificate III in Engineering - Mechanical Trade Machining	✓ Fitter, Turner	Apprenticeship
MEM40119	Certificate IV in Engineering	✓ Higher Engineering Tradesperson ✓ Special Class Engineering Tradesperson	Apprenticeship
MEM50822	Diploma of Applied Technologies	✓ Advanced Manufacturing Technician ✓ Cyber-Physical Systems Technologist ✓ Digital Technologist ✓ Industry 4.0 Systems Technician ✓ Internet of Things Data Technician	Apprenticeship

Customised training solutions

Our customised workforce training solutions are designed to give you industry-standard training, relevant to your business and staff.

From short courses and skill sets to higher level courses that meet legislative and licensing requirements across a wide range of industries, we can help you achieve great results.

// **FIND OUT MORE**

about Queensland Future Skills Partnership micro-credentials

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