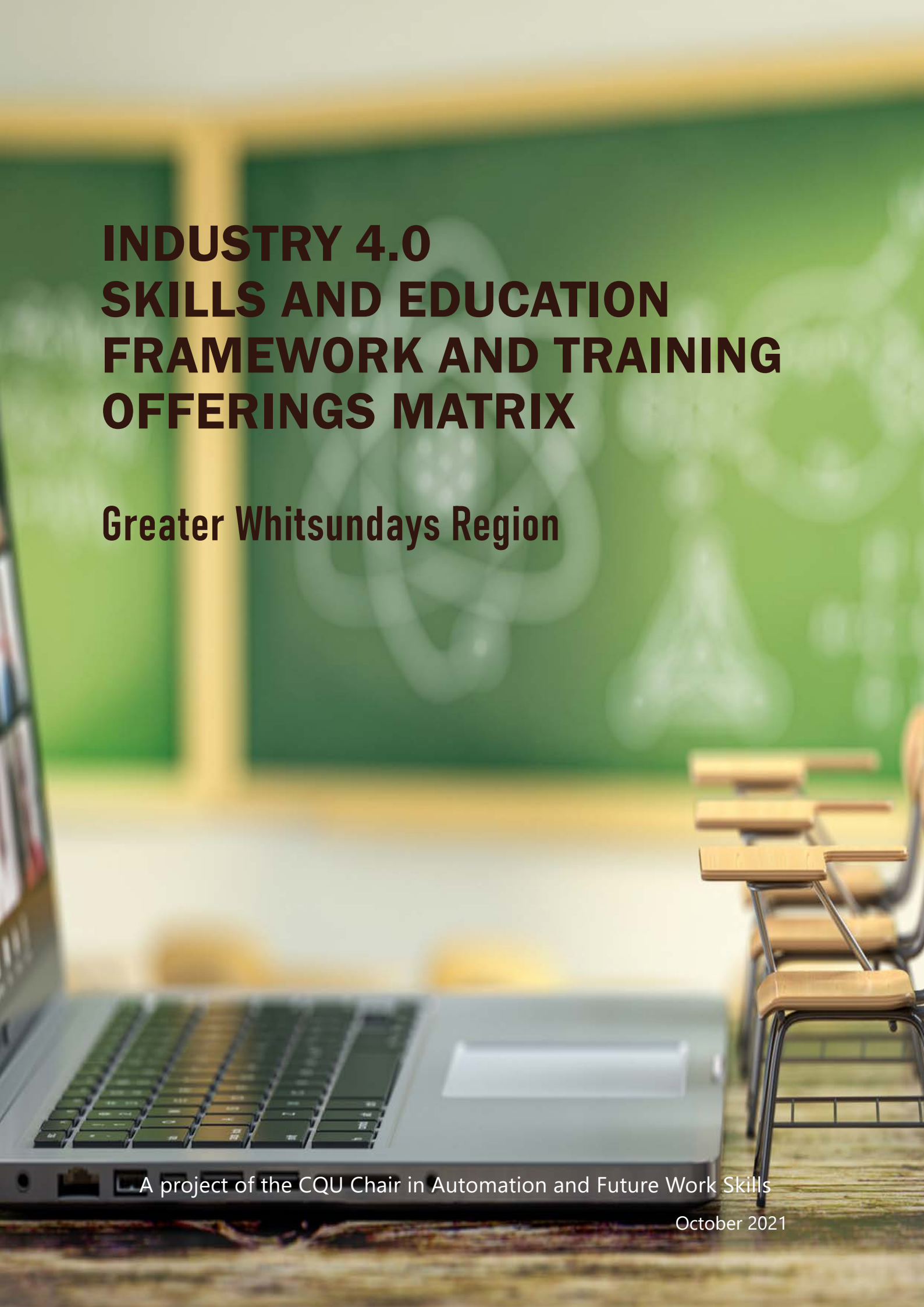


INDUSTRY 4.0 SKILLS AND EDUCATION FRAMEWORK AND TRAINING OFFERINGS MATRIX

Greater Whitsundays Region

A project of the CQU Chair in Automation and Future Work Skills

October 2021

About this work

This Industry 4.0 Education and Training Offerings Matrix for the Greater Whitsundays Region highlight research and emerging evidence in mapping education and training available for regional communities in the Greater Whitsundays Region to fully participate in future work opportunities. It considers currently available qualifications spanning the future Digital, Technical, Enterprise and Soft skills required for Industry 4.0 across the Australian Qualifications Framework (AQF) and potential career outcomes in the Mining and METS sector (pending further industry consultation). It is also foreshadowing similar work to be undertaken across the Agriculture, Health, SME, Construction and Defence Industry sectors. It proposes a departure point to deliver, in part, on key recommendations by the Greater Whitsunday Future Skills Roadmap namely to align training opportunities within the region to industry needs and standards and to inform the education and training pathways for emerging occupations.

This work is based on available literature, relevant internet sources and extensive desk-based research.

For any enquiries, please contact p.viljoen@cqu.edu.au.

Suggested citation

Viljoen, J.P., & Viljoen, R. (2021). Industry 4.0 Education Framework and Training Offerings Matrix for the Greater Whitsundays Region. Mackay, AU: Chair in Automation and Future Work Skills.

Copyright and Disclosure

Contents

Introduction 4

Methodology and Significance 4

Education and Training - prepare for I4.0 and beyond 5

Industry4.0 Skills and Offerings 8

Summary 13

Next Steps 14

Glossary 15

References 19

Introduction

Innovations underpinning Industry 4.0 (I4.0) are having a major impact on business and industry. This wave of new technologies has the potential to have a positive impact on business and industry specifically improving productivity levels, growth and responsiveness to global challenges, such as environmental sustainability. The associated risks relate to a potential increase in social inequalities, deterioration of working conditions and potential under- and/or unemployment due to automation[3-5], as was also evident during previous industrial revolutions.

I4.0 impacts businesses in the way they operate and is driven by the expectations of customers, the enhancement of products, collaborative innovation and organisational structures [6]. New technologies allow for physical products and services to be enhanced with digital capabilities that increase their value, making assets more durable and resilient. On the other side, data and analytics are transforming how these assets are maintained. Given the speed at which innovation and disruption are taking place, new forms of collaboration are required to assist with the plethora of customer experiences, data-based services, and asset performance through analytics [7].

Some essential aspects for businesses to be successful, and stay competitive, would be the revision of organisational structures as flexible hierarchies; implementing new ways to attract, retain and manage qualified individuals that are capable of implementing innovative ideas and strategies [8]; and developing innovative ways to evaluate and reward performance [7; 9]. While human capital and technological innovation will play the most important role in the success of companies, it will require ongoing training and upskilling of workers within these new employment relationships [8; 10].

Methodology and Significance

This work is conceptual in nature and derives its propositions from literature review and desk research of current scholarly publications, business press papers, professional reports, company (including university and training organisation) web pages, blogs and brochures.

Searches included secondary literature with the combination of various screening terms: 'industry 4.0' or 'automation' or 'future work skills' and 'qualifications' or 'courses' or 'higher education' or 'training'.

Digital, technical, enterprise and soft skills were identified as relevant to 'future work skills' mapped to 'qualifications' and 'courses' within the information and communications technology and engineering disciplines.

As for the scientific approach, it uses a qualitative design of research, the method of indirect observation and description presented in a matrix identifying gaps and opportunities. This integration matrix should be considered as a conceptual framework in which literature review and desk research lead to the development of theoretical propositions [11; 12] and to be further informed by targeted consultation.

This work aims to provide -

- A taxonomy of Industry 4.0 Digital and Technical skills and Enterprise and Soft skills, and education requirements based on a recent, comprehensive literature review.
- Examples of current education and training offerings targeted at Industry 4.0 (both available 'in region' and 'more generally' i.e. online) across the AQF.
- Identify potential gaps in training and education offerings at program (qualification) level.
- Link AQF levels to existing roles across a broad range of industries, where possible.
- A tool to progress industry consultation across a broad range of industries facing similar workfoce demands.

Education and Training – prepare for I4.0 and beyond

The impact of automation and digitisation across labour markets and a significant shift towards sustainability make it essential to future-proof workers from technological change and assist organisations by offering new skills to stay relevant. This technology-driven labour market change, accelerated by the COVID-19 pandemic, not only creates disruption but also creates new opportunities for redeployment and reemployment [11-13].

The acceleration in automation places a large percentage of repetitive jobs at risk of redundancy while creating the need for new roles and skills across industries. New jobs will increasingly require complex problem-solving, social and system skills and therefore require higher levels of education, training and specialised study. This rising predisposition to skill requirements disproportionately affects older and lower-income groups and those working in industries most susceptible to automation by new technologies [14].

Given the anticipated increase in the range of knowledge and skills with which workers would need to be equipped to adapt to remain productive and employable, education and training solutions should allow for the expanded scope of tasks in existing jobs.

Besides developing digital and technical skills and knowledge relevant to technological advancements, it is equally important to enhance the development of generic enterprise and soft skills which are essential for preparing workers to be flexible and to cope with the rapid changes in the future workplace as a result of disruptive technologies [9; 18].

- As regions adapt to the ongoing impacts of technology on businesses and workforces, organisations need to find new education and training opportunities to address the upskilling needs of their workforce to ensure they remain productive and employable amid I4.0.
- It necessitates a new mindset of continual development and lifelong learning to reskill the current workforce.
- It requires closer integration, collaboration and training partnerships between organisations and education and training providers, supported by the government and society, to equip people to meet these challenges [12; 15-17].
- Dialogue between industries and education providers can ensure that the requirements of the digital economy are reflected in training provisions.
- Improved mobility and pathways between vocational and higher education and between the different training and continuous professional development programs and systems are required
- Improved recognition of skills that are still relevant in the workplace, despite not being connected to an employee's specialist area, should be considered [17].

In their study, "Embracing Industrial Revolutions: A multi-faceted continuum of change and transformation fuelling ongoing adaptation", authors Viljoen and Viljoen [19], developed a competence model of the challenges imposed by the Fourth Industrial Revolution, as described by authors Hecklau, Galeitzke, Flachs and Kohl [20], linked to skills and competencies. [See Figure 1].

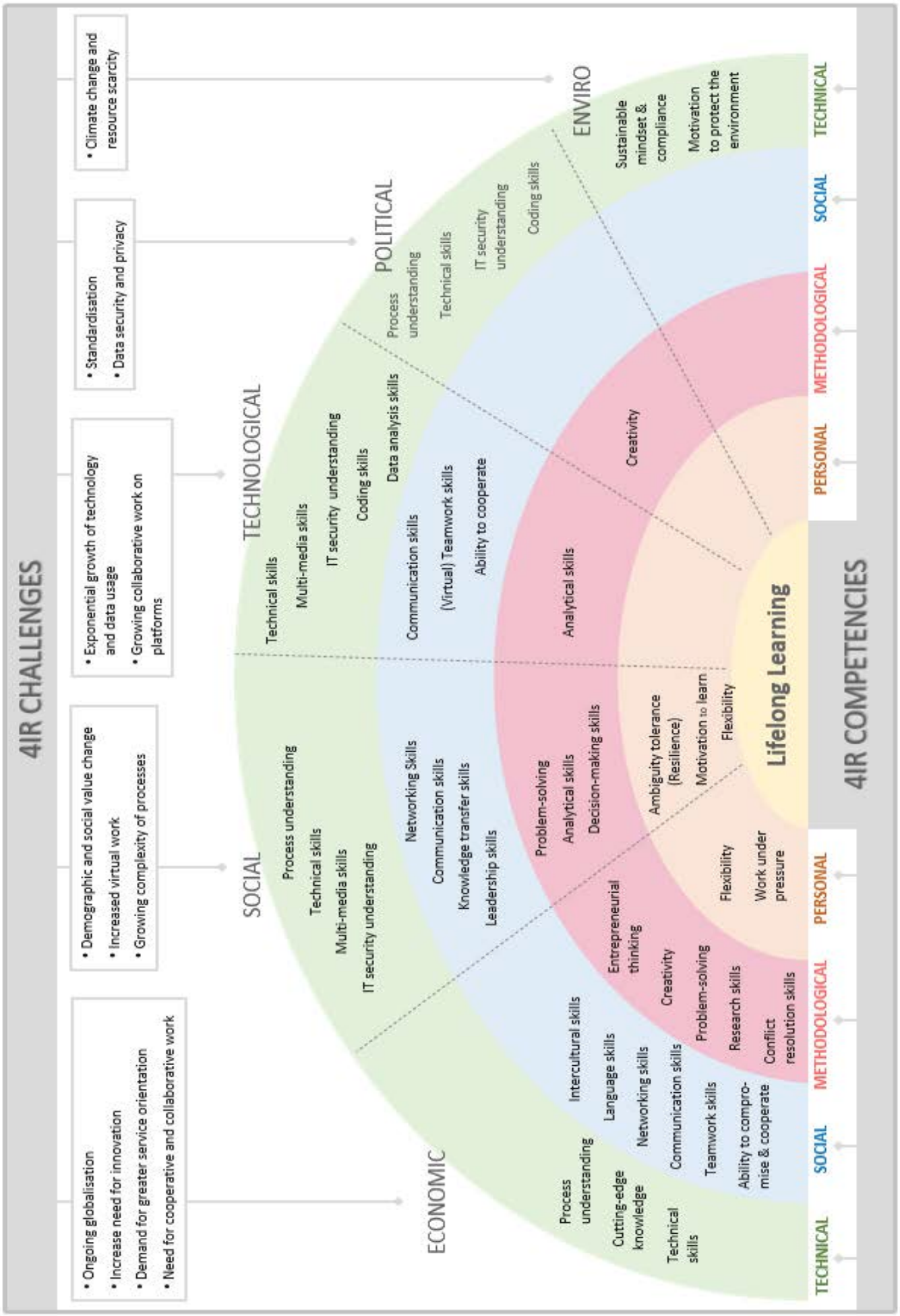


Figure 1. Competence model of the Fourth Industrial Revolution (4IR) [19 (p13)].

Figure 1 (page 6) shows the Competence model of the Fourth Industrial Revolution (4IR) [19], considering political, economic, social, technical, environmental and legal factors, with skills coloured according to the competency cluster in which they are categorised.

All workers need skills to interact with digital technology. Accordingly, education systems around the world ...

> **"need to create workers with the skills and competencies required to thrive in a continuously changing environment. The most important skill is the ability to acquire new skills — life-long learning"** [9].

Core skills, as identified by the Mackay Regional Jobs Committee in the Greater Whitsunday Roadmap [2], are the skills that will be required across broad-reaching workforces and essentially need to form the foundation of education and training programs for both new entrants and transitional workforces.

The core skills include those identified as technical skills (*see Figure 1*), while the additional component of enterprise and soft skills, identified as methodological and social skills should get attention to support long-term job success.

Although there is no question about the extent, urgency and universal nature of the future skills challenge, it also offers an opportunity to establish long-term, sustainable, equitable and inclusive growth for the education sector as well as the global workforce [12].

The workforce of today and the future generations needs to redirect its professional path due to the changes that digitalisation, automation and artificial intelligence progress have on the world of work.

Research and industry consultation suggests education and training programs should address the increased demand in digital and technical skill areas like robotics, cloud computing, big data and analytics, artificial intelligence, virtual reality, internet of things, business process analysis and design.

However, equally important, programs should prepare individuals for the service orientated roles and creative occupations where greater cognitive-adaptability, design-thinking and empathetic reasoning is required if workers are to fulfil their human potential in a machine-augmented future [15; 21].

The type of skills required by organisations that are changing to stay relevant in the global market, profoundly impacts on an individual's career path:

- It requires the need for individuals to develop processes of learning new skills (reskilling) to enable them to do a different job or train people to do a job differently. [10-13].
- It requires individual workforce transitioning plans "which identify the existing skills gaps against the career goal and the [cross-industry skilling and] development pathways to address these gaps" [2].

Industry 4.0 Skills and Offerings

The *CQU Chair in Automation and Future Work Skills* role was established to focus on the impact of automation (mainly in the Mining and METS industries) on regional cities and communities. The initiative is forward- looking and aimed at exploring, modelling and proposing how regional cities and communities could not only adapt to the rise of automation in the resources sector but actually grow their respective economies and take full advantage of such development.

As such, a key objective of the Chair is to drive the development of new innovative training qualifications and courses in automation and new/future work skills. This is planned to extend beyond the mining and METS sectors to include Agriculture, Health, SME's and Construction. It includes the task to deliver on key recommendation three (3) of the Greater Whitsunday Alliance (GW3) and KPMG's Future Employment Study [22] and the Greater Whitsunday Future Skills Roadmap [2] to align training opportunities within the region to industry needs and standards (p25) and to inform the education and training pathways for emerging occupations (p31).

In response to these recommendations, and covered in this work, a matrix is used to map current education and training offerings across universities, registered training organisations and industries. It considers current qualifications spanning the future digital and enterprise skills required for Industry 4.0 across the Australian Qualifications Framework (AQF) and potential career outcomes in the Mining and METS sector, with placeholders for the Agriculture, Health, SME, Construction and Defence Industry sectors.

Ten Digital and Technical skills and six Enterprise and Soft skills were identified as being the common denominators of skills that are required to fully participate in future work.

DIGITAL and TECHNICAL SKILLS

Robotics
Object-Oriented-Programming (C/C++, Python, Java, C#/.NET, MATLAB), technical design, information systems, maths, physics

(Industry) Internet of Things
IoT Sensors, devices, networks, protocols, device programming, data practices and security.

Cloud Computing
Programming, databases, security and privacy, agile development, operating systems, virtualisation, networking.

Cognitive Computing
AI, neural networks, machine learning, natural language processing, sentiment analysis, contextual awareness, human-computer interaction, algorithms.

Big Data & Analytics
Quantitative and statistical analysis, mathematics, data visualisation, machine learning.

Machine-to-machine Learning
Programming basics, mathematics (linear algebra, calculus), statistics, Python, ML Algorithms.

Extended Reality (AR, VR, MR)
3D modelling, animation, programming, game, human-computer interaction, prototyping, haptic technologies.

Artificial Intelligence
Python coding, data science, machine learning, mathematics, physics, statistics, networking, graphical modelling.

Cyber Security | Privacy
Basic data analysis, programming fundamentals, security design principles, IT systems components,. Cryptography

Industry 4.0
Technological drivers, impact on work and industries, digital literacy.

ENTERPRISE and SOFT SKILLS

About the matrix

The integration matrix, as a tool, aims to identify gaps and opportunities for education and training offerings spanning the future work skills required for Industry 4.0.

Research validated Digital, Technical, Enterprise and Soft skills are used as denominators to examine qualifications ranked in accordance with the Australian Qualifications Framework (AQF).

The AQF is the national policy for regulated qualifications in Australian education and training. It incorporates the qualifications from each education and training sector into a single comprehensive national qualifications framework. The organising framework for the AQF is a taxonomic structure of levels and qualification types each of which is defined by a taxonomy of learning outcomes. The taxonomic approach is designed to enable consistency in the way in which qualifications are described as well as clarity about the differences and relationships between qualification types.

- The AQF level is depicted in the first two columns of the matrix.
- The qualifications listed in the second column of the matrix are limited to the Information Communication and Technology and Engineering disciplines, as identified through the desk research.
- Skills are indicated in the vertical columns and an X illustrates the presence of the skill being included in the course description, course structure and/or learning outcomes of the qualification that addresses, to some extent, the relevant skillset. Empty boxes indicate that the specific qualification does not include a reference to the particular skill.
- The last column of the matrix indicates the availability of the qualification. An R indicates those qualifications available in the region, whereas an O refers to those qualification available online or on-campus outside the region.

The matrix gives insight into where skills gaps occur and the potential opportunities for the development of new innovative training qualifications and courses in automation and new work skills, in the Mining, METS, Agriculture, Health, SME Construction and Defence Industry sectors.

The extended 'career outcomes' matrix maps the identified qualifications across AQF levels 2-8 against the most applicable job role/persona of that level and the potential career outcomes for the Mining and METS industries - to be confirmed after consultation with industry stakeholders. There are placeholders for other industries to be completed pending further research and industry consultation.

Education and training offerings spanning the future work skills required for Industry 4.0

AQF	QUALIFICATION	**Automation | Robotics | Machine Vision** 00-Programming (C/C++, Python, Java, C#/.NET, MATLAB), technical design, information systems, maths,	**Cloud Computing** Programming, databases, security and privacy, agile development, operating systems, virtualisation, networking.	**Big Data & Analytics** Quantitative and statistical analysis, mathematics, data visualisation, machine learning.	**Extended Reality (AR/VR/MR)** 3D modelling, animation, programming, game, human-computer interaction, prototyping,	**Cyber Security | Privacy** Basic data analysis, programming fundamentals, security design principles, information assurance fundamentals, IT systems	**(Industry) Internet of Things** IoT Sensors, devices, networks, protocols, device programming, data practices and security.	**Cognitive Computing** AI, neural networks, machine learning, natural language processing, sentiment analysis, contextual awareness, human-computer interaction, algorithms, data mining.	**Machine-to-Machine Learning** Programming basics, mathematics (linear algebra, calculus), statistics, Python, ML Algorithms.	**Artificial Intelligence** Python coding, data science, machine learning, maths, physical, statistics, Bayesian networking/graphical	**Industry 4.0** Technological drivers, impact on work and industries, digital literacy.	**Communication | Virtual Collaboration** Face-to-Face, virtual, oral, written, nonverbal, listening.	**Higher-Order Thinking** Problem-solving, adaptive, critical and analytical thinking and decision-.	**Teamwork and Collaboration** Face-to-face and virtual teams.	**Leadership | Management** Influence, guide, coach, delegate, organise and plan.	**Ethical Competence | Social Responsibility** Responsible actions in work situations; context-appropriate behaviour, respect, conflict resolution.	**Customer | Service Orientation** Focus on customer, provide service, keep end-user in mind.	**Regional | Online or Other**
		DIGITAL and TECHNICAL SKILLS										ENTERPRISE and SOFT SKILLS						
8	Graduate Diploma Graduate Certificate																	
	Artificial Intelligence			X		X			X	X	X	X	X					O
	Cyber Security			X		X					X	X	X					O
	Data & Cyber Management			X		X					X	X	X	X	X	X	X	O
	Digital Transformation		X	X		X	X			X	X	X	X	X	X	X	X	O
	Information Systems	X					X			X	X	X	X	X	X	X	X	R
	Information Technology	X	X	X	X	X	X		X	X	X	X	X	X	X			R
	Information Technology Fundamentals		X	X		X	X	X	X	X	X		X					O
	Engineering				X		X				X	X	X	X	X	X		R
	Information Systems	X	X	X			X				X	X	X	X	X		X	R
	Information Technology	X	X	X					X	X	X	X	X	X	X		X	R
	Mining				X		X				X		X					O
7	Bachelor Degree																	
	Applied Cloud Technology	X	X	X		X	X		X	X	X	X	X	X	X	X	X	O
	Cognitive Enterprise			X					X	X	X	X	X	X	X	X	X	O
	Computer Science	X	X	X	X	X	X		X	X		X	X	X	X	X	X	O
	Cyber Security		X	X		X	X					X	X			X	X	O
	Design and Technology Innovation	X	X				X	X	X	X		X	X	X	X	X		O
	Digital Enterprise	X		X	X		X		X		X	X	X	X	X		X	O
	Digital Media	X	X		X					X	X	X	X	X	X	X	X	R
	Engineering (Mechatronics, Resource Systems) (Honours)	X		X	X		X		X	X	X	X	X	X	X	X	X	R
	Engineering (Robotics) (Honours)	X					X		X		X					X		O
	Engineering Technology			X			X				X	X	X					R
	Information Technology	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	R
	Technology and Innovation	X	X	X	X	X	X		X		X	X	X	X	X	X		O
6	Adv Diploma Ass Degree																	
	Applied Technologies (No new enrolments)	X		X		X	X				X	X	X	X	X	X		R
	Applied Technologies - Advanced Manufacturing	X	X	X	X	X	X		X	X	X		X	X				O
	Digital Media	X	X		X					X	X					X	X	R
	Information Technology	X	X		X	X	X		X	X	X	X	X	X	X	X	X	R
	Engineering (Mining et al)				X		X		X		X		X	X	X	X		R
	Advanced Diploma of Industrial Automation	X		X			X				X							O
5	Diploma																	
	Aerotropolis Industry 4.0 (Mechatronics)	X					X			X	X	X	X	X			X	O
	Information & Communications Technology	X	X	X		X						X	X	X		X	X	R
	Information Technology	X	X		X	X	X					X	X	X	X	X	X	R
	Digital Enterprise	X	X	X			X			X		X				X	X	O
	Applied Cloud Technologies	X	X	X		X	X				X	X	X	X		X	X	O
	Applied Technologies		X		X		X				X		X	X				R
	Science and Technology			X							X		X					O
	Information Technology (UG Certificate)	X	X	X					X		X	X	X				X	R

Education and training offerings spanning the future work skills required for Industry 4.0
(continues)

AQF	QUALIFICATION	**Automation | Robotics | Machine Vision** OO-Programming (C/C++, Python, Java, C#/.NET, MATLAB), technical design, information systems, maths,	**Cloud Computing** Programming, databases, security and privacy, agile development, operating systems, virtualisation, networking.	**Big Data & Analytics** Quantitative and statistical analysis, mathematics, data visualisation, machine learning.	**Extended Reality (AR/VR/MR)** 3D modelling, animation, programming, game, human-computer interaction, prototyping,	**Cyber Security | Privacy** Basic data analysis, programming fundamentals, security design principles, information assurance fundamentals, IT systems	**(Industry) Internet of Things** IoT Sensors, devices, networks, protocols, device programming, data practices and security.	**Cognitive Computing** AI, neural networks, machine learning, natural language processing, sentiment analysis, contextual awareness, human-computer interaction, algorithms, data mining.	**Machine-to-Machine Learning** Programming basics, mathematics (linear algebra, calculus), statistics, Python, ML Algorithms.	**Artificial Intelligence** Python coding, data science, machine learning, maths, physical, statistics, Bayesian networking/graphical	**Industry 4.0** Technological drivers, impact on work and industries, digital literacy.	**Communication | Virtual Collaboration** Face-to-Face, virtual, oral, written, nonverbal, listening.	**Higher-Order Thinking** Problem-solving, adaptive, critical and analytical thinking and decision-	**Teamwork and Collaboration** Face-to-face and virtual teams.	**Leadership | Management** Influence, guide, coach, delegate, organise and plan.	**Ethical Competence | Social Responsibility** Responsible actions in work situations; context-appropriate behaviour, respect, conflict resolution.	**Customer | Service Orientation** Focus on customer, provide service, keep end-user in mind.	Regional | Online or Other
		DIGITAL and TECHNICAL SKILLS										ENTERPRISE and SOFT SKILLS						
4 Cert IV	Engineering	X					X				X	X	X	X		X		R
	Industrial Automation & Control	X					X				X		X	X				R
3 Certificate III	Automotive Electrical Technology						X					X	X	X		X	X	R
	Information, Digital Media & Technology		X				X				X	X	X			X	X	R
	Information Technology	X	X		X	X	X				X	X	X	X			X	R
2 Certificate II	Applied Digital Technologies	X	X	X	X	X				X	X	X	X	X		X	X	R
	Autonomous Technologies	X	X				X				X	X	X					R
	Autonomous Workplace Operations	X	X	X			X			X	X	X		X				R
	Engineering - Production Technology						X				X	X	X	X		X		R
	Information, Digital Media & Technology		X			X	X				X	X	X	X		X	X	R
	Integrated Technologies	X	X	X	X		X					X	X	X			X	R
1 Certificate I	Certificate I qualifications in Information Technology and Information, Digital Media and Technology superseded by Cert II qualifications VET in Schools.																	
Not on AQF Short Course | Industry Module | Certification	Applied Industry 4.0										x							o
	Connecting with the Internet of Things						x											o
	Creating engagement with virtual reality				x													o
	Digital Transformation Certification										x							o
	Effective Edge Computing		x															o
	Getting started with machine learning								x									o
	Industry 4.0 & Manufacturing Ingenuity (1-credit seminar course)										x							o
	Industry 4.0 Associate Certification Training										x							o
	Industry 4.0 Short Courses										x							o
	Industry 4.0 and Society (4.5 unit, elective)										x							o
	Industry 4.0 Introductory Course										x							o
	Transforming the workplace using AI									x								o
	Understanding Augmented Reality				x													o
	Using robots and RPA in the workplace	x																o
	Foundational Digital Skills Pilot Program	x	x	x	x	x	x	x	x	x	x							R

Career Outcomes for Mining and METS

AQF	QUALIFICATION	Location	Persona	INDUSTRIES: Mining and Mining Equipment, Technology & Services (METS)	Agriculture	Construction	Health	SME	Defence
8 Graduate Diploma Graduate Certificate	Artificial Intelligence	O	ENGINEERS | IT SPECIALISTS | MANAGERS	IT Artificial Intelligence Specialist					
	Cyber Security	O		Security Analyst, Security System Developer/Programmer					
	Data & Cyber Management	O		Chief Information Security Officer, Head of Cyber Security, Head of Digital Transformation Security					
	Digital Transformation	O		Software Engineer					
	Information Systems	R		ICT Support Technician					
	Information Technology	R		ICT Support Technician, Programmer					
	Information Technology Fundamentals	O		IT professional					
	Engineering	R		Qualified Mining Engineer					
	Information Systems	R		IT professional					
	Information Technology	R		Network Specialist, Programmer, Database Administrator, Server Specialist, App Developer, High-level System Architecture Manager					
	Mining	O		Mining Engineer, Site Manager					
7 Bachelor Degree	Applied Cloud Technology	O		Network Support and Operating Systems Management, Cloud Support Engineer, Systems Engineer					
	Cognitive Enterprise	O		Business Analyst, Big Data Manager, Change Management Consultant, Business Process Analyst, Digital Transformation Consultant					
	Computer Science	O		Network Specialist, Programmer, Database Administrator, Server Specialist, App Developer, High-level System Architecture Manager					
	Cyber Security	O		Security Analyst, Security System Developer or Programmer, Business Continuity or IT Security Engineer					
	Design and Technology Innovation	O		Product Designer, Business Development Manager, Graduate Consultant, Commercialisation Specialist, Innovation Strategist					
	Digital Enterprise	O		Digital Business Innovations Manager					
	Digital Media	R		Corporate Communications Manager					
	Engineering (Mechatronics) (Honours)	R		Electrical Engineer, Controls & Automation Engineer, Process Control Engineer, Mining Engineer					
	Engineering (Robotics) (Honours)	O		Mining Engineer, Mechatronics Specialist, Process and Automation Specialist, Robotics Sensor Integration Specialist					
	Engineering Technology	R		Engineering Technologist					
	Information Technology	R		Programmer, Developer, Software Engineer, Data/Information Analyst, ICT Support Engineer					
	Technology and Innovation	O		Data Scientist, Software Engineer, Systems Analyst, Business Intelligence Developer, Infrastructure Manager, Enterprise Architect					
6 Adv Diploma Ass Degree	Applied Technologies	R	DOMAIN SPECIALISTS	Digital Technology Specialist					
	Applied Technologies - Adv Manufacturing	O		Mechatronic/Manufacturing Technologist, Maintenance Planner, Mine Deputy					
	Digital Media	R		Digital Media Specialist, Web/Graphics Designer, Corporate Communications Specialist					
	Information Technology	R		Network Administrator, Programmer, Database Administrator, App Developer, System Architecture Technician					
	Engineering (Mining et al)	R		Engineering Associate					
	Advanced Diploma of Industrial Automation	O		Automation/Maintenance Supervisor, Equipment Tradesperson, Machine Repairer, Technician					
5 Diploma	Aerotropolis Industry 4.0 (Mechatronics)	O	TECHNICIANS	Structural Engineer / Project Manager, Telecommunications Specialist					
	Information & Communications Technology	R		Database Administrator, ICT Customer Support Technician/Officer					
	Information Technology	R		Security Analyst, Database/Systems Administrator					
	Digital Enterprise	O		Digital Product Innovation Developer, Data & Business Information Professional					
	Applied Cloud Technologies	O		Technical Support Level 1, Installation & Support Consultant					
	Applied Technologies	R		Advanced Manufacturing Technician, Cyber-Physical Systems Technologist					
	Science and Technology	O		Scientist					
	Information Technology (UG Certificate)	R		IT Support Officer					
4 Cert IV	Engineering	R		Level II Engineer Tradesperson					
	Industrial Automation & Control	R		Industrial Automation & Control Technician					
3 Cert III	Automotive Electrical Technology	R	OPERATORS | ASSISTANTS	Automotive (Electrical) Technician					
	Information, Digital Media & Technology	R		IT Technician/User Support Officer					
	Information Technology	R		IT Technician/User Support Officer					
2 Cert II	Applied Digital Technologies	R		Software Technical Support					
	Autonomous Technologies	R		Trainee / Apprentice					
	Autonomous Workplace Operations	R		Trainee / Apprentice					
	Engineering - Production Technology	R		Maintenance / Machine Repairer					
	Information, Digital Media & Technology	R		Office Assistant					
	Integrated Technologies	R		Technology Assistant					

PENDING FURTHER RESEARCH AND INDUSTRY CONSULTATION

Summary

- Note that qualifications in Information Technology, Information Systems, and Engineering are available from the majority of universities and training organisations in Australia with similar course structures. In these instances, they were only listed once and where applicable identified as being regionally available.
- A total of 48 qualifications were identified nationally and mapped across level 1-8 of the AQF - Figure 2.
- Of the total 48 qualifcations mapped, 28 are being offered within the region - Figure 3.
- Digital and Technical skills are being addressed - to some extent - within regionally available qualifications and presents the opportunity to further investigate the topics and assessment included - Figure 4.
- Soft and Enterprise skills are being addressed - generically - in most qualifications available as it forms part of most training packages and learning outcomes of all qualifications - Figure 5.
- Although the identified skills are being addressed, the focus on Industry 4.0 are not explicit within a single qualification or pathway/suite of qualifications.

Figure 2.
Qualifications (48) mapped across AQF Level 1-8.

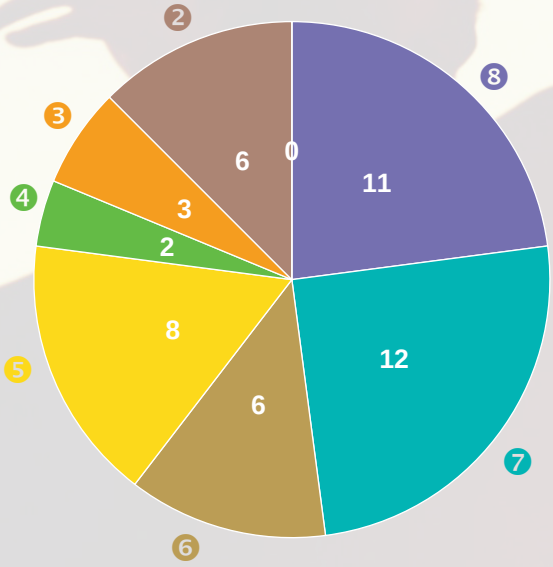


Figure 3.
Qualifications (28) available in the region.

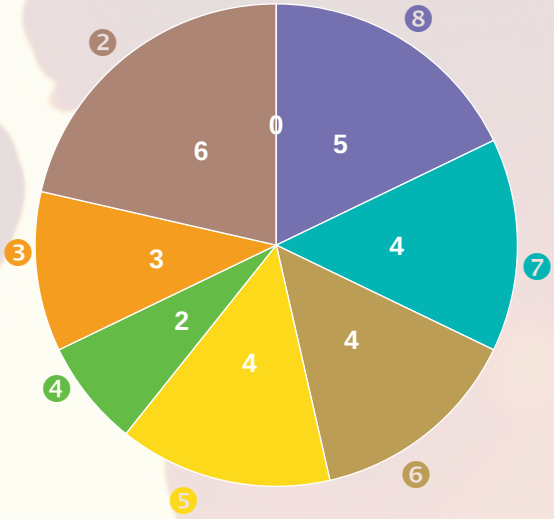


Figure 4.
Digital and Technical Skills - Regional Offerings

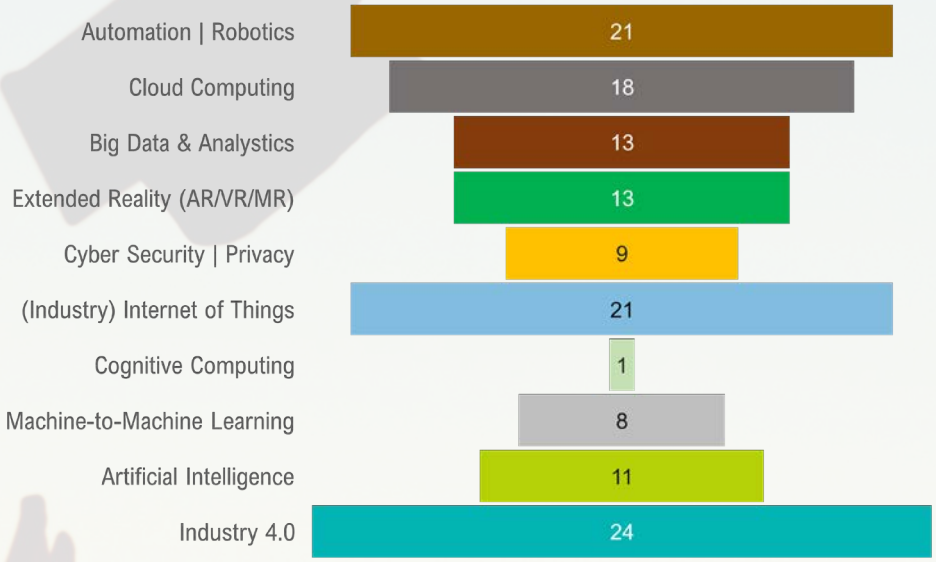
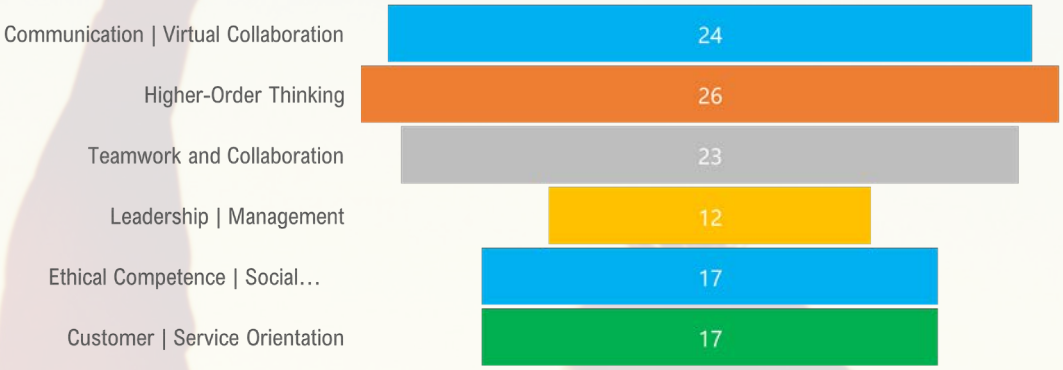


Figure 5.
Enterprise and Soft Skills - Regional Offerings



Next Steps

1. Examine and map the education and training offerings that are regionally available against the matrix at individual units, detailed topic and assessment criteria level – November 2021.

2. Undertake further research and industry consultation to identify career outcomes for the Agriculture, Construction, Health, SME and Defence Industry sectors - April 2022.

3. Undertake consultation with different industry sectors to determine industry-specific requirements for new program development. Priorities being Mining and METS (early 2022) with other identified sectors to follow and be completed (Dec 2022).

The outcome of this work has the potential to inform education providers, community and industry on aspects related to current and future workforce preparation and/transitioning to Industry 4.0. An important element of success will be the close engagement with industry and government to ensure training courses are relevant and practical for Queensland's industries.

Glossary

A

Australian Qualifications Framework (AQF)

AQF Levels: Level summaries and qualification type learning outcomes descriptors

The Australian Qualifications Framework (AQF) is the national policy for regulated qualifications in Australian education and training. It incorporates the qualifications from each education and training sector into a single comprehensive national qualifications framework.

The organising framework for the AQF is a taxonomic structure of levels and qualification types each of which is defined by a taxonomy of learning outcomes. The taxonomic approach is designed to enable consistency in the way in which qualifications are described as well as clarity about the differences and relationships between qualification types.

Artificial Intelligence

Theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages. Include programming languages and other topics, such as: Python, data science, machine learning, AI, mathematics, statistics, Bayesian networking/graphical modelling, physics, coding.

B

Big Data and Analytics

The use of advanced analytic techniques against very large, diverse data sets that include structured, semi-structured and unstructured data, from different sources, and in different sizes from terabytes to zettabytes. Include advanced decision algorithms, real time analytics, quantitative and statistical analysis, mathematics, data visualisation and machine learning.

C

Cloud Computing

On-demand availability of computer system resources, especially data storage and computing power, without direct active management by the user. Large clouds often have functions distributed over multiple locations, each location being a data center. Include programming, databases, security and privacy, agile development, operating systems, virtualisation, networking.

Cognitive Computing

The use of computerized models to simulate the human thought process in complex situations where the answers may be ambiguous and uncertain. Include: AI, neural networks, machine learning, natural language processing, sentiment analysis and contextual awareness, human-computer interaction, algorithms, data mining.

Communication

Face-to-Face, virtual, oral, written, nonverbal, listening. Communicate and present; business communication and digital communication - platforms and etiquette.

Customer | Service Orientation

Business philosophy that puts the needs of the customer over the needs of the business - thinking that aligns business goals with customer's goals.

Cyber Security

The application of technologies, processes and controls to protect systems, networks, programs, devices and data from information disclosure, theft of or damage to hardware, software, or electronic data, and the disruption or misdirection of the services. It aims to reduce the risk of cyber-attacks and protect against the unauthorised exploitation of systems, networks and technologies. Include basic data analysis, programming fundamentals, security design principles, information assurance fundamentals, IT Systems components, Cryptography.

E

Ethical Comptence

The conscious decisions and actions taken in situations - to feel obliged to one's own moral principles and to act responsibly taking into account legal standards as well as economical, ecological, and social consequences. Context-appropriate behaviour, respect, conflict resolution, relationship management, active listening.

Extended Reality (Augmented/Virtual/Mixed)

Augmented Reality (AR) adds digital elements to a live view often by using the camera on a smartphone e.g. Snapchat lenses, game Pokemon Go. Virtual Reality (VR) implies a complete immersion experience that shuts out the physical world. Extended Reality (XR) is the term referring to all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables, where the 'X' represents a variable for any current or future spatial computing technologies.

While AR was popularised through the recent Pokemon Go phenomenon, the applications for industry are more far reaching. Computer models and simulation results can be visualised through AR during the design stage, allowing for virtual prototypes to be examined in the physical world. IoT data can be visualised on a working product providing insight into internal conditions without the need for monitors, gauges or dials and entire factories can be overlayed with data to provide real time information about performance, materials and stock levels and much more. Sales and marketing teams can even use AR to demonstrate products to potential buyers without physical stock and examine various configurations or variations of a product on the fly.

Include 3D modelling, animation, programming, game technology, soundscapes, human-computer interaction, prototyping, haptic technologies.

H

Higher-Order Thinking

Problem-solving, adaptive, critical and analytical thinking and decision-making. Include concept formation, concept connection, getting the big picture, visualization, problem solving, questioning, idea generation, analytical (critical) thinking, practical thinking/application, and synthesizing/ creative thinking

I

Industry 4.0

Context of future work; an overview of the impact of technological advancements, tools, interconnectivity, automation, machine learning, and real-time data, smart technology, etc. Understanding digital terminology, including automation and augmentation and emerging technologies like Artificial Intelligence, Virtual Reality, Blockchain etc. (high level meaning and examples of applications in industry).

Internet of Things

Physical objects, that are embedded with sensors, processing ability, software, and other technologies, and that connect and exchange data with other devices and systems over the Internet or other communications networks. E.g., Smart home security systems, autonomous farming equipment, wearable health monitors.

The Internet of Things (IoT) enables insights into product performance, usage and customer experience that were not previously possible. Real time access to usage data provides companies with feedback that improves their products at every level – from initial design and manufacture to delivery and service to end of life management and iterative design improvements. The ability to fully understand not only the performance but also how a product is consumed by the end user facilitates better quality in-life service and transforms a simple 'thing' that leaves the factory into a service and ongoing relationship with customers over the lifecycle of the product and beyond.

Include IoT Sensors, devices, networks, protocols, device programming, data practices and security. Terminology include: IoT, IIoT and IoE – Internet of Things, Industrial IoT and Internet of Everything.

L

Leadership Skills

The ability of an individual or a group of individuals to influence and guide followers or other members of an organisation. Leading teams through skills in decision-making, public speaking, delegating, communication, conflict resolution, collaboration and taking ownership of the task at hand, planning and organising, building relationships (external and internal).

M

Machine-to-Machine Learning

The field of study that gives computers the capability to learn without being explicitly programmed (the process of teaching a computer system how to make accurate predictions when fed data). Enabling computers to tackle tasks that have, until now, only been carried out by people. Include programming basics, mathematics (linear algebra, calculus), statistics, Python, ML Algorithms.

R

Robotics

A combination of sophisticated programming and powerful hardware that make use of smart sensor technology to interact with the real world around it. An interdisciplinary field that integrates computer science and engineering. Robotics involves design, construction, operation, and use of robots. Include Object-Oriented Programming (C/C++, Python, Java, C#/.NET, MATLAB), technical design, technology, information systems, mathematics, physics

T

Teamwork

The collaborative effort of a group to achieve a common goal or to complete a task in the most effective and efficient way. This concept is seen within the greater framework of a team, which is a group of interdependent individuals who work together towards a common goal. Collaboration can be face-to-face or between virtual team members that is carried out via technology-mediated communication.

References

1. Australian qualifications framework second edition. 2013. https://www.aqf.edu.au/sites/aqf/files/aqf-2nd-edition-january-2013.pdf.
2. GWA. 2021. Greater Whitsunday Future Skills Roadmap. https://static1.squarespace.com/static/5e4ce5c91e5a64752b65c169/t/6011f81d0f7b8726d5b05e69/1611790399867/GW3_Future+Skills+Roadmap+Publication+%5BFinal%5D.pdf.
3. Chung H. 2021. Adoption and development of the Fourth Industrial Revolution technology: Features and determinants. . https://www.mdpi.com/2071-1050/13/2/871 .
4. Schwab K. 2017. The Fourth Industrial Revolution. https://books.google.com.au/books?id=0etrDQAAQBAJ.
5. Kang HS, Lee JY, Choi S, Kim H, Park JH, Son JY, Kim BH, Noh SD. 2016. Smart Manufacturing: Past research, present findings, and future directions. https://doi.org/10.1007/s40684-016-0015-5 .
6. Rossouw J. 2018. What does the Fourth Industrial Revolution mean for your business? https://insights.principa.co.za/what-does-the-fourth-industrial-revolution-mean-for-your-business.
7. Schwab K. 2016. The Fourth Industrial Revolution: What it means, how to respond. https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/.
8. Xu M, David HM, Kim SH. 2018. The Fourth Industrial Revolution: Opportunities and challenges. https://doi.org/https://doi.org/10.5430/ijfr.v9n2p90.
9. Seet P, Jones J, Spoehr J, Hordacre A. 2018. The Fourth Industrial Revolution: The implications of technological disruption for Australian VET. https://ro.ecu.edu.au/ecuworkspost2013/4821.
10. Ivaldi S, Scaratti G, Fregnan E. 2021. Dwelling within the Fourth Industrial Revolution: Organizational learning for new competences, processes and work cultures. https://doi.org/10.1108/JWL-07-2020-0127.
11. Cann O. 2020. The reskilling revolution: Better skills, better jobs, better education for a billion people by 2030. https://www.weforum.org/press/2020/01/the-reskilling-revolution-better-skills-better-jobs-better-education-for-a-billion-people-by-2030/.
12. Mehra A, Mann G, Green S. 2021. Reskilling the workforce, one person at a lifetime. https://www.weforum.org/agenda/2021/06/reskilling-the-workforce-lifelong-learning/.
13. Zahidi, S. 2021. Building back broader: 6 steps to a global jobs recovery plan. https://www.weforum.org/agenda/2021/06/building-back-broader-6-steps-to-a-global-jobs-recovery-plan/.
14. Davis N. 2016. What is the fourth industrial revolution? https://www.weforum.org/agenda/2016/01/what-is-the-fourth-industrial-revolution/.
15. Haenish, S. 2021. Four lessons in workforce skilling and lifelong learning. https://www.weforum.org/agenda/2021/05/back-to-school-4-lessons-in-workforce-skilling/.
16. Wightman, B. 2020. Hundreds of millions of workers need reskilling. Where do we start? https://www.weforum.org/agenda/2020/01/hundreds-of-millions-of-workers-need-reskilling-where-do-we-start/.
17. Kagermann H. 2013. Recommendations for implementing the strategic initiative INDUSTRIE 4.0. http://thuvienso.startupdanang.vn/bitstream/TTKHCNDaNang_123456789/357/1/Recommendations%20for%20implementing%20the%20strategic%20initiative%20INDUSTRIE%204.0.pdf
18. Thurston M, Hayes L. 2021. Will the 5th Industrial Revolution be the next renaissance? https://www.aurecongroup.com/blog/posts/5th-industrial-revolution-next-renaissance.
19. Viljoen JP, Viljoen R. (unpublished). Embracing industrial revolutions: A multi-faceted continuum of change and transformation fuelling ongoing adaptation. https://www.cqu.edu.au/research/organisations/chair-in-automation-and-future-work-skills.
20. Hecklau F, Galeitzke M, Flachs S, Kohl H. 2016. Holistic approach for human resource management in industry 4.0. https://doi.org/https://doi.org/10.1016/j.procir.2016.05.102.
21. World Economic Forum. 2020. The future of jobs report 2020. https://www.weforum.org/reports/the-future-of-jobs-report-2020#report-nav.
22. KPMG. 2020. Future Employment Study. Greater Whitsunday Alliance. https://static1.squarespace.com/static/5e4ce5c91e5a64752b65c169/t/5f72e20a6c7b762662a5b6fe/1601364627102/Future+Employment+Study-+28+Sept+FINAL.pdf.

CQUniversity
Chair in Automation and Future Work Skills

The Chair in Automation and Future Work Skills is funded by CQUniversity and BHP to coordinate research, outreach and engagement with relevant industries across Queensland, as well as to drive the development of new innovative training qualifications and courses in automation and new workplace skills beyond the mining sector, including in METS, Agriculture, SMEs and Construction.

BM Alliance Coal Operations Pty Ltd
BHP Community Project

The BHP Mitsubishi Alliance (BMA) is the largest Australian coal mining company operating in Central Queensland as a joint venture with BHP and Mitsubishi each owning 50%. They bring people and resources together to build a better world through policy, practice and partnerships.

The purpose of the partnership between BMA and CQUniversity is to bring people and resources together to unlock and accelerate skills, training and educational outcomes for the future in the communities of which they are part.

Scan this code using a QR Reader app on your smartphone to access THE INDUSTRY 4.0 SERIES.