



# Consultation paper

## Identification and prioritisation of new digital and technology content in training packages

### Background

As part of its \$585.3m Skills Package announced in the 2019/2020 Federal Budget, the Commonwealth is trialling new approaches to expand the role of industry in the national training system. These approaches will strengthen Australia's Vocational Education and Training (VET) system by ensuring it remains responsive, respected and flexible, providing Australians with the skills needed to succeed in modern workplaces and employers with the workers needed to grow a strong economy.

Initially two pilot Skills Organisations were announced for human services care and digital technologies. Recognising that the mining industry is at the forefront of industries undergoing large-scale skills shifts due to changing technologies and future global demands, the Australian Government announced mining as the third Skills Organisation pilot on 1 November 2019.

The [Joyce Review](#) proposed that these Skills Organisations be owned by industry and lead change to ensure the VET system better meets the needs of employers, the economy and learners. The Department of Education, Skills and Employment (the Department) is supporting target industries to develop and establish the pilots.

The Mining Skills Organisation Pilot (MSOP) was officially launched on 7 May 2020 by Senator the Hon Michaelia Cash, then Minister for Employment, Skills, Small and Family Business and the Hon Steve Irons, then Assistant Minister for Vocational Education and Training and Apprenticeships. The MSOP will be federally funded until 30 June 2023.

Following a national consultation and engagement process that involved industry and other key stakeholders, MSOP has established four 'project hubs' each of which is tackling a skills development issue of critical importance to the mining industry.

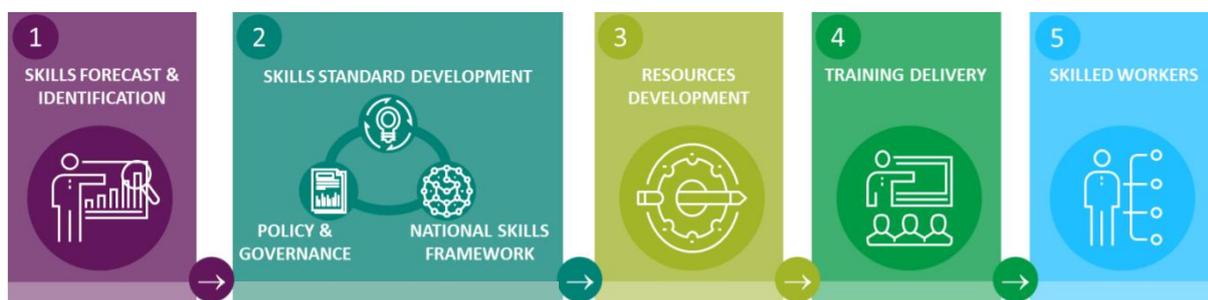
The 'digital transformation' project hub is set to develop a process and criteria for identifying new digital/technology related content for inclusion in training products to ensure the essential skills and knowledge needed to adopt and deploy new technologies are present as and when required by industry.

## Context

Australia's VET system can be conceptualised as a 'skills pipeline' comprising five stages (Figure 1). Each stage represents a key element of the skills development process and together, produce skilled workers that meet the evolving demands of Australian employers and the economy more broadly.

The first stage of the pipeline involves evidence-based, industry-validated intelligence on the factors shaping the skills profile and job composition of the workforce. It includes grassroots consultation to understand how new and emerging technologies are changing the skills and knowledge needed by an individual worker and whether those technologies are redefining existing job roles and reconfiguring job pathways.

**Figure 1. VET Skills Pipeline and its role in the development of a skilled workforce**



This validated intelligence is then used to inform a key element of stage two, the development and maintenance of skills standards, or nationally endorsed 'training packages' as they are currently termed. These are then used as the basis for delivery of training to both new entrants and existing workers.

This consultation paper is focussed on stage one and how, in the context of emerging technologies, we might reconceive the mechanism and speed with which we identify their impact on the workforce. This will not only strengthen the relationship between VET and Australia's innovation sector but also redefine the role and importance of VET in workforce development.

## Training packages

Nationally endorsed training packages remain a central pillar of Australia's VET system and are considered to be the embodiment of an 'industry-led' training system.

The first training package was endorsed back in 1997 and while the policy framework has been frequently reviewed since that time, industry remains responsible for training package development and maintenance.

Training packages comprise individual units of competency that codify the skills and knowledge needed to perform a job to the standard required in the workplace. The units are then packaged into qualifications that align to one or more job roles. Small groups of units may also be packaged into Skill Sets to enable learners to quickly upskill or meet a particular licensing or regulatory need.

Training packages do not capture the specifics of a technology. Rather, they codify the skills and knowledge needed to *apply* the type of technology - the intention being that the skills and knowledge acquired by the learner are as portable as possible across proprietary brands of technology.

The identification and codification of cutting-edge skills needed to adopt new and emerging technologies is currently undertaken by Industry Reference Committees (and their supporting Skills Service Organisations) as part of maintaining the currency of their training package.

The Resources and Infrastructure Industry Training Package captures the skills and knowledge needed for operational job roles in the metalliferous, coal, extractive, drilling and civil construction sectors. To optimise the portability of skills, many of the units of competency have been designed to be common between the sectors and where possible, qualifications have been designed to be relevant across the industry (Appendices A and B).

**RESOURCE AND INFRASTRUCTURE INDUSTRY TRAINING PACKAGE (RII 7.0)**  
50 qualifications from Cert I through to Advanced Diploma  
42 Skill Sets  
726 units of competency

As digital transformation continues apace, and new types of skills are needed to apply new and emerging technologies, training packages and the processes by which they are maintained and endorsed have come under pressure to be more responsive. Research has highlighted that not only does Australia have a high number of decision and approval points in comparison to similar international systems, but that there are also a high number of stages where stakeholders are consulted.<sup>1</sup>

MSOP believes that for the Resources and Infrastructure Industry Training Package, even within the current authorising environment, there are ways to significantly improve speed-to-market by focussing on the early identification and prioritisation of new digital/technology related content.

## New and emerging technologies

Australia's mining industry has long been recognised as the cornerstone of the Australian economy. In 2019-20, it delivered A\$202 billion or 10.4 per cent of gross domestic product. In doing so, it became the largest economic contributor to the Australian economy.<sup>2</sup>

*'Australia's future economic prosperity will depend on how well we can use our vast energy and mineral resources to play to our strengths, and how well we can adapt to follow the global market shift towards zero emissions.'*

Dr Larry Marshall, Chief Executive, CSIRO<sup>3</sup>

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<sup>1</sup> Wibrow B, Waugh J (2020) *Vocational qualification development: lessons from overseas*. NCVER, Australia

<sup>2</sup> <https://www.minerals.org.au/news/mining-largest-contributor-australian-economy-2019-20> accessed 08 July

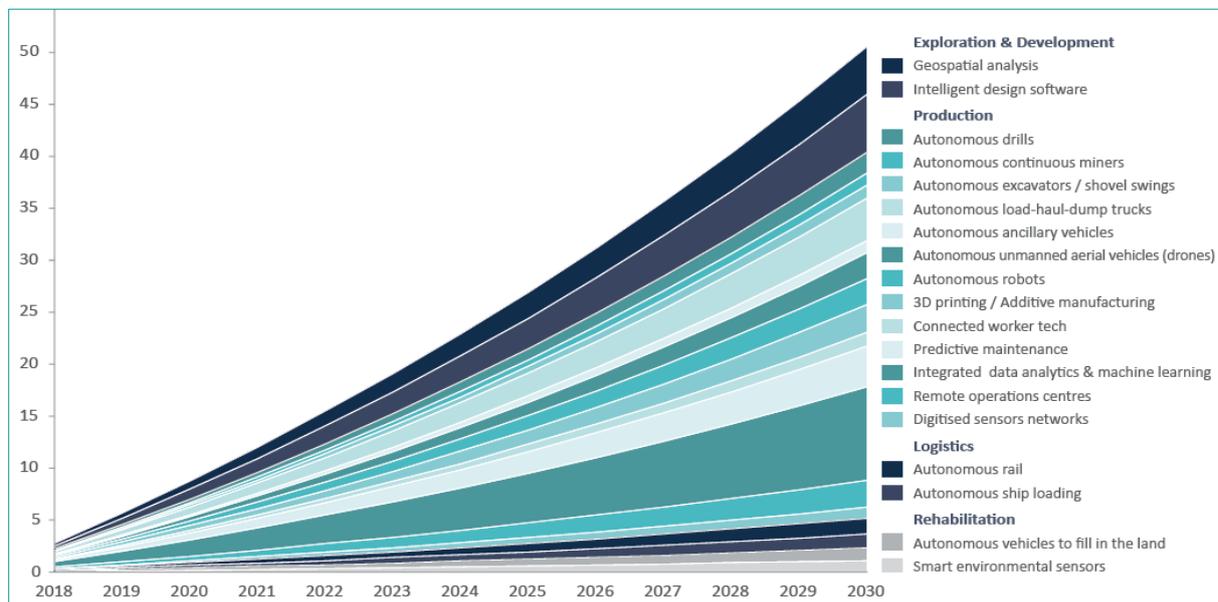
<sup>3</sup> Bruce S, Delaval B, Moisi A, Ford J, West J, Loh J, Hayward J (2021) *Critical Energy Minerals Roadmap*. CSIRO, Australia.

Australian mining is also a global leader in the application of technology and at the frontier of innovation to make the industry safer, more sustainable and more competitive across a range of commodities.

Technologies are revolutionising all aspects of mineral discovery, mining and processing. New sensing and sorting technologies are increasing mine productivity and safety. Automation in mining is reducing hazards and removing workers from harm. Automated analytical systems are helping acquire and process data across the minerals value chain, delivering faster and more reliable results.<sup>4</sup>

In 2030, the mining industry is expected to be able to generate an additional \$52 billion in Gross Value Added due to the deployment of key technologies (Figure 2).<sup>5</sup>

**Figure 2. Automation and robotics impact – additional value uplift by 2030 based on expected technology take up and impact**



Source AlphaBeta

Autonomous load and haul trucks, autonomous miners and predictive maintenance, along with integrated data analytics and machine learning, are expected to have the most significant impact on the sector (Appendix C).<sup>6</sup>

By 2034, it's predicted that 59 per cent of jobs in Australian mining will be enhanced or re-designed due to technology:

- 34 per cent of jobs will be augmented through new technologies;
- 25 per cent of jobs will be automatable.<sup>7</sup>

The impact of technology on the 10 most common roles in mining by 2034 suggests that they are more subject to augmentation than automation (Figure 3). While augmentation typically results

<sup>4</sup> <https://www.csiro.au/en/work-with-us/industries/mining-resources> - accessed 06 July 2021

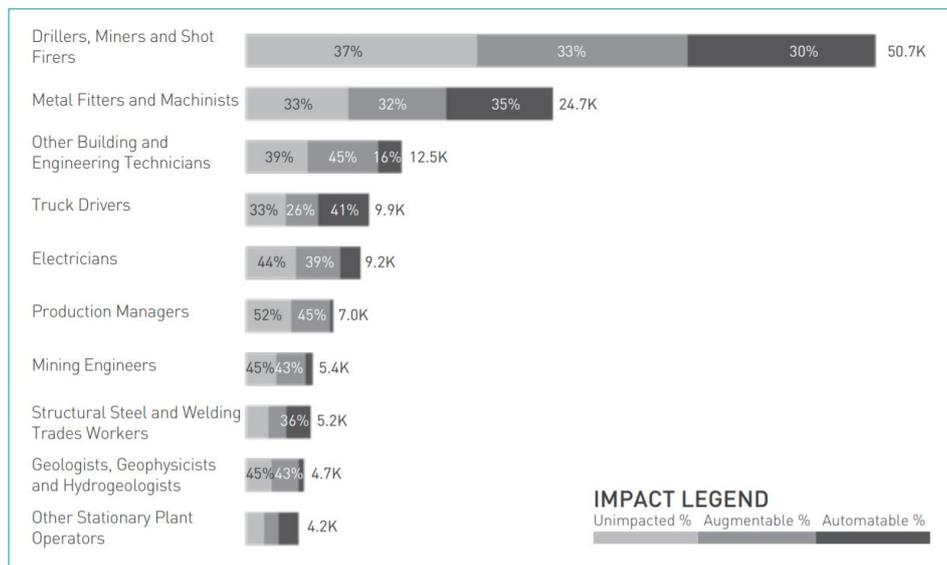
<sup>5</sup> AlphaBeta (2019) *Staying ahead of the Game*

<sup>6</sup> Ibid.

<sup>7</sup> Australian Computer Society and Faethm (2020) *Technology Impacts on the Australian Workforce*

in demand for upskilling, automation can trigger a need for upskilling or reskilling depending upon the portability and reconfiguration of skills into new job roles.

**Figure 3. Automation and augmentation of 10 most common mining job roles by 2034**



Source. Faethm and Australian Computer Society

There are 240,000 people directly employed by the resources sector and a total of 1.1 million direct and indirect jobs in the mining and mining equipment, technology and services (METS) sectors.<sup>8</sup>

### Identifying new digital/technology related content for training products

Although Australia has a strong reputation for world class research and innovation, due to a variety of factors, it has not been as successful in translating this research into valuable economic outputs. One of the factors has been identified as the availability of the skills, knowledge and capabilities needed to absorb new knowledge and to adopt and adapt new ideas within industry (absorptive capacity).<sup>9</sup>

The current VET system has no formal policy that systematically and comprehensively connects it to Australia’s Innovation Agenda or the bodies that have been progressively established to drive innovation and adoption of new technologies across the economy. This means that there is no formal ‘early warning’ mechanism that can methodically unpack the implications of new technologies on skills and job roles across the full economy.

Nationally endorsed training packages tend to be updated with new digital/technology related content once adoption levels have passed the ‘tipping point’ where industry is consciously choosing the ‘new’ technology over existing approaches.

Waiting until this tipping point before technology-related skills are identified and deliberately codified into training packages, can act as an unintended brake to accelerated adoption of

<sup>8</sup> <https://www.minerals.org.au/news/mining-largest-contributor-australian-economy-2019-20> accessed 08 July

<sup>9</sup> CSIRO Futures (2020) *Value of science and technology*. CSIRO, Australia

technology across the vast majority of industry and contribute to the loss of Australia’s research and innovation advantage.

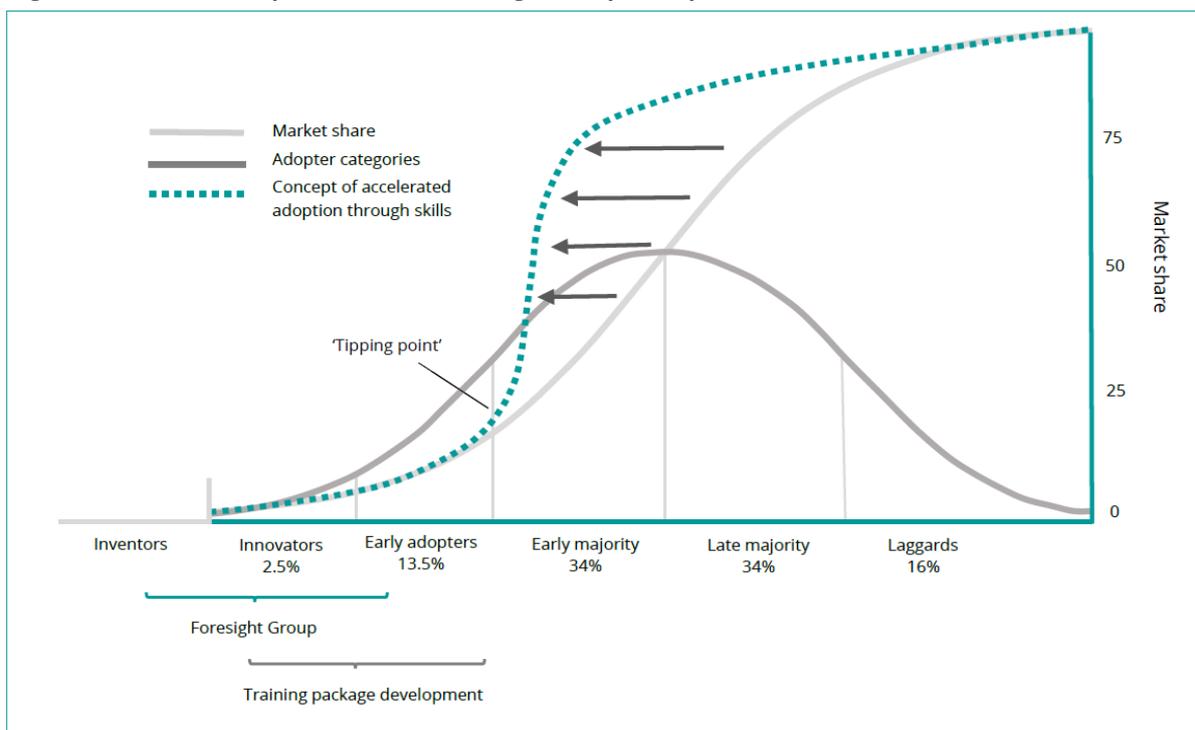
MSOP is therefore exploring how to significantly close the gap between the creation of new technologies and the identification of skills needed within the workforce to apply those new technologies and accelerate adoption.

## The Foresight Group

Although the rate at which new technologies are adopted can vary dramatically depending upon the industry and value proposition, those technologies that are commercially embraced typically follow the trajectory of the innovation adoption curve which groups the market into five categories based on their readiness to accept new ideas.

Working with this adoption model, MSOP is now exploring the concept of a Foresight Group comprising key stakeholders from the first two categories in the innovation adoption curve – the “innovators” and the “early adopters”. Importantly, it would include a third category of stakeholders drawn from those that operate well ahead of the curve – the “inventors” (Figure 4).

**Figure 4. Innovation Adoption Curve and Foresight Group concept**



The role of the Foresight Group would be tightly focussed on three areas:

1. Identification of new and emerging digital technologies relevant to Australia’s mining industry (which may include emerging technologies in adjacent industries or along the supply chain);
2. Advice on the likelihood of technology adoption/commercialisation, scale of adoption and timeframe; and
3. Advice on the implications for established mining practices in relation to job roles and the skills profile of the existing workforce.

It is envisaged that the Group would formally meet twice per year. Ultimately, the advice from the Foresight Group could be used in several ways, including:

- Updating existing units of competency or developing new units of competency;
- Redesigning existing qualifications to reflect how job roles are being reconfigured;
- Developing new qualifications to support new and emerging job roles;
- Developing new skill sets and enhancing existing qualification design to incorporate intra/inter-industry pathways that enable the workforce to upskill and/or reskill.

Although this paper considers the Group's role in the context of updating training packages, the three areas that it is proposed the Foresight Group provide advice are just as relevant to the concept of occupational standards/training standards (currently being tested by Skills Organisations as part of the qualification reform work being led by the Department).

Members of the Foresight Group would comprise:

- **The inventors** which would draw from those organisations at the cutting edge of Australia's Innovation Agenda and may include established Cooperative Research Centres (CRCs), recently announced Industrial Transformation Research Hubs<sup>10</sup> and the Commonwealth Scientific and Industrial Research Organisation, for example:
  - [CSIRO](#)
  - [MinEx CRC – Mineral exploration](#)
  - [CRC TiME – Transformations in Mining Economies](#)
  - [Innovative Manufacturing CRC](#)
  - [Industry Transformation Research Hub](#) in Intelligent Robotic Systems for Real-Time Asset Management
  - [Industry Transformation Research Hub](#) for Resilient and Intelligent Infrastructure Systems (RIIS) in Urban, Resources and Energy Sectors
- **The innovators and early adopters** would include those mining organisations recognised by industry as leaders in the adoption and scaled application of new technologies. It could also include mining contractors known for their agility and early adoption, and a range of Mining Equipment, Technology and Services (METS) companies known for commercialisation of new technologies:
  - [Fortescue Metals Group](#)
  - [Rio Tinto](#)
  - [OZ Minerals](#)
  - [Roy Hill](#)
  - [Hexagon Mining](#)
  - [Epiroc or Sandvik](#)
  - [Pybar](#)
  - [Petra](#)
  - [AEP Elical](#)

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<sup>10</sup> <https://www.arc.gov.au/news-publications/media/media-releases/74-million-bring-australian-research-and-industry-together> accessed 21 July 2021

### Who are the “Inventors”

**CSIRO** is Australia’s national science agency and works with industry, government and the research community to turn science into solutions. For the mining industry, its work focusses on frontier innovations, for example, longwall automation, rock mass modelling, in-situ recovery, tracking in underground mines, resource-specific logistics and smart mine mapping.

**Industry Transformation Research Hubs** are a Government initiative focussed on finding innovative solutions for key industry challenges in one or more of the ‘Industrial Transformation Priority’ areas which includes oil, gas and energy resources; and mining equipment, technology and services, critical minerals processing. There are two hubs announced in 2021 with relevance to the mining industry.

**Co-operative Research Centres** are a Government initiative that supports industries’ ability to compete and produce through industry-led collaborative research that brings together research bodies and industry organisations. Activities can include new research, proof of concept, pre-commercialisation activities, industry focused education and training. Launched in 1990, there are currently 20 CRCs being funded with five having direct relevance to the mining industry.

The value proposition for inventors’ participation in the Foresight Group is compelling. If discussion on their technology initiatives leads to the training package being updated with the skills and knowledge needed to apply that technology in industry, it potentially increases both the speed and scale of adoption.

The value proposition for participation of the innovators and early adopters is the opportunity to influence the speed with which the training package is updated and as a consequence, the speed at which the workforce can then be upskilled and made ready to adopt the new technology. Ensuring there is a sufficient supply of skilled workers to adopt new technology also alleviates skill shortages and dynamic inflation of labour costs.

Other organisations may be of value to the Foresight Group or find value in being exposed to its conversations, for example, the Australian Information Industry Association and the Digital Skills Organisation Pilot.

### Prioritisation of advice from the Foresight Group

Advice from the Foresight Group would need to be analysed to understand the implications for existing content and the design of the Resources and Infrastructure Industry Training Package.

The Group’s advice and proposals to include new digital/technology content in the training package will also need to be prioritised. Given the range of factors that influence prioritisation, it is proposed that a multi-criteria decision analysis approach (MCDA) be adopted (Table 1).

**Table 1. MCDA for prioritisation of new digital/technology related content**

CRITERIA	WEIGHTING (w)	PROPOSALS							
		Proposal A		Proposal B		Proposal C		Proposal D	
		Score (s)	Total (w x s)	Score (s)	Total (w x s)	Score (s)	Total (w x s)	Score (s)	Total (w x s)
1. <b>Portability</b> of skills between job roles	#%	H (2) M (1) L (0)							
2. Positive impact on <b>safety</b>	#%								
3. Positive impact on <b>productivity</b>	#%								
4. Positive impact on <b>sustainability</b>	#%								
5. <b>Speed</b> of technology adoption	#%								
6. <b>Likelihood</b> of technology adoption	#%								
<b>PRIORITISATION/TOTAL</b>	100%	n/a		n/a		n/a		n/a	

Criteria would be focussed on the impact of the new skills and knowledge – both on job roles and the more strategic priorities of the industry, for example, the positive impact of the technology on industry safety, productivity and sustainability. Criteria would also include the likelihood and speed of technology adoption. All criteria would then be weighted according to relative importance.

Once the various proposals are scored against each criteria, and then processed against the weightings, the prioritisation of proposals is complete.

Depending upon the nature and scope of the proposal/s, MSOP may choose to further validate the proposal/s through its industry networks and/or sector committees. Once this prioritisation and validation process is completed, MSOP would initiate the process for training package development and endorsement.<sup>11</sup>

### Supporting RTOs to lift the quality of outcomes and increase speed-to-market

Testing approaches to improve the quality of training delivery and enhance the quality of outcomes is part of MSOP’s formal role. In that context, the rich nature of the Foresight Group’s advice might also be used to support professional development of VET practitioners, especially as the pace of technology change will pose increasing challenges for the vocational currency of trainers and assessors.

The *Standards for Registered Training Organisations 2015* mandate that practitioners maintain currency of their industry skills and knowledge, and are able ‘to show how they have maintained, upgraded or developed new skills relevant to current industry needs’ (Figure 5).<sup>12</sup>

<sup>11</sup> The process assumes that under the new arrangements for industry engagement, MSOP has formal responsibility under the Commonwealth for the maintenance of the Resources and Infrastructure Industry Training Package.

<sup>12</sup> [www.asqa.gov.au](http://www.asqa.gov.au) *Users’ Guide to Standards for RTOs 2015* accessed 09.09.2021

**Figure 5. Vocational currency of VET practitioners – Standards for RTOs 2015**

*'Clause 1.13  
In addition to the requirements specified in clause 1.14 and clause 1.15, the RTO's training and assessment is delivered only by persons who have:*

- vocational competencies at least to the level being delivered and assessed*
- current industry skills directly relevant to the training and assessment being provided*
- current knowledge and skills in vocational training and learning that informs their training and assessment.'*

How to capture the Group's insights in such a way that also extracts practical value for VET practitioners may best be conceived through discussion with those RTOs considered to be high quality providers by the mining industry. Options might include the delivery of 'Insight' sessions involving members of the Foresight Group which could be further supported through the establishment of 'communities of practice' to create a sustainable approach to lifting the quality of training delivery and assessment more broadly.

A further option could be the development of training resources to help practitioners' delivery of the newly incorporated technology-focussed skills in the training package.

Prioritising which new training package content would have training resources developed, could be through an MCDA approach and associated criteria (Table 2).

**Table 2. MCDA for prioritisation of training resource development to support new technology content in the Resource Industry Training Package**

POSSIBLE CRITERIA	WEIGHTING (w)	PROPOSALS							
		Proposal A		Proposal B		Proposal C		Proposal D	
		Score (s)	Total (w x s)	Score (s)	Total (w x s)	Score (s)	Total (w x s)	Score (s)	Total (w x s)
1. <b>Portability</b> of skills between job roles	#%	H (2) M (1) L (0)							
2. <b>Projected enrolments</b> in the units, skill set or qual	#%								
3. <b>Availability</b> of alternative resources	#%								
4. <b>Shared investment</b> in development costs	#%								
5. <b>Complexity</b> of technology	#%								
6. <b>Speed</b> of technology adoption	#%								
<b>PRIORITISATION/TOTAL</b>	100%	n/a		n/a		n/a		n/a	

Building RTO capability in any new technology-related training package content will be fundamental to ensuring RTOs are both keen and able to deliver. The combined and cumulative benefit of 'Insight' sessions, communities-of-practice and authoritative training resources should also help improve the speed-to-market of the new training package content once endorsed by Skills Ministers.

# Consultation questions

- A. Are there any **key issues that pose a practical barrier** to the role and effectiveness of the Foresight Group?
- B. If there are key issues with the role or effectiveness of the Foresight Group, **how can these be addressed** whilst maintaining the principle of significantly improving the speed-to-market of technology-related content in training packages?
- C. What are the **key risks** that such a model needs to mitigate against?
- D. What are the **key criteria** against which proposals for new digital/technology content in the Resources and Infrastructure Industry Training Package should be evaluated (see Table 1)?
- E. Are there **additional ways** that advice from the Foresight Group might benefit the quality of VET?
- F. Are there **viable alternatives** to the Foresight Group concept that would significantly improve the speed-to-market of technology-related content in training packages?

## RII Resources and Infrastructure Industry Training Package

### Competency fields and sector relevance

Use of competency field by sector	Competency field code	Competency field to which units relate
<b>General fields of competence applicable to all sectors</b>	RIIRIS	Risk management
	RIIGOV	Governance and compliance
	RIIWHS	Work health and safety
	RIIENV	Environment
	RIIQUA	Quality
	RIICOM	Communication
	RIILAT	Leadership and teamwork
	RIIBEF	Business effectiveness
	RIIFIA	Financial administration and management
	RIIIMG	Information management
	RIICCR	Customer and community relations
	RIIPRM	Project management
	RIIARO	Autonomous and remote operations
<b>Technical fields of competence applicable to all sectors</b>	RIIBHD	Blasting hole drilling
	RIIBLA	Blasting
	RIISAM	Service and maintenance
	RIIHAN	Load handling
	RIIVEH	Vehicle operations
	RIISTD	Sampling, testing and data processing and recording
	RIIERR	Emergency response and rescue
<b>Technical fields of competence applicable to more than 2 sectors</b>	RIIMEX	Materials extraction
	RIISRM	Stockpile and reclaim material
	RIIMPO	Mobile plant operations
	RIIPRO	Processing (general)
	RIIPEO	Plant and equipment operations
	RIICAR	Conservation and rehabilitation
	RIIWMG	Water management
	RIIWBP	Waste and by-products
	RIIRAI	Resources and infrastructure
	RIISDM	Spatial data management
	RIIUND	Underground mining
	RIICTT	Trenchless technology
	<b>Civil Construction</b>	RIICWD
RIICWM		Civil works (management and supervision)
RIICCM		Civil works (common units)
RIIRTM		Road and traffic management
RIICRC		Road and pavements construction and maintenance (general)
RIICBS		Bituminous surfacing
RIICRM		Road marking
RIICSG		Civil structures (general)
RIICFW		Foundation works
RIICBM		Bridge construction and maintenance (general)
RIICTB		Timber bridge construction and maintenance
RIICPL		Underground services
RIICTC		Tunnel construction
RIIDML		Demolitions

Use of competency field by sector	Competency field code	Competency field to which units relate
<b>Coal Mining</b>	RIPEO	Coal mining (general)
	RIIMCU	Coal mining (underground)
	RIIMCO	Coal mining (open cut)
	RIIMCP	Coal mining (coal preparation)
	RIIDES	Coal mining (diesel engine systems maintenance)
<b>Metalliferous Mining</b>	RIIUMM	Metalliferous mining (underground)
	RIIMSM	Metalliferous mining (small mines)
	RIIEGS	Exploration and field work
	RIIMPG	Processing (general)
	RIIPHA	
	RIIPGP	
	RIIPBP	
	RIIPBE	Beneficiation
	RIIMPG	
RIIPSM	Smelting	
<b>Drilling</b>	RIINHB	Drilling (general)
	RIIOGD	Drilling (oil and gas)
	RIIOGF	
	RIIOGN	
RIWSV	Drilling (well servicing)	

## RII Resources and Infrastructure Industry Training Package

## Qualifications by sector and occupational outcome/s

Code	Qualification title	Occupational outcome
	<b>Coal sector</b>	
RII60320	Advanced Diploma of Underground Coal Mining Management	<ul style="list-style-type: none"> <li>o Coal Mine Manager</li> <li>o Coal Mining Engineering Manager</li> </ul>
RII60720	Advanced Diploma of Surface Coal Mining Management	<ul style="list-style-type: none"> <li>o Coal Mine Manager</li> <li>o Coal Mining Engineering Manager</li> </ul>
RII50120*	Diploma of Surface Operations Management	Departmental Manager
RII50920	Diploma of Underground Coal Mining Management	<ul style="list-style-type: none"> <li>o Undermanager</li> <li>o Shift Supervisor</li> </ul>
RII40220	Certificate IV in Surface Coal Mining (Open Cut Examiner)	Open Cut Examiner
RII40420	Certificate IV in Underground Coal Operations	<ul style="list-style-type: none"> <li>o Underground Coal Mine Supervisor</li> <li>o Underground Coal Mine Deputy</li> </ul>
RII40520*	Certificate IV in Resource Processing	Mineral Processing Supervisor
RII41319*	Certificate IV in Emergency Response Coordination	Emergency Response Coordinator
RII30120*	Certificate III in Surface Extraction Operations	<ul style="list-style-type: none"> <li>o Production Operator</li> <li>o Miner</li> </ul>
RII30220	Certificate III in Underground Coal Operations	<ul style="list-style-type: none"> <li>o Production Operator</li> <li>o Miner</li> </ul>
RII30420*	Certificate III in Resource Processing	Process Operator
RII30520*	Certificate III in Mining Exploration	Geological Technician
RII30719*	Certificate III in Emergency Response and Rescue	Emergency Response Team Member
RII20120*	Certificate II in Resources and Infrastructure Work Preparation	Entry Level Worker
RII20220*	Certificate II in Surface Extraction Operations	Operator in the workplace, under direct supervision
RII20320	Certificate II in Underground Coal Mining	Underground Coal Miner, under direct supervision
RII20520*	Certificate II in Resource Processing	Process Operator
RII20620*	Certificate II in Mining/Field Exploration	Field Assistant/Fieldworker (Mining)
RII10115*	Certificate I in Resources and Infrastructure Operations	Pathway into Cert II and Cert III qualifications
	<b>Metalliferous</b>	
RII60120	Advanced Diploma of Metalliferous Mining	Metalliferous Mine Manager (Specialised/Technical)
RII40320	Certificate IV in Underground Metalliferous Mining Operations (Underground)	<ul style="list-style-type: none"> <li>o Advanced Metalliferous Mining Operations</li> <li>o Team Leader/Mine Supervisor</li> </ul>
RII40520*	Certificate IV in Resource Processing	Mineral Processing Supervisor
RII41319*	Certificate IV in Emergency Response Coordination	Emergency Response Coordinator
RII30320	Certificate III in Underground Metalliferous Mining	<ul style="list-style-type: none"> <li>o Trade Level Employee</li> <li>o Production Operator</li> </ul>
RII30420*	Certificate III in Resource Processing	Process Operator
RII30520*	Certificate III in Mining Exploration	Geological Technician
RII30719*	Certificate III in Emergency Response and Rescue	Emergency Response Team Member
RII20120*	Certificate II in Resources and Infrastructure Work Preparation	Open Cut Miner
RII20420	Certificate II in Underground Metalliferous Mining	Operator/Mine Assistant
RII20520*	Certificate II in Resource Processing	Process Operator
RII20620*	Certificate II in Mining/Field Exploration	Field assistant/Fieldworker (Mining)
RII10115*	Certificate I in Resources and Infrastructure Operations	Pathway into Cert II and Cert III qualifications

<b>Drilling</b>		
RII60415	Advanced Diploma of Drilling Management	Mine Manager (Specialised/Technical)
RII50620	Diploma of Drilling Operations	Senior Driller/Field Supervisor
RII50820	Diploma of Drilling Oil & Gas (Onshore)	Oil/Gas On Shore Drilling Supervisor
RII51020	Diploma of Well Servicing Operations	Mineral Production and Development Drilling Supervisor
RII40520*	Certificate IV in Resource Processing	Mineral Processing Supervisor
RII40920	Certificate IV in Drilling Operations	<ul style="list-style-type: none"> <li>o Advanced Drilling Operations</li> <li>o Senior Driller</li> </ul>
RII41120	Certificate IV in Drilling Oil & Gas (Onshore)	Oil/Gas Onshore Senior Driller
RII41220	Certificate IV in Well Servicing Operations	Derrickman
RII41319*	Certificate IV in Emergency Response Coordination	Emergency Response Coordinator
RII30430*	Certificate III in Resource Processing	Process Operator
RII30520*	Certificate III in Mining Exploration	Geological Technician
RII30719*	Certificate III in Emergency Response and Rescue	Emergency Response Team Member
RII31820	Certificate III in Drilling Operations	<ul style="list-style-type: none"> <li>o Trade Level Employee</li> <li>o Driller</li> </ul>
RII32020	Certificate III in Drilling Oil/Gas (Onshore)	Floorman (Oil/Gas Onshore)
RII32220	Certificate III in Well Servicing Operations	Floorman (Oil/Gas Onshore/Offshore)
RII20120*	Certificate II in Resources and Infrastructure Work Preparation	Small Mine Operator
RII20520*	Certificate II in Resource Processing	Process Operator
RII20620	Certificate II in Mining/Field Exploration	Field Assistant/Fieldworker (Mining)
RII20920	Certificate II in Drilling Operations	Drillers' Assistant
RII21120	Certificate II in Drilling Oil/Gas (Onshore)	Floorman (Oil/Gas Onshore)
RII10115*	Certificate I in Resources and Infrastructure Operations	Pathway into Cert II and Cert III qualifications
<b>Quarrying (Extractive)</b>		
RII60220	Advanced Diploma of Extractive Industries Management	Mine Manager (Specialised/Technical)
RII50120*	Diploma of Surface Operations Management	Departmental Manager
RII40120*	Certificate IV in Surface Extraction Operations	<ul style="list-style-type: none"> <li>o Team Leader</li> <li>o Supervisory Role</li> </ul>
RII40520*	Certificate IV in Resource Processing	Mineral Processing Supervisor
RII41319*	Certificate IV in Emergency Response Coordination	Emergency Response Coordinator
RII30120*	Certificate III in Surface Extraction Operations	Highly Skilled Production Officer
RII30420*	Certificate III in Resource Processing	Process Operator
RII30520*	Certificate III in Mining Exploration	Geological Technician
RII30719*	Certificate III in Emergency Response and Rescue	Emergency Response Team Member
RII20220*	Certificate II in Surface Extraction Operations	Semi-Skilled Operators
RII20520*	Certificate II in Resource Processing	Process Operator
RII10115*	Certificate I in Resources and Infrastructure Operations	Pathway into Cert II and Cert III qualifications
<b>Civil Infrastructure</b>		
RII60520	Advanced Diploma of Civil Construction Design	Senior Civil Construction Designer
RII60620	Advanced Diploma of Civil Construction	Civil Project Management
RII50420	Diploma of Civil Construction Management	<ul style="list-style-type: none"> <li>o Civil Construction Site Designer</li> <li>o Civil Construction Site Manager</li> </ul>
RII50520	Diploma of Civil Construction Design	Civil Construction Designer
RII40720	Certificate IV in Civil Construction	<ul style="list-style-type: none"> <li>o Operations Technician</li> <li>o Specialist Civil Construction Personnel</li> </ul>
RII40820	Certificate IV in Civil Construction Design	Civil Construction Design Assistant
RII30820	Certificate III in Civil Construction Plant Operations	Face Loader Operator
RII30920	Certificate III in Civil Construction	Operator
RII31220	Certificate III in Civil Foundations	Construction Operator
RII20120*	Certificate II in Resources and Infrastructure Work Preparation	Civil Construction Worker
RII20720	Certificate II in Civil Construction	<ul style="list-style-type: none"> <li>o Assistant Roles</li> <li>o Support Roles</li> </ul>
RII20819	Certificate II in Bituminous Surfacing	Road Paver
RII10115*	Certificate I in Resources and Infrastructure Operations	Pathway into Cert II And Cert III qualifications

\*Qualifications used by two or more sectors

## Use cases of digital automation technologies in the mining industry

Phase	Technology	Description
<b>AI and connected ecosystem</b>		
Exploration	Geospatial analysis	Algorithms applied to geospatial data to detect viable ore bodies and analyse existing ore bodies (eg. detect impurities)
Development	Intelligent design software (eg. digital twins)	Simulation software that allows analysis and testing of mine sites, operations and scenarios to inform decision-making, for training, and to predict and prevent equipment failure
Production and logistics	Predictive maintenance	Use of real-time and historical data to anticipate problems concerning equipment or sites
	Machine learning/ data analytics	Application of historical and real-time data to optimise the resource-to-market chain
<b>Operational hardware</b>		
Production	Autonomous drills	Drills that navigate the mine site and drill designated areas using a range of sensors and GPS
	Autonomous continuous miners	Machines that are capable of both cutting and crushing the rock face (typically used underground)
	Autonomous excavators/ shovel swings	Machines that excavate and shovel ore without operator intervention using GPS, Lidar etc
	Autonomous load-haul-dump trucks	Vehicles that can haul, load and dump ore without operator intervention, using sensors
	Autonomous ancillary vehicles	Various ancillary vehicles on a mine site – eg. water trucks used for dust control, compaction – could be automated
	Autonomous unmanned aerial vehicles	Remote-controlled drones are used as an alternative to terrestrial survey mapping, with other potential uses including pit wall mapping and spare parts transportation
	Maintenance robots	Use of aerial or land-based robots for dangerous or repetitive maintenance tasks (eg robotic tyre changers)
	3D printing	Additive manufacturing (3D printing) to construct spare and bespoke parts
Logistics	Autonomous rail	Trains which transport ore from the mine to the port without operator intervention
	Autonomous ship loading	Use of cameras, thermal imagers, lasers and sensors to load a ship from a central control room
Production and logistics	Digitalised sensor networks	Sensors that collect physical, chemical and other data, converting it into a digital format for analysis
Rehabilitation	Autonomous vehicles	Use of autonomous vehicles to fill-in land. Advanced sensor technology required due to the unstable ground conditions
	Smart sensors	Use of smart sensors and data analytics to monitor environmental conditions
<b>Connected worker</b>		
Production and logistics	Remote operations centres	Monitoring/operation of equipment from a remote operations centre, using advanced IT systems and virtual reality technologies
Production	Use of wearables	Technologies that enable workers to interact with the sensors, robots and surrounding systems, or that otherwise augment the worker

Source: AlphaBeta (2019) Staying ahead of the game