

# The Work Skill Development (WSD) Framework, Applied to Minerals Industry Employability - A Story of Practice

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## Abstract

*The application of the Work Skill Development (WSD) Framework to the issue of minerals industry employability is outlined, including how an enhanced curriculum model is being used to help students develop independence (WSD level 3), self-actuation (WSD level 4) and self-determination (WSD level 5). The model is based primarily not on what the university or students want. Rather, through reverse-field analysis, the model is based on evidence of what minerals industry employers require and what students can do to meet these expectations. Some of the outcomes of this approach are presented, and recommendations for the future are suggested.*

## Introduction

Since 2007 the University of Wollongong's Mining Engineering Department has focussed on improving students' employability skills. Using constructionist pedagogy, with scaffolded learning, the programme is based on an enhanced curriculum model (Baafi et al., 2008; see Figure 1). The sectors enclosed within the middle brackets represent a traditional university programme, which has been surrounded by the activities shown outside the middle brackets. To a large extent, these enriched curriculum activities occur through engagement with employers, industry experts, other providers, and professional and industry bodies. Recently, the model has been evaluated using the Work Skill Framework Model of Engaged Learning and Teaching (MELT; Banaranaike and Willison, 2014) and current Workplace Integrated Learning (WIL) best practices, to provide a rigorous, theoretical, broadly-accepted framework for what is being done, and to identify opportunities for improvements in the programme.

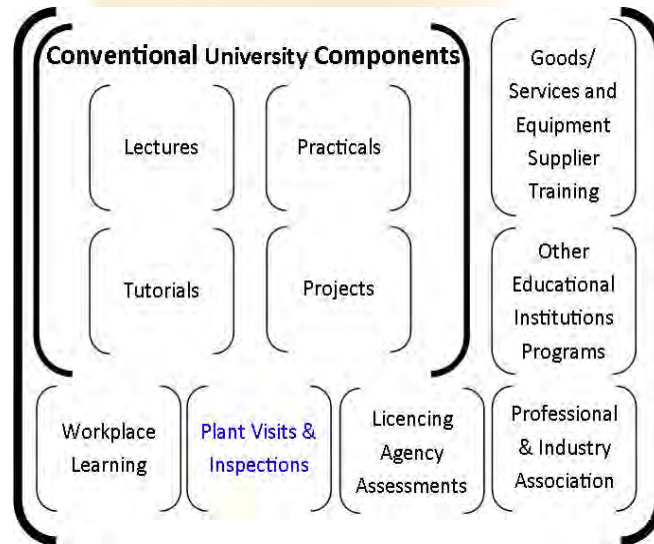


Figure 1: University of Wollongong Mining Engineering Enhanced Curriculum Model.

### Practice or Theory Gap Addressed

The major gap that has been addressed by comparing the enhanced curriculum model (Figure 1) with the Work Skill Development Framework is the structured development of students' autonomy and independence, as shown by the movement through Levels 1 to 5 in the Framework diagram. To an extent, we have revised the way in which the enhanced curriculum model is presented (Figure 2). Predominately, lectures are representative of Level 1 (Prescribed Direction); practicals, tutorials and projects are closer to Levels 2 and 3 (Bounded Direction and Scaffolded Direction). The activities on the right-hand side and bottom of the figure closely resemble Levels 4 and 5 (Self-Actuated Direction and Open Direction), since they require far more student involvement and choice in what activities are carried out and how they are carried out.

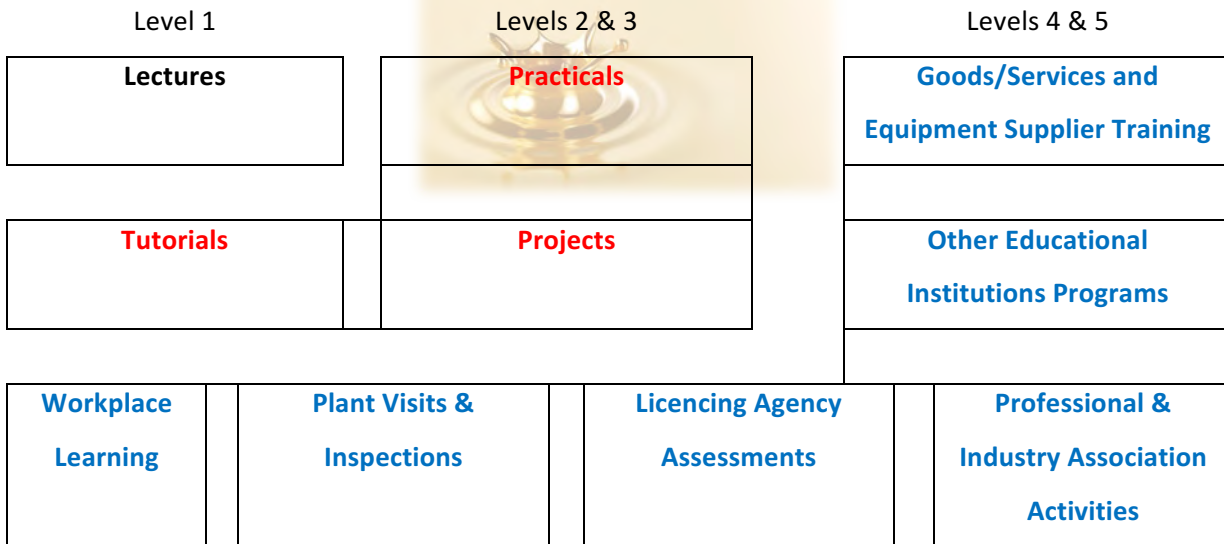


Figure 2: The Enhanced Curriculum Model using the MELT Work Skill Development Framework.

**Approach**

In terms of the MELT pentagon criteria:

- Embark and Clarify: The purpose is for students to take responsibility for their own employability and to clarify what employers require. The focus is not on what students or the university wants, but rather, based on evidence, what it is that minerals industry employers want. This evidence comes from the Australasian Institute of Mining and Metallurgy (AusIMM), Graduate Attributes (AusIMM, 2005), mineral industry companies’ mission and values statements, the essential and desirable criteria used in recruitment advertisements, questions asked at interviews and information sought from referees.
- Find and Generate: What skills and competencies (both technical and generic) do employers require? How do students know that these are the skills and competencies for which employers are looking? What are the sources for gaining and demonstrating those skills and competencies? To answer these questions, students engage in open-ended brainstorming and personal reflection regarding what they can demonstrate and what actions they will personally take to overcome gaps.
- Organise and Manage: Students are encouraged and supported to generate a portfolio of demonstrated evidence and experiences for each of the employability category requirements.
- Analyse, Trial and Synthesis: Students are encouraged to identify levels of opportunities and analyse their interests and abilities to synthesise strengths, gaps and areas for development.



- Evaluate and Reflect: An Action Learning cyclic experiential learning model is used for on-going student personal improvement and building practices compatible with graduate/professional attributes. This provides a solid foundation for moving into continual professional development and life-long learning, setting up students to be successful professionals, for many years after they graduate.

- Communicate, Apply and Continual Use: This includes building students' self-confidence, resilience and persistence, which are keys to success in the cyclic minerals industry. Examples of MELT Work Skill Development Level 4 and 5 (activities represented by the right-hand side and bottom boxes of Figure 2) include:

- Goods/services and equipment supplier training - using Orica to deliver the drilling and blasting parts of the course, and using Maptek for mine planning software skills development. Also, using materials and manuals provided by goods and services providers.
- Other Educational Institutions Programs – examples include students gaining White Cards, (enabling them to be approved to work on construction and infrastructure sites), completing the Underground Coal Induction course (which is compulsory for anyone wishing to work in an underground coal mine in New South Wales or Queensland), and gaining a First Aid Certificate (which is highly valued by employers). Students can also gain competencies in the use of hand and power tools and complete competencies from the Certificate IV in Leadership and Management, as this qualification is included in many minerals industry employer graduate development schemes.
- Professional and Industry Association Activities - students are encouraged and supported to become active members of the Australasian Institute of Mining and Metallurgy (AusIMM), Engineers Australia (EA) and other relevant industry associations, such as the Institute of Quarrying Australia (IQA). The opportunities and networking that membership to such bodies enables have helped students to increase their employability skills, and lead to offers of positions in the industry. Students present at conferences and attend AusIMM technical events. Through AusIMM membership, students also gain access to current material, applicable to Australian conditions.
- Licencing Agency Assessments - mining engineering subjects are mapped to competencies in the Vocational Education and Training (VET) industry-recognised Surface Mining Certificate IV and Diploma, which are the statutory qualifications in most states for Surface Mining and Quarry, Shift Supervisors or Manager licences. This enables students to gain additional national training package

industry-based qualifications or competencies using mutual recognition between the University and VET providers. Students also gain statutory licences and permits, such as a First Aid certificate, complete recognised mine induction courses, get underground mine driving licences or powderman's/shotfirer's permits.

- Plant Visits & Inspections – field trips to Hunter Valley Open Cut Coal mines, West Coast Tasmanian and Western New South Wales underground and surface metal mines are carried out, as well as to a wide range of mining industry associated facilities. Typically, students visit approximately 20 mines across a wide range of commodities, using various mining methods during their degree.
- Workplace Learning– Structured completion of national mining and industry competencies and/or training package qualifications whilst on vacation professional experience employment. Students have outlined that they derive great value from eLearning sites, particularly online discussion modules for their subjects. Discussion modules have generally been limited to student-to-student peer learning, with guided moderation by tutors and lecturers. In this programme, valuable additional learning has been achieved by involving industry professionals providing mentoring and responses to students' questions in specific subject and/or topical areas, as shown in Baafi (2016). A real advantage of this approach has been the translation of theory and technical knowledge into real world problems. The industry-based forum has resulted in students re-calibrating what they are being taught and what awaits them in the real world. It has also proven invaluable to lecturers, as it has alerted them to the relevance and currency of what is being taught during lectures/tutorials. Feedback from industry professionals has been highly positive and they have been most impressed that the mining staff opened up eLearning presentations to students to be evaluated by industry-based personnel.

Participation in these additional curriculum enrichment activities is mainly non-compulsory, but due to the differences these activities make when seeking employment, there is a high degree of student participation and involvement. Almost all of these activities are arranged and managed through the AusIMM University of Wollongong Student Chapter, including planning itineraries, managing budgets, liaison with site personnel to gain approvals, conducting risk assessments, and organising personal protective equipment. Senior students also brief other students on what to expect and how visits relate to their studies or gaining employment. Together with the completion of the portfolio templates shown in Appendixes A, B and C, students are mainly self-directed, with some guidance. This provides them with the opportunity to develop independence and self-actuated direction, and to determine their own guidelines on what is appropriate for their career in the minerals industry.



## Results and Outcomes

Consistent with scaffolded learning, MELT is being used to build on prior work that has been done at the University of Wollongong, so that the results and outcomes are due to both the approaches previously taken in these programmes, with the addition of MELT. Thus, it cannot be claimed that the outcomes from the mining programme are entirely due to MELT, but rather a combination of blending previous approaches with the new knowledge gained through MELT.

## Examples of Outcomes and Results

*World QS ranking* - The University of Wollongong's World QS ranking for the Mining Engineering department has improved from the 101-150 band in 2015, to the 51-100 band in 2016, and now to 26th in the world in 2017. This current ranking is higher than any mining engineering department in Great Britain or China, and is the highest ranked mining engineering program in the world from a regional university. To a significant extent, this improvement has been due to employer and graduate feedback assessments, which in turn relate to the focus on enhancing student autonomy and improving employability skills.

*University of New South Wales (UNSW), Student Survey and comments* - Earlier this year the extended curriculum model and the AusIMM Minerals Industry Employability Skills Workshops (AusIMM2016), were delivered to final year mining engineering students at the University of New South Wales, who gave the following ratings out of 10 (with 1 being little value, 5 moderate value and 10 great value), for the seven topics covered:

1. What do you expect that minerals industry employers look for in applications?	9.14 out of 10
2. Who do minerals industry companies recruit and at what levels?	8.86 out of 10
3. What do minerals industry employers look for?	9.18 out of 10
4. How to research for employment opportunities of 10	9.23 out
5. Techniques for planning an application	9.14 out of 10
6. Building a Portfolio of Evidence	8.78 out of 10
7. Recommended non-university activities	8.78 out of 10
Overall average	<b>9.02 out of 10</b>

This student feedback constitutes the highest ever rating for the delivery of AusIMM Minerals Industry Employability Skills Workshops, and this is a direct result of presenting the programme with a focus on Levels 4 and 5 of the MELT framework.

UNSW students were also asked to add comments regarding the programme. Overwhelmingly, students provided highly favourable comments, e.g., " Great advice on the big opportunities of mining. I am not worried about jobs now, because I'm more than happy to send off many targeted applications. Thanks heaps".

*Commonwealth Office of Higher Education Outstanding Learning and Teaching (OLT) Citation*

The program has received an OLT citation, as shown in (Tolhurst, 2014).

*Mining Engineering statistics from the 2014 Commonwealth government graduate Survey*

% of Resource Industry Engineering Graduates in full-time employment

- University of Wollongong	96.7%
- Queensland	90.7%
- Adelaide	87.3%
- UNSW	84.7%
- Curtin	80.1%
- University of WA	79.7%

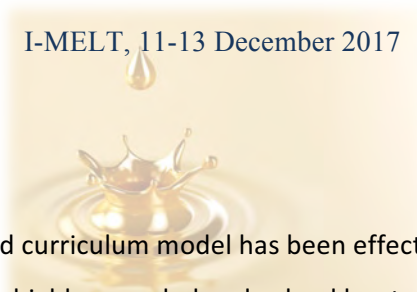
Federation and Murdoch, numbers too small to be significant; Monash, no graduates

(Source: My University website <http://myuniversity.gov.au>)Resource Industry

Engineering Graduates Median Starting Salary 2014

- University of Wollongong	\$89,000
- Curtin	\$80,000
- University of WA	\$77,000
- Adelaide	\$77,000
- Queensland	\$75,000
- UNSW	\$75,000

(Source: <http://myuniversity.gov.au>)



## Discussion

The mining engineering enhanced curriculum model has been effective in improving the World QS ranking for the department. The model is highly regarded and valued by students, and industry employers recognise the benefits, as shown by the high graduate employment rate and median starting salaries.

Underpinning this approach with the MELT Work Skill Development Framework has enabled a rigorous critical review to be carried out to identify strengths and opportunities for improvements in the delivery of the model.

This review has identified that:

- The approach may be suitable for other universities conducting minerals industry programmes. There could be a role for AusIMM (the professional body) to guide the implementation of the approach, in the best interests of the nation and the industry.
- Until now, the major effort has been focussed on the 3rd and 4th year, Levels 4 and 5 skills development. To assist secondary school students in developing these higher order skills, increased guidance (with specific examples) may need to be developed for 1st and 2nd year students.
- The approach provides significant opportunities for students to develop independence and autonomy, especially through using the templates shown in Appendices 1, 2 and 3 progressively throughout their course. The information contained within these portfolios provides students with substantial evidence to demonstrate their skills and competencies and this is highly valued by potential employers.

## Conclusion

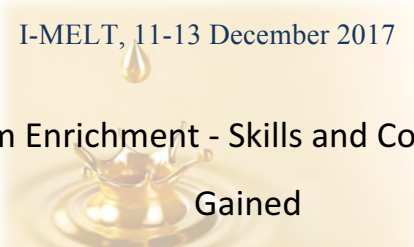
The Work Skill Framework MELT model has been applied to the minerals industry enhanced curriculum approach used at the University of Wollongong. This has enabled a rigorous critical review of existing practices. This has resulted in an improved focus on developing higher-level independence and autonomy by students, which are highly regarded employability skills by minerals industry companies. The value achieved by adding MELT has been demonstrated by the successful outcomes from the program.





## References

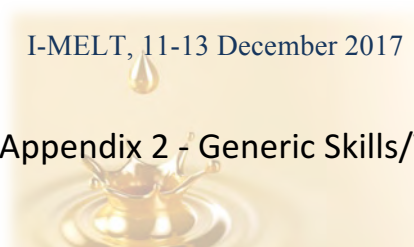
- AusIMM, (2005), *Report of the Graduate Development Program Taskforce*, AusIMM Bulletin, (pp 16-18), Melbourne
- AusIMM, (2016), *Minerals Industry Employability Workshops*, Webinars, conducted March and April, based on the work of Marston K. and Tolhurst R.
- Baafi E., Kell P. and Tolhurst R., (2008), *Developing Workforce Planning and Training Models for the Resource Industries, using Needs-based Research*, Australian Vocational Education Research Association Annual Conference, (pp 162-167), Adelaide
- Baafi E., Marston K. and Tolhurst R., (2016), *An on-line discussion forum to support mining engineering students' independent learning*, Australian Association of Engineering Education Conference, Coffs Harbour, December, pp 23-28
- Bandaranaike S. and Willison J., 2009 (revised 2014), "*Work Skill Development framework*" <https://www.adelaide.edu.au/rsd/framework/frameworks/WSD->, accessed 5th June 2017
- Tolhurst, R., (2005), "*Developing a Comprehensive, Inclusive Tertiary and Education Model for the Minerals Industry*", Australasian Institute of Mining and Metallurgy New Leaders Conference, Brisbane, April, pp 32-36
- Tolhurst R. (2014), "*Linking mining and materials engineering educators with industry and professional groups, to produce an enriched program and outstanding graduate employability*", Higher Education Office of Learning and Teaching Citation Application, April, Unpublished



Appendix 1 - Curriculum Enrichment - Skills and Competencies Gained, or to be Gained

	Skills and Competencies that can be, or will be, demonstrated from related activities
Goods/Services & Equipment Supplier Training	
Other Educational Institutions programs	
Professional & Industry Associations	
Licencing Agency Assessments	
Plant Visits & Inspections	
Workplace Learning	





 Appendix 2 - Generic Skills/Values

	University	Other
Safety and Risk Assessment		
Integrity, honesty and considerate		
Engage diverse views		
Teamwork, working together and caring about people		
Accepting responsibility and following through on commitments		
Managing environmental risks		
Valuing innovation, problem solving and taking opportunities to improve		
Achieving superior performance by stretching capabilities		



Prioritising by focussing on the things that are most important		



### Appendix 3 -Technical Skills/Competencies

Technical Skill/Competency	University	Other
Develop Operation Plans		
Design, prepare and conduct Drilling and Blasting		
Communicate information and computer skills		
Develop and maintain an environmental management plan		
Understand, monitor and report on compliance systems		
Understand surface coal mining methods		
Understand underground coal mining methods		
Understand surface hard-rock mining methods		
Understand underground metal mining methods		
Prepare a pit plan		
Understand mining transportation systems		
Maintain process control		
Understand mine services systems		
Conduct mine surveying operations		
Develop and implement the stockpile management plan		
Implement site waste		



and by-product plans		
Implement the site water management plan		
Prepare emergency response plans		
Prepare a ventilation plan		
Prepare spontaneous combustion plans		
Implement the gas drainage plan		
Design and Implement the strata management plan		