

USQ Campus locations



Engineering at USQ



- **3700 students study Engineering or Spatial Science**
- **80% study off-campus by Distance Education**
- **Most Distance Education students work full-time and study part-time**

AQF Level 6 programs and Engineers Australia's Three Stage 1 Competency Categories

**Flexible Pathways
On & off-campus**

Stage 1: Graduate Engineer

Stage 1: Graduate Engineering Technologist

AQF Level 6

Stage 1: Graduate Engineering Associate

VET	USQ
Advanced Diploma	Associate Degree
2 year FT	2 years FT
4 years PT	4 years PT

USQ Bachelor of Engineering Technology
3 years FT
6 years PT

USQ Bachelor of Engineering Or Combined Degree
4 - 5 years FT
8 - 10 years PT

Research projects and timeframes



- **Project 1: 2007-2009 USQ Technician students**
- **Project 2: 2010 Senior Fellowship**
 - VET and university Technician students
 - VET and university programs
 - USQ employer perspectives
 - Collaboration with IACT project
- **Project 3: 2011 ANET commissioned reports**

Australia has endured a decade of skills shortages in most engineering disciplines

- The demand for engineers has risen by 52% over the last decade compared to 20% for the Australian economy overall
- The number of **degree** graduates per year has remained relatively static over the period
- The number of graduates from **Associate Degrees, Advanced Diplomas** and **Diplomas** rose by 25% from 2001 – 2008 but has since dropped
- Graduates from **Associate Degrees, Advanced Diplomas** and **Diplomas** contribute 35%-40% of the new additions to the workforce each year
- Australia relies on skilled migration to meet engineering skills shortages. Overseas born engineers made up 41.8% of the engineering workforce in 2001 and 52.6% in 2010 – compared with 26% of Australian workforce
- Decade summary:
 - Total demand = 124,400
 - Total graduates = 94,495
 - Total migrants = 55,000
 - Retirements = ?

Initial research trigger

A rapid growth in student numbers in the USQ
Associate Degree in Engineering program

Student type	2005	2006	2007	2008	2009
Commencing	118	199	229	337	285
Continuing	254	273	416	506	523
Total	372	472	645	843	808

The research questions



- **Why did the students choose to study the Associate Degree rather than:**
 - a Bachelor of Engineering ?
 - an Advanced Diploma - VET sector?
- **Why did they choose to study part-time?**
- **What are their career aspirations?**

Research methodology



- **An online questionnaire was sent to distance education students studying the Associate Degree in Engineering**
- **13 questions - seven questions are relevant:**
 - **3 explored criteria used to select Associate Degree**
 - **2 explored the student's career aspirations; and**
 - **2 explored the student's future study plans**
- **Some questions allowed multiple answers**
- **Offered to all students in December 2006 and to commencing students in all semesters from March 2007 until S2 2009**

Results - 1



Why did you choose to study the USQ Associate Degree?

- 33% - It was a condition of employment
- 26% - Recommended by employer
- 26% - It has a good reputation
- 23% - A quick way to get an engineering qualification
- 16% - Not qualified for admission to a degree program
- 2% - It was recommended by my career's advisor
- 26% - Other: A good place for part-time students to start on a pathway

Did you consider studying full-time, on-campus?

- 40% - I could not afford to study full-time
- 26% - I did not want to study full-time
- 26% - I found work in the engineering industry (many new to engineering)
- 24% - I would have to travel more than an hour

Results - 2



What will happen when you graduate?

- 48% - I will get a pay rise
- 39% - I will get promoted
- 26% - I will change jobs in same organisation
- 26% - I will apply for a job with another organisation
- 13% - I will do the same job and receive the same pay

What is your career goal?

- 63% - To work as a Professional Engineer
- 13% - To work as an Engineering Technician
- 9% - To work as an Engineering Technologist
- 15% - Other:
 - Manager
 - Project Manager
 - Master Technician
 - Highly skilled designer.

Results - 3



When you graduate will you undertake further studies?

- YES 81%:
 - 66% - Bachelor of Engineering
 - 24% - Bachelor of Engineering Technology

How important is it for you to receive full credit for prior studies?

- 85% - Very important
- 11% - Important

Summary

The Associate Degree is ideal for part-time students:

- It is a quick way to get an engineering qualification and get promoted
- It is a good place to start on a pathway to a higher qualification
- It is a good outcome after four years of part-time study
- There are well defined articulation pathways

Project 2 – USQ Senior fellowship



New research questions

- 1. Are the results representative of Engineering Technician students across Australia?**
- 2. What Engineering Technician programs are offered in Australia?**
- 3. What articulation pathways are available for Engineering Technician graduates?**
- 4. What perspectives do the employers of USQ students have on Engineering Technician education?**
- 5. How do institutions recognise prior learning and workplace experience?**

Methodology



- 1. Programs: Study of online resources & interviews with staff**
- 2. Student perspectives: Online questionnaire**
- 3. Employer perspectives: Online questionnaire**
- 4. Articulation pathways: ALTC pathways project & IACT project**
- 5. Recognition of prior learning: ALTC pathways project**

Engineering Technician Education Straddling the VET – HE divide



- **AQF Level 6 qualifications**
 - Advanced Diploma – a Vocational Education and Training (VET) award
 - Associate Degree – a Higher Education (HE) award
- **Different pedagogies**
 - HE programs are curriculum based
 - VET programs are competency based
- **Recommended program aims:**
 - To prepare graduates for careers as Engineering Associates
 - To provide graduates with efficient pathways to full degree qualifications

International Benchmark



- **International Engineering Alliance: The Dublin Accord**
- **Current signatories of the Dublin Accord are:**
 - Canada; Ireland; South Africa; and UK
 - Australia & New Zealand are on a path to become signatories
- **Engineers Australia's accreditation process is aligned with the Dublin Accord standard for Engineering Technicians**
- **Graduates from accredited programs are eligible for membership of Engineers Australia as Engineering Associates**
- **Equivalent to a Bologna short-cycle award**

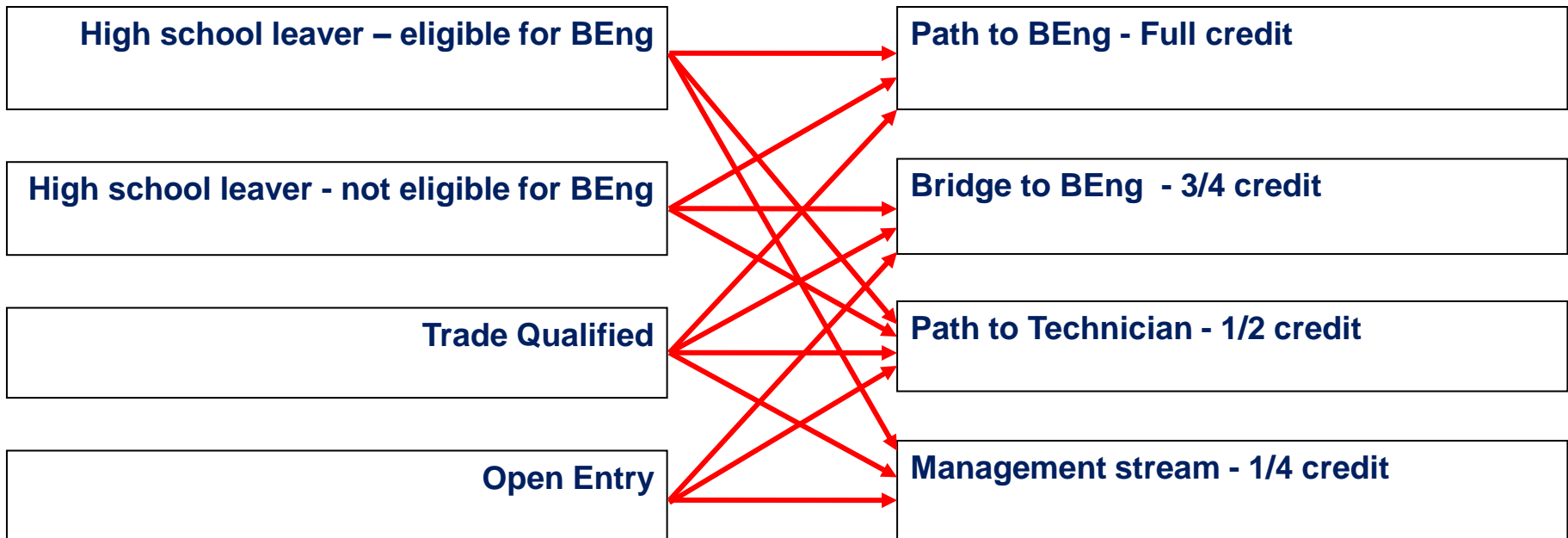
Australian Associate Degrees of Engineering

Institution	Specialisations or Majors	Mode
ANU and CIT	Mechanical; and Electronic Engineering	ONC
CQU	Civil; Electrical; Mechanical; Mining (Surface); and Mining (Underground) Engineering	OFF
Polytechnic West	Maintenance Engineering	ONC
RMIT	Advanced Manufacturing; Civil; Electrical / Electronic; Mechanical; and Network Engineering	ONC
Southbank Institute of Technology	Civil Engineering	ONC
Swinburne	Engineering	ONC
TAFESA	Electronic Engineering	ONC
University of South Australia	Civil; Electrical & Information; and Mechanical Engineering	ONC
	Defence Systems Engineering	ONC ONL
University of Southern Queensland	Agricultural; Civil; Computer Systems; Electrical & Electronic; Environmental; Mechanical; and Power Engineering	ONC OFF

Characteristics of Associate Degrees

Admission Requirements

Program Outcomes



Combinations of admission standards and program outcomes

The aims of Associate Degrees



- **Some programs aim to equip graduates to meet both outcomes:**
 - **To equip students with the skills to become an Engineering Associate**
 - **To receive full credit to articulate to a Bachelor of Engineering**
- **Other programs aim to equip graduates for only one outcome**
- **There is an inherent tension between these two aims**
- **Only three programs are accredited by Engineers Australia**

Skills Councils & Engineering



- AgriFood Skills Australia?
- Auto Skills Australia?
- Community Services and Health Industry Skills Council
- **Construction and Property Services Industry Skills Council**
- **Electrocomms and Energy Utilities Industry Skills Council**
- ForestWorks Industry Skills Council?
- Government Skills Australia
- Innovation and Business Industry Skills Council?
- **Manufacturing Industry Skills Council**
- Service Industries Skills Council
- **SkillsDMC National Industry Skills Council**
- **Transport and Logistics Industry Skills Council**

“VET does not do engineering – it does engineering trades & extrapolates to AQF Level 6”

**Engineers Australia
Stage 1 Competency Standard**



Specialisation	Engineering Disciplines				Training Package
	Civil	Electrical	Mechanical	Mining	
Building Construction	***				R1109 Skills DMC
Building services	***				R1109 Skills DMC ?
Structural	***				R1109 Skills DMC ?
Geomechanics	***				R1109 Skills DMC ?
Road & rail engineering	***				
Air transport	***				
Water transport	***				TDM07 Transport & logistics
Water engineering	***				
Public health	***				
Soil	***				
Aerospace					
Etc.					

VET Skills Councils & Advanced Diplomas

Industry Skills Council	Advanced Diploma of...	Code #
Electrocomms and Energy Utilities Skills Council	Electrical Engineering	UEE60107
	Electronics and Communications Engineering	UEE60207
	Computer Systems Engineering	UEE60407
	Industrial Electronics and Control Engineering	UEE60607
	Instrumentation and Control Engineering	UEE61510
	Refrigeration and Air-conditioning Engineering	UEE60707
	Renewable Energy Engineering	UEE60907
Innovations and Business ISC	Telecommunication Engineering	ICT60202
	Telecommunication Network Engineering	ICT60210
Manufacturing Industry ISC	Engineering	MEM60105
SkillsDMC National ISC	Civil Construction Design	R1160509
	Civil Construction	R116060

Engineering Advanced Diplomas currently offered : 2010/2011

Advanced Diploma of...	Program Code	Sum	Number of Institutions offering the full qualification								
			QLD	NSW	ACT	VIC	TAS	SA	WA	NT	RTO
Civil specialisation											
Engineering Design	40604SA	6/6	2/1		1	1/2	1	1			
Civil & Structural Engineering	52011	2							2		
Structural Engineering	91155NSW	4/2		4/2							
Electrical specialisation											
Electrical Engineering	UEE60107	7/11	1	4/8		1		1			
Electronics & Communications Engineering	UEE60207	2/8	1	1/2		0/3		0/1	0/1		
Electronic - Technology	UEE60307	0/4	0/1	0/2	0/1						
Computer Systems Engineering	UEE60407	11/12	1			9		1	0/1		
Industrial Electronics and Control Engineering	UEE60607	2		2							
Refrigeration & Air-conditioning Engineering	UEE60707	2/0	1/1					1/1			
Renewable Energy Engineering	UEE60907	1		1							
Explosion Protection	UEE61207	0/4	0/1	0/2	0/1						
Electrical - Technology	UEE61307	0/7	0/1	0/2		0/3		0/1			
Electrical Technology (Expires 2008)	91035NSW	1		1							
Electronics Technology (Expires 2008)	91037NSW	1		1							
Electrotechnology (Indust Electron & Control Eng)	51974	1							1		
Mechanical specialisation											
Engineering	MEM60105	12/13	1	4/5		1/3		3/1	2		1
Engineering Technology	21622VIC	10/12		1/0		9/12					
Engineering (Aerospace)	15696VIC	1				1					
Engineering Technology (Principal Tech Officer)	14309VIC					5					
Mining specialisation											
Engineering (Oil & Gas)	52170	1							1		

VET Advanced Diplomas offered in 2011



- **7 Skills Council's qualifications**
 - 9 Electrical
 - 1 Mechanical
- **9 State accredited qualifications**
 - 3 Civil
 - 3 Electrical
 - 3 Mechanical
 - 1 Mining
- **Only two offers are accredited by Engineers Australia**

Program issues

- **The diversity in both sectors:**
 - Too complex for students and employers to understand
 - Few programs are accredited – the international benchmark
- **Multiple Skills Councils**
 - Develop qualifications to meet narrow industry requirements
 - Do not cover all engineering sectors – particularly Civil
 - Do not appear to use a common approach
- **Articulation pathways difficult to define from VET to HE**
 - Pedagogical differences
 - Flexibility in VET programs impacts on credit awarded and process
 - Variable outcomes and standards

Dual sector institutions provide models for efficient articulation pathways and blended pedagogies

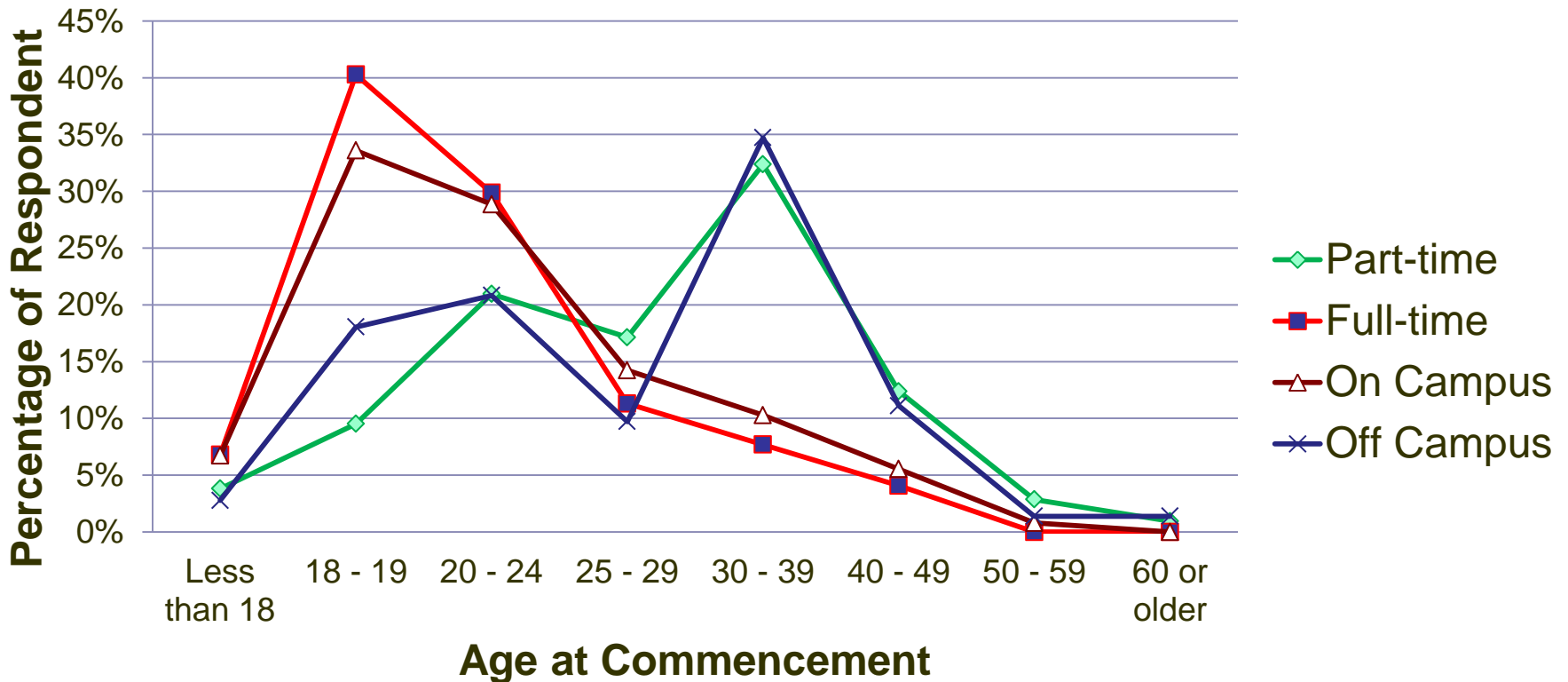
Engineering Technician students



- **A 51 item questionnaire was developed after consulting senior engineering teaching staff in VET and HE institutions**
- **The questionnaire was offered online to students at 11 institutions during Semester 1**
- **327 students from 9 institutions completed the questionnaire**
 - **5 VET institutions – 5 states**
 - **3 universities – 3 states**
 - **1 dual-sector university**

Demographics

A comparison of the ages of on-campus, off-campus, part-time, and full-time students

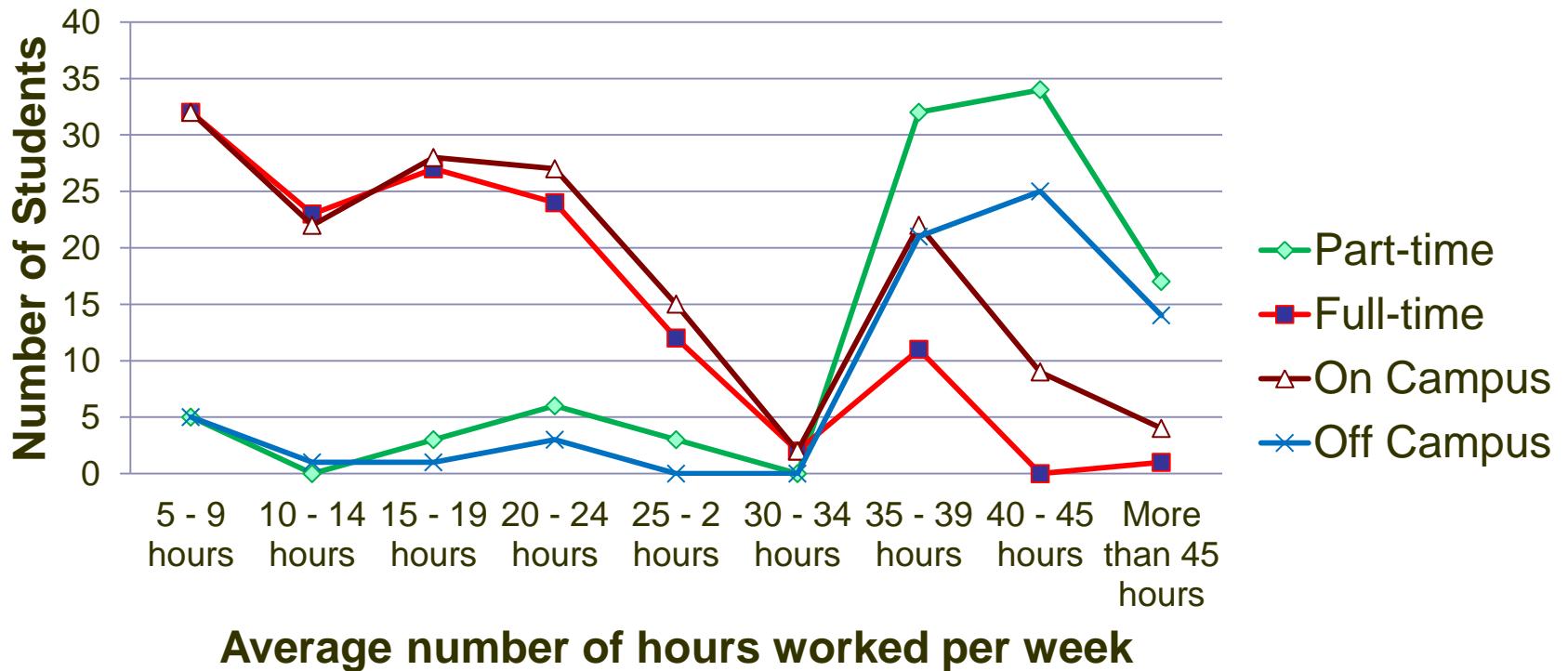


Student data

- 45% believed they were eligible for BEng
- 40% were studying an Associate Degree
- 45% were studying an Advanced Diploma
- 15% were studying a Diploma
- 40% were studying civil engineering**
- 25% were studying mechanical engineering
- 15% were studying electrical engineering**
 - ** Compare with the number of Training Package qualifications taught
- 11% were female
- 12% were international students
- 68% were full time students – 32% part-time
- 78% on-campus - 22% off-campus

Employment

Hours worked by study patterns



Career Aspirations

Students' post graduation plans

Student preferences	% of Respondents
Seek full-time employment in the engineering industry	46.0%
Continue to study full-time	35.9%
Stay in the same job and on the same pay rate	6.3%
Change jobs but stay in the same organisation	10.5%
Apply for a job in another organisation	15.2%
Receive a pay rise	16.0%
Be eligible for a promotion in the same organisation	15.2%
Other	11.8%

- 57% plan to enrol in a Bachelor of Engineering program
- 51% have the career goal to work as a professional engineer
- Only 16.3% have a career goal to be an engineering associate

Discussion



- **75% plan to undertake further study - Confirmation**
- **Over 50% have a career goal to work as a Professional Engineer - Confirmation**
- **Only 16% plan to work as an engineering associate - Confirmation**
- **This will continue to contribute to shortages of Engineering Technicians**

Recommendations



For engineering schools & accrediting organisations:

- **A two-year program is ideal for part-time students:**
 - Most students receive significant benefits when they graduate; and
 - It is a good starting point for less confident students
- **A two-year program should be designed to meet two aims:**
 - To prepare graduates for careers as Engineering Technicians; and
 - To provide efficient pathways to degree programs

Recommendations....



For engineering employers & organisations:

- **Employ part-time students as cadets to help overcome skills shortages**
- **Review the work profiles and career options of Engineering Technicians to make them more attractive and rewarding**

Project 3 - Participation in ANET Studies

Australian National Engineering Taskforce

Partner Organisations



The Association
of Professional
Engineers,
Scientists &
Managers,
Australia

The Academy of
Technological
Sciences &
Engineering

Engineers
Australia

The Australian
Council of
Engineering
Deans

Consult Australia
(formerly The
Association of
Consulting
Engineers

ANET commissioned three reports...



- *Pathways from VET Awards to Engineering Degrees: a higher education perspective.* ACED: Robin King, David Dowling and Elizabeth Godfrey
- *Scaling Up: Building engineering workforce capacity through education and training.* Louise Watson and John McIntyre
- *Engineering Skills Capacity in the Road and Rail Industries.* Workplace Research Centre, University of Sydney, and National Institute of Labour Studies, Flinders University

Executive Summary & Recommendations

<http://www.anet.org.au/>

Principle findings



1. Improving VET – HE pathways

- Only 6% of commencing students in engineering degrees are admitted on the basis of a VET award (average 10% for all higher education courses).
- A detailed study of the 2003 entry cohorts into engineering degree programs in eight universities revealed:
 - 65% for all engineering degree students complete
 - 20% of students who entered on the basis of a VET award, mature age or special entry completed their engineering degree

Recommendations..



1. Improving VET – HE pathways

1A: Engineering degree providers should develop strong, and mapped articulation agreements with VET providers offering Advanced Diplomas or Associate Degrees in engineering and related technologies

1B: Engineering degree providers should diagnose any gaps in the knowledge and skills of VET graduates early in their program and provide appropriate academic support to address such gaps.

1C: Providers of engineering programs in both the VET and HE sectors should enhance the provision of transitional support, such as mentoring and career advice, to students who have the potential to embark on a VET-HE pathway.

Principle findings



- 2. Increased industry and employer collaboration in course delivery.**
- **The most authentic HEd engineering programs are those which provide students with structured programs of work-integrated learning.**
 - **There is considerable variation in the quality of the provision of professional practice experiences and the value derived from it by students.**
 - **There is potential to better align the HEd engineering curriculum with the work that engineers do, moving from the traditional ‘front-loaded’ model of delivery to a collaborative model that integrates employers and industry in all stages of course design and delivery.**

Recommendations



2. Increased industry and employer collaboration in course delivery.

2A: Engineering degree providers should develop industry-collaborative models of course delivery

2B: Employers in engineering-related fields should support employees and students enrolled in para-professional and professional engineering studies through internships and the provision of structured work-integrated learning experiences.

2C: Engineers Australia should review their accreditation provisions requiring exposure to professional practice with a view to strengthening the level of industry collaboration in engineering degree programs

Principle findings



3. Revitalise the 2-year Technician qualifications in engineering

- There is significant unmet demand among employers for two-year trained engineering technicians with qualifications at the Advanced Diploma or Associate Degree level.
- Demand for three-year-trained Engineering Technologists has the potential to grow, but this occupational category remains ill-defined.
- Increasing the output of graduates from two-year qualifications could alleviate Australia's acute shortage of technically-trained engineering staff in the short term as well as increase the number of professional engineers (through HE pathways) in the longer term.
- Although Advanced Diploma-level qualifications have the potential to provide a pathway to higher education degrees, training packages are not structured in a way that facilitates this role

Principle findings



3. Revitalise the 2-year technician qualifications in engineering

- Despite severe skills shortages in many sectors of engineering over the last five years, Australia's output of graduates with Advanced Diplomas in engineering-related qualifications over the period has been static.
- In contrast, the number of graduates with Associate Degrees is growing strongly, albeit from a low base.
- Advanced Diplomas in engineering and related technologies appear to be under-utilised in the national training system and some engineering-related training packages do not offer qualifications at the Advanced Diploma level.
- More than half of total VET provision of Advanced Diplomas in engineering and related technologies is in courses developed outside of the national training package framework and accredited at the state level

Principle findings



3. Revitalise the 2-year technician qualifications in engineering

- Differences in government funding between the VET and HE sectors creates anomalies and inconsistencies for both students and course providers.
- Programs offering wage subsidies such as apprenticeships and traineeships are not available to students enrolled in higher education awards such as Associate Degrees.
- This can lead to inequities for both employers and students in areas lacking easy access to a VET provider.
- These inconsistencies in policy and funding have the potential to distort the provision of courses at the technician level and to create anomalies in student demand for equivalent courses delivered in each sector.

Recommendations

3. Revitalise the 2-year technician qualifications in engineering

3A: Industry Skills Councils responsible for engineering-related training packages should review their provision of Advanced Diploma courses to ensure the qualifications are recognised nationally and internationally.

3B: Industry Skills Councils should ensure that engineering-related qualifications at the Advanced Diploma level provide adequate foundation skills and knowledge for a successful transition to higher education studies in engineering .

3C: VET organisations should actively encourage students in the final year of Certificate III (Trade) or Certificate IV-level programs in engineering-related technologies to continue into an Advanced Diploma.

Recommendations

3. Revitalise the 2-year technician qualification in engineering

3D: More HE and VET providers should develop Associate Degree programs in engineering to assist in alleviating skills shortages at the technician level, while providing a strong articulated pathway from these courses to professional engineering programs in higher education.

3E: Employers in engineering-related fields should provide employment-based cadetships to employees and students enrolled in technician qualifications

3F: The Ministerial Standing Committee on Tertiary Education, Skills and Employment should review the funding of technician qualifications in engineering and related technologies for the purpose of removing inconsistencies between the funding of VET and HE providers.

Principle findings



4. Addressing skills shortages in regional economic contexts.

- **Building engineering capacity is difficult in regional areas where demand for engineering skills from a particular industry may be high, but participation levels in relevant education and training programs are likely to be low**
- **There is evidence that education delivered in the workplace, with the support of employers and the involvement of senior staff can be successful in building engineering capacity in workplaces that are geographically or educationally isolated.**
- **Senior engineering staff can play a significant role in training and assessment by completing the Certificate IV in Training and Assessment or HE equivalent. The potential of such arrangements should be exploited to increase education and training capacity through industry-collaborative models of course delivery.**

Recommendations



4. Addressing skills shortages in regional economic contexts.

- 4A:** *Employers experiencing skills shortages in regional economic contexts should explore the potential of distance learning to upgrade the skills of their existing and potential workforce at both the technician and professional level.*
- 4B:** *Registered Training Organisations (RTOs) and higher education providers should assist regional employers to address skills shortages in engineering through the provision of distance learning and mechanisms to involve senior engineering employees in aspects of course delivery and assessment.*

Big picture issue for VET sector



What is aim of AQF Level 6 engineering programs?

- To educate for a specific employer?
- To educate for a specific industry?
- To educate to for global workforce - by being accredited by Engineers Australia?

Resources



ANET: <http://www.anet.org.au/>

David Dowling: dowling@usq.edu.au

- **Dowling, D. (2011). *A review of Engineering Technician education in Australia*. Paper presented at the 2011 ASEE Conference and Exposition, Vancouver, Canada.**
- **Dowling, D. (2010). *The career aspirations and other characteristics of Australian para-professional engineering students*, In the proceedings of the 2010 AaeE Conference, Sydney.**
- **Dowling, D. (2010). *A review of para-professional engineering education in Australia: Exploring the VET-HE divide*, In the proceedings of the 2010 AaeE Conference, Sydney.**
- **Dowling, D. (2010). *The career aspirations of a cohort of Associate Degree students: Implications for engineering educators and the profession*, In the proceedings of the EE2010 International Conference on Innovation, Good Practice and Research in Engineering Education, Aston University, Birmingham, UK.**