SUPPORT DOCUMENT

Vocational education's variable links to vocations — support document

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This document was produced by the author(s) based on their research for the report *Vocational education's variable links to vocations* and is an added resource for further information. The report is available on NCVER's website: <http://www.ncver.edu.au>.

This document should be attributed as Fredman, N, Moodie, G, Bexley, E & Wheelahan, L 2013, *Vocational education's variable links to vocations — support document*, NCVER, Adelaide.

Published by NCVER, ABN 87 007 967 311

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Introduction

This support document provides the data and methods used to reach the findings reported in the report *Vocational education's variable links to vocations* (Moodie, Fredman, Bexley and Wheelahan, submitted). The vocations project is researching how to improve pathways within education, within work and between education and work. The project is over three years and consists of three inter related strands:

Strand 1: entry to vocations, concentrating on VET in Schools as pathways to work or further study;

Strand 2: the role of educational institutions in fostering vocations, concentrating on vocational education and training and higher education institutions; and

Strand 3: understanding the nature of vocations in work today and their potential improvement.

The three strands are analysing four industry case studies: the finance industry, primary industry, health and electrical trades/engineering to help link their research. This support document includes case studies from engineering, financial planning, medicine and veterinary studies (agriculture).

The case studies use the concepts of 'educational and employment logics' to describe the relation between education and work (Iannelli & Raffe 2007; Wheelahan, Moodie & Buchanan 2012b). In economies where education systems follow an employment logic there are strong connections between work and education with strong links between employers and educational institutions, and large components of work-integrated or work-based learning. Vocational education has a relatively high status and is regarded an educational destination that leads to valued occupational outcomes. In economies where the education system follows an educational logic, the relation between education and work is weaker, and vocational education functions more as a component of the education system with strong links to schools at one end and with higher education at the other end. Links between employers and educational institutions are weaker. Vocational education tends to have a lower status, and is regarded more as the alternative for students who do not achieve academically. The nature of the logic of a system refers to the relation between education and work and relations between social partners (employers, unions, government and educational institutions) and not to the structure and content of curriculum. Consequently, countries such as Germany which have a strong employment logic underpinning vocational education also have a broad based education which includes preparation for citizenship as well as for an occupation. Countries such as England and Australia where there is a strong educational logic underpinning vocational education have a more task focused curriculum.

However, while a country may have a system which can be characterised as having an employment or educational logic underpinning vocational education, there are variations within countries between industries where the relation between education and employment follows an employment logic, while others may follow an educational logic. The overall relation between education and work is thus characterised by the dominant relation and is reflected in the status of vocational education overall. In this support document, each of the case studies uses the concepts of an employment or educational logic to discuss the nature of the relation between education and work in that industry.

The first chapter examines mostly data from the NCVER's student outcomes survey to investigate employment, study and skills outcomes of mid-level qualifications. The second chapter examines data from the Australian Bureau of Statistics' survey of education and work to investigate changes in the level of occupation of graduates of mid level qualifications. The concluding chapters report case

studies of mid-level qualifications in engineering, financial planning, physicians assistants and veterinary technology.

Employment, study and skills outcomes of mid-level qualifications

By Nick Fredman

Previous work in the vocations project discussed the contention that diplomas are being replaced by bachelor degrees as currency in the labour market and that there has been a hollowing-out of mid-level jobs, and put forward the view that the development of mid level skills was the 'missing link' in education and work in Australia (Wheelahan et al. 2012a, Wheelahan et al. 2012b). This chapter adds to this discussion by examining how mid-level qualifications currently perform in preparing their graduates for employment, further study and skills enhancement, and compares them to lower qualifications. It presents quantitative data and analysis which complements previous work on enrolment and employment outcome patterns for mid-level qualifications, including work within the Vocations project (Moodie and Fredman 2013). The analyses presented are carried out using the latest available edition of NCVER's Student Outcomes Survey, carried out in March 2011 and relating to study undertaken in 2010.

In earlier work within this project Moodie and Fredman (2013) analysed the changing patterns of student load and of employment rates for qualifications defined as mid-level in vocational and higher education, that is certificate IVs, diplomas, advanced diplomas, associate degrees and bachelor degrees, across fields of education. It was found that vocational diplomas maintained their share of the student load of mid-level qualifications from 2002 to 2011, with considerable variation by field of education, that the bachelor degree share fell and that the certificate IV share rose. It was further suggested that changes in shares of mid-level qualifications' student load does not seem to be related to employment rates, with the only discernible pattern being generally increasing enrolments and falling graduate employment coinciding with the global financial crisis from 2008, again with considerable variation across fields. The variation found in Moodie and Fredman (2013) suggests the importance of examining outcomes in relation to fields of education and work. Further, the varied stated purposes of mid-level qualifications discussed in the report suggest that the evaluation of outcomes should also consider age differences, as different age groups are likely to have differing needs in terms of further study and entry to and progression in the labour market.

There have been several previous quantitative analyses of the employment outcomes of vocational education and training qualifications using NCVER's Student Outcomes Survey. Karmel and Nguyen (2006), using the 2003 Student Outcomes Survey, focused on the wage benefits, as a proxy of increased skills and productivity, of completing different levels of VET qualifications compared to non-completion, but also examined the effects of highest previous qualification level on being employed, controlling for age group and field of education. Their findings might suggest some doubt about the effectiveness of mid-level qualifications compared with that of higher certificates in terms of employment and wage outcomes. They found that the probability of people being in any employment was highest for graduates of bachelor degrees and post-graduate degrees, followed by certificates III graduates, with certificate IV graduates having a higher probability than advanced

diploma but not diploma graduates. Males were more likely to be in full-time employment and for males and females certificate III graduates had the highest probability of being in full-time employment followed by bachelor or higher graduates, and certificate IV graduates had a higher probability than diploma or advanced diploma graduates. Returns in wages to completing a qualification were found to be related to previous qualification: those with low-level qualifications received a return, while those with a previous certificate IV or higher qualification did not. However, while the overall probabilities of outcomes presented in this work accounted for field of education and age differences, and while the relative independent effects of age and field of education as well as qualification level are given in the regression co-efficients presented, differences due to age and field *within* qualification levels is not evident.

Karmel and Fieger (2012), using the 2009 Student Outcomes Survey, examined the value of completing a VET qualification more broadly than Karmel and Nguyen (2006): that is, how completion affected the outcomes of employment, further study, a combination of employment and further study, occupational status, salary and a composite 'improved employment' outcome relating to whether the respondent was employed after and not before training, in a higher skilled job after training and reported at least one job-related benefit of training. Karmel and Fieger (2012) also examined a broader range of explanatory variables than Karmel and Nguyen (2006), including sex, qualification level and field of education of training undertaken, labour force status before training and socio-economic status. The later study mainly examined whether completion mattered for the outcome variables for different groups defined by the explanatory variables. Karmel and Fieger (2012) found that the greatest relative benefit of completion was that of a higher probability of further study, and that an employment benefit to completion occurred for those not employed before study. Completions matter for wages for those who undertook a qualification at the level of diploma or above and for those who were not employed before training and who had undertaken a qualification at the level of certificate III/IV. Again however, while overall differences of age and field are accounted for and presented, differences within qualification level are not evident.

Stanwick (2006) investigated whether upper-level VET qualifications — defined as diplomas and advanced diplomas — were successful in leading to employment at associate professional level or higher or to university study, also using the 2003 Student Outcomes Survey. These two outcomes were found to vary markedly by age group and field of education. While just over a quarter of graduates aged 15–24 were employed as associate professionals or higher, over half of those aged 25 or higher were so employed, with outcomes strongest in architecture and building and weakest in information technology and the creative arts. Movement to university study also varied by age and field, with 32% of the younger group moving to higher education and 14% of the older group doing so. In some narrow fields such as accountancy and banking and finance over half of the graduates had moved to higher education. In this case, while split cross-tabulations show important differences by field and age group in the actual outcomes within mid-level qualification graduates, the possible independent explanatory of other variables, such as gender and labour force status and skill level of jobs before training, are not accounted for, as they can be in multivariate regression analysis.

Previous work then has suggested a changing and perhaps declining role of mid-level qualifications and a mixed picture of the effectiveness of mid-level qualifications in comparison with higher certificates and pointed to the importance of differences related to field of education. This chapter seeks to add to this discussion by asking the extent to which the stated purposes of mid-level qualifications — labour market entry, further study and skills progression — are being achieved. As these purposes may vary for people of different stages in their working lives and for different fields of education and work, the way the qualification outcomes vary with field of education studies and with age are examined.

Data and method

To address the research question the paper follows Karmel and Nguyen (2006), Stanwick (2006) and Karmel and Fieger (2012) in examining a range of outcomes related to educational and occupational progression that are available in NCVER's Student Outcomes Survey. It uses the latest available edition of the survey available at the time of writing, which was carried out in March 2011 and which related to study undertaken in 2010.

Because of the small sample numbers of some qualification levels in some fields, in this study we are following the approach of Karmel and Nguyen (2006) and Karmel and Fieger (2012) in using a qualification level category of 'diploma and above'. The paper considers qualifications in this category as mid-level to compare their outcomes to those of lower level qualifications.

In its presentation of evidence the paper proceeds by firstly examining some differences in extent of participation, employment before and after study of further study by different broad age groups in the VET system, to suggest some difference of the purposes of mid-level qualifications by age group. Following this a range of outcomes are examined in more detail. Each outcome, as defined in the Findings and Discussion section below, has been coded as a binary variable, for example being employed or not at the time of the survey. To examine how each outcome varies by qualification level and by field of education, crosstabulations of the proportions of the 'positive' outcome (for example being employed) by qualification level and field of education are presented. Broad fields of education (that is, those coded with two digit in the Australian Standard Classification of Education) are presented, along with selected narrow (four digit) fields of education that have relevance as case studies in the Vocations project that are cited in the discussion as pertinent examples of the varied nature of occupational and educational progression. It should be carefully noted that such crosstabulations do not account for how other variables such as gender and labour force status before study may affect outcomes, it being unwieldy to further split what are already three-way tables. However with this caveat in mind it is suggested that, when examined with other evidence, important data about the actual occupational and educational flows in different fields are presented in these tables. An indication of the reliability of results is given by showing which proportions have a standard error greater that 50% of its value or less than that but greater than 25%.

To examine the overall effects of each qualification level on outcomes, in comparison with other levels and while controlling for other explanatory factors such as gender, field of education, labour force status before study and previous study history, the regression methods of Karmel and colleagues cited above are used. While the latter studies were concerned with the effects of completions, this study, in examining the effectiveness of qualifications in the labour market, restricts the sample examined to those who have graduated from a qualification. The outcomes are each examined with a binary logistic regression model. That is, a model of the probability of one outcome in comparison to another, such as the probability of a graduate being employed in comparison with not being employed in the case of the first outcome examined. The results presented for each outcome are the average probabilities of an outcome for each qualification level. These are given for the whole sample, and also for separate models constructed for each of three broad age groups used, to examine how outcomes differ by age group. These probabilities are derived from the regression equation, accounting for the effects of each explanatory other factor other than qualification level by holding the values of each such factor constant at its average value (the factors used in each model are noted under each relevant table). To examine the statistical significance of the differences between probabilities, z tests were conducted between every pair of probabilities across levels and across age groups for each outcome, and the significance of differences (at the 95% level of confidence) are

noted below as relevant ('significant' is used in this sense throughout the chapter). Details for each model of its fit statistics, odds ratios between the effects of each category of each factor are shown in the appendices to this chapter and details of the z tests of difference between probabilities are available on request.

The diversity of mid-level qualification students

Karmel and Nguyen (2006) emphasise the diversity of the VET student population, with younger people entering the labour market and more likely to be studying full-time and older people more likely to be in the labour market and studying part-time to gain specific skills. Table 1 shows the size of each of three broad age groups studying in the VET system in 2011, the proportions these groups make up of the total, and how men as a group and women as a group in the VET system have somewhat different age profiles.

Table 1 Age and gender make-up of VET students 15 years and older, 2011

Age group	Number of students	% of graduates in each age group	% of males in each age group	% of females in each age group
15–24	799 457	43.0	46.7	39.1
25–44	681 241	36.6	35.6	37.7
45+	379 644	20.4	17.8	23.2
Total	1 860 342	100.0	100.0	100.0

Source VOCSTATS (www.ncver.edu.au/resources/vocstats/intro.html) extracted on 1/7/2012.

Table 2 shows some overall differences by age in employment and study patterns of those graduating from VET programs studied in 2010 and in this compares those graduating from diploma or higher level program with all graduates. Those over 25 are more likely to be employed before and after training and in contrast to the youngest group show little difference in proportions employed full-time before and after training. Among graduates under 25, those who completed a program at a diploma or higher level are less likely to be in full-time work after study and more likely to be in further study. Among the older groups, the diploma and higher graduates are more likely to have been in full-time employment before study and to be in full-time employment after study and only slightly more likely to be in further study.

Table 2 Employment and further study characteristics of each broad age group of graduates of all qualifications and of diplomas and above, per cent, 2011

Age group	Employed full-time before training		Employed full-time after training		In further study after training	
	All	*Dips and above*	*All*	*Dips and above*	*All*	*Dips and above*
15–24	23.9	23.2	40.7	34.1	40.1	44.1
25–44	54.5	63.1	55.7	61.1	29.4	31.5
45+	50.0	61.6	48.9	60.2	23.6	27.7
All age groups	**41.3**	**51.2**	**48.2**	**53.1**	**32.4**	**34.2**

Source NCVER (2011).

Tables 1 and 2 provide some initial support for the suggestion made in the introductory section that mid-level qualifications have a differing purpose or balance of purposes for different age groups. The chapter will now consider how a range of outcomes vary by qualification level, field of education and age group.

Outcomes, levels, fields and age

Employed after study

The first binary outcome examined is simply that of being employed or not at the time of the survey, that is six months after study. Table 3 shows the proportion of graduates employed full or part time after study by qualification level and field of education. Diploma and above graduates have a similar employment rate to that of certificate III and IV graduates. However, the differences across levels are more stark in some fields: in engineering overall and the two narrow engineering fields of education considered, certificate III and IV graduates have a considerably higher employment rate than the diploma and higher graduates; while in nursing the diploma and higher graduates have a somewhat higher employment rate than do the certificate III or IV graduates (91% compared with 87% and 86% respectively).

Table 3 Percentage of graduates in employment six months after training, by level of qualification and broad and selected narrow field of education, 2011

Field of education	Cert I	Cert II	Cert III	Cert IV	Dips and above	All levels
Natural and physical sciences	–	65.9**	64.7	59.6	61.4	**62.2**
Information technology	–	47.8	48.4	58.2	63.1	**56.1**
Engineering and related technologies	62.7	74.4	90.8	94.6	83.0	**85.6**
Process and resources engineering	86.6	85.5	90.7	95.9	87.7	**89.7**
Electrical and electronic engineering and technology	36.9**	78.4	93.8	96.1	76.9	**88.6**
Architecture and building	76.2	75.6	93.4	88.3	83.9	**86.3**
Agriculture, environmental and related studies	53.6	74.5	87.4	90.1	92.3	**82.8**
Agriculture	41.4*	77.3	91.0	91.1	94.2	**85.4**
Health	42.1	79.7	83.2	87.7	91.0	**84.3**
Nursing	–	12.4**	86.8	86.0	91.0	**88.4**
Veterinary studies	43.5	62.3	80.4	87.6	78.0**	**71.6**
Education	43.7	100.0**	78.0	91.2	98.2	**89.9**
Management and commerce	55.2	61.9	75.8	83.7	85.7	**76.3**
Banking and finance	100.0**	42.8*	72.7	72.9	68.6	**70.8**
Society and culture	53.4	55.9	77.0	83.0	83.7	**77.6**
Creative arts	36.5	53.7	53.4	60.3	68.2	**60.1**
Food, hospitality and personal services	55.8	67.7	77.5	85.8	71.8	**73.3**
All fields	**57.6**	**66.9**	**80.8**	**83.1**	**83.4**	**77.4**

Source NCVER (2011).

Notes Blank cells indicate a zero sample size.

* Relative standard error > 25%. ** Relative standard error > 50% or cell sample size < 10

Table 4 shows the predicted probabilities of being employed after study for each level within each broad age group, controlling for sex, broad field of education and whether employed or not before study. Here we see that probabilities for the diploma and higher graduates are similar to those for certificates III and IV, although with a statistically significant higher probability than for certificate III graduates among the 25–44 year olds and a significantly higher probability for certificate IV and III graduates among graduates over 44.

Table 4 Predicted probabilities of being in employment six months after training, all ages and split by age group, 2011

Qualification level	Age 15–24	Age 25–44	Age 45+	All ages
Diplomas and above	0.62	0.63	0.60	0.64
Certificate IV	0.62	0.63	0.54	0.62
Certificate III	0.65	0.59	0.54	0.62
Certificate II	0.50	0.48	0.42	0.49
Certificate I	0.47	0.49	0.40	0.47

Source NCVER (2011).

Notes Probabilities are derived by holding the variables for sex, broad field of education and whether employed or not before training constant at their average values.

These results reinforce previous findings and discussion in the vocations project about regulatory and labour market change. The higher rate for nursing graduates at the diploma and higher level compared to that at certificate III or IV reflects the change in registration requirements for an enrolled nurse from a certificate to a diploma, so that certificates are now more of an articulation qualification and the diploma has a clear occupational outcome (Fredman 2012, p.10). The lower rate for diploma and higher graduates in the narrow field of education of banking and finance perhaps reflects the increased use of higher education qualifications as entrance screening for higher level work within finance fields (Yu et al. 2012, p. 22).

Employed full-time after study

Labour market goals from study may be better reflected in full-time employment rates. Table 5 shows such rates by qualification and field. Here again diploma and higher graduates have a similar rate to certificate III and IV graduates. There are similar but larger differences to those noted above in the broad field of engineering and the narrow engineering fields considered. The proportion for diploma and higher is much lower than that for certificate III or IV and there is a somewhat different pattern within nursing where the proportion for diploma and higher is higher than that for certificate IV but lower than that for certificate III.

Table 5 Percentage of graduates in full-time employment six months after training, by level of qualification and broad and selected narrow field of education, 2011

Field of education	Cert I	Cert II	Cert III	Cert IV	Dips and above	All levels
Natural and physical sciences	–	36.4**	29.6	26.3	35.8	**30.4**
Information technology	–	15.6**	27.8	28.0	34.8	**29.6**
Engineering and related technologies	38.5	54.4	81.7	86.8	64.9	**72.8**
Process and resources engineering	58.9**	72.3	81.7	90.3	63.8	**78.9**
Electrical and electronic engineering and technology	19.4**	63.4	89.5	87.2	65.1	**80.3**
Architecture and building	49.7	59.6	83.9	78.1	57.9	**71.9**
Agriculture, environmental and related studies	24.5	50.2	71.5	75.1	72.3	**63.4**
Agriculture	14.1**	48.6	73.6	72.4	80.9	**64.1**
Health	0	41.0	46.3	51.8	48.1	**45.8**
Nursing	–	12.4**	50.0	29.4	39.7	**36.5**
Veterinary studies	0	18.1	29.4	50.7	40.8**	**27.8**
Education	12.7**	54.6**	15.6	61.2	74.5	**56.9**
Management and commerce	23.5	19.9	42.3	59.3	61.5	**45.3**
Banking and finance	100.0**	4.9**	41.4	35.9	38.6	**38.5**
Society and culture	22.2	26.2	27.6	39.8	44.7	**33.3**
Creative arts	1.5**	14.1	13.8	16.9	20.4	**16.8**
Food, hospitality and personal services	18.6	27.1	43.0	48.0	30.6	**35.6**
All fields	**28.6**	**35.1**	**53.2**	**54.5**	**53.1**	**48.2**

Source NCVER (2011).

Notes Blank cells indicate a zero sample size.

* Relative standard error > 25%. ** Relative standard error > 50% or cell sample size < 10.

The regression results presented in table 6 are also similar to the overall employment probabilities, except that in this case the diploma and higher probabilities are significantly higher than those for certificate III in the two older age groups, considerably so in the oldest age group within which the proportion for diploma and higher graduates is also significantly greater than that for certificate IV graduates.

Table 6 Predicted probabilities of being in full-time employment six months after training, 2011

Qualification level	Age 15–24	Age 25–44	Age 45+	All ages
Diplomas and above	0.22	0.28	0.27	0.28
Certificate IV	0.27	0.28	0.23	0.28
Certificate III	0.30	0.20	0.17	0.23
Certificate II	0.12	0.16	0.14	0.13
Certificate I	0.08	0.17	0.08	0.11

Source NCVER (2011).

Notes Probabilities are derived by holding the variables for sex, broad field of education and whether employed or not before training constant at their average values..

Altogether these results reinforce the points about qualifications and labour market pathways in finance and nursing fields noted in the previous subsection. The lack of clarity about the role of mid-level qualifications in engineering discussed in chapter 4 also seems reflected in Table 5, while the age related results in Table 6 perhaps reflects that certificates, particularly certificate III for apprenticeships and traineeships, are only clear labour market pathways for younger people.

Further study after training

The value of mid-level qualifications as study pathways is assessed in the following four tables. We first look at further study in general. Table 7 shows the proportions of graduates in further study by level and field. Results for diploma and higher are only a little higher than those for certificate III and IV graduates. There are differences within fields, with the diploma and higher results considerably higher in engineering, suggesting a pathway rather than labour market role for the mid-level qualification, while the reverse could be said for mid-level qualifications in nursing, in which the diploma now has a clear job outcome, compared with the certificate IV.

Table 7 Percentage of graduates in further study six months after training, by level of qualification and broad and selected narrow field of education, 2011

Field of education	Cert I	Cert II	Cert III	Cert IV	Dips and above	All levels
Natural and physical sciences	–	22.6**	29.8	40.1	37.7	**35.2**
Information technology	–	28.1**	52.4	44.4	44.4	**46.6**
Engineering and related technologies	34.3	32.1	19.6	22.4	41.9	**24.9**
Process and resources engineering	17.1**	22.4	20.8	20.5	47.6*	**22.0**
Electrical and electronic engineering and technology	100.0**	45.7	26.1	28.6	42.0	**32.9**
Architecture and building	25.5	35.2	21.4	27.9	33.7	**26.2**
Agriculture, environmental and related studies	34.2	29.6	22.3	21.9	22.9	**25.1**
Agriculture	49.4	29.7	20.1	18.3	15.2	**23.4**
Health	46.5	25.5	29.7	37.9	34.1	**31.0**
Nursing	–	45.4**	20.1**	37.7	32.6	**33.8**
Veterinary studies	48.1	53.4	37.8	16.6*	23.1**	**40.9**
Education	33.1*	0	26.7	27.0	32.7	**27.3**
Management and commerce	28.5	43.1	36.3	30.1	33.6	**35.4**
Banking and finance	100.0**	44.6**	42.9	46.0	41.4	**43.2**
Society and culture	23.5	43.6	36.1	38.1	31.7	**36.2**
Creative arts	44.3	49.1	49.2	57.6	39.4	**48.2**
Food, hospitality and personal services	28.1	35.0	26.3	26.5	25.8	**30.2**
All fields	**33.2**	**36.3**	**29.0**	**32.9**	**34.2**	**32.4**

Source NCVER (2011).

Notes Blank cells indicate a zero sample size.

* Relative standard error > 25%. ** Relative standard error > 50% or cell sample size < 10.

The regression results in Table 8 also show very similar probabilities across levels, apart from the aged 15 to 24 group among whom the mean predicted probability for graduates of certificate IV and II programs are significantly higher, and that for graduates of certificate III programs significantly lower, than that for graduates of diploma and above programs. Within each level there is a similar pattern of decrease from the youngest to oldest age group (all significant differences). Diploma and higher qualifications therefore do not seem distinct in leading to further study, and this reinforces the findings of the vocations project that people are increasingly gaining multiple qualifications by varied pathways, albeit with variations across fields (Wheelahan et al. 2012a, Wheelahan et al. 2012b). Further study does appear to be a particular concern for young people. One question in the SOS asks the main reason for study. Considering the responses of those having graduated from diploma and

higher programs, the response ‘to get into another course of study’ was nominated by 17% of those aged 15–24, 3% of those aged 25–44 and 1% of those aged 45 and over.[1]

Table 8 Predicted probabilities of being in further study six months after training, all ages and split by age group, 2011

Qualification level	Age 15–24	Age 25–44	Age 45+	All ages
Diplomas and above	0.32	0.27	0.24	0.28
Certificate IV	0.38	0.27	0.23	0.28
Certificate III	0.29	0.25	0.22	0.26
Certificate II	0.42	0.28	0.21	0.33
Certificate I	0.38	0.27	0.21	0.29

Source NCVER (2011).

Notes Probabilities are derived by holding the variables for sex, broad field of education and whether employed or not before training and highest level of qualification before training constant at their average values.

Further study at bachelor degree or higher

If the mid-level qualifications considered as a category here, which are mainly diplomas, are not distinct in leading to further study in general, they may be distinct in leading to further study at a bachelor degree or higher level. That is, we may see a role as a ‘cross-over’ qualification between VET and higher education, which is how Karmel and Nguyen (2003, p.11) described the contemporary role of the diploma. Table 9 shows proportions of all graduates studying at bachelor degree or higher, by level and field. Overall these proportions clearly increase the higher the qualification level. Within diploma and higher qualifications proportions are particularly high in natural and physical sciences (29%), information technology (27%) and nursing (20%).

[1] In this chapter I do not examine the question for reasons of study systematically, or use this variable as a control in the regression models of outcomes even though I acknowledge outcomes are probably related to prior reasons, because I have some concerns about the validity of the relevant question in SOS in measuring study motivation. This question allows only a single ‘main reason’. In Fredman (2013) I discuss study motivation using data from the Australian Bureau of Statistics Survey of Education and Training which allows for multiple responses to a question similar to that in the SOS. As I examined, many people nominate multiple reasons, and the pattern of reasons given is quite different for second qualifications than for first qualifications. Further, I think interpretations of the SOS question might vary: for example, 14% of all those who already have a job before training nominate ‘to get a job’ for this question. Presumably these respondents do not actually need to get any job, and some may mean they studied to get a better job. Due to validity concerns about this question not fully capturing and perhaps mis-interpreting motivation, I make some general points about how responses to this question vary between age groups of diploma and higher graduates, rather than make a systematic presentation of all the results to this question, or use the variable as a regression control.

Table 9 Percentage of graduates in further study at bachelor level or higher six months after training, by level of qualification and broad and selected narrow field of education, 2011

Field of education	Cert I	Cert II	Cert III	Cert IV	Dips and above	All levels
Natural and physical sciences	–	0	6.7**	7.2*	29.3	**13.3**
Information technology	–	0	7.1	4.1*	26.7	**11.9**
Engineering and related technologies	2.7**	3.4	1.5	1.9*	18.2	**3.0**
Process and resources engineering	5.3**	0.8**	1.0**	2.5**	26.4**	**2.2**
Electrical and electronic engineering and technology	0	0.7**	1.5*	2.4	13.9	**2.6**
Architecture and building	2.0*	0.7**	0.6**	3.5*	16.5	**2.3**
Agriculture, environmental and related studies	4.7**	3.1	2.4*	3.2*	4.8*	**3.0**
Agriculture	0	5.9	2.2*	5.6**	3.8**	**3.9**
Health	3.6**	3.2*	6.5	10.1	15.6	**7.9**
Nursing	–	15.9**	1.5**	22.3	19.6	**19.6**
Veterinary studies	3.7**	3.1**	3.4**	3.9**	23.1**	**3.8***
Education	0	0	4.5	5.1	11.5*	**5.4**
Management and commerce	1.0**	5.9	7.0	5.6	13.5	**7.9**
Banking and finance	0	3.5**	4.6*	7.1	23.7	**12.6**
Society and culture	0.9**	2.9	4.6	8.3	16.7	**7.5**
Creative arts	5.9**	5.0*	9.0	6.6	18.6	**11.1**
Food, hospitality and personal services	7.6**	4.7	7.0	3.3*	7.2*	**5.7**
All fields	**2.0**	**3.9**	**4.2**	**6.9**	**15.2**	**6.1**

Source NCVER (2011).

Notes Blank cells indicate a zero sample size.

* Relative standard error > 25%. ** Relative standard error > 50% or cell sample size < 10.

The predicted probability results in Table 10 also show that the probability of being in further study at a bachelor degree of higher level, while being quite small in each case, falls sharply at lower qualification levels (each apparent difference being significant). We also see that within qualification levels this probability falls in older age groups (all significant differences). Taking into account the considerable variation across fields and also any variation due to sex, whether graduates were in employment before study and previous qualifications, we can see that diploma and higher qualifications play some role as cross-over qualifications for those under 45, but does less so, at least within six months of study, for older people.

Table 10 Predicted probabilities of being in further study at bachelor level or higher six months after training, with 95% confidence limits, 2011

Qualification level	Age 15–24	Age 25–44	Age 45+	All ages
Diplomas and above	0.11	0.9	0.05	0.10
Certificate IV	0.05	0.04	0.02	0.05
Certificate III	0.03	0.02	0.01	0.03
Certificate II	0.03	0.02	0.01	0.03
Certificate I	0.01	0.02	0.01	0.01

Source NCVER (2011).

Notes Probabilities are derived by holding the variables for sex, broad field of education and whether employed or not before training and highest level of qualification before training constant at their average values.

Employed after training for those unemployed before training

We now consider measures of occupation progression, first the role of qualifications in securing work for those previously unemployed. The binary outcome considered here is, for all those who were unemployed before training, whether or not they were employed after training. Table 11 shows the proportions of those unemployed before training who were employed after training by level and field. We can see that this measure for certificate IV graduates is 42%, while it is 45% for diploma and higher graduates, both of which are considerably lower than that for certificate III graduates (53%). Among diploma and higher graduates the fields having a particularly high proportion on this measure include agriculture (82%) and nursing (60%) and architecture and building (59%).

Table 11 Percentage of those not employed before training who were employed six months after training, by level of qualification and broad and selected narrow field of education, 2011

Field of education	Cert I	Cert II	Cert III	Cert IV	Dips and above	All levels
Natural and physical sciences	–	46.3**	29.3	22.8*	37.8	**30.3**
Information technology	–	6.6**	24.2	28.7	38.5	**28.7**
Engineering and related technologies	35.5	46.0	74.8	65.3	51.3	**58.2**
Process and resources engineering	47.8**	53.6	65.8	100.0**	79.3**	**60.9**
Electrical and electronic engineering and technology	0	51.8	90.7	85.8**	42.2	**68.6**
Architecture and building	44.5	50.7	86.5	44.5	59.2	**63.7**
Agriculture, environmental and related studies	20.6**	45.1	54.4	35.6*	69.0	**47.0**
Agriculture	16.2**	48.5	57.2	34.5**	82.3	**48.6**
Health	6.1**	31.5	48.6	48.7	59.5	**42.5**
Nursing	–	21.8**	0	56.7	59.6	**54.9**
Veterinary studies	6.1**	35.0	56.7	93.2**	100.0**	**42.2**
Education	41.3**	100.0**	64.1	49.1	100.0**	**53.7**
Management and commerce	26.0	38.5	47.0	46.5	40.2	**41.8**
Banking and finance	–	28.4**	41.3	35.0	31.9	**36.0**
Society and culture	28.7*	27.9	54.9	41.8	50.5	**48.3**
Creative arts	11.1**	27.4	28.4	34.4	38.2	**32.0**
Food, hospitality and personal services	24.5*	42.7	45.9	50.7	45.7	**43.7**
All fields	**30.7**	**38.1**	**53.0**	**42.2**	**44.8**	**44.0**

Source NCVER (2011).

Notes Blank cells indicate a zero sample size.

* Relative standard error > 25%. ** Relative standard error > 50% or cell sample size < 10

The predicted probability results shown in Table 12 show that in the youngest group the probability of being employed for diploma and higher graduates is statistically indistinguishable as that for certificate IV graduates while it is significantly somewhat less than that for certificate III graduates. It appears diploma and higher qualifications play less of a role in helping unemployed young people gain work than the apparently clearer pathways to work available for certificate IIIs, many of which are studied for apprenticeships and traineeships. Among the older two groups the apparent differences in these probabilities between diploma and above, certificate IV and certificate III graduates are not significant. There seems to be exceptions by field, and notably perhaps for policy considerations is the high proportion in agriculture, and the apparent high proportions in process and resource

engineering, and veterinary studies, also important fields in rural areas, although these two latter results are unreliable. Engaging rural youth within their home region is an important consideration in improving social inclusion (Cuervo and Wyn, 2012) a point also noted in the chapter on engineering education which observes a lack of advanced diploma engineering programs in rural areas. It should be noted that labour market entry appears to be a particular reason for young people to study. Considering the 'main reason for study' responses of those who have graduated from a diploma and higher programs, labour market entry appears particularly important for young people, with 39% giving the response 'to get a job' compared with 13% of those aged 25–44 and 8% of those aged 45 and over (noting my concerns about this question footnoted above).

Table 12 Predicted probabilities of being in employment six months after training for those who were not employed before training

Qualification level	Age 15–24	Age 25–44	Age 45+	All ages
Diplomas and above	0.49	0.46	0.35	0.46
Certificate IV	0.47	0.47	0.31	0.44
Certificate III	0.54	0.48	0.36	0.50
Certificate II	0.35	0.34	0.22	0.34
Certificate I	0.32	0.35	0.18	0.30

Source NCVER (2011).

Notes Probabilities are derived by holding the variables for sex, broad field of education and whether employed or not before training constant at their average values..

Working in the same occupation as training

The vocations project has focussed on the possibilities of more coherent progression through education and work and how such progression may be improved by the notion of vocational streams (Wheelahan et al. 2012b, Yu et al. 2012). The binary variable examined here is one measure of a coherent link between education and work. It is, for all graduates who are employed, whether or not their occupation, as coded by the Australian and New Zealand Standard Classification of Occupations at the unit group (4 digit) level, matches the occupation, also thus defined, associated with their completed qualification. Table 13 shows the proportions of those employed after study who are employed in the intended occupation associated with their qualification. Notably this is highest among certificate III graduates, and the proportion among diploma and higher graduates is also lower than that for certificate IV graduates. Within the group of diploma and higher graduates, high proportions of those studying in the occupation associated with their qualification are found among those studying towards the regulated professions in nursing, and health generally, and education, and in agriculture.

Table 13 Percentage of those employed six months after training working in the same occupation as their training, by level of qualification and broad and selected narrow field of education, 2011

Field of education	Cert I	Cert II	Cert III	Cert IV	Dips and above	All levels
Natural and physical sciences	–	55.3**	38.2	49.3	56.6	**46.3**
Information technology	–	–	23.5	17.9	33.2	**24.7**
Engineering and related technologies	6.8*	13.0	66.3	39.1	35.1	**49.1**
Process and resources engineering	10.7**	37.8	43.6	15.2*	37.9**	**36.5**
Electrical and electronic engineering and technology	0	8.0*	83.7	55.5	30.0	**64.1**
Architecture and building	7.1*	7.7	76.0	27.4	26.9	**50.9**
Agriculture, environmental and related studies	26.1**	20.4	34.5	35.4	37.3	**30.2**
Agriculture	43.6**	28.9	34.2	31.9	51.7	**34.4**
Health	6.1**	6.2	39.9	45.7	58.9	**34.4**
Nursing	–	–	8.4**	70.0	78.1	**72.3**
Veterinary studies	6.1**	36.2	42.2	88.8	35.7**	**52.0**
Education	–	–	64.5	31.8	56.6	**35.2**
Management and commerce	8.4*	26.8	32.0	23.3	17.9	**24.8**
Banking and finance	0	0	33.7	39.8	22.4	**31.1**
Society and culture	–	25.9	63.1	35.4	19.4	**45.4**
Creative arts	0	11.9*	9.1	9.0*	10.9	**9.8**
Food, hospitality and personal services	21.1*	20.8	58.0	37.7	2.7**	**40.1**
All fields	**8.7**	**17.7**	**54.6**	**31.1**	**25.5**	**37.2**

Source NCVER (2011).

Notes Sample base includes only those who had indicated an occupation after training.

Blank cells indicate a zero sample size.

* Relative standard error > 25%. ** Relative standard error > 50% or cell sample size < 10

The predicted probabilities shown in Table 14 show diploma and higher graduates have a fairly low probability across age groups, with those graduates 45 and over having a probability a little lower (if significantly so) than those younger. In each age group diploma and higher graduates have a considerably lower probability than certificate III graduates, and in the two older age groups diploma and higher graduates have an average probability statistically indistinguishable as that for certificate IV graduates. A low probability of working in the same occupation as study may be understandable for young people using a diploma or higher qualification as a cross-over qualification or a general path to further study, it is of concern that for older people the probabilities of working in the same occupation is the same or lower. However, in regard to coherence between education and subsequent work mid-level qualifications do not on the whole appear to perform particularly well for the two older age groups.

Table 14 Predicted probabilities of those employed six months after training working in the same occupation as their training, 2011

Qualification level	Age 15–24	Age 25–44	Age 45+	All ages
Diplomas and above	0.19	0.19	0.16	0.31
Certificate IV	0.31	0.20	0.15	0.35
Certificate III	0.53	0.35	0.26	0.54
Certificate II	0.18	0.08	0.05	0.18
Certificate I	0.05*	0.04*	0.05*	0.07

Source NCVER (2011).

Notes Probabilities are derived by holding the variables for sex, broad field of education and whether employed or not before training constant at their average values.

Working at a higher skill level

We also examined progression to more highly skilled occupations. The binary outcome variable used here is defined as, for those who were working both before training and six months after training, whether or not the skill level of the occupation after training is higher than the skill level of the occupation before training. Occupations and their skill levels are defined as in the Australian and New Zealand Standard Classification of Occupations at the unit group (4 digit) level. Table 15 shows the proportions of graduates working at a higher skill level by level and field. Overall the highest proportion is for certificate III (22%) followed by diploma and higher (17%) and certificate II (15%). High proportions among diploma and higher graduates are seen for those who have studied for the regulated occupations of nursing (41%) and electrical and electronic engineering (26%).

Table 15 Percentage of those employed six months after training working at a higher skill level, by level of qualification and broad and selected narrow field of education, 2011

Field of education	Cert I	Cert II	Cert III	Cert IV	Dips and above	All levels
Natural and physical sciences	–	0	26.3	31.5	25.7*	**27.6**
Information technology	–	0	25.7	16.5	29.6	**22.8**
Engineering and related technologies	13.0	17.8	24.5	9.6	20.0	**20.5**
Process and resources engineering	0.9**	8.4*	9.4	7.7**	10.0**	**8.7**
Electrical and electronic engineering and technology	52.6**	34.5	39.8	7.6*	26.0	**33.4**
Architecture and building	11.7	20.1	27.0	12.8	23.7	**22.3**
Agriculture, environmental and related studies	0	9.7	10.1	9.6*	10.2	**9.8**
Agriculture	0	8.2	6.7	11.7*	9.5*	**8.0**
Health	0	6.5	14.3	24.0	32.3	**18.2**
Nursing	–	–	10.6**	47.0	40.6	**41.0**
Veterinary studies	0	22.3	21.0*	32.7	0	**24.3**
Education	0	–	21.4	7.9	3.5**	**8.5**
Management and commerce	10.5*	17.3	23.2	12.0	11.9	**15.8**
Banking and finance	0	0	17.1	9.9	12.2	**13.1**
Society and culture	6.3**	11.5	20.9	13.8	15.8	**17.1**
Creative arts	0	20.5	15.6	10.2	25.3	**18.4**
Food, hospitality and personal services	14.5**	15.4	25.8	16.2	22.4	**20.9**
All fields	**11.1**	**14.6**	**22.2**	**12.3**	**16.6**	**17.3**

Source NCVER (2011).

Notes Blank cells indicate a zero sample size.

* Relative standard error > 25%. ** Relative standard error > 50% or cell sample size < 10

Moving to a higher skill level also varies considerably with whether a job after graduation is in the intended occupation or not as shown in table 16. This reflects an outcome of the coherence between education and work.

Table 16 Percentage of those employed six months after training working at a higher skill level, by level of qualification and whether occupation is the same as training, 2011

	Cert I	Cert II	Cert III	Cert IV	Dips and above	All levels
In same occupation as training	–	13.9	28.6	17.4	26.3	**24.8**
In different occupation as training	11.3	13.7	15.8	10.3	12.4	**13.1**

Source NCVER (2011).

Notes Blank cells indicate a zero sample size.

* Relative standard error > 25%. ** Relative standard error > 50% or cell sample size < 10.

Examining the predicted probabilities shown in Table 17, we can see that the highest probability for working at a higher skill level is for young people graduating from diploma and higher qualifications, at 0.36. This is a significantly higher probability than that for graduates of the other levels within this age group. For all levels probabilities fall quite markedly (and significantly) for the two older age groups. With the possible exceptions suggested by Table 16, mid-level qualifications, along with other qualifications, seem to do little to help workers over 24 move into more highly skilled work, at least within six months of graduation.

Table 17 Predicted probabilities of those employed six months after training working at a higher skill level, 2011

Qualification level	Age 15–24	Age 25–44	Age 45+	All ages
Diplomas and above	0.36	0.07	0.03	0.18
Certificate IV	0.26	0.07	0.03	0.16
Certificate III	0.31	0.09	0.04	0.23
Certificate II	0.26	0.07	0.02	0.17
Certificate I	0.24	0.06	0.03	0.15

Source NCVER (2011).

Notes Probabilities are derived by holding the variables for sex, broad field of education and whether working is in the same occupation as training constant at their average values..

The low probabilities for graduates over 24 moving to higher skilled work appear particularly stark if the main reason stated for study among those with a job before study is considered. The response 'to get a better job or promotion' is given as a main reason by 8% of graduates of diploma and higher programs aged 15–24 with a job before study, 20% of such graduates aged 25–44 and 15% of graduates aged 45 and over (again noting my validity concerns around this question discussed at footnote 1).

Conclusion

Previous research has suggested that the value of VET qualifications varies markedly across fields and by previous work and study history. It also seems that in recent years diploma enrolments have increased and employment rates of diploma graduates remained largely steady, again with considerable variation across fields. Further, it seems clear that mid-level qualifications play somewhat different roles for young people and older people. This chapter has further explored these questions by examining employment, study and skills outcomes in the 2011 Student Outcomes Survey. The findings here reinforced the conclusion that outcomes vary considerably by field of education. Fields of education are generally related to occupations which differ in labour market conditions and by extent of regulation, highlighting the segmented nature of the labour market (Yu et al., 2012). Such differences should caution us against universal prescriptions for the purposes of qualifications. The regression results presented here — showing the average probabilities of outcomes by qualification levels, while accounting for variations by field, sex and, as relevant, previous employment status and previous study — do suggest that diploma and higher qualifications are as a whole distinctive in some respects in patterns of outcomes compared to lower qualification levels. The results suggest that qualifications at diploma and higher levels are distinctive in leading to higher education and, for people under 25, in accessing more highly skilled work. The results also suggest that mid-level qualifications fare no better than other qualifications in terms of the very low probabilities of graduates over 25 moving to more highly skilled work. It should be borne in mind that the regression models explain some, but by no means all, of the variation in outcomes. However, such very low probabilities, when substantial numbers of workers over 25 appear to want to use diploma and higher course to gain more highly skilled work suggests that that there may be a need in many fields for mid-level qualifications that are strongly connected to occupational progression, and that this need is not being met.

Appendix: employment and study outcome regression results

The following tables report further results and details of the logistic regressions, modelling employment and study outcomes from the 2011 student outcomes survey, reported on in the previous chapter. Logistic regression is a method for modelling the probability of one of a number of outcomes of hypothesised explanatory variables. Binary logistic regression, used for each outcome here, models the probability of one of two possible outcomes. To model such probability outcomes is complex, and involves first expressing probability as odds, that is for example the odds of being employed as the probability of being employed divided by the probability of not being employed. To express the relative independent impact of the different explanatory factors the results of the regression can be given as odds ratios, that is how the odds of the relevant outcome changes if a particular factor changes, controlling for other factors. Each factor then has a co-efficient associated with it that expresses, in the case of categorical variables with which we are concerned with here, the odds ratio for the outcome if that category is 'true', compared with a reference category. These coefficients are called 'exponentiated' in the tables below to indicate that they are the particular coefficients derived from an exponentiating function in the modelling process.

For example, Table 18 models the outcome of being employed compared with not being employed. The fourth row of the table gives the co-efficient of the 'diplomas and above' category compared with the reference category of certificate I for the separately performed regressions for each broad age group, and all ages, controlling for the other explanatory variable in the model. The figure for the first column of this table is 1.83. This indicates that for 15–24 year olds the odds of those graduating from a diploma or above qualification is 1.83 times or 83% higher than the odds of those graduating from a certificate I. We can thus see which factors have a greater relative impact. Figures below 1 indicate decreased odds of being employed if that factor is true compared to the reference category. For example, again considering the first column, it can be seen that studying in information technology has a greater independent impact than any of the qualification levels, with those graduating from this field 3.13 (1/0.32) times less likely to be employed than those in the reference category of agriculture and environment, controlling for other factors.

While odds ratios are somewhat complicated to interpret, they are the best way to consider the relative independent impacts of different categories of different factors and to see which impacts are statistically significant, as indicated in the tables. To consider different categories within a factor, odds ratios can be converted into more easily interpretable probabilities. This has been done for the relevant tables in the main body of the chapter considering the independent impact of different qualification levels. As noted, the predicted probabilities are derived by holding the other independent variables constant at their average value.

Each table also reports the likelihood ratio, which is a measure of whether the model as a whole is statistically significant. The R-square figure is an indication of how much of the variation in the outcomes is explained by the model, with 0 being no variation and 1 all variation explained.

Model for being in employment after training

Table 18 Model fit, R-square, and odds ratio results for regression model of being in employment six months after training, all ages and split by broad age group

Parameter	Age 15–24	Age 25–44	Age 45+	All ages
Likelihood ratio	50527.6**	54301.6**	41421.8**	145949.9**
R-square	0.91	0.91	0.91	0.91
Exponentiated estimates (odds ratios)				
Intercept	5.01**	7.73**	10.16**	6.68**
Diplomas and above	1.83**	1.76**	2.29**	1.97**
Certificate IV	1.86**	1.75**	1.75**	1.86**
Certificate III	2.04**	1.50**	1.76**	1.81**
Certificate II	1.10	0.94	1.11	1.08
Certificate I	.	.	.	.
Male	1.00	1.24**	0.89	1.09*
Female	.	.	.	.
Society and Culture	0.71**	0.90	0.76	0.78**
Natural and Physical Sciences	0.33**	0.53*	0.39**	0.40**
Mixed Field Programs	0.43**	0.40**	0.35**	0.39**
Management and Commerce	0.82	0.70**	0.60**	0.71**
Information Technology	0.32**	0.29**	0.23**	0.28**
Health	0.76	1.44*	0.90	1.03
Food, Hospitality and Personal Services	0.82	0.68*	0.60**	0.73**
Engineering and Related Technologies	1.55**	1.17	0.88	1.27**
Education	0.83	1.36	1.04	1.18
Creative Arts	0.44**	0.29**	0.26**	0.35**
Architecture and Building	1.69**	1.20	1.02	1.47**
Agriculture, Environmental and Related Studies	.	.	.	.
Unemployed before training	0.16**	0.11**	0.07**	0.12**
Not in labour force before training	0.13**	0.07**	0.03**	0.09**
Not Employed (NFI) before training	0.19**	0.07**	0.09**	0.11**
Employed before training	.	.	.	.

Source NCVER (2011)

Notes * Significant at $p < 0.05$ ** Significant at $p < 0.01$
Missing values denote reference groups

Model for being in full-time employment after training

Table 19 Model fit, R-square, and odds ratio results for regression model of being in full-time employment six months after training, all ages and split by broad age group

Parameter	Age 15–24	Age 25–44	Age 45+	All ages
Likelihood ratio	58477.4**	72259.7**	36716.4**	161014.0**
R-square	0.94	0.96	0.88	0.93
Exponentiated estimates (odds ratios)				
Intercept	0.42**	1.22	0.58*	0.69**
Diplomas and above	3.15**	2.00**	3.84**	3.23**
Certificate IV	4.18**	2.06**	3.01**	3.26**
Certificate III	4.84**	1.30	2.06**	2.54**
Certificate II	1.53**	0.97	1.70**	1.25*
Certificate I	.	.	.	.
Male	1.39**	3.19**	2.78**	2.27**
Female	.	.	.	.
Society and Culture	0.30**	0.34**	0.42**	0.32**
Natural and Physical Sciences	0.18**	0.45**	0.50**	0.29**
Mixed Field Programs	0.24**	0.27**	0.28**	0.25**
Management and Commerce	0.51**	0.65**	0.73**	0.57**
Information Technology	0.20**	0.27**	0.36**	0.19**
Health	0.38**	0.56**	0.68**	0.56**
Food, Hospitality and Personal Services	0.46**	0.46**	0.64**	0.46**
Engineering and Related Technologies	1.94**	1.36**	1.13	1.46**
Education	0.55*	0.50**	0.57**	0.52**
Creative Arts	0.12**	0.13**	0.23**	0.11**
Architecture and Building	1.88**	1.10	1.16	1.44**
Agriculture, Environmental and Related Studies	.	.	.	.
Unemployed before training	0.40**	0.15**	0.11**	0.22**
Not in labour force before training	0.33**	0.11**	0.06**	0.18**
Not Employed (NFI) before training	0.53**	0.09**	0.12**	0.22**
Employed before training	.	.	.	.

Source NCVER (2011)

Notes * Significant at $p < 0.05$ ** Significant at $p < 0.01$

Missing values denote reference groups

Model for being in study after training

Table 20 Model fit, R-square, and odds ratio results for regression model of in study six months after training, all ages and split by broad age group

Parameter	Age 15–24	Age 25–44	Age 45+	All ages
Likelihood ratio	9243.96**	5213.52**	3644.24	17664.64
R-square	0.36	0.21	0.19	0.26
Exponentiated estimates (odds ratios)				
Intercept	0.60**	0.37**	0.23**	0.35**
Diplomas and above	0.86	1.02	1.27*	1.03
Certificate IV	1.05	0.99	1.21	1.04
Certificate III	0.72**	0.93	1.03	0.90
Certificate II	1.25	1.03	1.09	1.28**
Certificate I	.	.	.	.
Male	0.84**	0.88**	0.83**	0.86**
Female	.	.	.	.
Society and Culture	1.79**	1.55**	1.42**	1.61**
Natural and Physical Sciences	1.44	1.35	1.13	1.47**
Mixed Field Programs	1.69**	2.01**	2.41**	2.04**
Management and Commerce	1.45**	1.31**	1.35*	1.50**
Information Technology	2.20**	2.06**	1.93**	2.46**
Health	1.14	1.26	1.27*	1.21*
Food, Hospitality and Personal Services	0.91	1.07	0.88	1.10
Engineering and Related Technologies	0.95	0.95	0.98	1.01
Education	1.56	1.09	1.38*	1.18*
Creative Arts	2.16**	1.68**	2.62**	2.42**
Architecture and Building	0.93	1.04	0.86	1.07
Agriculture, Environmental and Related Studies	.	.	.	.
Unemployed before training	0.93	1.32**	1.49**	1.18**
Not in labour force before training	1.26**	1.54**	1.16	1.44**
Not Employed (NFI) before training	0.73	0.48*	1.16	0.67*
Employed before training	.	.	.	.
Highest previous qualification: year 12	1.19**	0.96	0.94	1.28**
Highest previous qualification: year 11 or Certificate I/II	0.97	0.90	1.02	1.06
Highest previous qualification: year 10 or below	0.85*	0.66**	0.62**	0.81**
Highest previous qualification: Diploma and above	0.99	0.87**	1.10	0.87**
Highest previous qualification: Certificate III/IV	.	.	.	.

Source Calculated from NCVER (2011)..

Notes * Significant at $p < 0.05$ ** Significant at $p < 0.01$

Missing values denote reference groups

Model for being in study at bachelor degree or higher after training

Table 21 Model fit, R-square, and odds ratio results for regression model of being in study at bachelor degree or higher six months after training, all ages and split by broad age group

Parameter	Age 15–24	Age 25–44	Age 45+	All ages
Likelihood ratio	16231.10**	7338.02**	2424.07**	22425.48**
R-square	0.55	0.29	0.13	0.32
Exponentiated estimates (odds ratios)				
Intercept	0.02**	0.01**	0.23**	0.01**
Diplomas and above	10.35**	6.34**	8.75**	8.48**
Certificate IV	4.82**	2.57**	3.15*	3.67**
Certificate III	2.54**	1.28	1.67	2.24**
Certificate II	2.23**	0.94	1.60	2.21**
Certificate I	.	.	.	.
Male	0.98	1.13	0.84	1.00
Female	.	.	.	.
Society and Culture	1.73*	2.01**	1.87	1.93**
Natural and Physical Sciences	2.03*	2.31*	1.64	2.64**
Mixed Field Programs	2.76**	3.20**	4.51**	3.27**
Management and Commerce	1.89**	1.23	1.20	1.86**
Information Technology	1.56	1.46	1.16	2.32**
Health	2.05**	2.00**	2.18*	2.09**
Food, Hospitality and Personal Services	1.49	1.58	0.97	2.00**
Engineering and Related Technologies	0.88	0.85	0.97	1.01
Education	1.90	1.61	1.84	1.41*
Creative Arts	1.15	1.66	3.08**	2.01**
Architecture and Building	0.46**	0.91	0.99	0.78
Agriculture, Environmental and Related Studies	.	.	.	.
Unemployed before training	0.80	1.09	1.38	0.97
Not in labour force before training	1.34	1.21	1.49	1.45**
Not Employed (NFI) before training	0.05**	0.62	2.06	0.33
Employed before training	.	.	.	.
Highest previous qualification: year 12	1.89**	1.44**	0.99	2.50**
Highest previous qualification: year 11 or Certificate I/II	0.78	0.72	0.49	0.93
Highest previous qualification: year 10 or below	0.44**	0.63*	0.49*	0.54**
Highest previous qualification: Diploma and above	1.60**	1.77**	1.74**	1.24**
Highest previous qualification: Certificate III/IV	.	.	.	.

Source Calculated from NCVER (2011).

Notes * Significant at $p < 0.05$ ** Significant at $p < 0.01$

Missing values denote reference groups.

Model for being employed for those unemployed before training

Table 22 Model fit, R-square, and odds ratio results for regression model of being employed six months after training for those unemployed before training, all ages and split by broad age group

Parameter	Age 15–24	Age 25–44	Age 45+	All ages
Likelihood ratio	7083.1**	2826.1**	1768.8**	10525.6**
R-square	0.62	0.42	0.39	0.48
Exponentiated estimates (odds ratios)				
Intercept	0.70	0.49*	0.44**	0.57**
Diplomas and above	1.99**	1.56*	2.46**	1.91**
Certificate IV	1.87*	1.66*	2.06**	1.82**
Certificate III	2.47**	1.75**	2.65**	2.30**
Certificate II	1.15	0.98	1.34	1.18
Certificate I	.	.	.	.
Male	1.11	1.26*	0.74**	1.09
Female	.	.	.	.
Society and Culture	0.61**	1.34	0.80	0.82
Natural and Physical Sciences	0.20**	0.75	0.47	0.37**
Mixed Field Programs	0.38**	0.60*	0.31**	0.42**
Management and Commerce	0.72	0.88	0.69	0.74*
Information Technology	0.27**	0.50*	0.18**	0.33**
Health	0.54*	1.62	0.72	0.79
Food, Hospitality and Personal Services	0.83	1.09	0.46*	0.88
Engineering and Related Technologies	1.38	1.73*	0.88	1.43**
Education	1.24	1.96*	1.05	1.04
Creative Arts	0.41**	0.38**	0.28**	0.42**
Architecture and Building	1.76**	1.33	0.93	1.85**
Agriculture, Environmental and Related Studies	.	.	.	.

Source Calculated from NCVER (2011).

Notes * Significant at $p < 0.05$ ** Significant at $p < 0.01$
Missing values denote reference groups.

Model for working in the same occupation as training

Table 23 Model fit, R-square, and odds ratio results for regression model of working in the same occupation as training six months after training, all ages and split by broad age group

Parameter	Age 15–24	Age 25–44	Age 45+	All ages
Likelihood ratio	32183.1**	15319.4**	9259.7	51403.7**
R-square	0.92	0.64	0.53	0.72
Exponentiated estimates (odds ratios)				
Intercept	0.04**	0.06**	0.13**	0.05**
Diplomas and above	4.81**	6.12**	3.91**	6.45**
Certificate IV	9.07**	6.82**	3.63**	7.41**
Certificate III	22.38**	14.20**	6.86**	16.64**
Certificate II	4.51**	2.35**	1.13	2.99**
Certificate I	.	.	.	.
Male	1.05	0.85**	0.74**	0.89**
Female	.	.	.	.
Society and Culture	1.21	1.62**	1.53**	1.53**
Natural and Physical Sciences	0.87	2.85**	1.47	1.64**
Mixed Field Programs	1.80	0.00**	0.00**	1.70
Management and Commerce	0.63**	0.85	0.65**	0.77**
Information Technology	0.58*	0.96	0.38*	0.70**
Health	2.09**	1.55**	1.08	1.53**
Food, Hospitality and Personal Services	1.69**	1.48**	0.61**	1.60**
Engineering and Related Technologies	2.38**	1.88**	1.47**	2.06**
Education	0.72	1.16	1.73**	1.42**
Creative Arts	0.16**	0.49**	0.26**	0.24**
Architecture and Building	3.70**	1.87**	0.68*	2.51**
Agriculture, Environmental and Related Studies	.	.	.	.
Unemployed before training	1.05	1.15	1.27*	1.21**
Not in labour force before training	1.10	1.62**	1.35*	1.45**
Not Employed (NFI) before training	0.95	1.65	1.34	1.28
Employed before training	.	.	.	.

Source Calculated from NCVER (2011).

Notes * Significant at $p < 0.05$ ** Significant at $p < 0.01$

Missing values denote reference groups.

Model for working at a higher skill level

Table 24 Model fit, R-square, and odds ratio results for regression model of working at a higher skill level six months after training than before training, all ages and split by broad age group

Parameter	Age 15–24	Age 25–44	Age 45+	All ages
Likelihood ratio	2511.10	3813.8	984.6	9121.6**
R-square	0.22	0.25	0.09	0.23
Exponentiated estimates (odds ratios)				
Intercept: Movement to a higher skill level	0.18**	0.08**	0.05**	0.09**
Intercept: Movement to a lower skill level	0.25**	0.13**	0.09**	0.13**
Diplomas and above	1.71**	1.13	1.12	1.16
Certificate IV	1.08	1.10	1.10	1.02
Certificate III	1.42	1.57	1.24	1.60
Certificate II	1.10	1.10	0.79	1.15
Certificate I	.	.	.	.
Male	1.04	1.00	0.83	0.97
Female	.	.	.	.
Society and Culture	1.34*	1.32*	1.90**	1.50**
Natural and Physical Sciences	3.00**	1.62	3.67**	2.68**
Mixed Field Programs	1.40	0.00**	0.00**	2.00
Management and Commerce	1.30	1.22	1.51*	1.59**
Information Technology	1.62*	1.95	0.44	2.64**
Health	1.69	1.41	1.76**	1.57**
Food, Hospitality and Personal Services	1.21	1.67**	2.20	1.85**
Engineering and Related Technologies	1.64**	1.34*	1.42*	1.65**
Education	1.40	0.80	1.09	0.84
Creative Arts	0.94	2.85**	1.86	2.08**
Architecture and Building	1.26	1.45**	1.56*	1.67**
Agriculture, Environmental and Related Studies	.	.	.	.
In same occupation as training course	1.47	1.81**	1.26**	1.63**
In different occupation as training course	.	.	.	.

Source Calculated from NCVER (2011).

Notes * Significant at $p < 0.05$ ** Significant at $p < 0.01$
Missing values denote reference groups.

Are diploma graduates losing mid level jobs to bachelor graduates?

By Gavin Moodie

This examines data from the Australian Bureau of Statistics' survey of education and work to determine whether diploma graduates are being displaced from mid level occupations by bachelor graduates.

2007-2012

We will examine data from 1998 to 2012, but we first examine data only from 2007 because in that year the Australian Bureau of Statistics changed the classification of occupations it used to report results from the survey of education and work.

Table 25 shows the occupations of people from 2007 to 2012 whose highest qualification was a bachelor degree. The proportion of bachelor graduates employed as managers fell steadily from 14.7% in 2007 to 13.8% in 2012. However, since this fall was well within the Bureau's relative standard errors of estimates for managers of from 3.7% to 4.6%, it should not be given much weight. Most people whose highest qualification was a baccalaureate were employed as a professional (55.1% in 2012), and these proportions changed a little from 2007 to 2012 although not with a marked trend. The proportion employed as managers or professionals fell slightly from 70.7% in 2007 to 68.9% in 2012, while the proportion employed as community and personal service workers increased somewhat from 5.1% in 2007 to 6.4% in 2012, but again well within the Bureau's relative standard errors of estimates. There was no marked trend in the proportions of bachelor graduates employed as clerical and administrative workers which remained around 11% or those employed as sales workers which remained around 4% from 2007 to 2012.

Table 25 Occupation of people whose highest qualification was a bachelor degree, 2007-2012, %

Occupation	2007	2008	2009	2010	2011	2012
Managers	14.7	14.0	14.3	14.6	14.0	13.8
Professional	55.9	56.4	55.8	55.6	57.1	55.1
Sub total managers and professionals	*70.7*	*70.4*	*70.2*	*70.3*	*71.0*	*68.9*
Technicians and trades workers	4.9	4.7	5.2	4.3	4.5	4.7
Community & personal service workers	5.1	5.6	5.7	5.6	5.3	6.4
Clerical and administrative workers	11.4	10.6	11.5	11.5	11.2	11.1
Sales workers	4.3	4.2	4.0	4.3	4.5	4.1
Machinery operators and drivers	1.2	1.7	1.1	1.4	1.3	1.7
Labourers	2.4	2.9	2.3	2.6	2.2	3.1
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0
Total (000)	1738.1	1839.6	1985.5	2052.9	2186.0	2301.4
Relative standard errors of estimates (%)						
Managers	3.7	4.3	5.5	4.4	4.6	4.6
Professionals	1.8	2.2	2.6	2.0	2.3	2.2
Technicians and trades workers	6.4	5.9	7.2	6.0	7.9	6.8
Community & personal service workers	6.2	6.4	8.1	8.6	7.7	5.6
Clerical and administrative workers	3.9	5.0	4.4	5.0	5.1	3.7
Sales workers	7.2	7.1	9.6	9.2	5.8	7.2
Machinery operators and drivers	13.8	10.5	17.9	13.6	11.3	11.2
Labourers	12.1	9.9	10.6	8.8	9.5	9.4

Source: Australian Bureau of Statistics (2012) Table 11 Employed persons aged 15–74 years, selected characteristics – by level of highest non-school qualification, and corresponding tables for previous years.

Next we examine the occupations of people from 2007 to 2012 whose highest qualification was a diploma or advanced diploma (Table 26). It will be noted that the proportion of diploma and advanced diploma graduates employed as managers decreased from 17.6% in 2009 to 15.6% in 2012, they had earlier sharply increased from 14.0% in 2007 to a peak in 2009. As a result the proportion of diploma and advanced diploma graduates employed as a manager was higher in 2012 than it was in 2007. These changes were well within the relative standard errors of estimates and so should not be given too much weight. The most common occupation of diploma and advanced diploma graduates was professional, but that this fell from 27.5% in 2007 to 23.8% in 2012. This fall of 3.7 percentage points is bigger than the Bureau's relative standard errors of estimate for professionals in 2012 (2.8%), so the fall is significant. Unlike bachelor graduates, diploma and advanced diploma graduates are spread relatively evenly amongst clerical and administrative workers (17.8% in 2012), managers (15.6%, which is higher than baccalaureates with 13.8%), community and personal service workers (14.5%) and technicians and trades workers (12.0%). There has been no significant change in the proportion of diploma and advanced diploma graduates employed in lower level occupations from 2007 to 2012.

Table 26 Occupation of people whose highest qualification was a diploma or advanced diploma, 2007-2012, %

Occupation	2007	2008	2009	2010	2011	2012
Managers	14.0	14.0	17.6	17.5	15.8	15.6
Professional	27.5	26.3	22.3	25.0	23.9	23.8
Technicians and trades workers	11.8	10.8	10.8	11.1	10.9	12.0
Community & personal service workers	15.7	14.4	16.2	14.1	15.7	14.5
Clerical and administrative workers	17.2	19.1	18.5	16.9	18.1	17.8
Sales workers	6.7	8.4	6.7	7.8	7.2	7.3
Machinery operators and drivers	2.5	2.3	2.5	2.9	3.1	3.2
Labourers	4.5	4.8	5.4	4.7	5.2	5.7
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0
Total (000)	946.2	986.2	1032.9	1113.1	1111.7	1242.9
Relative standard errors of estimates (%)						
Managers	5.5	4.5	6.4	5.2	5	3.9
Professionals	3.5	3.0	4.4	3.5	3.9	2.8
Technicians and trades workers	6.0	5.0	8.6	5.3	5.1	4.6
Community & personal service workers	4.9	5.6	5.3	5.4	4.5	5.1
Clerical and administrative workers	5.1	5.2	6.4	5.5	5.5	4.3
Sales workers	6.9	8.6	10.5	5.1	8.4	7.5
Machinery operators and drivers	9.3	11.4	15.1	14.2	10.6	11.4
Labourers	10.3	10.1	11.7	8.5	9.4	7.5

Source: Australian Bureau of Statistics (2012) Table 11 Employed persons aged 15–74 years, selected characteristics – by level of highest non-school qualification, and corresponding tables for previous years.

1998-2006

In the earlier series of classification of occupations from 1998 to 2006 we first examine the occupation of people whose highest qualification was a bachelor degree (Table 27). We note that the proportion employed as managers and administrators increased from 9.6% in 2002 to 11.2% in 2006, but that this was more than offset by a fall in the proportion employed as professionals from 58.7% in 2002 to 56.2% in 2006. The proportion of bachelor graduates employed as associate professionals changed somewhat from 2002 to 2006, but ended the period where it began at around 11%. The other sizeable occupation of bachelor graduates from 2002 to 2006 was intermediate clerical, sales and service workers, which increased modestly from 9.8% in 2002 to 10.2% in 2006.

Table 27 Occupation of people whose highest qualification was a bachelor degree, 2002-2006, %

Occupation	2002	2003	2004	2005	2006
Managers and administrators	9.6	9.2	9.5	10.2	11.2
Professionals	58.7	56.7	56.3	56.3	56.2
Sub total managers and professionals	*68.2*	*66.0*	*65.7*	*66.4*	*67.4*
Associate professionals	11.6	13.1	11.8	12.3	11.2
Tradespersons and related workers	1.9	2.0	2.0	2.5	2.2
Advanced clerical and service workers	2.6	2.3	2.9	2.5	2.6
Intermediate clerical, sales and service workers	9.8	9.2	10.2	9.3	10.2
Intermediate production and transport workers	1.2	2.1	1.7	1.5	1.6
Elementary clerical, sales and service workers	3.1	3.2	3.8	3.6	3.4
Labourers and related workers	1.6	2.1	1.8	1.7	1.5
Total (%)	100.0	100.0	100.0	100.0	100.0
Total (000)	1433.6	1424.1	1496.8	1611	1716

Source: Australian Bureau of Statistics (2006: 20) Table 12: employed persons, non-school qualification – by selected characteristics, and corresponding tables for previous years.

Table 28 takes the data shown in Table 20 back to 1998, the earliest year in which the Australian Bureau of Statistics conducted its survey of education. Its antecedent survey of transition from education to work was rather different. The proportions of bachelor graduates employed as managers and administrators (9.2% in 2001) and professionals (59.1%) did not change markedly from 1998 to 2001. The proportion employed as associate professionals increased from 9.3% in 1998 to 11.2% in 2001, but most of this was off set by the fall in the proportions of bachelor graduates employed as intermediate clerical, sales and service workers and other lower occupations.

Table 28 Occupation of people whose highest qualification was a bachelor degree, 1998-2001, %

Occupation	1998	1999	2000	2001
Managers and administrators	9.4	9.0	9.3	9.2
Professionals	60.2	60.2	59.9	59.1
Sub total managers and professionals	*69.6*	*69.2*	*69.3*	*68.4*
Associate professionals	9.3	10.0	10.8	11.2
Tradespersons and related workers	2.0	1.9	1.7	2.1
Advanced clerical and service workers	2.1	2.2	2.2	2.9
Intermediate clerical, sales and service workers	10.1	9.9	9.0	9.6
Intermediate production and transport workers	1.5	1.7	2.0	1.4
Elementary clerical, sales and service workers	3.3	3.4	3.0	2.6
Labourers and related workers	1.9	1.7	2.1	1.8
Total (%)	100.0	100.0	100.0	100.0
Total (000)	1104.6	1169.2	1242.4	1342.6

Source: Australian Bureau of Statistics (2001: 22) Table 13: employed persons, non-school qualification, and corresponding tables for previous years.

The proportion of people whose highest qualification was a diploma or advanced diploma employed as managers or administrators increased from 8.9% in 2002 to 10.2% in 2006, but this was more than off set by the fall in the proportion employed as professionals from 29.7% in 2002 to 27.6% in 2006 (Table 29). The proportion employed as associate professionals increased from 18.1% in 2002 to 21.4% in 2006.

Table 29 Occupation of people whose highest qualification was a diploma or advanced diploma, 2002-2006, %

Occupation	2002	2003	2004	2005	2006
Managers and administrators	8.9	7.2	9.3	9.8	10.2
Professionals	29.7	28.9	28.2	25.7	27.6
Associate professionals	18.1	19.9	19.5	21.1	21.4
Tradespersons and related workers	6.3	6.2	6.1	6.4	5.9
Advanced clerical and service workers	5.6	5.2	5.0	4.6	5.1
Intermediate clerical, sales and service workers	18.6	19.6	19.3	19.0	19.0
Intermediate production and transport workers	3.1	3.4	3.0	3.3	2.5
Elementary clerical, sales and service workers	6.1	6.1	5.8	5.9	5.0
Labourers and related workers	3.5	3.7	3.7	4.2	3.4
Total (%)	100.0	100.0	100.0	100.0	100.0
Total	745.1	763.6	821.4	848.8	874.2

Source: Australian Bureau of Statistics (2006: 20) Table 12: employed persons, non-school qualification – by selected characteristics, and corresponding tables for previous years.

We see from Table 30 that the trends for the employment of people whose highest qualification was a diploma or advanced diploma from 2002 to 2006 continued trends from 1998 to 2001.

Table 30 Occupation of people whose highest qualification was a diploma or advanced diploma, 1998-2001, %

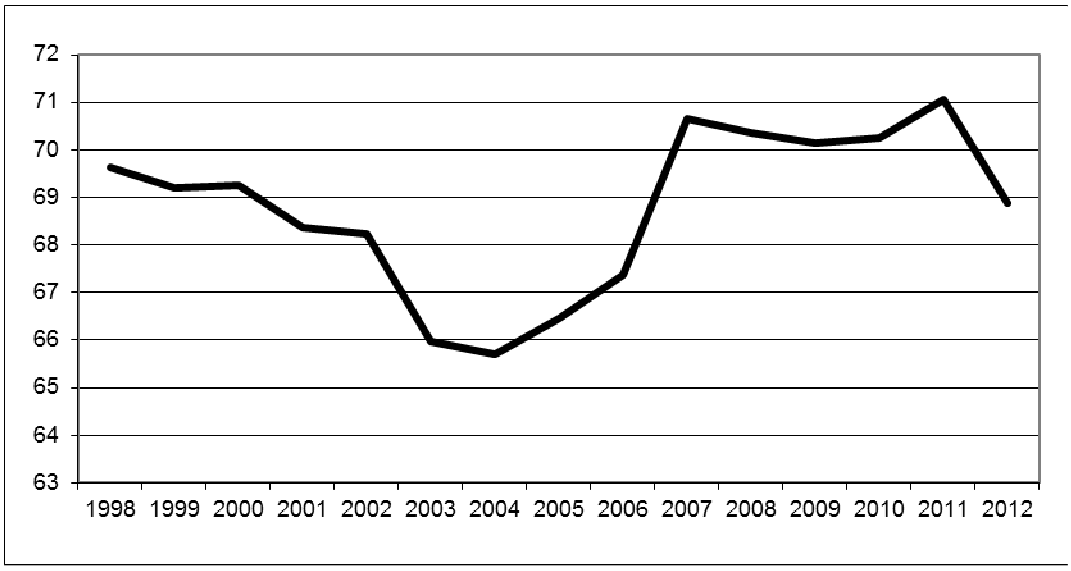
Occupation	1998	1999	2000	2001
Managers and administrators	7.9	7.3	8.1	9.0
Professionals	34.1	32.6	33.1	31.1
Associate professionals	16.0	17.2	18.7	18.6
Tradespersons and related workers	6.3	6.2	5.9	5.3
Advanced clerical and service workers	5.5	5.3	4.5	5.7
Intermediate clerical, sales and service workers	19.6	20.3	18.2	19.4
Intermediate production and transport workers	2.6	2.2	3.1	2.5
Elementary clerical, sales and service workers	4.9	5.1	5.5	5.3
Labourers and related workers	3.1	3.9	2.9	3.2
Total (%)	100.0	100.0	100.0	100.0
Total	788	779.5	814.3	673.9

Source: Australian Bureau of Statistics (2001: 22) Table 13: employed persons, non-school qualification, and corresponding tables for previous years.

Summary: bachelor and diploma graduates employed as managers or professionals 1998-2012

The break in the Australian Bureau of Statistics' classification of occupations in 2007 makes it difficult to compare the destination of diploma and bachelor graduates over the whole period from 1998 to 2012. Nonetheless, there may be some point in considering together the proportions of graduates who were employed in the top two occupations over the period, as professionals or managers and administrators from 1998 to 2006 and as professionals or managers from 2007 to 2012. We first examine the proportions for people whose highest qualification was a baccalaureate (Figure 1). This shows a steady fall of the proportions of people whose highest qualification was a baccalaureate being employed as a manager or professional from 1998 to 2004 and a recovery in 2005 and 2006. Following the break in the series in 2007 the proportion of bachelor graduates employed in the top two occupations started falling again.

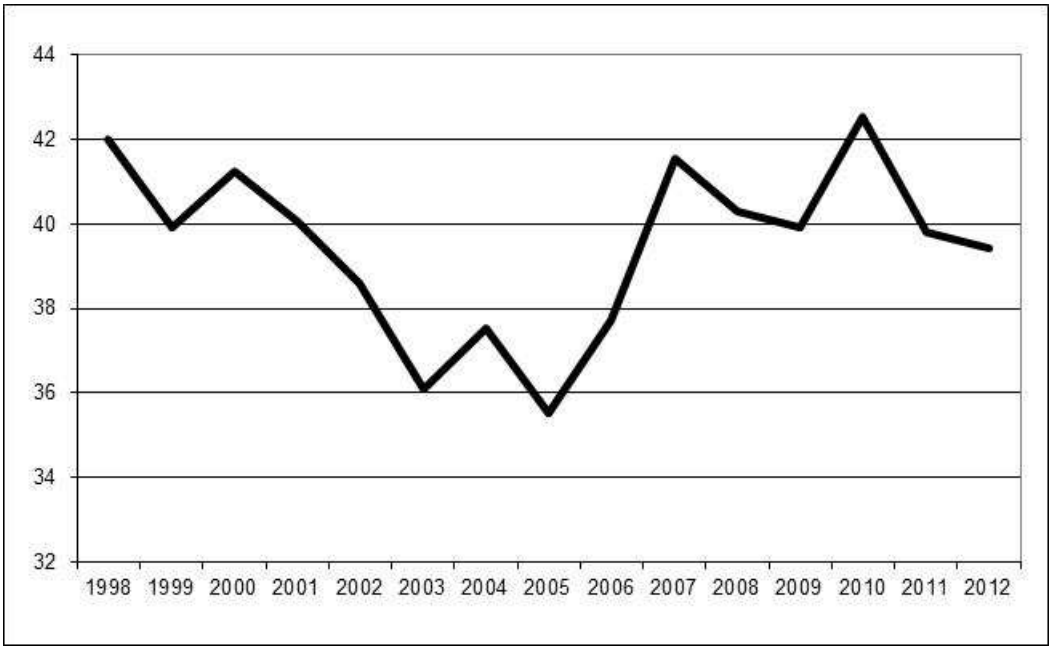
Figure 1 Percentage of people whose highest qualification was a bachelor degree employed as managers or professionals, 1998-2012



Source: Australian Bureau of Statistics (2012) Table 11 Employed persons aged 15–74 years, selected characteristics – by level of highest non-school qualification, and corresponding tables for previous years.

Figure 2 graphs the same data for people whose highest qualification was a diploma or advanced diploma. We note that the trend for diploma and advanced diploma graduates is the same as the trend for bachelor graduates, but rather sharper.

Figure 2 Percentage of people whose highest qualification was a diploma or advanced diploma employed as managers or professionals, 1998-2012

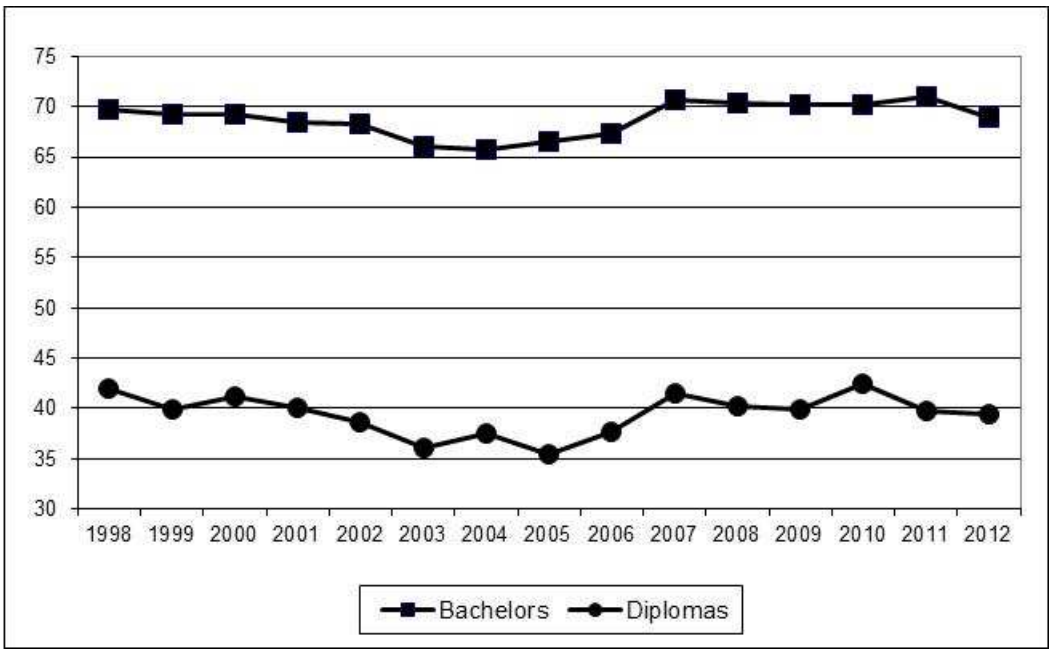


Source: Australian Bureau of Statistics (2012) Table 11 Employed persons aged 15–74 years, selected characteristics – by level of highest non-school qualification, and corresponding tables for previous years.

Figure 3 plots the data from figures 1 and 2 onto the same graph. The scale is much bigger so the changes aren't presented so strongly. Nonetheless, we can see from Figure 3 that the proportions of bachelor and diploma graduates employed in the top two occupations generally move in the same

direction over time. That is, the figure does not show that diploma and advanced diploma graduates' employment in managerial and professional occupations is being displaced by bachelor graduates.

Figure 3 Percentage of people whose highest qualification was bachelor or whose highest qualification was a diploma or advanced diploma employed as managers or professionals, 1998-2012



Source: Australian Bureau of Statistics (2012) Table 11 Employed persons aged 15–74 years, selected characteristics – by level of highest non-school qualification, and corresponding tables for previous years.

Conclusion

This review of data from the Australian Bureau of Statistics' survey of education and work from 1998 to 2012 does not provide strong evidence that people whose highest qualification is a bachelor degree are being employed at lower level occupations or that they are displacing people whose highest qualification is a diploma or advanced diploma in management, professional or lower level occupations. The proportion of diploma and advanced diploma graduates employed as managers or professionals has fallen since 2010 and the proportion of bachelor graduates employed in the top two occupations fell from 2011 to 2012, but these changes are within historical trends. Bachelor graduates may be displacing diploma graduates in the workforce, but data from future surveys of education and work will be needed to confirm this.

Case study: associate degrees in engineering, mining and geoscience

By Nick Fredman

This chapter examines associate degrees in engineering as a case study. It focuses on existing and proposed associate degrees in mining engineering and geoscience, with five of the eight people interviewed for this chapter involved in teaching these sub-disciplines or in the minerals industry. The chapter also refers extensively to other associate degrees and mid-level qualifications generally in engineering. The development, current use and potential of these qualifications are also placed in a broad economic context of the main themes and concerns and previous findings of the vocations project.

The focus on mining engineering and geoscience arose when the project team was made aware of an initiative launched in 2012 by the Minerals Council of Australia called the Minerals Industry National Associate Degree (MINAD) project. As discussed through the chapter, this project appears to have strong potential to answer some of the problems identified here from a broad range of data and sources in mid-level engineering education and work, and it could be a general model for such education and work in other fields. It must be stressed that while based on an existing program at one university and attracting interest from a broad range of employers, universities and TAFE institutes, the project remains largely at the stage of potential rather than realisation. It made sense therefore to compare the experiences of the minerals industry-related associate degrees with associate degrees in other engineering disciplines and a broad range of data sources.

In this chapter the views, experiences and information provided by eight interviews are related to mid-level engineering enrolment data, other data on the nature of the provision of engineering advanced diplomas and associate degrees, the data on employment outcomes presented in chapter 2, and a range of previous research and reports prepared by industry and government bodies.

The eight interview participants for this chapter consisted of:

- a minerals Council of Australia manager directing involvement in tertiary education;
- the training manager of a resources company;
- a representative of Engineers Australia involved in accreditation;
- five tertiary institution staff closely involved in developing and/or delivering associate degrees in engineering:
    - the higher education director of a TAFE institute;
    - a lecturer involved with the delivery of a suite of associate degrees at one university;
    - two teaching staff and a staff member involved in liaison with industry partners from a university delivering associate degrees in mining engineering and geoscience.

The chapter first discusses the nature, extent of and background to the 'skills shortage in engineering' which strongly frames much of the discussion of engineering education. It then discusses the nature of mid-level engineering education and work with particular reference to the accreditation systems of the professional body, Engineers Australia, before examining enrolment and completion patterns in engineering education between 2002 and 2011. The complexities of the current state of mid-level engineering education, and the attendant confusion among students, educators and employers, is then discussed, reflecting on key concepts of the vocations project: coherence, transitions with either education and employment logics, and the notion of vocational streams underpinned by socially-situated capabilities. The potential of the emerging associate degrees to overcome tensions between articulation and preparation for practice is then discussed before concluding remarks are made.

The engineering workforce and the skills shortage

The notion of a skills shortage in engineering generally and mining engineering in particular strongly frames the discourse on engineering education and work. The extent of concern about this apparent shortage is reflected in the inquiry the Australian Senate conducted into the issue over 2011–2012, which argued that there was an emerging 'nexus between the demand for infrastructure delivery and the shortage of appropriate engineering and related employment skills in Australia' (Senate Education Employment and Workplace Relations References Committee, 2012, p. 1). This concern is also reflected in the range of reports cited below and was common currency among our interview participants. One educator participant from a resource-rich state stated that due to the engineering skills shortage there 'anyone with a pulse can get a job in engineering'. Another educator involved in a mining associate degree stated that the purpose of the program was 'filling a need for para-professionals' that had come about due to a 'massive industry skills shortage', while the industry training manager participant noted that migration was a limited solution to under-supply of mining engineering skills because the skills shortage was an international problem.

Shah and Burke (2005) show that 'skills shortage' should be clarified if not defined because employers, unions, policy makers and researchers have different interests, viewpoints and perceptions of the issue. The same term can refer to different processes with different drivers that include: hard to fill vacancies, often relating to very specialised workers; 'skills gaps', where existing workers may not have adequate skills to meet needs; and, recruitment difficulties, which may be due to inadequate compensation for labour. Causes include slowness in the adjustment of wages to meet demand; slowness in the adjustment of supply; and lack of labour market information. The measurement of skills shortages therefore requires a range of techniques and analyses and this argument also implies that identified skills shortages can require one or more of a range of responses. Despite these complexities, a range of evidence suggests that within engineering occupations, to varying extent depending on specific areas, that there is an inadequate supply of skilled engineers in trades, technical and professional areas, and also that existing skills are not allocated to the best extent.

In a report for the Australian National Engineering Taskforce, which brings together employers, professional associations and educational institutions to examine issues in engineering, Pearce and colleagues (2010) presented evidence that there is a shortage of skilled labour across engineering trades, para-professions and professions. In particular, they cite the opinions of employers and engineers that sufficient labour is not available to complete work and that costs have been increased and projects organised inefficiently due to labour not available to undertake adequate planning and preliminary work.

Structural economic change over the past two to three decades appears to have adversely affected the supply and efficient allocation of engineering skills. The stated context for the development of the MINAD project includes a recognition of the decline of former work-based paraprofessional training provided by public utilities due to privatisation and the use of professional engineers in paraprofessional roles (Tuckwell 2012, p.4). More broadly, Toner (2003) outlines the evidence that substantial declines in apprenticeship numbers through the 1990s were due to 'self-reinforcing' structural demand-side changes including privatisation and corporatisation of public services, reduced firm size, growth of casual and part-time modes of employment and changes to industrial arrangements that meant training embedded in awards were undermined. As the Senate inquiry referred to above argues:

> It is a matter of historical record that, during the 1980s and 1990s, the public sector began to outsource infrastructure and other engineering work to private industry. Government public utility, infrastructure and other departments offered redundancies to engineers and public companies were privatised. Engineering positions in the public sector dried up, and cadetship programs were cut… The first and most obvious implication of this is that government departments, having shed their engineering staff, now lack any real in-house engineering expertise… In addition, industries which had previously drawn from the ranks of the public sector for the engineers now find themselves without a ready source of highly trained and experienced workers. Private companies are increasingly required to take responsibility for the training and development of their own engineers. (Senate Education Employment and Workplace Relations References Committee 2012, p.7)

One of our educator participants expressed a similar analysis of the central cause of the shortage of engineering skills. While stating that a certain revival of cadetships was a driver of the rise of associate degrees discussed in this chapter, he suggested that there was a lot of ground to make up:

> Until the early 90s a lot of the private consulting firms and companies and government bodies like main roads and electricity and local councils had cadetships and would advertise them. It was quite a big program in those days. They all went out of it in the 90s and rediscovered them in 2005. It was quite amazing. We had one big electricity organisation who didn't realise they had given cadetships to our students in the early 90s. We all knew that and they didn't. There was this whole period when the HR people were into no training, and staff turnover in HR areas is pretty big, and the history of the organisation was forgotten.

As well as the undermining of supply there appears to be increasing demand. Skills Australia (2012) has estimated the future demand for engineers, using the growth rates in ABS' Labour Force Survey from 2006 to 2011 to estimate growth from 2011–16, from those working in engineering-related occupations with an engineering qualification as their highest qualification. They note that there is no consistent definition of the engineering workforce and that there are limitations in using highest qualification in that, for example, a engineer who has gained a post-graduate management qualification will not be counted. Within these limitations they have estimated that the 2011 engineering workforce of 212 000 will increase by 2016 to 253 000, comprised of 34 000 managers, 147 000 professionals and 74 000 technicians and tradespeople. Skills Australia argue that this growth is being driven by the resources sector, increased defence projects, the National Broadband Network and other growing infrastructure needs such as in ports, water and environmental sustainability. It further argues that current completions of higher education and VET qualifications are barely above projected needs for new workers: for example it estimates 7400 new management and professional engineering jobs will be needed annually in 2011-2016 and domestic undergraduate completions in bachelor degree and above programs were 8521 in 2010, and this tight fit reflects a relative shortage.

While enrolment has steadily increased in recent years, as shown in Tables 31-33 below, Skills Australia questions the capacity of institutions to continue such increases to meet the labour force demands.

While engineering undergraduate enrolments are increasing, as can be seen in the third section of this chapter below, Pearce and colleagues (2010) note that completion rates are a low 52% for men and 58% for women, suggesting issues in the high level of preparation needed for, and the long and time- and effort intensive nature of, engineering programs. They note that student demand may not match the needs for skills without structured interventions to create incentives for students to enter particular areas. They note the low rate of women in engineering education and stress the need for clearer articulation pathways between VET and higher education. They also stress the importance of better retention in work, particularly for women and older workers.

In a study of the engineering workforce in the road and rail industries, Wise and colleagues (2011) argue that there is an approaching crisis in engineering skills capacity in these sectors. Part of the context of the shortage of supply was the restructuring of the rail industry in the late 1980s and 1990s which saw a 60% decline in the workforce. The diversity of responses by the states to nationally imposed restructuring in ownership patterns and other aspects of operations brought complexity to training and the allocation of labour (Wise et al. pp. 30–31). One result that project participants reported to Wise and colleagues was that engineers feel stretched between too many projects, and significantly for the focus of this chapter, feel that they do too much mid-level work such as the drafting and checking of drawings.

A skills shortage seems to be indicated by the fact that there is a low unemployment rate of 2.7% of the 'engineering workforce' as defined by Engineers Australia (those in the workforce with a qualification of diploma or above in engineering as their highest qualification). However, of those employed only 57% worked in what EA defines as an engineering occupation. While as this report points out many of those not working in an engineering occupation will be productively using the skills and knowledge acquired in their education, and some will be working in fields such as management of engineering, concerns that are closely related to engineering, this figure suggests a lack of fit between education for engineering and work. This is also suggested by the employment rates for graduates from VET and higher education of the different branches of engineering. An examination of broad employment outcomes undertaken for Moodie and Fredman (2013) shows that employment rates for new VET engineering graduates are relatively high but there is still considerable unemployment and marked variation between engineering fields. In 2011, six months after graduation, 84% of all diploma and above VET graduates were employed. The proportion among all engineering graduates was 83% and among narrow fields of education this varied from 79% for electrical and electronic engineering to 93% for maritime engineering. Among bachelor degree graduates four months after graduation in 2011, 77% of those available for full-time employment were employed fulltime. The proportions among engineering graduates varied from 73% for chemical engineers to 98% for mining engineers. However, as shown in chapter 2 only 35% of graduates of engineering at the AQF 5 and 6 levels in VET worked in the occupation of their training, and considering the narrow fields not shown in that chapter, this varied from 17% in automotive engineering to 76% in maritime engineering. Thus far graduates from all engineering fields can find work soon after graduation, but many do not work, at least in the short-term, in engineering, suggesting variation in the extent of demand for skilled engineers in different fields and some mismatch between education and the needs of work.

The mining and resources sector seems to be one area were the shortage of skills is clearest. The National Resources Sector Employment Taskforce (2010) has charted expected growth in resources employment based on steadily increasing investments as a proportion of GDP in oil, gas and minerals projects in 2001–2009, with for example an annual growth in mining jobs of 4.9% expected over 2008–2015. It also projects that nearly 10% of the 2010 mining workforce will retire by 2015. Based on higher education trends and the ABS Labour Mobility Survey the report estimates that over 2010–2015 there will be 1600 new jobs for mining engineers and 1300 needed for replacements, while there will be 1200 new graduates: a shortfall of 1700. Also over this period it is estimated that there will be 2200 jobs for geoscientists and 1650 needed for replacement demand and 300 new graduates: a shortfall of 3000 (with however the mining industry able to recruit from the majority of geoscientists who work in other industries). The Minerals Council interviewee noted that this report in particular signalled that something different needed to be done and sparked the conception that the capabilities of existing workers in the sector could be better harnessed with associate degrees and structured support from employers to enhance the supply of para-professionals and professionals.

The Kinetic Group (2012), reporting on the Queensland resources workforce, also discusses how a high demand for product has led to skills shortages. This report puts the Queensland mining workforce at 55 000 with an expected growth of 14 500 by 2014, 5000 more than supply availability. The 'pipeline training group', graduates, apprentices, cadets and trainees comprises 5.6% of the workforces and is expected to grow by 21.7% by 2014 (Kinetic Group 2012, p.11). There is a lot of churn in the industry: a turnover rate of 17% excluding contractors and 24% including contractors. Some 18% of separations occur within 12 months of recruitment. Those who live more than 300km from the work site (one third of the workforce) separate at twice the rate of those who live closer (p.15). Engineers have a higher than average resignation rate (13%) and there is a projection for the supply of engineers to decrease (p. 45). For geoscientists the turnover rate of 25% in 2010-11 was higher than the recruitment rate of 21% (p. 46). There's also high turnover in the 'internal talent pipeline' of 21% (p.44).

Hence the 'skills shortage in engineering' seems a real if multi-faceted phenomenon and one that varies between the branches of engineering. Structural change appears to have undermined the supply of engineering skills that were previously underpinned by strong mechanisms for entry-level and continuing education such as cadetships and government agency training programs, and the demand for such skills is increasing. The remainder of this chapter assesses the potential for strengthened mid-level engineering education and work to address this issue.

Mid-level education and work in engineering

A number of participants stressed the concept of the 'engineering team', that mid-level qualifications were an important part of a collective work effort that included a range of tradespeople, technicians, associate professionals and professionals. Engineering Australia defines the levels at which it accredits programs as leading to professional recognition in the following way:

- professional engineer (4 year bachelor of engineering programs);
- engineering technologist (3 year bachelor of engineering technology and similar);
- engineering associate (competency based)(generally advanced diplomas delivered by TAFEs); and
- engineering associates (curriculum based)(generally associate degrees delivered by universities).

The accreditation standards are all linked to international agreements with other like national bodies (Engineers Australia, Undated).

The ‘practice context’ of an engineering associate is introduced as:

> Engineering Associates focus mainly on practical applications. They may be expert in installing, testing and monitoring equipment and systems, in the operation and maintenance of advanced plant, and in managing or supervising tradespeople in these activities. They may be expert in selecting equipment and components to meet given specifications, and in assembling these to form systems customised to particular projects. (Engineers Australia 2011, p.3)

As is outlined in this document, full accreditation involves some students graduating and having their qualifications recognised in a work role (ongoing or obtained after graduation), and a sample of such graduates being interviewed by Engineers Australia. The practice context is the same for curriculum based and competency based programs.

Our participants discussed the nature of mid-level work in engineering in the context of the engineering team. One associate degree program, in civil engineering, has an emphasis on drafting and computer aided design, with the educator involved in this program stating that ‘there’s a number of areas that drafting skills are highly sought after such as in civil engineering and architecture, as well as other areas such as mechanical engineering. Most students start full-time and find work during the course so often drop to part-time and nearly all are employed in the area before graduation’. The mining company participants summarised the types of relevant work in the resources sector as: ‘Mine managers, mill managers, higher order superintendents, deputies, undermanagers, field specialists in geoscience, involved in investigative work. It might not be interpretive work’. He stressed professional engineers due to their scarcity were pushed up quickly from graduate programs and field-work to ‘scheduling, design, consulting work’ and this has led to an increasing need for people with both ‘good field skills’ and ‘good technical knowledge’. The Engineers Australia participants however questioned whether employers were clear about the nature and classification of mid-level work, and suggested there was much work to be done here in which the Engineering Australia documentation would be useful and the MINAD project a valuable experience; points that reinforce themes of the vocations project such as the need to change both education and work, and the need for institutional frameworks to enable individual to realise their full capabilities in education and work (Wheelahan et al. 2012).

Enrolment and completion patterns in engineering programs

In the first section above cited sources suggested that causes of shortages of engineering skills included an undersupply of engineering graduates at all levels, exacerbated by low completion rates, and capacity constraints with tertiary education. To examine such contentions, in this section enrolment and completion patterns in engineering programs are summarised and discussed.

Table 31 summarises student load in engineering programs from diploma to bachelor degree. While over 2002 to 2011 diplomas remained relatively steady, advanced diplomas fell by 779 or 11%. Associate degrees have seen a rapid rise, although considering available data from 2002 to 2009, the absolute increase of 632 has to be weighed against the fall of 444 in advanced diplomas, which are meant to prepare graduates for the same jobs. Bachelor degree load has steadily increased by 45%.

Table 31 Full-time equivalent load in all bachelor degree and mid-level engineering programs, 2002–2011

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Bachelor degree HE*	29 643	30 523	30 375	29 888	30 848	32 245	34 447	37 261	40 428	42 911
Bachelor degree VET*	9	14	19	5	136	0.0	0.0	0.0	68	0.0
Bachelor degree total	**26 652**	**30 537**	**30 394**	**29 893**	**30 984**	**32 245**	**34 447**	**37 261**	**40 486**	**42 911**
Associate degree HE*	167	162	155	168	227	358	559	799	NA**	NA**
Associate degree VET*	0	0	0	0	113	157	0	0	0	0
Associate deg total	**167**	**162**	**155**	**168**	**340**	**515**	**559**	**799**	**NA**	**NA**
Advanced diplomas	**6951**	**7895**	**7333**	**7427**	**7064**	**6106**	**5760**	**6507**	**6392**	**6172**
Diplomas	**6043**	**5001**	**4406**	**4638**	**4159**	**5811**	**6481**	**6734**	**6052**	**6146**

Source DIISRTE (2012b) Table 4.4: actual student load (EFTSL) for all students by narrow discipline group and broad level of course, full year 2009, and corresponding tables for previous years, and VOCSTATS online tables.

Notes * 'HE' here refers to load reported to DIISTRE, and 'VET' to load reported to NCVER.
** Not publicly available.

A similar picture emerges from an examination of load in process and resources engineering, as shown in Table 32. There has been a steady and considerable increase in bachelor degree enrolments, of 97%, and a tripling of the (small) associate degree load between 2004 and 2009. In this case diploma load has been variable but generally increasing.

Table 32 Full-time equivalent load in mid-level process and resources engineering programs, 2002–2011

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Bachelor degree HE*	2752	2750	3090	3132	3552	3899	4335	4849	5237	5411
Bachelor degree VET*	0	0	0	0	0	0	0	0	0	0
Bachelor degree total	**2752**	**2750**	**3090**	**3132**	**3552**	**3899**	**4335**	**4849**	**5237**	**5411**
Associate degree HE*	20	23	20	21	29	40	52	65	NA**	NA**
Associate degree VET*	0	0	0	0	0	0	0	0	0	0
Associate deg total	**NA**	**NA**	**20**	**21**	**29**	**40**	**52**	**65**	**NA**	**NA**
Advanced diplomas	**0.0**	**0.1**	**0.2**	**0.2**	**0.2**	**0.3**	**0.2**	**0.3**	**0.3**	**0.3**
Diplomas	**237**	**292**	**312**	**389**	**169**	**281**	**378**	**451**	**382**	**430**

Source DIISRTE (2012b) Table 4.4: actual student load (EFTSL) for all students by narrow discipline group and broad level of course, full year 2009, and corresponding tables for previous years, and VOCSTATS online tables.

Notes * 'HE' here refers to load reported to DIISTRE, and 'VET' to load reported to NCVER.
** Not publicly available.

In some contrast to concerns about supply and capacity, enrolment load in programs designed as entry to professional engineering (bachelor degree) and associate engineering (advanced diploma and associate degree) have been increasing over the last decade. Completions have also been increasing, as is illustrated in Table 33.

Table 33 Completions in all bachelor degree and mid-level engineering programs, 2002–2011

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Bachelor degree HE*	NA	NA	8 199	8 075	8 369	8 075	8 661	8 652	9 149	9 922
Bachelor degree VET*	0	0	0	0	0	0	0	0	0	NA
Bachelor degree total	**NA**	**NA**	**8199**	**8075**	**8369**	**8075**	**8661**	**8652**	**9149**	**NA**
Associate degree HE*	NA	NA	46	44	45	74	126	207	249	224
Associate degree VET*	0	0	0	0	0	5	0	0	0	NA
Associate deg total	**NA**	**NA**	**46**	**44**	**45**	**74**	**126**	**207**	**249**	**NA**
Advanced diplomas	1267	1341	1389	1491	1669	1619	1704	1397	1485	**NA**
Diplomas	2120	1948	1661	2129	1876	2030	2429	2545	2473	**NA**

Source DIISRTE (2012a), and corresponding tables for previous years, and VOCSTATS online tables.

Notes * 'HE' here refers to completions reported to DIISTRE, and 'VET' to load reported to NCVER. Bachelor degree HE includes pass and honours awards.
** Not publicly available.

The patterns discussed here suggest that increased attention on mid-level qualifications are warranted on two grounds: the increase in those trained to the associate engineer level is very small considering the decline in advanced diploma enrolments, compared to the significant needs discussed above for associate level engineers. This may be addressed by the use of mid-level programs as pathways, alongside support for study such as cadetship programs. As an example of the success of associate degrees in providing coherent pathways for those already in relevant industries into both higher-level work and further study, one of our educator participants estimates that half of the associate degree students at his institution come from trades backgrounds.

Lack of coherence in mid-level engineering education's links to work

The vocations project has emphasised a lack of coherence between qualifications that derive from VET and those that derive from higher education, and poor links between education and work in Australia (Wheelahan et al. 2012). Engineering appears to be a case in point.

There is a complex overlap between AQF 6 level qualifications in engineering on two fronts: type of program and sector of delivery. As discussed in the above section on mid-level engineering education and work, both advanced diplomas and associate degrees purportedly lead to the same jobs, those classified as engineering associates. In addition, while advanced diplomas have generally been delivered by TAFEs and increasingly by private VET providers, and associate degrees by higher education providers, the two sectors are merging in that traditional VET providers are delivering higher education programs and universities are delivering VET programs (Wheelahan et al. 2011). This means providers are confronted with a choice of which qualification to deliver and students are confronted with a choice of which qualification to study. In a study of the financial aspects of advanced degrees and associate degrees in engineering in Victoria, Karmel and Lu (2012) stress the complexity of these choices. For providers, associate degrees attract more than double the amount of public subsidy, $29 401 compared to $11 830 as of 1 January 2012 (although only universities can attract the former subsidy). For the student, an advanced diploma is considerably cheaper, and so seems a better investment if the goal is immediate labour market entry. However, if the goal is articulation to a bachelor program, due to the curriculum mismatches between VET and higher education students take longer to complete a bachelor degree from an advanced diploma than from

an associate degree. Therefore those articulating from an advanced diploma will face higher fees for their bachelor degree and a greater loss of potential earning and will face a considerably greater cost overall than those articulating from an associate degree. On the other hand, labour market currency of the two types of programs is not necessarily equal. Dowling (2011) shows, albeit generalising from a small sample, that employers prefer higher education to VET qualifications. That is, they prefer higher education bachelor degrees and associate degrees over both VET advanced diplomas and associate degrees offered by mainly VET institutions. The reasons given were fairly vague, relating to familiarity and status rather than any firm understanding of educational differences. Generally Dowling (2011) shows that employers, while seeming to be increasingly willing to support workers in study with cadetships and less formal arrangements, are quite unclear about the complexity of mid-level engineering education.

The complexity and diversity of mid-level programs across two qualification types has been identified in Dowling's (2010b) review of program structures and policy contexts as a problem for students and employers understanding the best program to lead to engineering associate work and/or articulation. Table 34 illustrates the complexity of advanced diploma offerings, across multiple industry skills councils (other fields of education are generally associated with one skills council) and multiple versions of training packages being delivered at one time. Dowling (2010b) identifies some particular problems with advanced diplomas: high variability making generalised credit arrangements difficult (receiving institutions prefer to assess credit individually); a lack of breadth and depth of knowledge for specialised practice as an engineering associate; and the lack of any off-campus offerings, limiting the role of advanced diplomas in meeting skills shortages in regional and rural areas, many of which contain major mining and infrastructure projects (in contrast to, for example, associate degrees offered by the University of Southern Queensland and CQUniversity, which are respectively largely and entirely offered as distance education). The lack of access to education in rural areas not only generates skill shortages in road, rail and mining as discussed in the first section impeding economic growth narrowly defined, but also impedes social inclusion and community development. As Cuervo and Wyn (2012) show, issues of identity and place, and avoiding the assumption that people should move from rural areas to access education and skilled work, are vital considerations in engaging rural youth. The educator interview involved in the longest running engineering associate degree explained that those studying by distance often did so out of a desire to stay in their rural town, often studied by distance full-time, often studied a program connected to their current work, and had on average a higher entrance score than the on-campus students for whom the qualification was more a pathway to the four-year program rather than being connected to their current work.

At the time of this paper only one program with discipline specialisations, at Chisholm Institute, had been accredited by Engineering Australia, despite extensive discussions (Dowling 2010b). However as of 16 April 2012, one discipline specialisation at Challenger Institute of Technology and one at The Gordon had been further accredited (Engineers Australia, 2012) as also included in Table 34. This table, adapted from Dowling (2010b, p. 18), with further information on the numbers of registered training organisations involved, gives an indication of the complexity of advanced diplomas in engineering and the lack of progress in accrediting these programs. The table shows programs governed by four skills councils and five training packages and which numerous training organisations are approved to deliver. A single offering has however been accredited by Engineers Australia.

Table 34 Engineering advanced diplomas developed by industry skills councils

Industry Skills Council	Package	Advanced diploma of …	Code	No. RTOs approved to deliver	Number accredited by EA
Electrocomms and Energy Utilities Skills Council	UEE07 Electrotechnology Training Package Version 3	Electrical Engineering	UEE60107	15	0
		Electronics and Communications Engineering	UEE60207	8	0
		Electronics and Communications Engineering	UEE60210	9	0
		Computer Systems Engineering	UEE60407	12	0
		Computer Systems Engineering	UEE60410	12	0
		Industrial Electronics and Control Engineering	UEE60607	2	0
		Industrial Electronics and Control Engineering	UEE60610	1	0
		Instrumentation and Control Engineering	UEE61510	2	0
		Refrigeration and Air-conditioning Engineering	UEE60707	5	0
		Renewable Energy Engineering	UEE60907	2	0
		Renewable Energy Engineering	UEE60910	1	0
	UEE11 Electrotechnology Training Package Version 4	Electrical Engineering	UEE62211	2	0
		Electronics and Communications Engineering	UEE60211	4	0
		Computer Systems Engineering	UEE60411	4	0
		Industrial Electronics and Control Engineering	UEE60611	0	0
		Instrumentation and Control Engineering	UEE61511	0	0
		Refrigeration and Air-conditioning Engineering	UEE62511	0	0
		Renewable Energy Engineering	UEE60911	0	0
Innovations and Business Industry Skills Council	ICT02 Telecommunications Training Package	Telecommunication Engineering	ICT60202	6	0
	ICT10 Integrated Telecommunications	Telecommunication Network Engineering	ICT60210	11	0
Manufacturing Industry Skills Council	MEM05 Metal and Engineering Training Package	Engineering	MEM60105	22	1
		Engineering	MEM60111	14	0
SkillsDMC National Industry Skills Council	R1109 Resource and Infrastructure Industry Training Package	Civil Construction Design	RII60509	2	0
		Civil Construction	RII60609	4	0

Source Adapted and updated from Dowling (2010b, p. 18), with numbers of RTOs approved to deliver sourced from <training.gov.au> on 9 October 2012 and numbers accredited as of 16 April 2012 sourced from Australian Engineering Accreditation Centre (2012).

Table 35 summarises the number of accredited advanced diplomas that are offered but not part of existing training packages developed by industry skills councils. Again there are several offerings, only two of which have been accredited by Engineering Australia.

Table 35 Engineering advanced diplomas not developed by industry skills councils

Advanced diploma of …	Program code	No. RTOs approved to deliver	Number accredited by EA
Engineering Design	40604SA	9	0
Civil & Structural Engineering	52011	3	0
Structural Engineering	91155NSW	3	0
Engineering Technology	21622VIC	13	2
Engineering (Oil & Gas)	52170	2	0

Source Adapted and updated from Dowling (2010b, p. 21), with numbers of RTOs approved to deliver sourced from <training.gov.au> on 9 October 2012 and numbers accredited as of 16 April 2012 sourced from Australian Engineering Accreditation Centre (2012).

Table 36 summarises the provision of associate degrees in engineering across Australia. A minority of programs have accreditation from Engineering Australia, although certainly a higher proportion than of the much larger number of offerings of advanced diplomas. Differences between those accredited and those not may reflect to some extent programs with a focus on articulation, for which accreditation is less relevant, and those with a focus on preparation for work, as discussed in the following section.

Table 36 Engineering associate degrees and their accreditation

Institution	Associate degree of ...	Discipline specialisations	Specialisations accredited by Engineers Australia (those provisionally accredited indicated with a P)
Australian National University and Canberra Institute of Technology	Engineering	Mechanical Electronic	
CQUniversity	Engineering	Civil Electrical Mechanical Mining (Surface) Mining (Underground)	Civil Electrical Mechanical
Polytechnic West	Aviation	Maintenance Engineering	
RMIT University	Engineering Technology	Advanced Manufacturing Civil Electrical/Electronics Mechanical Network Engineering	Advanced Manufacturing (P) Civil Electrical/Electronics Mechanical Network Engineering
Southbank Institute of Technology	Civil Engineering	Civil Engineering	
Swinburne University of Technology	Engineering	Engineering	
TAFESA	Electronic Engineering	Electronic Engineering	
University of South Australia	Engineering	Civil; Electrical & Information Mechanical Engineering Defence Systems Engineering	
University of South Australia	Engineering	Engineering	
University of Southern Queensland	Engineering	Agricultural Civil Computer Systems Electrical and electronic Environmental Mechanical Power engineering	Agricultural (P) Civil (P) Computer Systems (P) Electrical and electronic (P) Environmental (P) Mechnical (P) Power engineering (P)

Source Adapted and updated from Dowling (2010b, p. 18), with programs accredited as of 16 April 2012 sourced from Australian Engineering Accreditation Centre (2012).

Thus the complexity and lack of clarity in mid-level engineering education appears to pose problems for students, institutions and employers. Advanced diplomas appear to be problematic in following neither an educational nor an employment logic: they have poor links to further education, and despite a functional and work-oriented curriculum, they have an unclear place in engineering work due to poor recognition by employers or the professional body and perhaps in their work orientation being too narrow for the knowledge and skills needed for mid-level engineering occupations.

Tension between articulation and preparation for practice in associate degrees

While there may be problems in advanced diplomas in following an educational or an employment logic, associate degrees may also have problems that reflect a tension between the two logics. One overview of curriculum in engineering education put this as:

> The associate degrees listed above have clearly been designed to fulfil two different roles. Some are entry pathways with credit into bachelors degrees in engineering with no expectation of

> accreditation at the engineering associate level. Others are intended to be terminating qualifications, driven by the needs of a specific industrial target group. As a result there may be potential for confusion amongst students and employers about the standing and role of the qualification, inherent tension in attempting to design programs that attempt to equip graduates both with the knowledge they need to work as an Engineering Associate and also receive full credit in a BEng program. (Godfrey and King, 2011, p. 146).

Engineers Australia, until 2010 at least, viewed curriculum-based programs as mainly aimed at articulation and problematic for practice and in this favoured a competency-based approach, while arguing that there needed to be national accreditation linked to international standards for advanced diplomas (Engineers Australia and Consult Australia, 2010). However, the Engineers Australia representative interviewed indicated that a number of associate degree programs had changed, especially those accredited or seeking accreditation, and contained more substantial preparation for work. Other interviewees stressed the need for a depth of knowledge and a curriculum-based approach as preparation for mid-level work as well as articulation. The Minerals Council of Australia interviewee stated that in programs planned out of the MINAD project, students will need to understand the 'broader engineering landscape' and so will need to be convinced of the need for basic maths and science. Due to the differences between this and the competency-based training that many of the existing trade-qualified workers are used to, careful planning with the cooperation of Engineers Australia and educators will be vital if the MINAD programs are to be successful. One educator defined the associate degrees at his institutions as 'more knowledge based than VET programs and more practical and vocational than bachelor degree programs', deriving their strength from being 'a real hybrid model'.

In better linking mid-level qualifications to work, it appears more needs to be done to educate students about and prepare them for the nature of the work that such qualifications can lead to. In asking mid-level engineering students across Australia about the role of engineering associates, Dowling and Godfrey (2011) found while a large minority did not respond or indicated a lack of knowledge, only a small minority explicitly discussed work roles as a career path or stepping stone to professional engineering study. The responses appeared least clear from the dual sector institution included in the study that was most focused on articulation. Students with work experience were less likely to give no response and on the whole gave more detailed responses to questions about the work of engineering associates. On the whole, respondents defined the role as having more to do with assisting professional engineers, and needing work certified by professional engineers, than the Engineering Australia definition which emphasises specialisation and the ability to independently assess and certify work. The authors recommend that programs include education in the role of associates and that, significantly for the argument made in the vocations project for changing work as well as education, Engineering Australia and employers make the role more attractive and rewarding.

In other results from this survey focusing on career aspirations (Dowling, 2010a), only 16% of students indicated plans to become an engineering associate, while 75% had plans for further study and 51% planned to become professional engineers. However, for many the latter may be a longer-term goal with shorter-term prospects of intermediate work, as the highest proportion in a multiple choice of immediate goals after the current program was 'full-time work in the engineering industry', at 46%. The above discussion suggest there is growing recognition by educators, the professional body and employers of the potential for associate degrees in engineering to meet a real need for a qualification that provides clear pathways to work as well as to further study and further career progression.

Conclusion: capabilities, associate degrees and cadetships

The supply of skilled engineers and their career and educational progression has been undermined by recent structural economic change in Australia, and a resultant shortage of engineering skills is being exacerbated by increasing demands in resource extraction and infrastructure. The generally weak links between education and work in Australia is reflected in the numbers of engineering graduates not working or working in other fields, despite apparent widespread shortages, and the generally complex and confused overlap between VET and higher education undercuts the ability of mid-level qualifications to address these issues. Completion rates in engineering are lower than in other fields, further exacerbating the under supply of graduates.

The vocations project has posited that educational and occupational progression is not just a matter of individual attributes but should be framed around the broad notion of capabilities developed by Amartya Sen and Martha Nussbaum, a notion that stresses the social and institutional support needed for individuals to realise their capabilities (Wheelahan et al. 2012). The MINAD project appears to have high potential for addressing the issues discussed in this chapter by establishing clear occupational and educational pathways that are appropriately supported. The project involves employers, institutions in both VET and higher education, and the professional body, seeing that mid-level work roles need to be clarified, and recognising that students will need pedagogical support and support from a workplace through cadetships or similar programs.

The educator participant involved in the longest-running associate degree program, while discussing an apparent revival of cadetships, related that a roads authority was appearing to address the sharp shortage of skilled workers in regional areas by paying students a full-time wage to study an accelerated associate degree program on-campus, and then supporting them to continue study towards a three year bachelor of engineering technology while working in regions. Another educator stressed the usefulness of exit points and flexibility of program structure in addressing the needs of many students to work and take a break from study: many students in this program were able to gain full-time work after qualifying for a diploma in computer-aided design, and then, perhaps after a break, continued to study part-time towards an associate degree.

While the cooperation of institutions and employers in providing structured help appears highly useful, there were potential problems identified from experience by the resource company interviewee, who noted that university structures can find cadetships difficult to deal with, and that in the field employers can forget that cadets are as much learners as they are workers. And while there are encouraging signs of the revival of cadetships and other support, it appears much more needs to be done: Dowling's (2010a) survey of mid-level engineering students indicates that while two-thirds of those working in engineering had time off for study and exams, only one-third had any support for on campus activities, which our participants agreed were very important for in-depth learning. Nevertheless, associate degrees combined with structured support appear to be a very useful model for strengthening mid-level education and work.

Case study: financial planning

By Emmaline Bexley

The financial planning industry in Australia

Financial planning emerged as a distinct occupation in Australia in the 1980s (Cowan, Blair & Taylor 2006). At that time practitioners were likely to be accountants, bankers or insurance brokers who were 'self-taught, with most having no specific formal education in financial planning' (Cowan et al. 2006, p.46). The industry grew extremely quickly after the introduction of compulsory superannuation, creating the impetus for regulating the industry following the Financial System Inquiry (FSI, or the Wallis Inquiry) in 1996.

Financial planning was regulated as part of the financial services industry with the superannuation industry under the Financial Services Reform Act 2001 (FSRA) (Cull 2009; Jackling and Sullivan 2007). Under the Act, people providing financial advice must comply with Regulatory Guide 146: Licensing: Training of financial product advisers. RG 146 aims to 'protect consumers of financial advice by ensuring that those who provide the advice are competent to do so', because 'retail clients generally do not have the resources or expertise to assess whether their adviser has an appropriate level of competence to provide financial advice. It is important for ASIC to set training standards that ensure a level of competence' (ASIC 2012).

RG 146 requires that those offering financial advice should have undertaken training at an equivalent of at least the Australian Qualification framework certificate III for tier 2 (financial product sellers) or AQF diploma for tier 1 (those providing independent financial advice) (ASIC 2012). Training is likely to be ongoing, for RG 146 requires that practitioners be trained in the particular areas in which they are providing advice, and that their knowledge be up to date. The areas of specialisation covered by RG 146 are: securities; derivatives; managed investments; superannuation; insurance—general, life and broking; deposit products and non-cash payment products; foreign exchange; first home saver accounts; margin lending facilities; and regulated emissions units. Training must be completed via a course listed on the ASIC Training Register, but this is to change to a self-regulated system in 2013.

Entry pathways to financial planning, therefore, include completing a diploma/advanced diploma in financial services (financial planning) or equivalent as the minimum requirement under ASIC, or, above that, bachelor's degree, post-graduate studies, or professional accounting qualification with a financial planning specialisation.

Accreditation

Three professional associations represent financial planners; the Financial Planning Association (FPA) as well as the accounting bodies CPA Australia and the Institute of Chartered Accountants in Australia (ICAA) (Cull 2009). The FPA, formed in 1992 to develop financial planning as a profession, today has over 12 000 members of whom around 5000 are certified CFP (FPA interview, 2012). These planners manage the finances of over five million Australians with a combined investment value of around AUD650 billion in 2006 (Jackling and Sullivan 2007).

The Financial Planning Association introduced certification of practicing financial planners in 1997, with education key to certification and ongoing registration (Cull 2009). Before 1 January 2007

financial planners could gain certification with FPA as a CFP having completed a diploma or advanced diploma financial services (financial planning), with additional training requirements offered within FPA. In 2007 FPA moved to a bachelor for certification. From 2012 a bachelor degree will be required for practitioner affiliation as well (interview with FPA).

Credential creep: education and professionalisation

A concern with the status of financial planning as an industry or a profession has underpinned shifts in the level of training necessary to practice as a financial planner. Dickman's (1974) definition of an industry is useful here:

> (A group) of persons engaging in the same business or plying the same craft. Membership reflects the trade practiced…the primary function of which…is to establish control over the practice of that trade by setting standards of workmanship (quoted in Murphy and Watts 2009).

The contrast between an industry and a profession lies in the emphasis on ethical standards, theoretical basis and impartiality that characterise a profession; for example in the useful definition endorsed by the Australian Council of Professions that has been adopted by the ACCC, a profession is:

> A disciplined group of individuals who adhere to high ethical standards and uphold themselves to, and are accepted by, the public as possessing special knowledge and skills in a widely recognised, organised body of learning derived from education and training at a high level, and who are prepared to exercise this knowledge and these skills in the interest of others (ACCC 2008).

The representative bodies involved in financial planning have begun to shift financial planning from an industry to a profession, with the Institute of Chartered Accountants in Australia commissioning a paper on the issue in 2007 (Brown 2007; see Cull 2009). The move by the FPA to require at least a bachelor qualification for certification as a CFP has been seen as motivated by a desire to have the industry recognised as a profession, and to bring it into line with professions such as accounting and law (Cowan et al. 2006, Jackling and Sullivan 2007).

Therefore, while financial planning, as a regulated industry, requires only a diploma equivalent qualification by law, practitioners have a strong incentive to hold a bachelor qualification to associate themselves with the FPA. Further, institutions offering courses leading to careers in the regulated and/or accredited professions tend to seek a market advantage by having their courses accredited by top professional bodies, which also drives credential creep. For example, the Financial Planning Association (FPA) accredits the Deakin bachelor of commerce (major in financial planning) as an approved degree for entry into the Certified Financial Planners education program, leading to profession accreditation as a CFP.

Interviews undertaken for this study concentrated on the effects of this apparent credential creep on entry to the industry, and the way people navigate education-to-work, occupation-to-occupation and work-reeducation-occupation pathways in financial planning.

The interview program

For this study, interviews were undertaken with: a senior leader of the FPA with over fifteen years experience in the Association; a course coordinator from a private college delivering training to financial planners, and a course-coordinator and a teacher of mid-level accounting qualifications at a TAFE. Further interviews had initially been envisaged, but it was clear that there would be little to be gained, for each interview yielded the same story – albeit from differing perspectives.

Views of the FPA about vocational pathways to financial planning, training requirements, and professionalisation

The FPA has changed its policies and practices in recent years aimed at professionalising the financial planning industry. These changes are important to our study for they entail changes to the educational qualifications necessary to be affiliated with the Association, and therefore limit entry to the profession. Even though ASIC's RG 146 is the baseline for practice, the requirements of the Association shift the goalposts for those who seek certification and therefore the most prestigious level of industry recognition.

Early in 2011 the FPA changed its membership structure so that it represents only practitioners, not licensees (employers, such as banks). The FPA saw this move as ensuring that it can act in the best interests of financial planners themselves – without undue influence from those who employ them, and who may have an interest in compromising the ethical base necessary to professionalism. Shoring up the ethical credentials of the Association can be seen as integral to shifting financial planning from an industry to a profession, following the definition of a profession given above of a group with a shared ethical set of ethical standards as central to the notion of professionalism.

A further plank of the shift from industry to profession being engineered by the Association is the requirement, undertaken in stages from 2007, that the only pathway to certification as a CFP be a degree. As one interviewee put it, 'At the end of 2010 the door banged shut on people who didn't have a degree to get that certification'. From 2013 Authorised Financial Planners (the lower level of accreditation with the FPA) will require a bachelor qualification too. For our interviewee, this is a natural progression: 'Financial planning is very new, the FPA is only 20 years old. Ours is not like the history of other professions [i.e. their history if much longer] and the move to a degree reflects the growing level of complexity in the profession'. Further, 'it's not just [credential] creep for its own sake, it's the increasing level of complexity in the market. The system gets more and more complicated and people need help to navigate it. Think about it like buying a phone 15 years ago and doing it now: now there's plans and products and data allowances. It's like that.'

While the changed requirements of the FPA are to some extent an impediment to entering the industry for people who do not have senior school qualifications for entry to a bachelor degree, our interviewee told us that progression to the industry straight from initial education is rare. Most financial planners move into the industry from other careers, especially accounting, so one could imagine someone entering accounting via a certificate III or diploma and up-skilling on the job. A number of postgraduate qualifications in financial planning can be entered on the basis of professional experience and thus meet the requirement of a minimum bachelor qualification without an individual necessarily having completed a bachelor degree.

Other changes to the industry are being driven by ASIC. Our interviewee told us that ASIC had just announced that it would be closing its training register. Once the register is decommissioned it will be up to RTOs to self-regulate their courses as complying with RG 146. Our interviewee intimated that this may lead to a diminution in standards at some RTOs; they indicated that course content had been devalued since the introduction of training packages, 'because people have found they can get away with teaching less'. This, it was felt, would make bachelors even more valuable, for they are underwritten, in a sense, by the reputation of the universities.

FPA accredits a number of university degrees, and has formal arrangements with 8 universities which will give credit for units undertaken at FPA. There is thus a tight nexus between professionalisation, credential creep and shared purpose between universities and the Association, and it is likely that the

closing of the training register will strengthen the bond further. As our interviewee put it, 'We expect that from this week there'll be an even greater desire for unis to get on the bus with us'. The FPA has historically been the arbiter of the financial planning knowledge base. Through the 1990s a diploma developed by the FPA's predecessor association was the industry standard, and even RTOs, historically, were evaluated against the FPA standard. The shift away from mid-level qualifications seems to be a consolidation of the Association's intellectual authority: 'It's a traditional pathway for a profession to define its own knowledge area', said our interviewee.

A final matter that became evident in interviewing the FPA representative was the very sharp distinction in the industry between financial planners proper – those who give advice across a range of financial areas and whose advice may not be tied to any product – and people employed to sell financial products, who are also regulated under RG 146. For our FPA representative there is a clear distinction between these two groups, and the FPA is lobbying to have the term 'financial planner' reserved in legislation for the former group.

Views from a private college

Advice from the Academic Director of Curriculum and Programs at a private college delivering in-house diploma-level training in financial planning for investment corporations aligned with the views of the professional association. The courses delivered by the private college are aimed at meeting the requirements of RG146 for those giving financial advice to clients of banks, investment business and similar bodies. The educational programs were directly related to compliance with the Regulation, and the employment logic of the program was so strong that the interviewee seemed surprised at questions relating to pedagogical issues. For example, when asked about how the courses prepared participants for the next level of study, our interviewee indicated that in practice once RG146 compliance was met (i.e. diploma level) students were unlikely to be motivated toward further study, saying, 'I can't emphasise enough how compliance-driven this training is'. The interviewee also told us that they felt that a graduate of a bachelor degree with a financial planning specialisation would come out with little more than a diploma graduate in their ability to practice financial planning, since both would be RG146 complaint. This final point shows just how heavily educational offerings were driven by an employment logic rather than the status relations that might be associated with an education logic.

Views from a TAFE

At the TAFE we spoke to the head of department of the accounting school and the program coordinator responsible for courses in financial training. The winds of change in the financial planning industry had already struck here, with a mooted diploma in financial planning having been unable to attract sufficient students to go ahead. The coordinator said explicitly that they saw the industry standard as moving toward bachelor qualifications and that the diploma was no longer going to be attractive, despite its being sufficient for RG146 compliance. The Head noted the discrepancy between the requirements of the FPA and of ASIC, implying that it was the FPA requirement that was likely to drive student choices of vocational and educational pathways.

An additional concern raised by the TAFE was that the rising cost of VET courses, particularly after recent budget cuts to VET in Victoria, would reduce access to vocational pathways for people from disadvantaged backgrounds. Indeed, they noted that the cost difference between VET and HE was now negligible, so the main attractor to the TAFE course would be the briefer time for the courses. Implicit in this discussion was the recognition that the status of the higher education qualification

would outweigh this. The TAFE did offer higher education programs, but again, as we found in the first year of this project, TAFE's higher education offerings compete on status with university higher education offerings. With a small number of exceptions, TAFE's higher education programs are not eligible for public funding and this further disadvantages them in competing with universities for students.

When asked about the future of mid-level qualifications, the interviewees felt that this was going to be determined by the [state] government policy, which is unknown. They were strongly of the view that TAFE is vital for both 'second chancers' and those for whom university was not 'a good fit'. The opportunities offered by mid-level qualifications in the supportive environment of a TAFE was seen to be threatened by the absence of transport concessions for those studying qualifications of less than 10 weeks, the increase in fees charged by TAFEs to make up for government funding shortfalls and the high level of VET fees compared to those for Commonwealth supported higher education programs, perceived debt aversion for those from disadvantaged backgrounds and recent drops in university cut off scores.

Financial planning and the shift from industry to profession

Financial planning, then, has shifted in just three decades from a specialisation of accounting or insurance broking undertaken largely by self-taught practitioners, to a regulated industry requiring mid-level qualifications to practice, and finally to a nascent profession that in practice requires the status of a bachelor or postgraduate qualification for a high-level career.

The effect of this apparent credential creep on entry to the industry, and the way people navigate education-to-work, occupation-to-occupation and work-education-occupation pathways in financial planning was an extremely strong example of the hollowing out of a vocational pathway. The difference between membership of a regulated industry and membership of a high status profession was spelt out in the explicit and implicit educational requirements. The employer-sponsored training for 'product sellers' delivered by the private college was in sharp contrast to the flight from TAFE to bachelor (or postgraduate) education at university illustrated by both the recent moves of the professional association as well as the fact that TAFE that could not gain sufficient enrolments for its financial planning diploma.

Case studies of physician assistants and veterinary technologists

By Gavin Moodie

Arguably the posited hollowing out of the middle of the skill distribution is happening in the work force, perhaps reflecting broader economic changes or employers' choices about the structure of work. If this is true there seems little scope for intervention by educational institutions. Nonetheless, some institutions have developed qualifications with an employment logic to prepare graduates for mid level roles in the workplace. These are para professional roles or ones that are between skilled and professional occupations. Since there are few informative examples of these qualifications in Australia the team decided to include in its study the introduction of qualifications for physician assistants and veterinary technologists, notwithstanding that the Australian qualifications for these roles are bachelor or above.

Physician assistant

The antecedents of physician assistants are in military medical assistants –

> Assistants in one form or another have been supplementing the services of doctors at least since the seventeenth century in Europe. One group of assistants, called feldshers, was first introduced into the Russian Army by Peter the Great (1672–1725).
>
> By the early twentieth century feldshers provided much of the medical care received by the rural population in Russia. Russian doctors however, were critical of these assistants who, they argued, lacked adequate training and provided inferior medical services. Despite the disdain Russian doctors held for feldshers, the medical profession rejected any proposals to improve their training, fearing that better trained, but cheaper assistants would replace many doctors.
>
> By the 1970s, there were over 500 000 feldshers practising in Russia, mostly in isolated areas.
>
> (Jolly 2008, p.3)

Feldshers also provide primary, obstetrical and surgical care in many rural medical centres and ambulatories in Armenia, Kazakhstan, Kyrgyzstan and Uzbekistan. Feldshers were part of the inspiration for Communist China's barefoot doctors.

US strong foundation

Physicians assistants originated in the US. In 1942 the US Government invited Dr Eugene Stead, Jr, then the Dean of Emory University Medical School, to develop an accelerated 3 year medical education program to supply doctors for the war effort (Forde and O'Connor 2009, p.2). In 1961 Dr Charles L Hudson (1961, pp.839-840) proposed the 'creation of two new groups of assistants to doctors from nonmedical and nonnursing personnel', one of which would be 'assistants with special training, intermediate between that of the technician and that of the doctor, who could not only handle many technical procedures … but could also take some degree of medical responsibility'. Hudson proposed that this assistant have two or three years of higher education plus 'vocational training'.

The proposal for physician assistants was attractive because it was estimated that in 1970 about 30,000 medics were being discharged from the US military each year, mainly from Vietnam, of whom only about a third were employed in civilian health roles (Carter 2001, p.130). Nonetheless, the proposal was opposed by the American Medical Association. Despite the AMA's opposition (Brooks, in Sweet, 2011), Hudson's proposal was taken up by Stead, now chair of the department of medicine at Duke University Medical Center. Stead launched a physician assistant's program in 1965 whose first students were former US Navy hospital corps. He based the curriculum partly on his direct knowledge of the fast-track training of physicians in World War II. Dr Hu Myers started a program in 1968 at Alderson-Broaddus College and Dr Richard Smith started a program in 1969 at the University of Washington.

The AMA didn't resolve to develop educational guidelines and certification procedures for physician assistants until 1970. Physician assistants were recognised in legislation by Colorado in 1969 and by California in 1970, and by 1972 some 17 states had enacted legislation recognising physician assistants.

Importantly, physician assistants work under guidelines established by the American Medical Association. Physician assistants are licensed by the medical board in each state to practice medicine under the supervision of physicians. They are authorised to conduct physical examinations, diagnose and treat illnesses, order and interpret tests, advise on preventative health care, help in surgery, and write prescriptions in 47 US states. Physician assistants can provide from 75% to 90% of primary care services. While a physician assistant may provide care without their supervising physician being physically present, they have to be available by phone or electronically (Kogan and Stewart 2009, p.220).

In 2007 there were more than 68,000 physician assistants practicing in the US. The Department of Veterans Affairs was the first employer of physician assistants and remains an important employer. In 2009 some 38% of physician assistants worked in hospitals, 35% in group physicians' practices, 9% in solo physicians' practices, 8% in rural or community health centres and 10% in other settings. Some 36% worked in primary care, 22% in surgical specialties, 11% in internal medicine, 10% in emergency medicine, 3% in general surgery and 16% in other roles (American Academy of Physician Assistants no date, pp.2, 3).

In 2011 there were about 12,000 students enrolled in 156 accredited physician assistant programs offered in 44 US states. Most are graduate programs requiring a baccalaureate for entry and leading to the award of a masters in physician assistant studies, health science or medical science. A few programs are still at bachelor level. There is no set curriculum length, but the average program is 26.8 months. The first year of physician assistant's program gives students a broad background in medical principles, with a focus on clinical applicability. This typically includes coursework in anatomy, physiology, biochemistry, pharmacology, physical diagnosis, pathophysiology, microbiology, clinical laboratory sciences, behavioral sciences, and medical ethics. In the second year students undertake clinical training in a variety of inpatient and outpatient settings. These rotations include areas such as family medicine, internal medicine, obstetrics and gynecology, pediatrics, general surgery, emergency medicine, and psychiatry. Over the course of their educational program, physician assistant students typically complete more than 2,000 hours of supervised clinical practice (Kogan and Stewart 2009, p.222).

Physician assistants are also widely employed in Taiwan (Hooker, Hogan and Leeker 2007, p.82) and are employed in Canada, England and Scotland (Edwards 2007) and have been introduced in the Netherlands and South Africa (Sim 2011).

Australia's halting start

The initiative for physician assistants in Australia came in 2006 from Peter Brooks (2006, p.14), then dean of the University of Queensland's faculty of health science. A research paper of the Australian parliamentary library in 2008 concluded that 'Given that Australia is experiencing similar health workforce shortages and that it is faced with similar health needs as Britain, Canada and the United States, it may be that it will also experience comparable health benefits from the introduction of physician assistants as part of a future multi dimensional health strategy' (Jolly 2008, p.42).

South Australia Health trialled six physician assistants trained in the US in 3 Adelaide hospitals from October 2008 to October 2009 (Ho and Maddern 2011, p.256). Queensland Health conducted a pilot of physician assistants from May 2009 to May 2010 in which five physician assistants who were trained and had considerable experience in the US worked in a variety of health service settings in Queensland. The evaluation (Kurti and colleagues 2011, p.1) found that 'Overall, the evaluation has found that once the initial implementation phase had passed, most doctors and nurses worked well with the PAs.'

The first physician assistant's program in Australia was the master of physician assistant studies first offered by the University of Queensland in July 2009 (University of Queensland 2010, p.86). The program comprised half a year of coursework and a full year of clinical rotations. The entry requirements were a bachelor's degree in biological or health sciences or a related field and one year direct patient care experience (University of Queensland no date). The program admitted 11 students in its first year and 23 students in its second year.

However, in May 2011 the University of Queensland (2011) announced that it would close its physician assistant's program 'in the light of a combination of key factors. This includes the resignation of the Program Director and the difficulty in recruiting a replacement within this field, the significant uncertainty about the future of a physician assistant workforce in Australia, and the associated financial risk'. Swan (Swan & Wilkinson 2012) described this explanation as 'very diplomatic'. Others cited trenchant opposition from the Australian Medical Association and nurses (Edwards 2007; Jolly 2008, p.32; Swan & Wilkinson 2012; Sweet 2011a; Pashen in Sweet, 2011b). Physician assistants were, however, supported by the Australian College of Rural and Remote Medicine (2011). The closure was criticised heavily by Brooks, now at the University of Melbourne (Sweet 2011b).

Other Australian universities have started physician assistant programs. The University of Adelaide promoted a master of physician assistant studies in 2010 but is not offering the program in 2012. James Cook University (2011) introduced a bachelor of health science (physician assistant) in 2012. The program comprises coursework for the first two years and clinical health service placements with limited residential blocks in the third year. Entrants are required to have a health related degree or equivalent and a minimum of two years equivalent full time experience in a healthcare setting that includes direct patient contact (James Cook University no date).

Edith Cowan University (no date) introduced a master of medical science (physician assistant) program in 2011. The program's entry requirements were a baccalaureate in biological, health sciences or a related field and one year of direct clinical care experience. The program comprised half time

coursework in the first year and four full time clinical rotations in the second year. The program is not included in the university's 2012 handbook.

The Australian and state governments seem likely to continue promoting physicians assistants, since a review by Health Workforce Australia concluded that physician assistants could make a significant contribution to addressing a number of key health needs (Miller et. al. 2011, p.1).

Veterinary technologist: University of Queensland

Australia also followed the US in establishing veterinary technology programs, where they may have been introduced by extension from physician assistants. Kogan and Stewart (2009, p.220) argued that the US should introduce 'a mid-tier veterinary professional health care provider (referred to in this article as a veterinary professional associate [VPA]), similar to the human medical profession's physician assistant'.

The first and currently only veterinary technology program offered in Australia is by the University of Queensland. The University of Queensland has offered vocational programs in agriculture since 1990 when it amalgamated with the Queensland Agricultural College. The Queensland Government established the Queensland Agricultural College as a combined agricultural college and experimental farm in 1897 in Gatton, on the Ipswich side of Toowoomba, an hour's drive west of Brisbane. By 1987 the college enrolled 1441 higher education students, 643 in baccalaureates and 1432 students in 'other' undergraduate programs, probably diplomas (Commonwealth Tertiary Education Commission 1987, pp.41-44). The college also offered the Queensland certificate in agriculture.

Following the college's amalgamation with the University of Queensland, the university has concentrated his agricultural and related programs at Gatton, relocating its veterinary science program to the campus in 2010. The university retained the agricultural college's vocational education programs. It now offers some 30 vocational programs ranging from certificate I to advanced diploma in animal care and management; agriculture, horticulture and conservation and land management; and forest and forest products. In 2011 the university offered an associate degree in applied science with majors in animal production; animal welfare and inspection; equine studies; marine resources; plant studies; and wilderness reserves and wildlife. However, the university no longer offers these associate degrees.

The university started offering a bachelor of applied science (veterinary technology and management) in 2003 with 28 students. Several students had a background in veterinary nursing and about half had a rural background. Most students enrolled to gain employment in a veterinary practice. About 17% of students sought to transfer to veterinary science, although the veterinary technology degree does not gain credits towards the bachelor of veterinary science (Clarke 2004, p.38).

Students may complete the veterinary technology program jointly with a certificate IV in veterinary nursing. The program is broadly similar to other veterinary technology baccalaureates, such as that offered prominently by Purdue University since the late 1990s (Clarke, Schull & Coleman 2009, p.241). The first year establishes a foundation in sciences such as chemistry, biology, animal anatomy and physiology. The second year introduces biochemistry and microbiology and applied sciences such as genetics and animal breeding, animal reproduction and animal nutrition. The final year is intensively clinical with a combination of laboratory classes and clinical placements, concentrating on small animals but also including equine and big animal health and management studies. (Clarke, Schull & Coleman 2009, p.241). The clinical rotations and industry placements are in locations such as the

university's veterinary teaching hospital, veterinary practices, zoos, wildlife parks, government agencies, welfare organisations, animal breeding enterprises and pharmaceutical companies.

Of the early graduates of the program, 74% were employed in veterinary practice (Table 37).

Table 37 Destination of veterinary technology graduates 2003-2005

Destination	Number	%
Employed		
Veterinary practice		
General	23	35
Specialist/emergency	11	17
Allied animal industries	5	8
Government agencies	5	8
Wildlife parks and zoos	2	3
University teaching & technical support	3	5
Further study		
Research honors	1	2
Undergraduate	9	14
Postgraduate	1	2
In transition/unemployed	5	8
Non veterinary/animal	1	2
Total	**66**	**100**

Adapted from Clarke, Schull and Coleman 2009, p.242) Table 1: employment of graduates at February 1, 2006.

A review of rural veterinary services conducted for the Australian Government in 2003 argued that –

> 5.65 The veterinary profession should promote new models of rural practice that can generate better returns and support better working conditions and remuneration for principals and staff. Rural mixed practices need to become larger multi-person, multi-skilled practices, actively promoting their skills to animal production enterprises and servicing larger areas.(Frawley 2003, p.77).

Furthermore –

> 9.80 Scope exists for veterinarians and para-professionals professionals in allied fields to work more cooperatively and closely. For example, rural veterinary nurses could undertake many routine tasks, freeing veterinarians to undertake more specialised tasks and there is considerable scope for veterinarians and agricultural scientists to establish joint farm consultancy practices.
>
> (Frawley 2003, p.115)

However –

> 5.55 A professional attitude that might inhibit the development of more efficient practices – in terms of overall management and use of resources – is that towards para-professionals and professionals in related disciplines. Among older veterinarians, in particular, there is some antipathy towards para and other professionals. Understandably, there is a concern about nonveterinarians 'poaching' traditional veterinary work, thereby diminishing actual or potential practice income. This has obvious validity in respect to service providers operating in opposition to veterinarians in areas such as pregnancy diagnosis. However, in both smaller and larger rural mixed practices, using the skills of non-veterinarians to undertake many of the more routine tasks in a practice would relieve the veterinarian(s) for those tasks of 'veterinary science' for which they have been trained. (Frawley 2003, p.76)

The coordinator of the final year of the University of Queensland's veterinary technology program reports that veterinary practice is changing faster than veterinary principals realise. Opportunities for veterinary technology graduates are emerging in practice management, specialist technical areas such as emergency and critical care, dermatology and veterinary research and veterinary pharmaceuticals. Opportunities are also arising in stock inspection for disease control and animal welfare regulation (Clarke 2004: 39).

Conclusion

These studies of educational institutions introducing to Australia mid level qualifications with an employment logic have had mixed results. While physician assistants and veterinary technologists are well established in the US and have spread to some other countries, they have yet to be taken up widely in Australia. The University of Queensland closed its physician assistant's program after only two intakes, although physician assistant programs are now being offered by James Cook University and perhaps other Australian universities. While the University of Queensland continues to offer a veterinary technician's program and a program is being offered by Massey University (2012) in Aotearoa New Zealand, the program has not yet been taken up by other Australian veterinary schools.

Central to the success of these qualifications has been their acceptance by the relevant industry. The Queensland and South Australian departments of health and Health Workforce Australia support and even promote the introduction of physician assistants. However, physician assistants have been opposed trenchantly by the Australian Medical Association and nurses, which may be slowing their adoption in Australia. While there has been less overt opposition to the introduction of veterinary technologists in Australia, the industry is structured differently and the indifference of veterinary principals may be slowing the introduction of veterinary technologists.

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