Innovation agents

Vocational education and training skills and innovation in Australian industries and firms – Volume 2

Phillip Toner

Jane Marceau

Richard Hall

Gillian Considine

NCVER

Innovation agents

Vocational education and training skills and innovation in Australian industries and firms – Volume 2

Phillip Toner
Jane Marceau
Australian Expert Group in Industry Studies, University of Western Sydney

Richard Hall
Gillian Considine
ACIRRT, University of Sydney

Publisher's note

This volume is a companion to *Innovation agents: VET skills and innovation in Australian industries and firms – Volume 1*. The detailed report of the project is contained in volume 1 while volume 2 contains the appendices.

ISBN 1 920895 45 0 web edition
TD/TNC 77.02

Published by NCVER
ABN 87 007 967 311
Level 11, 33 King William Street, Adelaide SA 5000
PO Box 8288, Station Arcade SA 5000, Australia
<http://www.ncver.edu.au>

Appendix 1: Data tables for construction of the composite index of innovation

Table 30: R&D expenditures by industry, Australia

ANZSIC		3-year average R&D expenditures	Industry % of total R&D expenditures
		1997 to 1998–1999 to 2000	
B	Mining (including services to mining)	429.19	10.44
C	Manufacturing	2111.96	51.38
21	Food, beverage and tobacco manufacturing	191.74	4.66
22	Textile, clothing, footwear and leather	19.52	0.47
23	Wood and paper product manufacturing	102.19	2.49
24	Printing, publishing and recorded media	17.36	0.42
25	Petroleum, coal, chemical	364.20	8.86
26	Non-metallic mineral product manufacturing	57.20	1.39
27	Metal product manufacturing	296.96	7.22
28	Machinery and equipment manufacturing	1037.71	25.24
29	Other manufacturing	25.10	0.61
D	*Electricity, gas and water supply*	*26.30*	*0.64*
E	*Construction*	*48.48*	*1.18*
F	*Wholesale trade*	*321.06*	*7.81*
G	*Retail trade*	*13.87*	*0.34*
I	*Transport and storage*	*35.10*	*0.85*
J	*Communication services*	*141.31*	*3.44*
K	*Finance and insurance*	*97.34*	*2.37*
L	*Property and business services*	*818.57*	*19.91*
M	*Government administration and defence*	*3.04*	*0.07*
N	*Education*	*0.83*	*0.02*
O	*Health and community services*	*5.68*	*0.14*
P	*Cultural and recreational services*	*25.62*	*0.62*
Q	*Personal and other services*	*3.89*	*0.09*
Total		**4110.70**	**100.00**

Note: The percentages sum to 100 only if the 1-digit industry categories are used.
Source: Derived from ABS (2002a unpublished data)

Table 31: R&D expenditures as a percentage of industry value added, Australia

ANZSIC		R&D expenditures[1]	Industry value added	R&D as % of industry
		$m	1999–2000	Value added
B	Mining (including services to mining)	429.19	28 102	1.53
C	Manufacturing	2111.96	73 892	2.86
21	Food, beverage and tobacco manuf.	191.74	15 392	1.25
22	Textile, clothing, footwear and leather	19.52	3 044	0.64
23	Wood and paper product manufacturing	102.19	5 357	1.91
24	Printing, publishing and recorded media	17.36	7 012	0.25
25	Petroleum, coal, chemical & manuf.	364.20	10 389	3.51
26	Non-metallic mineral product manuf.	57.20	4 271	1.34
27	Metal product manufacturing	296.96	11 402	2.60
28	Machinery and equipment manufacturing	1037.71	14365	7.22
29	Other manufacturing	25.10	2 660	0.94
D	*Electricity, gas and water supply*	*26.30*	*15 507*	*0.17*
E	*Construction*	*48.48*	*35 836*	*0.14*
F	*Wholesale trade*	*321.06*	*32 615*	*0.98*
G	*Retail trade*	*13.87*	*32 652*	*0.04*
I	*Transport and storage*	*35.10*	*31 141*	*0.11*
J	*Communication services*	*141.31*	*18 466*	*0.77*
K	*Finance and insurance*	*97.34*	*38 639*	*0.25*
L	*Property and business services*	*818.57*	*67 557*	*1.21*
M	*Government administration and defence*	*3.04*	*24 070*	*0.01*
N	*Education*	*0.83*	*27 098*	*0.00*
O	*Health and community services*	*5.68*	*34 262*	*0.02*
P	*Cultural and recreational services*	*25.62*	*10 890*	*0.24*
Q	*Personal and other services*	*3.89*	*14 384*	*0.03*
Total		**4110.70**		
Gross value added at basic prices less ownership of dwellings; accommodation, cafes & restaurants and agriculture. R&D data are not collected for these industries.			485 111	0.85
Gross value added at basic prices less ownership of dwellings			519 754	

Notes: Given the volatility in annual R&D expenditures within an industry, a three-year average expenditure from 1997 to 1998–1999 to 2000 was used.

Reference year for chain volume measures is 1999–2000.

Ratio of R&D to value-added is the sum of R&D for sub-divisions 66–67.

Excludes industries for which no R&D data are available.

Table 32: Measures of capital investment by industry, Australia

	Capital expenditure[1]	Industry share of total CAPEX[2]	Investment rate
	$m		CAPEX as a % of value added
Agriculture, forestry and fishing	5 353	6.9	41.2
Mining	10 805	14.0	45.7
Manufacturing	12 217	15.8	17.7
21 Food, beverage and tobacco manufacturing	2 655	3.4	19.3
22 Textile, clothing, footwear and leather manufacturing	339	0.4	10.7
23 Wood and paper product manufacturing	1 147	1.5	12.7
25 Petroleum, coal and chemical manufacturing	1 934	2.5	20.3
26 Non-metallic mineral product manufacturing	659	0.9	17.3
27 Metal product manufacturing	2 694	3.5	23.1
28 Machinery and equipment manufacturing	1 671	2.2	12.8
29 Other manufacturing	253	0.3	10.8
Electricity, gas and water supply	5 803	7.5	40.1
Construction	2 415	3.1	11.9
Wholesale trade	3 553	4.6	12.1
Retail trade	3 385	4.4	10.9
Accommodation, cafes and restaurants	2 661	3.4	20.3
Transport and storage	5 515	7.1	24.5
Communication services	6 638	8.6	38.4
Finance and insurance	5 956	7.7	10.5
Property and business services	6 211	8.0	13.2
Private community services	2 742	3.5	13.1
Cultural and recreational services	3 267	4.2	34.8
Personal and other services	858	1.1	16.7
All industries	77 380	100	21.1

Notes: 1 Given the variability in year-to-year CAPEX, a three-year average from 1997 to 1998–1999 to 2000 was used. The industry value added data for the finance sub-division was derived from national accounts data. The industry value added data for calculating the investment rate was for the year 1999–2000.

2 CAPEX = capital expenditure

Source: ABS (various years unpublished data)

Table 33: Percentage change in labour productivity 1992 to 1993–2000 to 2001 by industry, Australia

Industry	Percentage change in labour productivity
Agriculture, forestry and fishing	21.4
Mining	55.7
Manufacturing	22.8
Electricity, gas and water supply	54.3
Construction	-7.9
Wholesale trade	49.9
Retail trade	17.2
Accommodation, cafes and restaurants	7.5
Transport and storage	14.5
Communication services	45.4
Finance and insurance	29.6
Property and business services	na
Government administration and defence	na
Education	na
Health and community services	3.7
Cultural and recreational services	-0.5
Personal and other services	na
All industries	15.3

Note: na = not available

Source: Derived from ABS (1992–2001, table 22)

Appendix 2: Case study interview schedule

SKILL FORMATION IN INNOVATION-INTENSIVE FIRMS

A project by:
Australian Expert Group in Industry Studies
University of Western Sydney

&

ACIRRT
University of Sydney

For the National Centre for Vocational Education Research

Company Name .....

Address .....

Interviewee .....

Position of Interviewee.....

Telephone No .....

Date of Interview.....

Commercial-in-confidence

Background Briefing for Interviewees

A series of eight company case studies are being undertaken as part of a larger study of vocational-level occupations in innovation-intensive industries in Australia. (Vocational-level occupations are those either learned on the job or through TAFE and other private providers. They include occupations such as production process worker; trades and maintenance; warehouse/transport, clerical and some marketing, accounting and computing jobs.)

Earlier research has identified the following four industries; manufacturing; mining; communications; and business services, as being especially 'innovation-intensive' in terms of their expenditure on research and development , new capital investment, training, rate of productivity growth and implementation of work organisation change.

Innovation-intensive firms are those which have comparatively higher rates of introducing new or improved products and services (product innovation) and higher rates of introducing new production methods, such as new equipment and work organisation changes.

The purpose of the case studies is firstly, to examine how innovation-intensive firms *recruit, maintain* and *update* their VET workforce skills. Secondly, how do innovation-intensive firms adjust their workforce skills in response to product innovation and to process innovation, such as new capital equipment and work organisation change? Finally, what changes, if any, are required of the training system to facilitate innovation in firms?

Commercial-in-Confidence

Training/Human Resources Manager

1. (a) Total no of employees in the workplace? …….

1. (b) Total sales/turnover 2001? < $5m. $6-10m. $11-20m $21-50m. >$51m.

2. What is the Approximate Distribution of Employees in Occupations in the workplace? (Numbers or percentages are OK).
   Managers (HR, Finance etc) …….
   Other professionals- (university graduates working in specialised roles such as engineers, computer programmers, accountants) …….
   Secretarial/Clerical/Accounts …….
   Supervisors/Forepersons …….
   Trades/maintenance …….
   Production/process …….
   Warehouse/transport …….

3. (a) Does the firm have a formal process for identifying where training is needed?

3. (b) What is this process?

3. (c) If there is no formal process, what other steps are taken to identify where training is needed?

4. (a) What types of training opportunities does the firm provide for its employees?
   Formal training outside the workplace
   Formal training in the workplace
   In-house courses
   Mentoring
   Structured or informal opportunities to learn from other staff
   Paid or unpaid study leave
   Payment of course/HECs fees
   Any other …….

4. (b) What are the main purposes of this training?

4. (c) How important are the following reasons for training?
   To maintain the currency of existing skills
   To introduce new skills
   To fill skills gaps
   To retain employees
   To induct new employees

5. About what percentage of employees in this workplace have a professional development plan?
   What types of things do these plans include?
   How are they negotiated?

6. (a) About what percentage of the workplace payroll is spent on training? ……%

6. (b) How is this amount determined?

6. (c) What specific items is this money spent on?

6. (d) On what basis is expenditure on training allocated?
   Does each employee have a training entitlement, such as a set number of hours per year?
   How much emphasis is given to identified training needs?
   How much to the personal or career development of employees?

6. (e) Does the firm have a preference for training that will lead to a recognised qualification ?

6. (f) What contribution are employees expected to make to training provided by the firm?

   Are employees expected to undertake their own training in addition to, or in place of, training provided by the firm?

7. (a) For which of the key occupational groups identified above do you use the following sources of training?
   In-house programs
   Mentoring or demonstrating
   TAFE
   Universities
   Adult education centres or colleges
   Private VET providers
   Equipment suppliers
   Other (please explain) ……

7. (b) What are the primary sources of training for each occupational group and why are these sources preferred?
   Managers (HR, Finance etc) ……
   Other professionals- (university graduates working in specialised roles such as engineers, computer programmers, accountants) ……
   Secretarial/Clerical/Accounts ……
   Supervisors/Forepersons ……
   Trades/maintenance ……
   Production/process ……
   Warehouse/transport ……

7. (c) What is your assessment of the quality, cost and responsiveness of the training provided by these different sources?
   In-house programs
   Mentoring or demonstrating
   TAFE
   Universities
   Adult education centres or colleges
   Private providers
   Equipment suppliers
   Other (please explain)

8. (a) Are any recruitment difficulties currently being experienced in this workplace? For what occupations?

8. (b) What do you think is the cause of these difficulties?

8. (c) Have you experienced recruitment difficulties in the past? How did you overcome them?

8. (d) From what sources do you recruit new staff for this workplace?

8. (e) Has the migration of skilled personnel been used as a recruitment solution?
   For what reasons?
   For what occupations?

9. (a) Are there any particular skills that you believe *new* employees commonly lack? Consider each occupation group separately.
   Managers (HR, Finance etc) ……
   Other professionals- (university graduates working in specialised roles such as engineers, computer programmers, accountants) ……
   Secretarial/Clerical/Accounts ……
   Supervisors/Forepersons ……
   Trades/maintenance ……
   Production/process ……
   Warehouse/transport ……

9. (b) Why do you think new employees lack these skills?

9. (c) What types of difficulties do these skill gaps create? How do you overcome them?

10. (a) Among existing employees, what types of skills do you believe are now are lacking in each occupation group?
   Managers (HR, Finance etc) ……
   Other professionals- (university graduates working in specialised roles such as engineers, computer programmers, accountants) ……
   Secretarial/Clerical/Accounts ……
   Supervisors/Forepersons ……
   Trades/maintenance ……
   Production/process ……
   Warehouse/transport ……

10. (b) What do you believe are the main reasons for these skill gaps?

10. (c) Have similar gaps been experienced in the past? How have they been overcome?

10. (d) In what ways, if any, do current skills gaps affect the workplace?
   Costs and efficiency
   The development of new products or processes
   The introduction of innovations in products or processes
   The organisation of work teams
   Entry to new markets
   Other ……

10. (e) What steps are being taken to overcome the problems arising from these skill gaps?

11. (a) Have any significant product or process innovations (including work organisation changes such as 'team based production') been introduced in this workplace within the last two years? What were they?

11. (b) Why were these changes made?

11. (c) How important was training for existing workers in the successful introduction of these innovations? In what ways?

11. (d) Which of the following training sources were used?
    In-house programs
    Mentoring or demonstrating
    TAFE
    Universities
    Adult education centres or colleges
    Private providers
    Equipment suppliers
    Other (please explain)

11. (e) Was the training customised to the particular requirements of the workplace? In what ways?

11. (f) What is your assessment of the quality, cost and timeliness of the training that was provided?

11. (g) Overall, what skills do you think existing workers require to be able to handle product or process innovation effectively?

12. (a) Are there important technologies being used in the workplace for which you experience difficulty in finding suitable external training? How are these difficulties being overcome?

12. (b) Are you considering introducing any in the near future?

12. (c) How important is the availability of external training in decisions made to introduce new technologies?

13. Over the last 2–3 years have you changed the sources of training you use for your workers? (For example more reliance on internal and less on external training). If so, why?

14. (a) In this workplace, are there any workers employed by other firms (outsourced providers or labour hire or agency workers) working alongside your employees?

14. (b) How do these workers upgrade their skills when their tasks change because of the introduction of new products, processes or equipment?

15. Does your workplace employ apprentices, trainees, or use Group Training schemes? What changes, if any, are required in these forms of training to facilitate innovation in your firm?

Commercial-in-Confidence

Production Manager

1. When was the company established?

2. Who owns the firm?

3. What are the principal products/services/major brands?

4. (a) Does the firm undertake R&D?
   If yes, what percentage of turnover does R&D expenditure represent?

4. (b) What are the major purposes of R&D?

4. (c) Is this R&D conducted within this workplace?
   If not, where?

4. (d) To what extent are workers in the following occupations involved in R&D?
   Managers (HR, Finance etc) ……
   Other professionals- (university graduates working in specialised roles such as engineers, computer programmers, accountants) ……
   Secretarial/Clerical/Accounts ……
   Supervisors/Forepersons ……
   Trades/maintenance …….
   Production/process ……
   Warehouse/transport …….

4. (e) Are the skills of these occupations adequate for success of the R&D?

5. (a) Does your firm purchase technology licenses or patents?

5. (b) Does the technology transfer to your company involve employees undertaking training?

5. (c) To what extent are the following occupations involved in this technology transfer?
   Managers (HR, Finance etc) ……
   Other professionals- (university graduates working in specialised roles such as engineers, computer programmers, accountants) ……
   Secretarial/Clerical/Accounts ……
   Supervisors/Forepersons ……
   Trades/maintenance …….
   Production/process ……
   Warehouse/transport …….

5. (d) To what extent are the skills of these occupations adequate for success of the technology transfer?
   Managers (HR, Finance etc) ……
   Other professionals- (university graduates working in specialised roles such as engineers, computer programmers, accountants) ……
   Secretarial/Clerical/Accounts ……
   Supervisors/Forepersons ……
   Trades/maintenance …….
   Production/process ……
   Warehouse/transport …….

5. (e) Which of the following sources are used to provide training for technology transfer?
In-house programs
Mentoring or demonstrating
TAFE
Universities
Adult education centres or colleges
Private providers
Equipment suppliers
Other (please explain)

5. (f) What is your assessment of the quality, cost and responsiveness of the training provided by each of these sources?
In-house programs
Mentoring or demonstrating
TAFE
Universities
Adult education centres or colleges
Private providers
Equipment suppliers
Other (please explain)

6. (a) Who or what drives *product* innovation in your industry? (For example, retailers, major customers, capital equipment suppliers, raw materials or component suppliers, R&D, competition from other firms, internal cost reduction targets).

6. (b) How does your firm keep up to date with these developments?

6. (c) Does your workplace have a system for exploiting suggestions for *product* innovation from its workers, but particularly from production and process employees?

6. (d) How important are these suggestions for *product* innovation? (Please give examples).

7. (a) Who or what drives *process* innovation in your industry? (For example, retailers, major customers, capital equipment suppliers, raw materials or component suppliers, R&D, competition from other firms, internal cost reduction targets)

7. (b) How does your firm keep up to date with these developments?

7. (c) Does your workplace have a system for exploiting suggestions for *process* innovation from its workers, but particularly production and process employees?

7. (d) How important are these suggestions important for *process* innovation? (Please give examples).

8. (a) Has a significant product or process innovation (including work organisation changes, such as multiskilling or 'teams') been introduced in this workplace within the last few years?

8. (b) Why were these changes made?

8. (c) Was training for production and process level workers required to support in the introduction of this innovation?

8. (d) Was training required for other occupations affected by the innovation ?

8. (e) Which of the following sources of training were used?
   In-house programs
   Mentoring or demonstrating
   TAFE
   Universities
   Adult education centres or colleges
   Private providers
   Equipment suppliers
   Other (please explain)

8. (f) What is your assessment of the quality, cost and responsiveness of the training provided by these sources?

9. (a) Among existing employees, what types of skills do you believe are now are lacking in each occupation group?
   Managers (HR, Finance etc) ……
   Other professionals- (university graduates working in specialised roles such as engineers, computer programmers, accountants) ……
   Secretarial/Clerical/Accounts ……
   Supervisors/Forepersons ……
   Trades/maintenance …….
   Production/process ……
   Warehouse/transport …….

9. (b) What do you believe are the main reasons for these skill gaps?

9. (c) In what ways, if any, do current skills gaps affect the workplace?
   Costs and efficiency
   The development of new products or processes
   The introduction of innovations in products or processes
   The organisation of work teams
   Entry to new markets
   Other …….

9. (d) What steps are being taken to overcome the problems arising from these skill gaps?

10. (a) In this workplace, are there any workers employed by other firms (outsourced providers or labour hire or agency workers) working alongside your employees?

10. (b) How do these workers upgrade their skills when their tasks change because of the introduction of new products, processes or equipment?

11. Does your workplace employ apprentices, trainees, or use Group Training schemes? What changes, if any, are required in these forms of training to facilitate innovation in your firm?

Appendix 3: Case study results

Forensic Services Group, New South Wales Police Service

Role and structure of the Forensic Services Group

The Forensic Services Group (FSG) is part of the New South Wales Police Service. There are 400 persons employed in the group. There are two branches within the Forensic Services Group, the Finger Print and Physical Evidence branches. Total employment in the Forensic Services Group, which also includes clerical and administrative support staff, is split evenly across the two branches.

The primary activity of the Forensic Services Group is the investigation of crime scenes, using forensic evidence techniques for the examination of finger prints and/or other physical evidence, such as DNA, blood and other body fluids, and any other physical evidence involved in the commission of a crime or which may link a crime to a suspect. The Forensic Services Group officers also present the evidence in court for the prosecution. Within the New South Wales Police Service, the technology of finger print analysis has been used for around 100 years. The widespread use of physical evidence is much more recent, largely because advances in this field of forensic science, especially in DNA analysis, occurred only in the last few decades. The Forensic Services Group officers are only involved in major crimes, such as murders, armed robberies and kidnapping. Aside from forensic work, a section within the Forensic Services Group provides training to local police, in particular, scene of crime officers (SOCOs) in basic 'high volume' forensic work, such as finger print analysis for house breaking and car theft.

Institutional re-organisation

The Forensic Services Group was formed over the last decade with the amalgamation of the two branches which now form the Forensic Services Group. Prior to this they were discrete branches, operating independently of one another. The integration was designed to overcome large inefficiencies arising from a lack of coordination in the activities of the branches. The amalgamation of the branches has enabled officers to work more closely, attend crime scenes together and coordinate evidence-taking.

All members of the Forensic Services Group are police officers who enter as constables and must have three years experience in general duties police work before undertaking a specialisation. The Forensic Services Group experiences no difficulty in recruitment, as many constables seek to enter the forensic speciality. Some three to four years ago the police service began recruiting civilian graduates in forensic science. These civilians are not part of the Forensic Services Group, but are placed across the state in police stations where they assist scene of crime officers in basic 'high volume' forensic work, as described above.

While the Physical Evidence branch collects and interprets evidence, the task of undertaking higher-level scientific work, such as complex chemical and DNA analyses, is conducted in a separate organisation within the Department of Health, the Division of Analytical Laboratories. This organisation provides scientific analyses for a variety of state government authorities, including the Police Service, and departments responsible for the management of the environment and water use. Interestingly, the Division of Analytical Laboratories employs only university-trained personnel,

even for roles such as laboratory assistants or technical officers. These are positions which previously were filled with TAFE graduates possessing diploma or advanced diploma qualifications. The reason for this change is the surplus of university-trained science graduates, in fields such as biochemistry and chemistry, who are prepared to work in positions such as laboratory assistants. Other innovation-intensive organisations, such as private medical research laboratories, contacted in the course of this study, indicated they had the same experience.

Type and role of training

Historically, Forensic Services Group members acquired their skills solely through on-the-job experience, but over the last decade a formal training regime has been established whereby all members of the Forensic Services Group must undertake a Diploma in Public Safety (AQF level IV). The Physical Evidence branch of the Forensic Services Group commenced diploma training in 1993 and the Finger Print branch two years later. The diploma consists of a minimum of 1420 hours of instruction delivered through flexible delivery and residential components. The diploma is typically delivered over ten hours of instruction and practical work per week for four years. Officers are permitted four hours of study leave per week, with the remainder of the required hours taken up with practical on-the-job work or off-the-job study in their own time. The diploma has a number of core subjects, but is structured into elective subjects allowing for specialisation in crime scene investigation or fingerprint identification. The diploma can be converted to a Degree of Applied Science (Forensic Investigation). The diploma is conducted through the Canberra Institute of Technology (CIT). The diploma is linked closely with the practical work of the Forensic Services Group officers. Senior Forensic Services Group officers provide workplace assessment of some of the practical tasks required for the diploma.

All police in the Forensic Services Group, including new recruits and serving officers with many years experience, were required to undertake the diploma. To ensure a balance between training and meeting the work commitments of the Forensic Services Group training, enrolments were phased in over several years. Many of the existing older police officers, some of whom had only the school certificate as their highest qualification, found the return to 'school' challenging, so the Forensic Services Group management provided funds for additional tutoring in mathematics and chemistry to enable the officers to successfully complete the science-based subjects of the diploma.

The Canberra Institute of Technology was chosen to conduct the diploma through a tender process. The members of the Forensic Services Group were strongly supportive of the quality and relevance of the diploma course content. They felt that the fact the Canberra Institute of Technology was a TAFE made the course much more practical than if the same course had been delivered through a university.

In addition to the diploma, Forensic Services Group members participate in a variety of short courses, either delivered in house or through external trainers. Aside from the forensic-related training, the Forensic Services Group offers off-the-job training in a broad range of work-related courses, such as computing for clerical staff and police officers.

The police service covers all costs associated with training, such as study leave, tuition fees, travel and accommodation costs. While the Forensic Services Group has a separate budgetary allocation for training, the budget is largely based on historical precedents for training within the Forensic Services Group. This historical precedent is sufficient to ensure officers 'achieve a minimum level of competence' in their duties. To meet the very large training costs in the first years of the diploma, when all officers of the Forensic Services Group underwent training on a rolling basis over several years, training funds were diverted from the general training budget for the police service. This was done in recognition of the importance senior police management placed in putting the Forensic Services Group on a more professional basis. As one officer stated, senior management recognised the importance of turning police forensic work, which was previously regarded as 'secret police business', into a more 'transparent' activity. No figure was available for training costs as a

proportion of payroll, but given the magnitude of the training task, it must have exceeded 10% of the payroll of the Forensic Services Group.

Drivers of training and innovation

A strong element in the support for the diploma was the high level of participation of the Forensic Services Group in the development of the diploma curriculum. A national approach was taken to the development of the course, as all state police forces simultaneously introduced formal training for their forensic services sections. All state police forces cooperated in the establishment of the diploma and, like New South Wales, require their forensic specialists to undertake the diploma. Without this coordinated effort there would have been insufficient demand to make it financially viable for the Diploma to be offered by Canberra Institute of Technology on a continuing basis. Prior to the introduction of the diploma, police forces in other states sent their forensic specialist to New South Wales, notably in the finger print field, to receive training. This expertise, along with advice from other states, was used in the design of the national curriculum used by the Canberra Institute of Technology. This extensive participation in the design of the curriculum and course structure was conducive to generating support within the Forensic Services Group and other police forces for the changes.

The introduction of formal vocational education in the diploma is clearly a major development in the approach to skills acquisition within the Forensic Services Group. A number of drivers were identified as promoting this change. The first was the increased sophistication of forensic techniques and equipment, such as DNA identification, which require a comparatively high level of technical knowledge to perform. Secondly, given the increased importance of forensic evidence in court cases, and the development of case law as to the use and admissibility of such evidence, it was regarded that the attainment of certain minimum levels of formal qualification and demonstrated competence was required of Forensic Services Group officers. In this sense the successful presentation of forensic evidence in a court of law represents a quality threshold by which the success of the Forensic Services Group, its methods and training is adjudicated. Thirdly, legislative changes such as occupational health and safety, require formal training in work situations, such as the handling of blood samples, which are potentially dangerous. Fourthly, there was also what was described as 'political' an element in the training decision-making process. This includes, for example, a push for training in the identification of chemical and biological agents following certain terrorist threats or analysis of bushfires, following major outbreaks. The Forensic Services Group officers suggested an insightful distinction between 'proactive' training, which is based on longer-term planning, such as the diploma course and some short and refresher courses; and 'reactive' training such as that stimulated by 'political' factors.

Training has been undertaken to introduce a recent innovation. This relates to new procedures for the collection of DNA samples from offenders and crime scenes. Training was undertaken in proper sampling procedures and the use of sample collection equipment. The training was provided for Forensic Services Group staff through recently developed modules taken from the diploma.

The principal constraint on training is the limited budget for the introduction of new technologies. For example, the Forensic Services Group would like to introduce a system for the digitising of fingerprints at a crime scene and the linking of this to a central finger print database. This would allow for much faster identification of suspects. Such a system would also require extensive training of users in proper procedures and equipment use. The introduction of this system is, however, some years away owing to budget constraints. The introduction of new technologies is intimately linked to training as 'training is introduced in a very coordinated fashion' along with new technologies. The principal change sought to the training system was the introduction of web-based courses for rural police officers receiving training from the Forensic Services Group. Again, budgetary constraints have delayed the introduction of this training method.

The Forensic Services Group does not undertake its own research and development, but has close relations with advances in forensic science through two channels. The first is a substantial contribution to the funding of the National Institute of Forensic Science. The New South Wales Police Service allocates $5 million per annum to the institute. Other police services also contribute to the institute. The institute undertakes research and development as well as dissemination of the latest techniques, through seminars and short courses. Aside from the institute, the police services of Israel, the United Kingdom and the United States were identified as major sources of innovation in police forensic science. The second channel is through Forensic Services Group officers' membership of international professional associations, such as the Finger Print Society and the International Association for Identification, journals and attendance at national and overseas conferences.

Pathology Unit, Gosford Hospital

Role and structure of Pathology Unit

Gosford Hospital is a large public facility, offering most general and specialist services for a rapidly expanding population. The hospital is undergoing major capital works at present to meet the growing demand. The principal activity of the unit is the provision of pathology services to the local area health service. Pathology services are therefore provided to a number of hospitals and other facilities in the boundaries of the area health service.

To meet demand for its services, the unit operates 24 hours a day, seven days and week. It has a total staff of around 90 persons, who work on three eight-hour shifts, with most of the staff employed during the day and afternoon shifts, as there is lower demand for its services at night. Demand for its services is almost entirely generated by doctors requesting pathology tests for in-patients, out-patients and casualty. The occupational structure of the unit comprises:

- 7 managers
- 2 information technology specialists
- 5 medical pathologists (doctors)
- 5 clerical/administration/accounts
- 70 scientific officers/technical officers/technical assistants. The majority in these classifications are technical officers, who account for around 60% of the total (42 out of 70).

The distinction between scientific officers and technical officers is that the former have science degrees in fields such as microbiology and biochemistry and the latter have TAFE qualifications such as diplomas and advanced diplomas. Of the technical officers, four are trainees undertaking Advanced Diplomas in Pathology Techniques. The students attend TAFE colleges about 100 kilometres from the hospital. The hospital reimburses tuition fees and provides study leave equivalent to four hours per week. Technical assistants have a skill level commensurate with an AQF level II. There are no tradespersons attached to the unit as maintenance of plant and structures at the unit is provided by the general hospital maintenance employees.

The principal duties of the scientific officers include management of testing and measurement equipment used in the lab. This entails the calibration of the instrument (to ensure that it is operating to the required tolerances and performing according to the requirements for particular pathology tests), the ordering of spare parts and associated supplies such as reagents used in the equipment or associated tests, maintenance and 'trouble shooting' of the equipment to ensure a high level of plant utilisation, and the supervision of new methodologies for the operation of the equipment or the introduction of new tests using the equipment. Technical officers are principally responsible for undertaking standardised tests using pathology specimens and for some minor calibration and maintenance.

It was noted in the Forensic Services Group case study that, for many medical laboratories, the surplus of science graduates had displaced TAFE-qualified technical officers. This was not the case in the unit. When asked why, it was attributed to the local labour market and the distance of the hospital from universities in Newcastle and Sydney. When positions become vacant in the unit they are advertised as scientific/technical officers, and the majority of applicants are technical officers.

There are no shortages in the supply of pathologist, scientific and technical officer occupations; however, there are difficulties in recruiting technical assistants. Duties of technical assistants include, for example, blood collection, transport of pathology samples and data entry. Some reasons for the shortages include employment of these positions by private pathology laboratories and the difficulty of attracting people to work in the Gosford region, which is about 100 kilometres from the much larger labour pools of Sydney and Newcastle. These shortages are overcome by more assiduous advertising and search for suitable employees.

There are also skill shortages amongst new recruit scientific officers and technical officers. These shortages are practical skills in the competent operation of particular equipment. These deficiencies apply more to recently graduated scientific officers than to technical officers, given that technical officers tend to do their studies on a part-time basis while employed at a pathology laboratory, where they can develop their practical skills. Another source of skill shortage, even amongst experienced new staff to the unit, is the absence of statewide standardised equipment and procedures for pathology services. In New South Wales, pathology equipment and procedures differ across the various area health services, which cover all regions of the state, and even across the large teaching hospitals. On transferring to a different area health system or possibly a different hospital, staff require re-training in different equipment and procedures. Procedural differences include, for example, methods for specimen collection, documentation of procedures, the method for informing persons of results, range of persons to be informed and the information conveyed. This lack of standardisation in equipment and procedures has the effect that training provided in house or through equipment suppliers must be customised to the needs of the unit.

Type and role of training

The expectation of the unit is that employees have their basic qualifications prior to entry. Even so, the manager of the unit estimated the training budget was equivalent to around 5% of the payroll. The quantum of training depended very much on particular circumstances; in particular, the rapidity of the introduction of new equipment, new tests and procedures and the rate of labour turnover. The rate of labour turnover has a major impact on training expenditures, as outlined above, as new staff may require re-training in equipment and procedures.

The purpose of training was twofold: firstly, the maintenance of 'quality and accuracy' in pathology services, and secondly, the adoption of new technologies and new standards for tests and procedures. All production personnel are involved in training as new equipment, new tests and procedures are introduced. There is a strong preference for training to be accredited. This is due to the unit having accreditation under the International Standards Organisation (ISO Standard 17025) and other bodies, which require full documentation of procedures, training and competencies of employees in the Pathology Unit.

In addition to the ad hoc training required as new tests and procedures are introduced, there is also a formal process of training assessment of all employees conducted annually. This comprises self-assessment by employees of what training they would like to undertake and assessments from the employee's manager as to what training is required. Given the prominence of quality assurance within the unit, there are monthly quality meetings where advice from staff and complaints or advice from users of the unit's services are discussed. These quality meetings may lead to changes in procedures and operations which, in turn, can require training to implement.

Four suppliers of training for technical officers, and indeed, for all staff, were identified. These included:

- In-house training within the unit. This training related mostly to the introduction of new equipment and testing procedures. This training was provided mostly by the section managers, and these managers 'signed off' on the training. As a result of International Standards Organisation requirements, 'documentation is required for everything', including training, and the unit applies a competency-based system of training to fulfil these requirements.
- The area health service provides annual management training of a generic nature to all managers and supervisors.
- Equipment suppliers and suppliers of other inputs, such as chemical reagents, have a key role in the training of unit staff. Equipment and other input suppliers are the principal sources of innovation within the Pathology Unit, such as the one at Gosford Hospital. This, in part, is because the unit does not undertake in-house research and development. Even if the unit did undertake research and development, equipment and other input suppliers would remain a key source of innovation.
- TAFE is used by the unit for the training of its four trainee technical officers, as well as the training of technical officers prior to their employment in the unit.

The manager of the unit was satisfied with the quality, cost and timeliness of training

Training and innovation

A number of changes had been introduced over the last two years which required training. One of these was the introduction of a new technique for providing blood transfusions, which entailed a shift from a manual tube technique to an automated cassette. Training was provided by the equipment supplier and in house by unit staff. The training had to be customised given the above-mentioned decentralisation of pathology standards. The unit manger was satisfied with the quality, cost and timeliness of the training provided by the equipment supplier.

When questioned about the primary skills required for the successful introduction of innovation, the response was 'a willingness to adapt to change'; although, interestingly, the promotion of the willingness amongst staff to accept change was regarded primarily as a 'management issue'. Managers needed the ability to 'enthuse staff for change and to regard it as not threatening'. This was a responsibility where more training for managers within the unit is warranted.

Drivers of training and innovation

Training

- The need to maintain a variety of accreditation standards within the unit. These include the International Standards Organisation accreditation under standard 17025. (The accrediting body for the unit is the National Association of Testing Authorities NATA). Every three years the unit is audited by National Association of Testing Authorities. This audit consists largely of an examination of the documentation of pathology and related procedures and the demonstrated competency testing of staff to operate equipment and implement these procedures. The pathology standards are set by the Royal Australian College of Pathologists and the Australian Council on Health Care Standards. International Standards Organisation accreditation is essential for the unit to claim money for conducting pathology services from the Health Insurance Commission, through Medicare. Similar accreditation is required by private pathology laboratories. Other accreditation standards that must be met by the unit are set by occupational health and safety legislation.
- Introduction of innovation through new equipment and other inputs.

Innovation

- The unit does not undertake its own independent research and development program, although it does assist doctors with drug trials conducted at the hospital. This is a small contribution to the skills and development of capacity for innovation for the unit.
- As indicated above, suppliers of equipment and other inputs, such as reagents, are a key source of innovation. This is largely due to the considerable research and development which occurs within the medical equipment industry. This industry is dominated by large United States, European and Japanese firms.
- The other key source of innovation are the customers or users of the unit's services. Doctors and patients are very demanding and insist the unit provide both high-quality and responsive service and use the latest testing procedures and equipment.
- Professional associations, journals and conferences also provide sources of innovation for the unit.

Beringer-Blass Winery

Role and structure of the winery

The Wolf Blass Winery is located near Nuriootpa, in the Barossa Valley of South Australia. The site contains grape growing areas, a large winery and administration headquarters for Beringer-Blass in South Australia. The original Wolf Blass winery was established in the 1960s, although the company was taken over several years ago by the major brewing firm Fosters. Over the last three years the site has undergone major capital investment, costing tens of millions of dollars with new vineyards planted, a large expansion in processing capacity, utilisation of the latest technologies, including those developed on site. Turnover of the site is in excess of $50 m per annum.

Beringer-Blass was formed by Fosters through the amalgamation of the Wolf Blass facility with that of the Beringer label in the United States. The principal products of Beringer-Blass are premium bottled wines, which are sold domestically and exported. The wine industry is highly concentrated in Australia, following a succession of mergers over the last two decades. Four firms account for 80% of the industry volume, although a slightly smaller share of the industry's value of output. These firms are Southcorp, BRL/Hardy, Orlando/Wyndham and Beringer-Blass. The remaining production is provided by around 1000 smaller independent wineries. The Australian wine industry has a reputation for technological innovation, especially in the processing of grapes in the winery. This innovation is, in large part, responsible for the good-value-for-money reputation of the wine. This reputation is based on a combination of high quality and comparatively low cost.

The permanent workforce at the site is currently 137, but there is a large increase of 40 seasonal workers during the 'vintage' from January to May when the grapes are picked, crushed and first processed. The permanent workforce comprises:

- 10 managers
- 40 professionals (wine makers, engineers, marketing, accountants, information technology)
- 20 secretarial/administration
- 10 production supervisors
- 1 tradesperson (an additional two maintenance tradespersons are on long-term contract)
- 55 production process workers (increased by 40 during vintage)
- 2 warehouse personnel.

There are few occupational shortages, except for more experienced seasonal workers. These shortages can create difficulties as they can require training and/or a diversion of the permanent

workforce to explain tasks. The firm does not sponsor immigrants to fill vacancies at the site. The site operates 24 hours a day.

Type and role of training

There are six broad VET level occupations covered within the wine industry VET training system. These are cellar door (on-site retail sales); laboratory, viticulture, warehouse, cellar (wine production) and bottling. The site has no bottling facility, as the wine is shipped elsewhere for bottling.

The principal VET-related training is for the cellar workers, who undertake the Cellar Procedure course at AQF I–III levels. There are currently nine trainees enrolled in the cellar procedure course. The cellar procedure course covers aspects of the operation of the winery related to the safe operation of equipment and understanding of basic wine production processes. The processes including grape crushing, storing and fermenting and blending of wines. The equipment is quite diverse and includes: crushers; centrifuges to remove impurities from the juice; pumps and compressors used for transferring juice and wines into and out of large stainless steel containers, and for blending wines; refrigeration equipment designed to maintain the temperature of the wines in the vats at constant temperature during the summer months; equipment designed to mix red wine grape juice and red grape skins to ensure an appropriate colour is imparted by the skins to the juice (maceration); cleaning equipment and chemicals for the pipes and compressors and forklift driving for the wines stored in oak casks.

The production workers work under the guidance of production supervisors, experienced cellar workers who have undertaken an AQF III. The production workers are expected to work with minimal supervision. These workers carry a considerable responsibility, since one mistake, say in transferring wine into a contaminated vat or incorrectly blending wines from various vats, can result in the spoilage of tens of thousands of litres of juice or wine. The on-site wine-maker is responsible for directing key activities, such as determining the timing of the sequence of operations for specific batches of juice and wine and for issuing instructions on blending. These instructions are typically written on job cards issued to the production workers and supervisors. The production activity on site is similar to that in many 'continuous process' manufacturing plants, such as chemical and petroleum production. Fluids are pumped from one holding tank to another where various physical and/or chemical processes are undertaken. Each process typically involves the transfer of the fluid to a new holding tank. The processes are monitored either through direct inspection of the fluid, by monitoring external gauges or by subjecting samples to chemical analysis at the on-site wine laboratory.

The site operates under an enterprise bargaining agreement (EBA), largely based on the South Australian Wine and Spirit Award. The enterprise bargaining agreement has a training plan and a career path based on the attainment of accredited qualifications and experience. There are a number of grades, with the workers encouraged to progress to a new grade within two years. Grades 1–2 require AQF I; grade 3, AQF II and grade 4, AQF III, grade 5, AQF IV. By grade 5 the employee would be operating as a foreman or supervisor. Career progression beyond this level would normally involve the employee transferring out of award-based employment to become a 'staff' member. Training up to grade 4 is readily available, but training to supervisor level is available only if a position becomes vacant. By making training opportunities readily available management is also developing a 'succession plan' for production employees and developing 'spare capacity' amongst production employees.

Training was seen as an essential element in the company's plan to improve quality, productivity or 'continuous improvement' and for occupational health and safety. Productivity was based, in part, on a need to 'devolve responsibility down to the shop floor'. This devolution can only occur if the workers are competent in the operation of procedures and equipment and happy to accept responsibility for decision-making when the inevitable malfunction occurs.

Almost all of the VET training occurs on site. A variety of training providers are used. TAFE is the principal provider of training for the various Australian Qualifications Framework levels in the cellar procedures courses. The training is customised to the site's equipment and standard operating procedures (SOPs). Modules are selected from a variety of training packages to fit within the requirements of the site. The training manager and workers who were interviewed were pleased with the responsiveness of TAFE in customising the courses and with conducting the courses to suit the three shifts which run on site. (The site operates 24 hours per day). The responsiveness of TAFE is attributed to the willingness of the particular TAFE officers involved to service their clients' needs and to the increased competitiveness of the VET training market. TAFE is used mainly for providing the theoretical or classroom-based subjects. In-house workforce assessors are used to competency-test the practical subjects. For post-qualification training such as forklift operation and the use of fire fighting and safety apparatus in the plant, specialist private registered training organisations are used. Equipment suppliers are also a source of training, although at this site, much of the new and innovative equipment has been designed in house, along with the accompanying training manuals.

Training and innovation

The site operates a formal process for gaining suggestions from the workforce to improve quality and productivity through monthly meetings of the Enterprise Consultation Committee comprised of representatives of management and the shopfloor. This committee evaluates suggestions, with rewards to individuals and/or work units made, depending on the benefits flowing from the suggestions. Several important changes have been made either as a result of a suggestion from the shopfloor or with the active participation of work units. There are a number of important conditions leading to the more ready adoption of these suggestions. The first is that the site has been undergoing huge expansion in investment and capacity over the last three years. This very large increase in investment activity has made it possible to realise many of the suggestions from the shopfloor for improvements to machinery and production process. Secondly, much of the new equipment has been designed by the company's own professional engineers who work on site. These engineers and the shopfloor have worked closely together in designing this equipment. In many instances these suggestions result in training for their successful implementation.

One example of input from the shop floor was the suggestion for the design of equipment to mix red wine grape juice and red grape skins to ensure an appropriate colour is imparted by the skins to the juice. Suggestions such as this which lead to new equipment or alterations in equipment require re-training for employees and development of new standard operating procedures.

Occupational health and safety considerations also influence technology and training. The site is phasing out the use of diatomaceous earths (a type of clay) used for filtering wine at a certain stage in its production and replacing it with membrane technology. One of the considerations in moving to membrane technology is that regular exposure to diatomaceous earths, which is a very fine powder, poses a risk to respiratory systems. Another example is the crushing equipment. Grape-crushing equipment has traditionally been a source of high occupational health and safety concern in the industry. Typically, a crusher is constructed below the ground level, enabling the large truck carrying grapes to tilt their trays and empty the grapes into the crusher below them. This gave rise to the risk of personnel falling into the crusher. The new crusher was designed to remove these risks by constructing an elevated platform so that trucks emptied their grapes into the crusher, which was now placed at ground level. This move greatly reduced the possibility of operators falling into the crusher as they would now effectively have to climb onto the crusher to expose themselves to the risk of falling in. Another novel design was removing the crusher operator from the equipment by having the plant controls in an elevated booth from which the operator could directly control and monitor the equipment and surrounds. This required the installation of sophisticated electrical and hydraulic control mechanisms and associated gauges. The control booth also had closed-circuit TV installed to provide an even wider scope of vision to the operator. These shifts to the new technology required re-training.

Drivers of training and innovation

Training

A number of common drivers of both training and innovation were identified. These were the need to maintain high quality, given the highly competitive nature of the global wine industry. This particular winery aimed to produce both premium bottled wines, but also maintain high value for money by supplying quality wines at the lowest cost of production. A key 'objective' measure of quality is success in wine shows. Considerable importance is placed on winning wine show awards, both domestic and international. This is not only due to the obvious marketing benefits, but also the personal satisfaction that wine makers and other company staff receive from recognition by their industry peers. Continuous productivity growth was also expected, through either large-scale investments or the more incremental adjustments to work and other processes. Occupational health and safety considerations are also a high priority in the design of plant and work processes. The site participates in a voluntary external auditing of its occupational health and safety procedures conducted by Work Cover South Australia. A successful audit of the plant results in reduced workers compensation premiums. The plant has won awards for innovations in the safety design of its equipment.

As noted earlier a key driver is the award and enterprise bargaining agreement, with a company policy offering a career progression based on accredited training and experience. A flat management structure designed to devolve responsibility to the shop floor and a major program of capital works also encourages training.

Innovation

The key driver of product innovation is the 'style of wine' demanded by the customer. At this stage of the wine industry in Australia the demand for wine is quite decentralised, so that there is no monopsony (a single buyer) or near monopsony. In the United Kingdom for example, the market for wine is dominated by two retailers, TESCO and Sainsbury's. These retailers dictate wine style and price to producers. The situation in Australia may change, however, as Coles and Woolworths gain a larger share of the wine market through their department stores.

The wine industry, like almost all rural industries, funds research and development and marketing through a levy on primary producers. The wine industry imposes a levy on wineries and grape growers for research and development undertaken through the Australian Wine Research Institute (AWRI). This pooling of resources by wineries creates a critical mass of research resources and talent. The institute provides research and development and a technical advice service to growers and wineries and produces a regular newsletter which summarises the latest technical developments. The wineries and grape growers are represented on the governing boards of the research institute and influence the direction of research. The large wineries, such as Beringer-Blass, undertake their own research and development to promote firm-specific innovation

In addition, there is a Cooperative Research Centre for Viticulture (CRCV). This research centre is funded by the federal government and the institute through a levy on growers. One of the programs conducted by the cooperative research centre (Programme Four) is specifically designed to forge closer links between the results of research and workforce education, by conducting training sessions for all levels within the wine industry workforce and to improve the quality of the wine industry training system. For example, under Programme Four, funding from the Australian National Training Authority (ANTA) was gained for the development, over the last two years, of an additional 57 units of instruction within the industry training packages. The program has also developed a training assessors network and increased the number of assessors within the industry from 55 to 395 persons.

While wineries are competitors, there is also a culture of cooperation within the industry, described as 'one big fellowship'. For example, there is a system of reciprocal work experience within the

global wine industry whereby foreign winery employees gain work experience in firms. This is an important mechanism for the global transmission of new technology.

Local and overseas capital goods suppliers actively promote innovation. Interestingly, some of the equipment which has produced large cost savings is both simple in design and use. One example is a metal pallet stacker for hogsheads or large wine barrels. Formerly, full hogsheads were arranged in a large 'pyramid'-shaped structure; but this was very labour-intensive, as the hogsheads were moved by hand. They also posed high occupational health and safety risks as the pyramids could reach several metres in height. A local Barossa Valley machine shop invented and manufactures a metal pallet stacker inserted between the barrels, which enables the hogsheads to be stacked in a rectangular fashion using a forklift. This not only greatly reduces the time to stack the barrels, and reduces occupational health and safety risks, but also makes it much simpler to remove the necessary wine samples from the barrels as the wine matures. This simple device, however, required the employees to re-train as even 'highly experienced' forklift drivers had to be taught the unique procedure for operating the pallets.

Another important source of product and process innovation is a major technical conference held every three years in Australia where papers on research and development are delivered by researchers from research institutes, universities and companies, and exhibitions are provided by equipment and other input suppliers. Wine-makers also have their own domestic and international professional organisations, which are active in promoting and disseminating innovation.

Environmental Services Branch, New South Wales Department of Public Works and Services

Role and structure of the branch

The Infrastructure and Environmental Services Branch provides engineering design services and construction project management to the New South Wales Government, other domestic and international public agencies and private firms. It provides these services to clients in Australia and overseas. It specialises in the design of facilities for the water industry such as dams, sewerage works, water treatment plants and reticulation systems linking industry and consumers to these facilities.

In addition to engineering design services and construction project management, the branch undertakes research and development through the Manly Vale Hydrographical Laboratory, which does basic research into ocean tides and currents and water flows in the state's dams. The branch is also responsible for developing engineering standards for the water industry, which are used by other government departments, local councils and private industry. It has also been contracted to develop innovative engineering solutions. For example, it was contracted by the World Bank to adapt water treatment plants to population sizes from large cities to small country towns in under-developed countries.

The Branch has around 200 employees. The occupations employed include:

- 10 managers
- 120 professionals, mostly civil, electrical and mechanical engineers, but also including information technology
- 55 technical officers with TAFE diploma and advanced diploma qualifications in mechanical, electrical, hydrographical and computer-aided design. There are also a small number of qualified construction tradespersons, who undertake the role of project manager for construction projects involving the branch.
- 10 secretarial and clerical positions.

Over the last five years the branch has undergone a major change in its operations, which, in turn, has affected staff skill requirements and training. As a result of the New South Wales Government participation in National Competition Policy, the Department of Public Works and Services was corporatised. Corporatisation of public sector services has involved making the work of the branch operate in a 'competitively neutral' manner. Hence it pays a dividend to the government and is self-funding by competing with the private sector by winning open tenders for design work from the public and private sectors. In addition, the government has imposed a requirement for the branch to serve as the technological leader in New South Wales and Australia for engineering design in the water industry. This objective is to be fulfilled by the branch undertaking innovative design work of world-class level, developing a range of engineering standards which are used by all firms and other government agencies in the water industry and investing in research and development. This role was imposed on the branch by the New South Wales Government as a result of recommendations by the Gyles Royal Commission into the Construction industry conducted in the early 1990s. (These requirements are clearly at odds with National Competition Policy, as they impose activities and costs on the branch that private firms are not required to bear.) These changes in the operating requirements of the branch have demanded major changes in the skills of the workforce, although, as will be noted below, there are some concerns about the capacity of the VET system to respond to these changes.

The most important change that corporatisation has demanded is for all staff to improve their project management skills and adopt a much more 'commercial' orientation to both their design work and their relations with clients. This entails increased responsiveness to tenders for work and client needs, more efficient use of internal branch resources in undertaking design work and a greater focus in design work on reducing the costs of construction and operation of projects for clients. One simple example will illustrate the transition required by the branch employees. Prior to corporatisation, the allocation of staff resources on engineering projects was not necessarily linked to the revenue or the size of the project being undertaken. Staff were allocated to particular sections within the branch and did not shift between sections in response to demand for labour as new projects began and other projects were completed. Since corporatisation, however, a much closer alignment of staff resources to project revenue and workload has occurred.

In addition, the manager noted that there has been a shift in the expectations of management as to the role of senior staff. Senior staff are no longer viewed as employees, but rather as project managers with greater autonomy and responsibility. In addition to these project management and commercial skills, the development of efficient teamwork within the branch has become of heightened importance. The branch manager noted that 'the day of the individual went out with Henry Ford', by which he meant that the increased competitive pressure the branch was under placed a premium on the efficient use of the branch's labour resources. In particular, the type of complex engineering design work undertaken by the branch requires multi-disciplinary cooperation and this can best be achieved by efficient teamwork. These changes arise from the need for the branch to be entirely self-funding by winning competitive tenders. This is in marked contrast to the previous regime where the branch was fully funded out of the department's central budget allocation.

In response to the increased responsibilities and the need to more closely match employees' remuneration with market rates, the branch is shifting its technical officers from the technical officer award, which had only four salary increments, to the administrative and clerical award, which has a very broad salary range. Similar problems did not exist for professional engineers.

Type and role of training

Almost all of the employees start work in the branch with formal qualifications, either from TAFE or university. The branch has very low staff turnover. This is due to the high degree of employee satisfaction with their work and the highly specialised nature of the engineering work, which means there are very limited opportunities for employment outside the branch.

The branch spends the equivalent of 7.5 to 10% of payroll on training. All training is directed at meeting skills needs in the branch and improving the performance of the branch. The branch has a formal process for identifying training requirements through a performance review program, which entails *inter alia*, negotiations between employees and section managers to identify skill gaps amongst employees and suggestions for their redress. Examples of training expenditures include paying for technical officers to upgrade their qualifications from diplomas to advanced diplomas or degrees. These payments cover study leave, exam leave, non-Higher Education Contribution Scheme (HECS) fees, books and consumables. Currently six technical officers are upgrading their qualifications.

The principal training providers are TAFE and private VET providers. TAFE is used to upgrade employees' formal qualifications. Private providers deliver training to fill skill gaps which arise owing to retirements, new technology or changed regulations which require training of only a few days. The principal types of private provider training cover occupational health and safety and computer skills. The branch is satisfied with the quality of technical training from TAFE, universities and private VET suppliers.

The branch has regular contact with the divisions within TAFE which supply its recruits, and provides advice to teachers as to its training needs. One example of this collaboration was that TAFE was contemplating no longer providing the diploma course in hydrography. Extensive lobbying by the branch kept the course going.

However, the branch manager is concerned at the omission of training in client relations, commercial project management and teamwork in the formal training of technical officers and professional engineers. As noted above, as a result of the branch shifting to self-funding, these skills are crucial to the survival of the branch. At present these essential skills are acquired on the job, although the manager would prefer staff to have acquired these skills as part of their vocational or professional education.

Nevertheless, the branch manager gave strong support for the current technical skills of training provided by the VET sector to the technical officers. In particular, he highlighted the practical orientation of the training technical officers receive at TAFE, which complements the higher-level engineering design skills of the professional engineers. The manager expressed this complementarity in the following terms. The Branch's professional engineers may be excellent at devising a technical solution to an engineering problem: 'professional engineers can design something wonderful'. However, they lack the ability to translate the 'design concept' into construction plans or other engineering designs which can be constructed or manufactured. The technical officers 'can tell you whether it is buildable'. Within the branch 'technical people are just as valued for buildability input as professional engineers are for design ability'.

In general the branch does not experience recruitment difficulties, although during a construction boom in civil engineering construction it can be more difficult to find the right person. Of more concern is the high average age of the branch's workforce, with most of the senior and experienced staff retiring in the next five years. The branch runs a graduate recruitment program where engineering students are employed on a temporary basis during university holidays as a means of identifying suitable staff. The manager would like to run a similar program for TAFE students, although he has met some resistance from more 'traditional' elements in the department. The branch has never needed to specially target migrants or to sponsor migrants to fill vacancies.

Drivers of training and innovation

The primary driver of training is the need for the business to maintain its technological competitive advantage. Another driver is government regulation, such as the recent requirement under occupational health and safety legislation for engineers and designers working on plans involving persons working in confined spaces to undertake prescribed training in this field.

The key driver of innovation within the branch is the 'leadership role in the construction industry' given by the Gyles Royal Commission to the branch in creating technical standards for the water industry. As noted above, this objective is fulfilled by the branch undertaking innovative design work of world-class level, developing a range of engineering standards which are used by all firms and other government agencies in the water industry and investing in research and development. Given this leadership role, most of the 'technology for our products is home-grown due to the leadership role the government has given us'. Another example of this home-grown technology is a software package called 'Total Asset Management' which contains engineering standards, maintenance schedules and budgeting information for water industry equipment such as dams, water treatment, sewerage, and reticulation systems. This software is sold to councils and industry.

While the branch is the primary source of standards and innovations within the water industry, the broad direction of this work is set by government regulation. This applies especially to environmental concerns such as salinity, more efficient water use and improved water quality.

The manager also recognised the importance of learning by doing within the branch as a source of innovation. He suggested that product and process innovation occurs through 'incremental developments by project teams'.

Competitive pressures from private engineering design firms also spur innovation. This pressure gives rise to innovations in designs which are aimed at gaining new work and reducing costs, both for the purchaser of the design and for the branch.

The branch develops its own proprietary software, but still makes use of generic computer training such as Microsoft Project Management and Access database programs to improve the branch's performance.

Finally, staff keep up to date with the latest engineering developments by attending conferences, some of which are supported by the branch, and through consulting the extensive engineering library maintained by the department and through membership of professional associations.

Optus Cadet Program, Optus Technical Education Centre, Lidcombe, New South Wales

Role and structure of the Cadet Program

Optus, a leading provider of telecommunications within Australia, runs an Engineering Cadet program out of the Optus Technical Education Centre at Lidcombe, New South Wales. The program is part of the Network Operations division which provides technical support and services to the three main business divisions within Optus: Mobile, Optus Business, and Consumer and Multimedia. The Network Operations division itself comprises three main business groups: Service Delivery, Network Management and Field Operations.

The Technical Education Centre at Lidcombe is the only technical training facility Optus has in New South Wales. Lidcombe has a fully functioning test laboratory and numerous computer labs for the purposes of training the cadets as well as technicians and other staff from within Optus. In addition, various vendors use the laboratory and computer facilities to test products before going to market and TAFE teachers take part in training courses at the centre to maintain and update their skill base on new and emerging equipment and technologies.

The Engineering Cadet program combines both formal and informal training over a three-year period. At the end of the three-year period cadets will have completed the Graduate Certificate of Telecommunications Engineering and will have gained extensive on-the-job experience through the additional on-the-job training program which combines both structured and unstructured learning.

Optus uses a number of avenues to attract applicants to the cadet program. Information about the program is available on the Optus web page, advertising in careers sections of newspapers is extensive, visits are made to career days at high schools within the Sydney metropolitan area and brochures are sent to regional schools to attract students from rural areas. Effort is put into attracting young women to the program by promoting the success of young women who have already completed the program. The recruitment process begins each year with applications required by early September. The number of new cadet positions open each year is decided by relevant Network Operations managers in conjunction with the team leader in charge of the cadet program.

The recruitment pool for cadets usually consists primarily of school leavers and it is not expected that the new cadets have any experience in the labour market. Therefore, the quality of the new recruits was not perceived in terms of 'skills gaps', as all skills required would be learnt during the cadetship. Rather the new cadets were seen as being 'a little raw' and 'lacking in confidence'.

The minimum requirement for applicants to the program is a Higher School Certificate with 2-unit maths, English and science. However, consideration is given to applicants who do not have a Higher School Certificate but who have completed a TAFE or equivalent course in the computing, engineering, or information technology field. Consistently there have been between 100 and 130 applicants each year for the 10 to 20 positions available. The volume of applicants and the quality required in new cadets necessitates a rigorous four-step selection process. The first step is the completion of an application form. Applicants who fulfil the initial criteria on the application form are then screened over the phone for attitude, verbal skills and consistency of information. Those who successfully make it through the initial screening then go to the Optus recruitment centre at North Sydney to take part in group assessment tasks which evaluate skills required on the job (for example, communication skills and team skills). The fourth step of the process for those who succeed in the group assessment task involves assessing applicants on a range of aptitude tests relevant to the technical engineering field (for example, numerical ability, mechanical reasoning, fault finding, and problem-solving). Reference checks are made on applicants who are offered positions and these applicants must undergo a medical check to determine suitability to the demands of the position (for example, colour blindness and tolerance for heights).

Currently there are 40 young men and 5 young women on the program including 12 first-year, 13 second-year and 20 third-year cadets. Cadets typically range in age from 17 through to 20 but occasionally there are older people in the program. Cadets are employed on a full-time annual contractual basis throughout the program and renewal of contracts and subsequent continuance on the program is contingent on individual performance.

The program has been running for nine successive years. In total, 108 students have graduated from the program. Offers of permanent positions upon the successful completion of the program are based on business needs and are therefore not guaranteed. However, to date, all graduates of the program were offered and took up full-time permanent positions within Optus at the completion of their cadetship. In the time that the program has been running, fewer than 10 cadets have not successfully completed the cadetship.

Throughout the cadetship and for those who are offered positions at the completion of the program, there is an extensive number of different specialist occupations within the three business groups of the Network Operations Division. However, after the first year, they are able to apply for positions outside this division in any one of the other major divisions within Optus if they want to gain broader experience in other divisions.

Type and role of training

All off-the-job training is conducted at Lidcombe TAFE, which is adjacent to the Optus Technical Communications Centre. Optus pays all course-related fees and all cadets are paid on a full-time

basis throughout their cadetship. Cadets are entitled to annual leave, which they are encouraged to take during the on-the-job component of their cadetship so as to avoid missing any TAFE classes.

In both the first and second year of the cadetship the training program is structured to include two blocks of off-the-job training at Lidcombe TAFE interspersed by two blocks of on-the-job training. The lengths of the blocks vary depending on the subjects to be covered, but typically TAFE blocks are of three to four months duration, with on-the-job blocks lasting two to three months.

In the third year of the program there is one on-the-job block between two TAFE blocks. The final sixth on-the-job block has, to date, been characterised by permanent full-time employment within Optus as a qualified graduate engineer. Graduate engineers are qualified in the management of local (LAN), metropolitan (MAN) and wide (WAN) telecommunications and data area networks. This work involves being able to analyse, coordinate and manage traffic over these networks. Graduate engineers are experts in the cabling, photonics and mobile phone technologies which are integral to the management of area networks.

The team leader in charge of the cadet program was very satisfied with the quality of the training which the cadets receive at the TAFE. Lidcombe TAFE is the only campus which offers the Graduate Certificate in Telecommunications Engineering.

The on-the-job component of the program is structured around five distinct learning environments.

- *Induction program:* all new employees, including cadets, must undergo a two-day induction program when they commence work at Optus. Core components of the induction program include occupational health and safety and environmental management.
- *Structured in-house technical training:* all cadets take in-house technical training courses during the on-the-job block which are additional to the classes run through the TAFE. These courses are aimed at providing skills specific to Optus' needs. This is a set program of courses which run back-to-back, building on the skills acquired at TAFE and the experience gained while on the job. The in-house training is developed and delivered by Optus trainers at the centre.
- *Vendor training:* supplementing the in-house component of the on-the-job structured training are vendor-specific training courses which are provided as new and emerging specialised technologies come onto the market. There is a wide range of vendors who provide training, including Nokia, Motorola and Fujitisu. Vendor training plays an important role in the overall training program at Optus for both cadets and qualified and experienced technicians to ensure that Optus stays on the cutting edge of new technologies.
- *On-the-job professional development:* to augment the skill base of cadets and taking into consideration the growing demand within the industry for well-rounded employees with a professional outlook, the cadet program includes supplementary courses aimed at improving professional development. Professional development courses are not part of a set program but are developed and provided when skills gaps in professional development are identified. Currently, there are two core courses in professional development which each cadet cohort undertakes—presentation skills and team work. However, other courses have been run to meet skills gaps, including writing skills, communication skills and counselling.
- *Buddy system:* when placed in the field during on-the-job blocks all cadets are 'buddied up' with an experienced technician or other staff member to ensure that on-the-job learning is continuous and consistent with Optus skill requirements. Every effort is made to ensure that each block of on-the-job training is in a different field from previous blocks to expose cadets to the wide range of support and services provided by the Network Operations division.

The structured in-house technology courses are developed by Optus technical training specialists who are experts not only in their chosen technology but also in contemporary training delivery mediums. The training which Optus provides in house is a combination of technology fundamentals and product-specific operations and maintenance courses. Technical training covers the main technology environment by including a number of basic modules such as data/information processing,

transmission, mobile, switching, satellite, and other emerging technologies. The content, duration and delivery of these programs have been configured to align with on-the-job training activities which complement their TAFE training. The TAFE and in-house training are intended to provide a flexible and enjoyable training medium for the cadets.

Optus has programs of workplace assessment and assessment on learning outcomes which require both students and employees to meet Optus qualified standards.

The vendor-provided training allows cadets to perform operations and maintenance on equipment and systems. The quality of vendor training was also seen to be satisfactory. However, due to the size of Optus, efforts are made to develop in-house training courses specific to new equipment and technologies within the guidelines of intellectual property agreements. Developing in-house vendor-specific courses makes the training more efficient in terms of cost and more responsive to the needs of the organisation.

Drivers of training and innovation

Significant drivers of training in the cadet program are the rapid changes in equipment and technologies in the telecommunications industry. The dynamic nature of the industry necessitates frequent training as new products emerge on the market. In response to the rapid changes in the industry, the telecommunications department in Lidcombe TAFE is constantly updating courses to incorporate new technologies. Teachers at the TAFE work closely with Optus and other industry leaders to ensure that the courses are meeting the needs of industry.

For example, recent developments in the emerging technologies of photonics play a crucial role in the cutting edge of the telecommunications industry. Photonics uses photons (or particles of light) to manipulate, transmit and store information. Lidcombe TAFE has taken a leading role in incorporating photonic technologies into existing courses to ensure that students are exposed to state-of-the-art tools and that they gain knowledge and skills on the latest equipment.

To manage the dynamic nature of the industry and the constant need to update equipment, the teachers at the TAFE rely on the development and maintenance of strong networks of industry contacts, such as Optus, to resource the courses with the latest technologies through donations of tools and equipment.

Significant drivers of the in-house structured training program provided to the cadets during the on-the-job blocks come from within the organisation. The Learning and Development unit within Optus and managers in the Network Operations division play a significant role in evaluating the outcomes of the courses and ensuring that any possible gaps in the skill development of cadets are addressed. The team leader in charge of the cadet program also has very regular contact with the cadets and identifies any need for professional business skills. Finally, the cadets themselves are able to make suggestions with regard to their own skill development and highlight any concerns they have with regard to their learning and development.

Manufacturing industry—plastics manufacturing

Role and structure

This national plastics company is a leading manufacturer of thermoplastics pipe systems in Australia. The company makes PVC and polyethylene pipes and fittings for sewerage, irrigation, water supply, mining, plumbing, power, electrical, industrial and communications for the transportation of fluids, energy and data. The company is considered to be one of the most technologically advanced and innovative manufacturers in the field and is a world leader in the development and manufacture of PVC and polyethylene pipes and fittings.

Production operates 24 hours a day 7 days a week. The company also has a comprehensive warehousing and distribution network to efficiently distribute their products. Annual sales and turnover is around $300 million with 2.5% of turnover devoted to research and development with a strong focus on one or two very specific products. The company has the only worldwide patent for the in-line production of a specific innovative plastics product and is therefore the only organisation in the world with productive capacity to manufacture this particular product.

The company employs approximately 800 people nationally. The breakdown of occupations within the organisation is provided below. The employees of particular interest to this case study are the polymer technicians who comprise 60% of all employees in the organisation.

Occupation	Count
Management	100
Professionals (engineers)	20
Sales representatives	60
Secretarial/clerical/accounts	20
Supervisors/forepersons	20
Tradespeople (electricians & fitters)	30
Production (polymer technicians)	500
Warehousing	40

Organisational restructure

Between 1998 and 2000 the company underwent significant organisational change under the direction of the new general manager of organisational development. In 1998 for example, the company was hierarchically structured, with reporting lines in production comprising supervisors, leading hands, charge hands, junior leading hands and operators. By 2000 organisational restructuring had reduced this line of reporting to a shift coordinator and operators with the aim to improve overall business performance and efficiency.

New organisational policy regarding recruitment and selection was also developed between 1998 and 2000. In 1998, new employees were 'hired through the gate'. By 2000, a labour supplier had been contracted to recruit and select all new employees. Suitability of applicants for the polymer technician position is now determined on the basis of performance on a test battery which includes an assessment of numeracy and literacy skills and a work attitude scale. All new polymer technicians are first hired on a casual basis until permanent positions become available. Those employed on a casual basis must apply for any permanent positions and selection is based on merit. Currently, turnover amongst technicians is relatively low at around 4–5%, so selection into permanent positions is competitive.

Type and role of training

The general manager of organisational development created a skills program in 1998 for the purpose of developing the technical skills of polymer technicians.

At the inception of the skills program a 'leading team' was created, comprising six technicians. To select the six technicians for the team, manufacturing staff on site were interviewed to determine who had the greatest experience, exposure and working knowledge of the production machines. In addition, nominated technicians were observed in the workplace to assess their skills in running shifts. The technicians selected for the leading team had an average of six to eight years of service with the company.

For the first four weeks, members of the team were rotated off their regular shift teams and were solely devoted to working on and perfecting the in-line production of an innovative plastic product.

When productive capacity was achieved a series of standard operating procedures were written and the team members were rotated back into other shift teams. These operating procedures and rotations freed other technicians for learning the new in-line production techniques and the team members were able to educate other members of the shift teams they were rotated into. Currently, three members of the original team still rotate in and out of other shift teams for the purposes of providing training to other technicians.

Corresponding with the organisational restructure and the creation of the leading team was the staged implementation across the organisation of national frameworks for training. Business proposals detailing the rates of return on the investment in training and the pay-back period of each training package implemented in the company were submitted to the board for approval before the programs were developed. It was proposed that once productive in-line capacity with the innovative plastic product was achieved, the extra time made available through improved manufacturing techniques would be used in training and up-skilling all polymer technicians through the national competencies.

A skills audit of polymer technicians was conducted in a pilot area of the company and extrapolated to the rest of the production process. After the audit, the general manager worked closely with the local TAFE to develop the program. The development of the company's national competencies was based on the Rubber Cable Making and Plastics Industry Training Package, which was assessed to be too generic for the company's purposes. Modules were written to integrate the company's training materials with the national training framework. This enabled the development of safety, technical and team development programs tailored for polymer technicians within the company. Teachers in the local TAFE ensured that these modules met the conditions and requirements of the training Package for a Certificate Level III for Polymer Technician Operators and a Certificate Level IV for Shift Coordinators.

Following on from the introduction of the skills program for polymer technicians has been the staged development of occupationally based skills programs for other employees in the company. An action learning training program was introduced for sales representatives. Most of the sales representatives in the company have between 10 and 15 years of experience in sales and there was nothing suitable in terms of a national training package. Therefore training is done solely in house and is based on the sales management system the company uses.

With regard to management training, a partnership was developed with Deakin University so that an accelerated learning path was available, particularly for young managers. The majority of managers within the company were not graduates so the training program commenced at an undergraduate level with basic management skills based on the British Chartered Institute of Management competencies. The program, however, provides learning through to a Masters of Business Administration level. Selection into the management training program is application-based. Currently there are approximately 20 managers on accelerated learning paths with six working towards a Masters of Business Administration.

In addition to the technician, sales and management training programs, modules are currently being written for warehousing employees and which will also be integrated with national standards.

All training programs are modular self-paced packages based on written materials. Suitable coaches have been identified within the organisation who provide support to training participants. The assessment of competencies is evidenced-based and evidence gathering has been embedded in the workplace through company processes. This means that evidence gathering for assessment of competencies is not separated from the day-to-day running of operations but is an integral part of daily procedures and processes. All assessments are carried out by one of the 20 qualified company assessors. To oversee the whole training process, the company has developed a partnership with a TAFE institute in each state. The role of TAFE is to audit the quality of the training and assessment process.

Drivers of training and innovation

Prior to 1998, the company had spent eight years trying to manufacture the innovative plastic product in an in-line productive capacity. The inability to reach productive capacity in manufacturing of this particular product was the key driving force behind the implementation of the various training programs.

Based on world standards, the company is performing excellently. At this early stage, it is difficult to quantify the impact of these training packages on business performance. Nevertheless, there are three major areas of improvement which have occurred in the company since 1998 and which may be attributable to the changes in the organisational structure and the implementation of the various training programs:

- ✧ Quality of process control has improved. Material costs are approximately 70% of total costs in the company, so better process control is a very good contributor to the bottom line.
- ✧ Responsibilities in the production role have been made clear and put into the perspective of the whole organisation. For example, prior to training, shift coordinators felt that productive performance was their primary responsibility. They are now acutely aware that being responsible for cost, safety, quality and people performance is as vital to business as production.
- ✧ Employees now have a fundamental theoretical understanding of plastics processing. Traditionally people had been placed in the organisation without this understanding as all learning was based on informal on-the-job training. Now there is formal training and assessment to ensure that all employees understand the reasoning behind plastics processing.

The principal constraint on training, particularly for polymer technicians, is cost. Production demand is tight and so the biggest cost in training polymer technicians is in rotating people off production lines for the purposes of training. As most of the work in creating the training programs was done in house, the initial set-up costs of the learning materials was only around $150 000, with annual recurring costs of around $25 000. However, it is clear that the training was needed to achieve in-line productive capacity in the manufacture of innovative plastic product. The subsequent achievement of productive capacity led to the patenting of this particular production process, and is therefore testimony to the ongoing role which training plays in innovation within this organisation.

Visy Pulp and Paper Mill

Role and structure of the mill

The Visy unbleached pulp and paper mill is located in Tumut in New South Wales. This $400 million state-of-the art mill is the only mill of its type in Australia and one of the most technologically advanced mills in the world. The mill is a pioneer in environmental and technical standards and is one of only three mills in the world with near-zero levels of effluent as a result of the closed-loop system of processing and production.

Construction of the mill began in 1999 and is the first fully integrated pulp and paper mill in Australia since 1981. Operation on the re-cycling of products began in April 2001 and the pulp and paper operation began in July 2001. On an annual basis the Visy Tumut Mill produces 240 000 tonnes of unbleached pulp sourced from virgin fibre and 60 000 tonnes from recycled paper for both export and domestic markets. The paper machine will produce 175 000 tonne of high-quality paper and cardboard products per year.

There are approximately 180 people on site at the Tumut mill. Of these, 130 are direct employees of Visy. The remaining 50 are maintenance tradespeople or laboratory technicians who are permanently located on site but employed through outsourced contracts. Of particular interest to this case study are the 80 Visy employees who are employed as production engineers.

The production engineers operate the plants which produce pulp and paper. The mill uses advanced chemical methods of production referred to as Kraft pulping. At the Visy mill are four sections where production engineers work in the pulping and paper process. Below is a brief description of each of these sections:

- *The wood yard:* wood waste is processed and logs are chipped for the boiler.
- *Fibre line:* raw materials are transformed into finished paper pulp through the use of chemicals and energy. The fibre line requires production engineers to operate large plants called digesters (or cookers) and washed stock screeners.
- *Chemical recovery process:* all chemicals used in the pulping process (cookers) are recovered for continual reuse in the cooking process. The chemical recovery process involves the operation of a number of large plants, including the power boiler, the turbine, the steam distribution system, the chemical recovery system and evaporators.
- *Paper machines:* pulp is converted into paper.

The production process

The fibre line and the chemical recovery process are the two main process lines of the whole production operation. The fibre line uses energy and chemicals to break down the material which holds the wood fibres together. This process, referred to as *digestion (cooking) and washing* results in two by-products; the washed pulp fibres (slush pulp) and a return liquor which contains chemical compounds, which have been altered through the digestion process and the dissolved wood substance.

The slush pulp continues on through the fibre line to the paper machine. The chemicals and dissolved wood substance go into the chemical recovery process.

During the chemical recovery process the chemicals are separated from the wood substances. The wood substances are burned to generate high-pressure steam that is used to power the mill. The chemicals extracted are processed back to the original compound and reused on the fibre lines. Without the chemical recovery, the process would be uneconomical.[1]

The slush pulp is very high in water content. The paper machine removes this excess water through pressure and suction to transform the pulp into a sheet. The sheet is then sent on to be dried on steam-heated cylinders before being sent to the storage and dispatch area.[2]

Type and role of training

Because Visy Tumut is the newest pulp mill in the world and has only been in operation for a year, the training strategy at the mill is closely linked to their recruitment strategy. No other mill like this exists in Australia so there were two elements to the recruitment process for production engineers. The first involved the recruitment of experienced operations experts who had a breadth of experience in terms of the number of workstations in which they had operating expertise and in terms of their capacity to train inexperienced people.

Recruitment process

For the fibre and chemical recovery lines, Visy advertised for experienced production engineers in countries with similar mills and equipment and recruited production engineers who had extensive experience in these processes. Attracting experienced people from overseas was made relatively easy because of the high profile which the technologically advanced Visy mill had attained throughout the international pulp and paper industry. In total, Visy recruited 20 production engineers for the fibre

---

[1] Calvin Biotech 2002, 'Kraft pulping; Energy consumption and production', viewed March 2004, <http://calvin.biotech.wisc.edu/jeffries/bioprocessing/pulping.html>.

[2] Paperhelp Online 2002, 'The bleached Kraft pulp mill', <http://www.paperloop.com/pp_mag/paperhelp/8.shtml>.

and chemical recovery lines from overseas who each had between 5 and 20 years experience. For the wood yard and paper machine, Visy was able to recruit experienced people from within Australia.

The second part of the recruitment process focused on finding suitable people locally who could be trained in the new technological processes on the fibre and chemical recovery lines. The Tumut area has had a good forest industry for some time, so Visy aimed to recruit operators who, although inexperienced in the new production processes that the Visy mill would be implementing, were experienced in the industry. The recruitment process for inexperienced production engineers was a three-step process. The technology used in the fibre and chemical recovery lines is all operated from control rooms in which operators sit in front of digital computer screens concurrently monitoring multiple numerical readouts and determining the relationship between the different parts of the process. Production engineers working on these lines require a high degree of skill. The first part of the recruitment process therefore involved applicants sitting a battery of tests which assessed their literacy, computer literacy, and quantitative and mechanical reasoning.

Applicants who were judged to have performed reasonably well on the test battery went on to the next part of the recruitment process. The second stage involved completing a pre-employment introductory pulp and paper course. This was a two-day workshop put together by TAFE at Tumut in conjunction with Box Hill TAFE in Victoria. The course aimed to provide applicants with a basic understanding of the production process which would be used on the fibre and chemical recovery lines. Applicants who completed the course submitted the assignment and demonstrated a reasonable understanding and interest in the process went through to the final stage.

The last stage of the recruitment process involved an interview process which was aimed at assessing the capacity of applicants to fit with the company culture as well as their willingness and ability to learn and their ambitions regarding a career in the mill. Visy sought people who would be committed to the whole mill operation and who would be prepared to eventually work in all areas of the mill.

Training

The bulk of the training for successful applicants has been on the job and has been managed by the experienced senior production engineers recruited from overseas. These engineers are first line managers who have a very hands-on approach to the whole production process and who train inexperienced production engineers in each of the workstations. The training effectively involves one or two experienced production engineers training a team of five inexperienced production engineers as they are working particular workstations.

The on-the-job training is based on the standard operating procedures (SOPs) which were developed for each of the workstations. The overseas manufacturers and suppliers of plant whose products are used at the mill were contracted to be involved during the construction, commissioning and initial start-up of the mill. In addition, they were to provide procedures for the operation of all plant supplied. However, the experienced operators have since modified these procedures to be specific to the Visy environment.

Currently, engineers remain in the one functional area, although they will rotate around different workstations to gain experience in the different plant in that area. For example, in the chemical recovery area, operators will move through roles, at different times operating the power boiler, the turbines and the evaporator. In the long term, however, the production engineers will be rotated between different functional areas so that they are capable of operating in any area of the mill. This rotation through functional areas will ensure that all production engineers are capable of working in different functional areas. Visy has a minimum staff level and it is a high priority for the company to gain maximum flexibility in the workforce.

With regard to formalising the on-the-job training, a training and assessment matrix was developed in November 2001 which mapped all the competencies required by Visy in each of the functional

areas. For example, in the wood yard, operation of the wood crane is one of the tasks. The competencies required for this have been identified, and appropriate training and assessment have been mapped to the acquisition of the skills needed.

None of the training and assessment matrices for the functional areas have been related to the available Australian Qualifications Framework training package. Visy chose not to run with the training package because, throughout the company, they had traditionally run with a system in which experienced operators developed operating procedures for each task required. Inexperienced operators were trained and assessed on their ability to competently perform the task to the level of the standard operating procedure specific to the Visy operating environment. Ultimately, the competencies based on the standard operating procedures will be linked to a formal qualification, but at this stage it is not a top priority of the company.

With regard to future training, there are two different developments underway. The first is a long-term option involving Tumut TAFE. Teachers here are in the process of developing materials for a certificate III and IV in pulp and paper services and manufacturing. Currently, however, there is no formal TAFE training available and the development of these certificate-level courses is a huge undertaking. It is envisaged that this long-term option will provide formal post-school training opportunities for youth in the local area as an entry-level qualification for a position as a production engineer with Visy. However, even once the courses have been designed and materials developed, it is recognised that there will be an issue of finding experienced teachers to deliver the course and conduct assessments. Although Visy currently has no interest in becoming a registered training organisation and would prefer that the training role remain with the local TAFE, it is acknowledged that ultimately, Visy production engineers will probably have to play an active role in the delivery and assessment of these TAFE courses.

The second training development underway is a short-term option until these certificates are available. This option involves enrolling incumbent production engineers in Canadian pulp and paper courses. This training will be in the form of self-paced distance education programs with lessons delivered through interactive websites with online submission of assignments. Tumut TAFE will provide additional chemistry and mathematics tutorials and will supervise exams.

The down side of the short-term training option is that accreditation will be provided by the Canadian vocational education and training system and will be specific to Canadian wood products and occupational health and safety legislation. All production engineers were told at the recruitment stage that they would be expected to complete a formal qualification, and it is expected that, in the next six months, 40 to 50 of the incumbent production engineers will go through the Canadian program. The advantages expected from this formal training are that production engineers will acquire the underpinning theoretical knowledge needed to be able to understand the production process. While acknowledging that experienced operators may pass on some of this knowledge through on-the-job training, the company feels that this can't be assumed. In a mill with zero release of effluent in which all excess water is irrigated back onto local farms and all excess by-products are reused, it is critical that production engineers understand the complexity of the *whole* production process. Visy thus needs to ensure that all operators have a sound theoretical knowledge of the chemicals used in production and how all the production processes fit together. This will be gained through formalised training such as the Canadian course.

Drivers of training and innovation

Training

The key driver of training has been the relatively small pulp and paper industry in Australia and the lack of recognition of the industry in the Australian training sector. Consequently, there was no alternative but for Visy to recruit experienced and skilled operators from overseas, both for the purposes of managing production at the mill and for the purpose of training inexperienced local employees.

The lack of appropriate training courses in Australia has meant that Visy has had to look overseas to Canadian courses, which are relatively expensive when compared to the cost of local TAFE courses were they available. However, the other key driver of training is the need for production engineers to develop a sound fundamental theoretical knowledge of the whole production process.

Innovation

Continued recycling of paper eventually leads to the deterioration of fibres, so virgin fibres have to be introduced into the pulp process. In Australia, paper machines have relied on local recycled paper and imported pulp. Australia annually imports 110 000 tonnes of softwood pulp and has a AUD$1.5 billion trade deficit in paper and wood commodities.[3]

Traditionally, small-scale pulp mills such as Tumut have been inefficient because of the cost of energy associated with breaking down wood fibres, with pulp and paper production among one of the most energy intensive segments of all industry. In an incentive package the Australian Government offered Visy an AUD$40 million package aimed at substituting imports, reducing the current account deficit and ultimately establishing an Asian export market for pulp and linerboard. Thus the drivers of training and innovation at the Visy Tumut mill are intrinsically linked to the initial construction and commissioning of the mill.

The Visy mill is the most energy-efficient mill of its kind in the world, and owing to the technologically advanced production processes that have been engineered as a result of research and development, the Visy mill also has the lowest usage of water and chemicals per tonne of pulp. These features have established Visy as a world-scale, self-sustaining pulp and paper company.

Visy is very focused on process improvement to increase production and quality. Currently, the pulp and paper produced at Tumut goes to making cardboard boxes and package; however, there is a great deal of scope for developing different packaging. It will take years for the inexperienced production engineers to gain enough skill to be sufficiently competent to be able to contribute to these process improvements, but once expertise has been achieved, there will be involvement from line staff in future research and development.

Getronics Australia

Role and structure of Getronics Australia

Getronics Australia is the Australian subsidiary of the global multinational information technology services company, Getronics. Getronics Australia employs approximately 600 staff, including employees and contractors, and specialises in providing the entire spectrum of information technology solutions to company and organisational clients. The company offers to market two integrated sets of services—'business solutions' and 'infrastructure solutions'. The former set of functions focuses on information technology consulting, primarily in the finance, retail and utilities sectors. Infrastructure solutions involve the design, implementation and ongoing management of clients' information technology infrastructure. Getronics offers the complete life cycle of services including:

- ✧ information technology infrastructure and systems design
- ✧ procurement of information technology assets
- ✧ deployment of the infrastructure
- ✧ management and support of all information technology services

[3] Pulp and Paper Industry 2002, 'Tumut Integrated Pulp and Paper Mill, Australia', viewed March 2004, <http://www.pulpandpaper-technology.com/projects/tumut/>.

- ✧ disposal of outdated assets
- ✧ refreshment of all equipment at the end of its service life.

Underpinning Getronics service delivery is the Sydney Enterprise Service Centre which provides an integrated approach to network management, service desk and field operations.

Getronics Australia's main areas of employment include:

- ✧ over 400 staff working in Managed Services
- ✧ approximately 30 staff working in Business Solutions
- ✧ over 80 support staff working in sales and administration.

Skills and Qualifications of Getronics Australia staff

Many of Getronics Australia's Business Solutions staff are university graduates often with degrees in computer science, computer engineering or related disciplines. Others may not necessarily hold formal university qualifications but will have extensive industry and professional experience in information technology consulting. All staff in this area will typically hold a number of specific technical qualifications in the form of particular vendor certifications. Common certifications include Microsoft Certified Systems Engineer, Microsoft Certified Systems Developer, or equivalent certifications in the operating systems of other vendors, including Cisco, Linux, Unix, Novell and Lotus.

Getronics Australia's Managed Services staff have a broader range of qualifications and skill sets. Depending on their particular role, staff in these areas might have TAFE qualifications in information technology, electronics or the electrical trades, university qualifications or technical certifications as described above. Many staff in this area may have a wealth of practical industry experience, some having worked in information technology services for 20 to 25 years and acquired a broad range of skills through that experience.

Some Getronics Australia recruits into the Managed Services area may already possess vendor certifications such as the Microsoft Certified Systems Engineer, but many will simply have a university or TAFE qualification. The TAFE qualifications will normally be a Certificate Level III in Information Technology (available in software applications, general, network administration) or a Certificate IV in Information Technology (available in client support/help desk, database administrator, technical advisor, multimedia developer/specialist, junior systems analyst/designer, junior programmer or network manager). Others may possess a Diploma in Information Technology.

In any event, the key qualifications needed by information technology staff, regardless of their background education and training, tends to be the relevant professional certifications pertaining to the operating systems they are required to work on—training courses designed and mandated by the big vendors and delivered by licensees, including private training providers and organisations such as Getronics. To the best of the respondent's and the researchers' knowledge, the key vendor-certified training is not supplied by TAFE or universities.

TAFE graduates and university graduates

Getronics Australia employs a number of TAFE graduates in several areas, although most are employed in the help desk area (providing technical support to users) and in the field area (providing technical and maintenance support, often for hardware, for example, fixing printers, routers and networks). When asked to compare the quality of TAFE and university graduates as recruits into Getronics Australia, one respondent from human resources noted that TAFE students tended to have a more realistic and informed perspective on the information technology industry and understood the realities of the industry better than university graduates. He noted that, in the

view of many Getronics Australia managers, including himself, TAFE teachers were more likely to 'be in the real world' than university instructors.

It was also noted that a common view within Getronics Australia was that university information technology education and training suffered from an over-emphasis on the academic rather than the practical and was hampered by the reliance of many university information technology departments on old technology. Universities were generally seen as not being able to keep pace with the fast-changing technological environment of the information technology industry.

When asked how well TAFE tended to cope with the challenges of training in new technologies and operating systems, the manager noted that TAFE was '50/50'—implying that they did a better job at producing relevant graduates than the universities, but they still did not always provide the skill sets demanded by Getronics Australia and the industry in general.

In recent years Getronics Australia has developed relatively strong and positive relationships with a key TAFE college specialising in information technology—Lidcombe TAFE. Getronics Australia managers have found the key teachers and managers at that TAFE to be 'exceptional'—responsive, focused on students and their employability and prepared to communicate with industry. Getronics Australia and Lidcombe maintain a steady ongoing relationship. Getronics Australia has assisted with placements from time to time and key TAFE staff visit Getronics Australia at least once a year to discuss the TAFE's plans, teaching and curriculum developments and ideas. Skill sets in demand are constantly changing and it is apparent that TAFE colleges need to be constantly in touch with industry in order to cater to those demands. For example, one manager at Getronics Australia noted that field services managers need field engineers technically trained in *both* hardware and software, but that most TAFE graduates were typically trained in one or the other. For field engineers, A+ was now the key certification. A+ was developed by United States-based CompTIA in conjunction with several of the world's largest hardware and software companies as an industry-wide, internationally recognised standard of basic competency levels in the field of computer service. A+ is offered internally by Getronics Australia through the Getronics Virtual University rather than by TAFE.

Type and role of training

Recruits into Getronics Australia will normally be expected to hold basic information technology qualifications, although some may have extensive professional experience and certain vendor certifications. The principal training needs faced by Getronics typically fall into two areas:

- ✧ further development of information technology professional skills and qualifications (typically professional certifications from Microsoft, Cisco and CompTIA)
- ✧ further development of business management skills and qualifications.

Both kinds of training need are generally met in house at Getronics through the global Getronics Virtual University. The Getronics Virtual University has been established as the company's main mechanism for providing employee technical and other training. The courses available through Getronics Virtual University cover six main areas: technology, business, home and personal, e-business, certifications and interpersonal. All training through the Getronics Virtual University is online and involves genuine self-paced learning.

The principal means for Getronics staff to acquire technical qualifications is through the certifications courses and modules. These courses provide staff with training in preparation for certification under Microsoft (including the Microsoft Certified System Engineer, Microsoft Certified Systems Developer and MCDBA for Database Administrators) and Cisco (including the Cisco Certified Network Associate and Cisco Certified Network Professional) as well as other vendor-specific certifications. As noted above Getronics Virtual University is licensed by the vendors to provide the relevant training and certification.

Ensuring that staff have the appropriate and required certifications has obviously been one of Getronics Australia's major training priorities. Staff are not compelled to undertake the training, and possession of certification is not necessarily a prerequisite for recruitment. However, from time to time, Getronics Australia has sought to encourage staff to acquire particular certifications in demand within the company by tying promotions to the acquisition of particular certifications. This has provided an effective means of encouraging staff to undertake technical training where specific competencies and certifications are required in order for Getronics Australia to meet customer demand for services in relation to specific operating systems.

The other major training need faced by Getronics Australia is in the area of business management skills. Getronics Australia employs a large number of technically oriented information technology professionals. In order to strengthen the business focus and management capability of their technical staff, Getronics Australia has recommended that information technology professionals seeking management positions undertake business management training also through the Getronics Virtual University.

Staff do not need permission or specific authorisation to undertake courses through the Getronics Virtual University: staff can simply log on, register for an account with the Getronics Virtual University and commence the course of their choosing. Training through the Getronics Virtual University is provided by Getronics Australia to its staff free of charge. This represents a significant investment on the part of Getronics Australia and Getronics globally. Acquiring technical certifications, for example, through private external providers is relatively expensive. The Getronics Virtual University is constantly adding new courses and updating existing courses as new versions of software and operating systems come on line. The Getronics Virtual University courses have been available to Getronics Australia staff for almost four years.

One respondent from Getronics Australia noted that, on occasions, there has been some staff disquiet with the requirement that training through the Getronics Virtual University is expected to be undertaken in staff members' own time. It was noted that this disquiet has gradually been alleviated by managers recognising that staff should be allowed at least some work time to work on their training, and by employees recognising that training and skill development is their responsibility and in their interests, and that a degree of commitment outside working hours is appropriate and reasonable.

One of the most important areas for the employment of TAFE graduates is in the help desk area. Over the past two or three years Getronics Australia has increasingly recruited its help desk staff from TAFE. Typically these recruits will need to undertake technical training in a relevant operating system, such as Cisco. It is a standard requirement for recruits working on Cisco in the help desk section to attend Cisco Boot Camp—an intensive, two-week introduction to the operating system—conducted by Cisco off site.

Drivers of training and innovation

The information technology services industry is inherently innovative in the sense that it is at the forefront of one of the most dynamic and rapidly changing areas of technology. Innovation is, in a sense, forced on information technology services companies as operating systems, software and hardware constantly change. Information technology change is obviously one of the key drivers of training demand. For example, as Microsoft moves from Windows 2000 to Windows XP, Getronics Australia staff need to acquire new skills and update their Microsoft certifications.

For Getronics Australia, innovation and training have also been driven by changes to the corporation's global perspective. Getronics has shifted from a traditional hardware manufacturer (a 'big box' environment) to a complete service information technology services company. Evidently the company needs to be able to keep up with, and indeed stay ahead of, developments in client

demands for new technologies, platforms, operating systems as well as new techniques to enable Getronics Australia to continue to provide high-quality consulting, design and support services.

Changing business imperatives also drive innovation and therefore training demands for Getronics Australia and its competitors. For example, in the late 1990s Year 2000 issues shaped the demands of many business clients, whereas in the early 2000s e-business has been a major issue for many clients. As a result, information technology consulting and many managed service staff now need to become conversant in the latest software and networking applications around e-business, such as Microsoft's .NET framework which allows for the integration of XML web services, windows-based applications and web solutions.

The future

Getronics Australia predicts that future training needs will continue to be met through the Getronics Virtual University. TAFE and university will continue to be seen as a source of recruits; however, the respondent interviewed held little prospect for a greater role for TAFE or universities (or private providers) in post-entry training. TAFE colleges and universities in particular struggle to keep pace with changing information technology, new applications and other products.

In terms of post-entry training, the Getronics Virtual University is seen to have two major advantages over TAFE, university or private provider training. First, Getronics Australia believes that it is cheaper and more effective to provide comprehensive, online, self-paced learning than to bring in external private providers or send out staff to off-site training. Second, providing employees with the ability to undertake study and training online with full flexibility frees up maximum time for employees to work on client work; key staff do not have to be taken off-line to undertake (or deliver) as much training.

The credentials and qualifications issued by the Getronics Virtual University are not recognised for the purposes of the Australian Qualifications Framework. The professional certifications provided through the Getronics Virtual University are, however, recognised globally throughout the information technology industry as relevant and meaningful. These are evidently the important qualifications for employment in the contemporary information technology industry. While Getronics Virtual University's other courses may not necessarily involve either vendor certification or articulation with the Australian Qualifications Framework, they have considerable cachet in the information technology labour market, given Getronic's status and reputation in the industry.

The National Centre for Vocational Education Research is Australia's primary research and development organisation in the field of vocational education and training.

NCVER undertakes and manages research programs and monitors the performance of Australia's training system.

NCVER provides a range of information aimed at improving the quality of training at all levels.

ISBN 1 920895 45 0 web edition