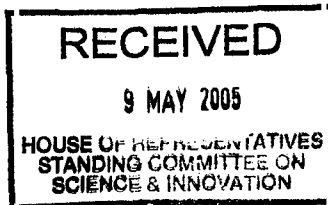




Early Childhood and Primary Education  
Secondary Education  
Technical and Further Education  
Vocational Education and Training  
Higher Education  
Adult and Community Education



Committee Secretary  
Standing Committee on Science and Innovation  
House of Representatives  
Parliament House  
CANBERRA ACT 2600

Dear Secretary

I am pleased to enclose a NSW Department of Education and Training submission to your inquiry into pathways to technological innovation. The submission draws on the findings of an Australian National Training Authority national project on skill ecosystems managed by this Department. The national project is built around a series of demonstration projects, three of which offer insights into areas relevant to the inquiry's terms of reference. The submission also examines some recent Australian research into the relationship between innovation and vocational education and training.

If the Committee would like to interview participants in the Skill Ecosystem project or others associated with the project at its forthcoming round of hearings, please contact Jeremy Gilling on (02) 9561 8750, or email [Jeremy.gilling2@det.nsw.edu.au](mailto:Jeremy.gilling2@det.nsw.edu.au).

Yours sincerely

A handwritten signature in cursive script, appearing to read "Leslie Loble".

Leslie Loble  
Deputy Director-General  
Strategic Planning and Regulation  
April 2005

**NSW Department of Education and Training  
Planning and Innovation Directorate  
Submission to the  
House of Representatives Standing Committee on Science and Innovation  
Inquiry into pathways to technological innovation**

<b>Skill ecosystems and innovation</b>
----------------------------------------

The inquiry seeks submissions with particular reference to

- pathways to commercialisation
- intellectual property and patents
- skills and business knowledge
- capital and risk investment
- business and scientific regulatory issues
- research and market linkages
- factors determining success
- strategies in other countries that may be of instruction to Australia.

The NSW Department of Education and Training is managing an Australian National Training Authority (ANTA) national project on skill ecosystems (<http://www.skillecosystem.net/>) involving vocational education and training (VET) providers in several states and territories. Skill ecosystems are networks of businesses, groups and organisations that interact to create clusters of skills and workforce capabilities in an industry or a region. They are shaped by

- the business environment – competition, inter-firm links, access to finance and product markets
- technology and its application in an industry
- government policy frameworks and institutions, including the role of VET providers
- modes of engaging labour and the operation of labour markets
- production processes and the way work is organised
- the quality, capacity and responsiveness of learning systems serving the network and the individuals within it.

A crucial difference between the skill ecosystem approach to understanding and furthering workforce development and the traditional approach is that the former approach gives primacy to the industry or community context of skills and workforce development, rather than to the training system's response to an already articulated need.

The ANTA national project is built around a series of demonstration projects (seven such demonstration projects are either under way or concluded, with further projects planned for 2005-06). Three of these demonstration projects offer insights into some of the topic areas that are of particular interest to the inquiry. A summary of the key findings of each project follows. (The projects are described in more detail in the attachment.)

## **1 Swinburne University of Technology (TAFE Division) Microtechnology and CRC project (Victoria)**

The project aimed through four sub-projects (see attachment) to demonstrate ways that the VET sector could work with cooperative research centres (CRCs) to increase innovation in firms (and networks of firms), and assist in commercialising and diffusing innovation. There is only a small window of opportunity for microtechnology to establish itself in Australia, and the development of technical skills will be crucial.

The achievements and lessons of the projects can be summarised as

- the need for two-way transfer of knowledge between VET and CRCs, with each sector all too often largely unaware of the resources and expertise the other is able to offer
- the value of innovation agents in furthering links between VET and CRCs – specifically in addressing the barriers (such as the prevalence within TAFE of departmental ‘silos’) that inhibit TAFE teachers from themselves acting as innovation agents
- demonstration of the value and sustainability of intersectoral cooperation – specifically, resource sharing, industry release for TAFE teachers, and collaboration in training delivery
- much enhanced awareness within each sector as a direct result of the demonstration project of the roles and capabilities of the other, leading to ongoing interactions and further cooperative projects (for example, the company builds the industrial skills to move from producing single prototype devices to streamlined mass production, while at the same time the TAFE teachers introduce their students to new knowledge areas)
- demonstration that even very small community and private RTOs can link with CRCs to their mutual benefit – although there are still considerable barriers to linking VET to large CRCs, some of which could be overcome if VET were seen as an integral part of the innovation economy
- if VET were appropriately funded, it could fill a crucial role in the research-to-market cycle during the prototyping and testing phases, when industry know-how is important.

A copy of the 12-page project brochure is enclosed for reference, and can be downloaded at

[http://www.skillecosystem.net/data/files/general/Creating%20future\\_cover.pdf](http://www.skillecosystem.net/data/files/general/Creating%20future_cover.pdf) and  
[http://www.skillecosystem.net/data/files/general/Creating%20future\\_text.pdf](http://www.skillecosystem.net/data/files/general/Creating%20future_text.pdf).

## **2 Water Innovation Network (WIN) project (South Australia)**

The project aimed to enhance the engagement of the VET sector with research and innovation undertaken in the South Australian water industry, and to identify the processes and outcomes that could be replicated in similar industries in other areas.

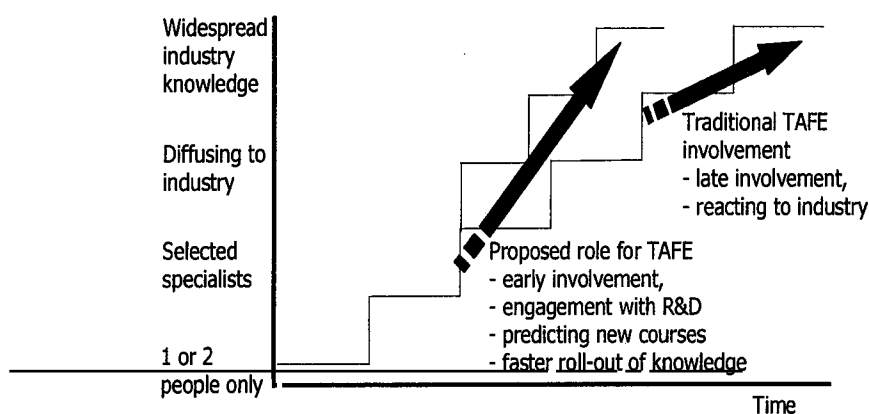
The VET sector’s engagement with industry normally occurs relatively late in the product/service cycle – typically three to five years after the initial research phase. The WIN project (see attachment for details) is an endeavour to move this point of engagement forward in the cycle by

- initiating industry contact and involvement at an early stage
- enhancing TAFE staff's first-hand knowledge of and involvement in research and innovation.

The focus was on industry barriers to uptake of application, measurement, control and data collection technology. The specific barriers that were identified were

- financial constraints
- lack of training
- lack of advice
- inadequate demonstration of the technology's benefits
- lack of integration of the technology into existing systems.

The project's leaders have illustrated this approach diagrammatically as below:



As the diagram suggests, it entails TAFE and other VET providers moving beyond a reactive response to already articulated industry training needs (usually manifested through skill shortages or gaps) to involvement with industry in identifying the barriers to take-up of innovation and technology, and developing training and skills development strategies to overcome these barriers. This would help address one of industry's main misgivings about the public VET sector: the long lead time between the articulation of a skill need and the availability of an appropriate public training response.

However, the success of this approach requires a considerable investment in building relationships, detailed research, and sharing of insights.

The project partners believe that TAFE SA is now much better placed to identify and overcome barriers to the uptake of new and innovative technology and work practices as they emerge, rather than several years after these needs have been identified. The sustainment of the network beyond the life of the project is clearly central to this objective.

Importantly too, the project partners believe that if the water industry is any guide, there are valuable national and international markets in other industries for the training solutions developed through this approach. The project has already seen

- considerable interest from other arms of TAFE in the model that has been trialled

- ongoing collaboration between the VET and higher education sectors in identifying and responding to industry innovation opportunities
- enduring links between TAFE and both industry and public-sector research and innovation organisations.

### **3 Riverina TAFE Constructed Wetlands project (NSW)**

This project differs from the other two in that it was funded not by ANTA but by the NSW Board of Vocational Education and Training. It has been included under the skill ecosystem project umbrella because of its close parallels to the other projects in purposes and outcomes.

Its purposes were to

- develop the role of Riverina TAFE as an innovation agent for the creation, diffusion and commercialisation of new knowledge and skills in the waste water management industry, including through its new consultancy service
- develop and implement new curriculum to support the use of wetland technology for waste water management by industry (particularly agriculture and horticulture) and urban developments
- improve local business and environmental practices, including effective management of water resources.

The project is nearing completion. The interim report identifies areas where the VET sector could profitably offer training to the industry:

- water monitoring
- sediment control
- wetland planting
- wetland plant propagation
- wetland monitoring and maintenance.

Proper maintenance (include possible eventual decommissioning) is crucial to wetlands viability. This area in particular offers wide possibilities for VET training delivery at a range of AQF levels – from litter and weed control to revegetation and recreational walkway design and maintenance.

At present there is no single clear pathway into the industry, and no consolidated body of wetlands skills has been identified that a VET training program could deliver. Given the value and growing importance of this technology for waste water management, the case for developing such a program – perhaps as a stream within either the Water Industry or the Conservation and Land Management Training Package – would seem to be strong.

### **4 Other research**

Many of the themes in the skill ecosystem projects echo the findings of recent research, some of which are outlined below.

Curtain (2004) examines two highly successful innovation economies – Finland and Singapore – each of which began from a lower base than but has now outstripped

Australia in this regard. He focuses in each case on the role of the VET sector in innovation, and draws lessons for Australia from their success.

Curtain notes that both countries adopt a broad concept of what innovation involves, including the diffusion of new technologies, processes and products. Within this conception, it is possible to recognise the fact that low and medium technology industries harness the research and development of others to support their own innovations.

Curtain emphasises the value of using the national innovation system concept to give VET a more direct role in promoting innovation. When innovation is viewed as a series of small, widely diffused changes (as distinct from one or a few major breakthroughs), VET has a clear and important role in supporting the diffusion of new technologies. This role could be enhanced through the following measures

- funding incentives and performance indicators for TAFE Institutes to help small and medium-sized businesses assess their technology needs and develop appropriate solutions (like their Finnish counterparts)
- a whole of government approach (not just within but also across state and federal tiers of government) to national innovation policy, and specifically to TAFE's role within it.

Curtain further argues that attention needs to be paid not just to developing technical expertise in the form of tertiary-educated scientists and engineers, but equally to the type of skills required at the para-professional level (one of the fastest-growing occupational groups in Australia over recent years). VET's role is crucial in this endeavour.

Toner (2004a) comments that

The VET sector is notably absent from Federal Government policies and programs on innovation and technology diffusion. The VET sector receives scant attention in the principal government statement on innovation policy, *Backing Australia's Ability. An Innovation Action Plan for the Future* (2001) and receives only a few incidental mentions in the comprehensive description of Australia's innovation system, *Mapping Australian Science and Innovation – Main Report* (2003). TAFE is specifically excluded from ABS measures of higher education R&D activity.

The Federal Government spends around \$6 billion a year on science and innovation in Australia through tax expenditures on private R&D and support for public institutions such as CRCs, CSIRO, ANSTO and NH&MRC. This is roughly six times the Federal Government expenditure on public and private VET. The VET sector is not a beneficiary of this large investment in innovation.

There are a number of other indications of VET's low profile in national innovation policy. There is no direct reference to VET in the six pages of guidelines on the CRC program published on the CRC Association website (<http://www.crca.asn.au/>). Also, AusIndustry's Registered Research Agency program (<http://www.ausindustry.gov.au/library/RRAlist040520050413104727.pdf>) lists only

five VET-related organisations out of nearly 200 organisations listed. (RRA status enables organisations to access various AusIndustry programs linked to the national innovation system, as well as conferring favourable tax status.)

Finally, although the Australian Research Council (ARC) funds research in universities, greater VET involvement as partners in the ARC's Linkage – Infrastructure, Equipment and Facilities (LIEF) program ([http://www.arc.gov.au/apply\\_grants/linkage\\_infrastructure.htm](http://www.arc.gov.au/apply_grants/linkage_infrastructure.htm)) in particular could be highly beneficial. This would also further the objectives of the LIEF program, which strongly emphasise cross-sectoral collaborative arrangements.

Ferrier *et al* (2003) investigated industries represented through the CRC program. They found that

- although CRCs are often able to meet niche training needs for small numbers of workers, they are not generally equipped to deliver training to large numbers of people in the skills that their innovations entail
- if the VET sector is to deliver this training, the planning will need to occur well in advance of the time of delivery
- this will require much closer mutual engagement between VET and CRCs
- the CRCs and VET providers are largely ignorant of each other's programs and activities, even in industries where they mutually specialise
- however, there are exemplary exceptions where the links are strong, and in these instances the shared benefits are great – these include the personal and professional development of staff in both organisations, and the identification and pursuit of new fee-for-service opportunities
- much more concerted attention should be paid to building links broadly across both sectors – this should be two-way, and should encompass not just knowledge creation, but also commercialisation and dissemination
- the VET sector in particular offers to the CRCs the capacity to extend prototyping into automation and mass production (see the Swinburne University of Technology microtechnology project outlined above and in the attachment).

Another recent study highlighted VET's potential role in innovation, whilst also investigating current barriers. Toner (2004b) interviewed TAFE teachers in manufacturing-related areas in NSW, Victoria and Queensland on how they maintain the currency both of their skill and knowledge base and of the equipment they use for teaching, as well as eight manufacturing firms that utilise TAFE training. He also conducted an extensive international literature review, and commissioned two international studies – on Germany and the United States respectively – to complement his Australian survey.

The study raises significant issues regarding TAFE's systemic capacity to meet industry training needs arising from the introduction of new and innovative technology and processes.

- The literature review and commissioned studies indicate a strong and growing international role for VET in technology diffusion. There are in all three of the intensively studied countries (Germany, the US and Australia) common difficulties in maintaining the currency of knowledge and equipment within

public technical institutions. These arise from the ageing teaching workforce, the rapid pace of technological progress, the high cost of leading edge equipment, the shift from generic classroom to workplace-specific training delivery, and discrepancies in pay and conditions between public VET institutions and private industry.

- Among these three countries, Australia lags in the recognition of VET's role in innovation and technology diffusion (as evidenced, for example, in Australian VET's 'very minor' share of government technology diffusion program funds). Australian VET is also relatively poorly integrated into broader industry policies. If the Australian VET sector is to raise its technology diffusion profile, it will require more teachers, upgraded equipment and possibly upgraded teacher technical qualifications.
- Overall, the institutions and processes used to identify and maintain the currency of equipment and teacher knowledge are inadequate. The teachers are particularly concerned at the age of TAFE equipment. However, they are adept at using compensatory strategies to maintain the currency of their equipment and knowledge – in particular the internet, informal networks of colleagues<sup>1</sup>, direct contact with industry and industry associations (including plant visits), and soliciting donations of equipment and consumables from companies. Some courses are heavily and increasingly reliant on such donations.
- Some small and medium-sized businesses base their capital equipment purchases on TAFE's capacity to provide training and technical advice. The TAFE teachers in turn are involved in product and process development through consultancies, return to industry programs, industry equipment demonstrations and exhibitions, and university research and development projects. This close collaboration between VET and industry in practice is difficult to reconcile with the government's inadequate recognition of VET as part of the Australian innovation system.

## 5 Conclusions and recommendations

The skill ecosystem demonstration projects and the recent Australian research all point to vital lessons on VET's current role, and more importantly its potential role, in innovation policy and practice.

The first is that a comprehensive understanding of innovation encompasses VET, and recognises that VET is ideally equipped for the role of diffusing new and innovative technologies to industry, particularly to small and medium-sized enterprises. Countries where VET is integral to their national innovation system significantly outperform Australia in this regard. National policy should reflect this understanding.

Second, the VET sector should engage with industry earlier in the production/service cycle. This will facilitate the early identification of barriers to the take-up of

---

<sup>1</sup> The Australian TAFE Science Teachers Network, for example, provides a strong collegial environment and offers invaluable professional development opportunities to its members.



innovation and technology, and the development of appropriate strategies to overcome these barriers. It will also open up new and promising fields of activity for the VET sector here and overseas.

Third, VET's engagement with research bodies and programs – notably CRCs, AusIndustry's Registered Research Agency program and the Australian Research Council – could and should be more extensive and intensive (see pages 5-6). Where these links are strong – for example, through the Swinburne UT microtechnology project – the mutual benefits are great and the complementarity of their respective contributions is evident. The CRC and ARC guidelines should be reviewed to offer greater encouragement of partnerships between the university/research and VET sectors (including assistance to the VET sector in interpreting these guidelines). Similarly, the AusIndustry RRA guidelines (which currently specify '... educational institutions such as universities and other higher education institutions' as eligible for RRA status) should explicitly invite RRA status applications from VET institutions.

Finally, the broad adoption of this expanded role for VET has policy and funding implications for government and the VET system. Particular attention needs to be paid to TAFE's knowledge and equipment base, and the professional development needs of its teaching staff.

## 6 Acknowledgements

Several Skill Ecosystem project leaders and other colleagues have contributed to this submission. We particularly wish to thank Peta Pash (Tea Tree Gully Campus, TAFE SA), who alerted us to the inquiry and proposed a joint submission, as well as Tony Smith (United Water, SA), Anne Bosio (Department of Further Education, Employment, Science and Technology, SA), Lyn Firminger (Swinburne University of Technology), Trevor Nottle (Torrens Valley Campus, TAFE SA) and Liz Keyes (Australian National Training Authority), each of whom augmented or corrected the submission at crucial points.

## 7 References

- Curtain, R. (2004) *Vocational education and training, innovation and globalisation*. Adelaide, NCVER/ANTA.
- Ferrier, F., C. Trood & K. Whittingham (2003) *Going boldly into the future. A VET journey into the national innovation system*. Adelaide, NCVER/ANTA.
- Toner, P. (2004a) *Why Innovation Policy Ignores VET*. Skill Ecosystems in practice: the experiences of demonstration projects in stimulating change. Sydney.
- Toner, P. (2004b) *Innovation agents: VET as an innovation Intermediary. A pilot study*. Adelaide, NCVER/ANTA.

## **ATTACHMENT**

### **ANTA national project on skill ecosystems Demonstration project details**

#### **1 Swinburne University of Technology (TAFE Division) Microtechnology and CRC project**

The demonstration project comprised four sub-projects:

- examination of the partnership between Swinburne UT (both the higher education and the TAFE divisions) and MiniFAB (the Micro-Bio-Nano Company) that evolved from the CRC for Microtechnology (a components of the technology hub centred on the synchrotron being built in the Monash Science and Technology Cluster), aimed at the transfer of skills and knowledge from the research setting into a number of VET teaching departments
- a resource sharing trial between MiniFAB, the TAFE mechanical and automotive, electrical and electronics, and industrial sciences departments, and Swinburne's Centre for New Manufacturing
- examination of Swinburne TAFE division's involvement in two CRC bidding processes – a bid for refunding through the Industrial Research Institute Swinburne (IRIS) of a number of manufacturing-related CRCs; and a new bid for an organic food products CRC
- mapping and modelling of several different existing relationships between CRCs and TAFE colleges or other registered training organisations (RTOs).

#### **2 Water Innovation Network (WIN) project**

A water industry innovation network was established in South Australia for the purposes of this project. WIN comprises United Water International (the major water utility managing Adelaide's water supply), plus a cluster of about 150 companies serving the industry, together with Torrens Valley TAFE and the South Australian Government. Importantly, WIN seems to be an enduring outcome of the project.

The WIN project is an endeavour to move the point of engagement between VET and industry forward in the product/service cycle by

- initiating industry contact and involvement at an early stage
- enhancing TAFE staff's first-hand knowledge of and involvement in research and innovation.

The approach was piloted through forums conducted at two centres involving grower-producers, irrigation trusts, extension officers, land and planning officers, and TAFE educational staff.

The wide range of specific initiatives include

- a partnership between TAFE and Measurement Engineering Australia in developing resources for TAFE courses in irrigation control
- TAFE collaboration with Caroma Industries in developing water saving plumbing fixtures

- discussions between TAFE and Sentek, a manufacturer and exporter of soil moisture measurement technology, on aligning the company's research and development program with Torrens Valley TAFE's courses
- shared use by TAFE students and company staff of a new teaching facility at Urrbrae TAFE campus sponsored by the pipe system manufacturer Philmac and built around a closed pumping system donated by Grundfos
- Torrens Valley TAFE's interactive video games unit's collaboration with United Water and research mathematicians on computational fluid dynamics systems – TAFE's contribution being to make the water flow data more accessible and comprehensible to non-mathematicians.

More recently, as a direct result of the WIN project, TAFE SA and United Water have embarked on pioneering research into the storage and treatment of stormwater in aquifers for later use in urban water supplies. TAFE's role is to ensure that skills development keeps pace with the expected outcomes of the research, which requires full access to the research team and the technology. (See [http://www.uwi.com.au/frames\\_new.php](http://www.uwi.com.au/frames_new.php), article headed "United Water leads unique TAFESA involvement in world-first research" of 5 April 2005.)

Finally, WIN members collaborated in a successful \$6.7 million submission to the Australian Government to establish the International Centre of Excellence in Water Resource Management, based in Adelaide. The collaboration involved TAFE SA, the CSIRO, six universities and three CRCs. WIN's involvement was pivotal in ensuring that the VET sector was included in the centre's learning programs. As a result, the centre offers training at all qualification levels from AQF 2 to higher degree (including PhD), covering occupations ranging from operator to management, technology design and research. (See <http://www.developmentgateway.com.au/jahia/Jahia/cache/offonce/lang/en/pid/2326>.)

### **3 Riverina TAFE Constructed Wetlands project**

The project's purposes were to

- develop the role of Riverina TAFE as an innovation agent for the creation, diffusion and commercialisation of new knowledge and skills in the waste water management industry, including through its new consultancy service
- develop and implement new curriculum to support the use of wetland technology for waste water management by industry (particularly agriculture and horticulture) and urban developments
- improve local business and environmental practices, including effective management of water resources.

Wetlands offer a natural technology for treating waste water and surface water containing high nutrient loads in order to lessen the damage it causes to our river systems. That they are grossly underutilised (relative to engineered solutions) for this purpose is due to public and official ignorance of their value in this regard, and the absence of retail outlets offering wetlands construction kits. There are also a range of negative industry and community views – many of them based on misconceptions – about the merits of wetland versus alternative engineered solutions to this problem.

The interim report identifies opportunities for the VET sector to deliver learning and skills development to this emerging industry. Further outcomes flowing from the project may include

- the development of learning products and programs for those engaged in wetlands design, construction and maintenance
- establishing a consultancy and brokerage service to support the diffusion of wetland technology
- diffusion of these products and services through Riverina TAFE's constructed wetlands website ([http://www.rit.tafensw.edu.au/nec/constructed\\_wetlands/default.asp#5](http://www.rit.tafensw.edu.au/nec/constructed_wetlands/default.asp#5)), including through an industry newsgroup.