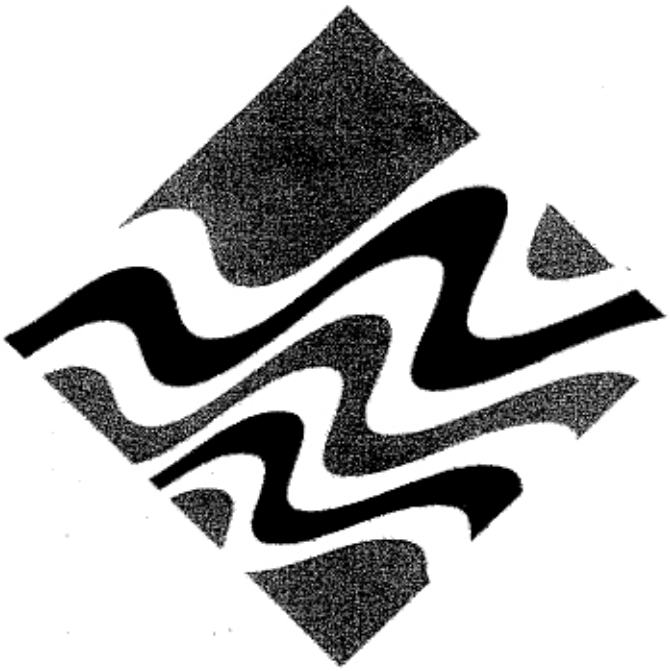

PHOTONICS **INSTITUTE**

Submission to House of Representatives

Standing Committee on Education and Training
Inquiry into vocational education in schools

5 June 2003

The Photonics Institute Pty Limited ACN 092 654 941
GPO Box 464 ACT, 2601 Australia
Phone +61 2 6251 8100 (Canberra)
Fax +61 2 6251 8200 (Canberra)

5 June 2003

The Chair
The House of Representatives
Standing Committee on Education and Training
Inquiry into vocational education in schools

The Photonics Institute Pty Limited

Background

The Photonics Institute Pty Limited (**"The Photonics Institute"**) is the education and training company of the Australian Photonics Cooperative Research Centre (**"APCRC"**). The APCRC was established under the commonwealth government's Cooperative Research Centres program in 1992. The APCRC punches above its weight in the photonics technology sector. The industry is based in Sydney, Canberra and Melbourne.

Australia is among the top ten global centres of excellence in photonics' – Steven G Duvall, PhD, Intel Fellow 1992

Photonics is the control, manipulation and storage of data using light. Photonics is the underlying technology of the Internet with applications in telecommunications, sensing, biomedical, robotics etc. The core skills and capabilities are centred on novel photonics materials, optical fibre, planar integrated circuits, automated manufacturing and information processing systems. The technology is developing at twice the rate of Moore's Law (doubling the number of circuits on a silicon chip every 18 months), which is effectively a doubling of capacity every **9** months.

The APCRC has 26 participants – Universities of Sydney, Melbourne, ANU, RMIT and UNSW and TAFE NSW and 20 Corporates both small to medium enterprises (SME's) and transnationals. The Australian Photonics CRC is the only CRC with TAFE NSW as a full participant and has been working for over five years with the TAFE Industry Partnership Centre located at the Australian Technology Park, and with Lidcombe College of TAFE in particular, to ensure that as the Australian photonics industry expands, there are people with the requisite skills to meet employment demands.

The APCRC via its commercialisation company, Australian Photonics Pty Limited (**APPL**) has been responsible in large measure for the creation of 14 spin off companies or new businesses, all of which are still operating today. Please see the ***attached*** chart. This is indeed a new and emerging industry.

All CRC's have an education and training objective. Typically this is concerned with the development of postgraduate programs and technology diffusion of research results to industry. The Photonics Institute for the APCRC has embarked upon a groundbreaking vertically integrated approach to meeting the labour force requirements of its industry.

In 1999, the APCRC undertook a review of the labour requirements facing the Australian photonics industry in order to maintain its 1.5% world market share. This equated to a turnover in excess of A$2B pa with between 18,000 to 24,000 people requiring training by 2010. This situation was made critical by the 'brain drain' of highly qualified researchers overseas.

The Photonics Institute has linked world-class researchers with industry and education providers to meet the skill needs of industry.

Half of these jobs were expected to be of a technical nature and the remaining half requiring a university qualification. This was the height of the 'dot com' boom.

An example of the explosive growth in photonics can be gauged from the growth of JDS Uniphase, the "Intel" of photonics. In 1994, this was a laser company with a small turnover raising its first US$20M in venture capital, run by an expat Australian, Kevin Kalkhoven. By 2000, it had a market capitalisation on NASDAQ of US$96B, bigger than Sony. Today, it has sales of US$840M pa and employs over 9,300 people, with a market capitalisation of US$4.9B, a 100-fold increase in 8-9 years.

Activities of the Photonics Institute

The Photonics Institute's vertically integrated approach has led to the implementation of the following activities: -

- A national travelling program for secondary students titled "***From Fountains to Photonics***" show, which has now travelled extensively around regional Australia and presented to audiences of more than 25,000 pa. In excess of 52,000 secondary students throughout Australia will have seen the presentation by December 2003. The Photonics Institute engaged Questacon to develop and deliver the Photonics Science Show – an hour-long entertaining look at this new and emerging area of science. This was Questacon's first venture into bringing specialised science to senior high school students – a difficult audience when you mention the word "physics". The Photonics Institute facilitated the development of content for the show with researchers in the field. This was the **first** major science show to focus on a cutting edge vocational theme **ever** to visit regional areas from as far as Moree in NSW to Port Headland in WA.

- A Photonics Science Show for Sydney Metropolitan schools from the Australian Technology Park in Sydney – more than 5,000 attendees since commencing the show in June 2002

- Involvement in the NSW Governments' 'e-Summer School" for less advantaged students. The photonics show was delivered in *real*

time over the Internet to all participating groups in NSW. A seminal comment made by a female year 10 participant was that at the start of the e-summer school, she expected to have a job 'in childcare" – at the end of the school – "I want a job in telecommunications!"

- Participation in the Siemens Science Experience for Year 9 students

- Intensive workshops where high school students "create something" and work together in an on-line community – to create – a game, a website and other materials to present. The PHOTONICS INSTITUTE linked these schools with expert support of researchers from The University of Sydney, RMIT, ANU and the University of Melbourne, Ericsson and IT professionals from the University of Sydney and the Photonics Institute. Selected schools were: -

    - Calwell High ACT
    - Bega High School NSW;
    - Ballarat (Ballarat High School, Sebastopol Secondary College, Mount Clear College, Ballarat Secondary College and Banksia Secondary College from metropolitan Melbourne.

- The development of curriculum for senior high school Physics in Victoria.

- A foresighted and strategic ("brave and courageous") decision to support photonics training has been made by TAFE NSW by developing and offering of Diploma / Advanced Diploma in Photonics both at Lidcombe College of TAFE and, more recently, at Mt Druitt College of TAFE).

- Similarly to NSW TAFE, the Canberra Institute of Technology (**CIT**) took a forward-looking approach with the development of curriculum in photonics. The Photonics Institute, with the support of the ACT Government (with a strategy of supporting photonics) accelerated the development of curriculum within **one** year, not the expected 5 years. This is the time frame required by new and emerging industries with rapidly developing technologies.

- The facilitation of curriculum developed in NSW TAFE, to CIT and with the aim of extending this to Victorian TAFE's. The Photonics Institute is acting as the 'honest broker' to bring this curriculum to Victorian VET sector. The Photonics Institute with industry support can bring these groups together.

- The Photonics Institute being **bound** (by Memorandum of Cooperation – currently being renewed and updated) to keep NSW TAFE teachers up to date with the latest developments in the industry.

- Approval from the NSW Board of Studies for the delivery of photonics in NSW high schools as an HSC TAFE-delivered (**TVET**) course as a pilot program in 2004. The equipment involved in photonics is extremely expensive, well beyond the reach of most universities, let alone high schools. In order to provide high school students with hands-on experience, the PI decided to leverage from existing concentrations of equipment at TAFE and universities. Lidcombe College of TAFE is taking advantage of drastically reduced prices for photonics equipment and is installing a clean room for use by its students. This will exceed most universities' ability to offer fibre-handling opportunities to students.

- A major initiative has been the development of a significant body of online content in photonics involving the collaboration of 5 Universities and available for use at other universities. (Universities of Sydney and Melbourne, ANU with RMIT and Macquarie Universities planning to contribute). To have 5 leading universities in the field collaborating and cooperating is regarded with some astonishment internationally. This activity has been supported by DEST.

- Rather than a single University develop one subject in photonics for its own use and possible on-line sale, the Photonics Institute is developing 10 modules or subjects lasting one session authored by leading researchers and teachers in the field. The Photonics Institute aims to adapt these materials for high school science curricula and also make these materials ***directly*** available to high school students in 2004 over the Internet and available for upgrading of relevant TAFE courses.

- Facilitation of new degrees in photonics within science and engineering departments of universities – e.g. at the Universities of Melbourne, Sydney, RMIT, UNSW, ANU, Newcastle, Macquarie and postgraduate degrees at ANU and UNSW.

- Development of a 'cool' website (exploreyourfuture.com.au) to meet the high school audience's expectations of a "non science looking" science site. We have tried to make a place where students can explore, experience, find and create something about science.

VOCATIONAL EDUCATION AND TRAINING ISSUES REGARDING EMERGING TECHNOLOGIES

By definition, working with and in the area of emerging technologies necessitates an entrepreneurial approach. Traditionally, such an approach has been unfamiliar to the VET sector. Indeed, the VET sector seems to find the area of emerging technologies and its associated culture difficult to grasp

and respond to in ways that are meaningful, particularly to the SMEs working in this area. Evidence of this is the apparent lack of VET courses, or even parts of courses, in new and emerging technologies, their applications and anticipated future developments.

Emerging technologies and emerging industries have very special and different needs from traditional industries. Emerging industries are characterised by: -

- a rapid pace of growth that demands of their people enormous energies and inputs of time;
- development of new products;
- the attraction and sourcing of investment, and
- the myriad of other requirements associated with building start-up companies.

Generally, the people who work in and manage these companies are both cash-poor and time-poor - further education and training is not a high priority for these people. That issue alone has potential consequences for such industries in the medium to long term. These people are acutely aware that, in terms of Return on Investment ("ROI"), any competencies they help to develop for their industry today will most likely be superseded within a maximum of one to two years, requiring their further input into a continual updating process.

The current national training framework does not pay particular or adequate attention to the training needs of companies involved in the development of emerging technologies. In fact, the training package milieu unintentionally discourages the VET sector from meeting those companies' training needs. The ramifications of this are significant: on one hand, there is a federal government policy initiative ("Backing Australia's Ability") that fosters innovation and the further development of emerging technologies, whilst on the other hand there is a national, federally supported VET system that fails to respond adequately in identifying and meeting the training needs of such companies. This becomes of even greater consequence when it is acknowledged that the vast majority of these companies are SMEs.

The following VET issues particularly apply to these companies that work in the field of emerging technologies and emerging industries:

- Companies that work in emerging industries find it difficult to source sufficient workers with the required skills. Currently, this fact is being neither acknowledged nor addressed by existing VET programs. By their very nature, in emerging industries there are large and very fast increases and decreases in the numbers of people required - the employment market in these industries is, by its nature, **volatile**. It is a major challenge to the VET sector to respond in a timely, flexible manner to this issue.

- Development of new VET courses in these emerging technology areas is sometimes hampered by inappropriate and lengthy approval and accreditation processes. For example, by the time it takes to identify and generate units of competency for these areas,

and then develop training packages, the applications of those technologies have moved on considerably, and the training package and, perhaps, the unit of competencies are redundant before they have been implemented. This can be summarised by the pace of change in the industry – 'what is on the bench today, will be on a chip tomorrow'.

- The effects of the application of knowledge associated with emerging technologies are sometimes incremental and, therefore, are more about new content than about new competencies. This difference needs to be recognized. For example, when a process changes because of a new technology, it is perhaps not necessary that the competency needs to be changed. Rather, it may be that the knowledge associated with the competency needs to be updated. On the other hand, sometimes, the knowledge associated with disruptive innovation and the application of emerging technologies requires the development of a new competency. The training framework needs to accommodate the implications of ***both*** disruptive innovation and incremental innovation. Each of these necessitates new roles for the VET sector.

- Since emerging technologies are often "enabling" technologies, by default they will run across several industry areas. Photonics is such a technology with widespread applications using light instead of electronics. Implicitly, the VET sector then needs to acknowledge that teaching areas will need to be straddled and boundaries will need to be blurred. This has important implications for collaborative work between traditionally "siloed" disciplines, teaching sections and teachers in ways that are not currently part of the VET teaching paradigm.

- There is a need, also, for these technologies to be embedded rather than for them to stand-alone. This is especially the case with those technologies that are converging with Information Communication Technologies ("ICT") - eg bioinformatics, biotechnology, biometrics, nanotechnology, and photonics. Each of these will require different skill sets than those we currently identify. It follows that they will also require different training content and different ways of delivering that content. The VET sector has neither seriously begun to address this issue, nor how the sector will keep up with this embedding, nor how it will ensure its teachers maintain their currency of content knowledge and teaching skills.

- The VET sector in photonics has been recognised as a viable mechanism for the transfer of new practices, developed through research and development. This is the exception. How the VET sector responds to taking on that role, or whether it does so, has not begun to be addressed.

- The vast majority of training packages and VET delivered in Australia are designed to meet the needs of mature industries and existing technologies and industrial practices. There is a danger that the VET sector will become increasingly incapable of meeting the

needs of young companies involved in the development and implementation of emerging technologies. Hence, scarce VET funding is used to support established and traditional industry sectors, and is generally not made available to support emerging, high growth industries. This becomes a serious structural barrier to the development and delivery of training in these areas. Such training courses usually begin with high development costs and low student numbers. These numbers are unpredictable. The VET system seems perplexed by this and seems paralyzed in responding to this in a meaningful manner.

- Emerging technologies can change industrial practice quickly. As an emerging technology is itself embedded into an industry's componentry, for example, so too will the skill requirements change - eg electronics industry and the transition from valves to integrated circuitry. The VET sector remains challenged by how it can reasonably respond to this.

- The VET sector sees emerging industries as a funding source, but does not recognise that SMEs that characterise these industries are less able to fully fund training programs than established industry. These companies guard cash carefully. They recognise that they have training needs but there is a perception amongst them that the VET sector does not understand those needs, nor does it seem keen to embrace their call for a more equitable funding mechanism to support their particular needs.

- As yet, the VET system has no formal funding mechanisms for implementing new courses in emerging industries. This is further complicated by the barrier of the high cost involved in both developing and accessing training resources in new areas.

- The small business management training needs of SMEs working in emerging technologies and emerging industries are quite different, in some ways, from those of SMEs working in traditional industries. This fact is not yet acknowledged in any training package content.

- There is a lack of traineeships in the areas of emerging technologies and emerging industries. Often, these areas transcend a number of industry areas, and involve a convergence of a range of technologies. The usual traineeship development processes need to be adjusted to take into account these factors.

Recommendations

1. DEST to establish a new funding program to meet the special VET needs of emerging industries such as photonics. These would require a quick approval process where the appropriately qualified organisations apply. (World-class researchers closely linked to the emerging industry).

2. The Photonics industry / Institute approach may be seen as a generic model for new and emerging industries. This model could be used to spread 'best practice' to other industries at a similar stage of development.

3. High school students are media 'savvy' – we have to let them know that there are exciting careers out there in these 'hitech' industries. Kids use the digital media and obtain their information from it. A combined approach of: -

   i. Raising awareness by 'shows' both entertaining and with scientific content presented by young people;
   ii. Reinforcing this experience with an appropriate resource i.e. non-boring web portal for students, **parents and teachers**. The Photonics Institute ran a number of focus groups before the web name "exploreyourfuture" was developed, rather than the "Photonics Institute" – generally agreed as very boring by 16 year olds.

   has proved successful to date and is recommended.

4. As per 3.ii. above – schools and or TAFE's in regional areas **need to have increased bandwidth to participate in the digital culture**. In reality, city schools also have to have adequate bandwidth. Schools if connected, are on average 50kb per second. South Korea, for example, has 90% of households connected at 20 Mbs per second, 400 times faster. This is not just an issue for the photonics industry – the bioinformatics industry has long term expectations of using petabytes of data i.e. a billion billion bits per second.

5. Photonics has a great appeal to school students as they can see this application of physics in their daily lives. The VET in schools experience has to be linked in practice where the industry is now, and hopefully where it is heading. (for photonics – this is in advanced manufacturing). Students need to develop **generic skills**.

6. Provide resources for the professional development of teachers. Our experience has been that for example, TAFE teachers of electronics, the old technology, welcome the opportunity to interact with leading researchers and industry to develop new skills to teach photonics. This interaction is **essential,** as you have to create a mechanism to keep teachers up to date, in a rapidly changing industry.

7. The trade off for expediting the approval of the TVET course in photonics was in its exclusion from calculation in a students' TER Score. It is recommended that these subjects be approved quickly **and** be included in the TER score.

8. DEST to conduct a review of approval processes and mechanisms for VET sector courses and curriculum with a view to simplifying and amending them to ensure they meet the training needs of emerging industries.

9. The nature of new and emerging industries is that they are complex and not resourced to receive students on work experience. Operations usually occur in clean rooms that are not designed as training venues. The initiative of Lidcombe TAFE by investing in such a Cleanroom facility is to be applauded. Similar facilities are the norm for the biotechnology sector. It is recommended that facilities that match industry standard be funded and developed.

10. New and emerging companies are cash and time poor. Work experience in industry is difficult to provide in this environment. It is recommended that at this level, work experience not be a compulsory requirement of the subject. This experience can be gained if recommendation 9. is adopted.

11. The commercial efforts of APPL and Redfern Photonics in creating new businesses provide an example of an Australian emerging industry based on research. A generic skill required by all new businesses is an understanding of innovation, entrepreneurship and communication. The often-quoted example of Australian innovation – the Hills Hoist (still quoted!) is past – we need to move on and equip these students with the skills noted above. These ideas should be included in the vocational education curriculum.

I look forward to discussing these issues with the Committee.

Lee Ridge
Chief Operating Officer

Australian Photonics Group

Australian Photonics Pty Ltd - Incubator

REDFERN PHOTONICS

REDFERN OPTICAL COMPONENTS

COMPONENTS
Active & Passive

RPO

TECHNOLOGY
PLATFORM

Kadence Photonics

AUTOMATED
MANUFACTURING

BANDWIDTH FOUNDRY

FOUNDRY
SERVICES

PHOTONICS INSTITUTE

E & T

Investment

Photonics Foundation

Consulting

Bandwidth SOLUTIONS

Centaurus TECHNOLOGIES

VPIsystems™

* REDFERN INTEGRATED OPTICS

INTEGRATED
CIRCUITS

* adaptif PHOTONICS

MODULES

* RBN Redfern Broadband Networks

SYSTEMS

cactusfiber

FIBRES

* NUFERN

FIBRES
App. Specific

* 法尔胜光子 FASTEN PHOTONICS

FIBRES
Longhaul

**** Investee companies***