

A SUBMISSION

TO

**THE HOUSE OF REPRESENTATIVES STANDING COMMITTEE ON
SCIENCE AND INNOVATION**

INQUIRY INTO PATHWAYS OF TECHNOLOGICAL INNOVATION

FROM

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THE AUSTRALIAN PHOTONICS STORY

DISCLAIMER

This paper is submitted to the Inquiry to address matters of public interest – the successes of the Australian Photonics Cooperative Research Centre (“Photonics CRC”) in its 12 years of operation from 1992, and recent events that have attracted media interest¹ associated with the collapse of its efforts to win ongoing funding from the CRC Program^{2,3} in 2004, and the subsequent impact of this on its operations in 2005. The story below includes aspects associated with each of the eight “issues” that the Inquiry is investigating, and I have drawn these out in the summary section.

This submission is made in my private capacity. I was the CEO of the Photonics CRC from its inception in May 1992 to November 2004. I believe that there are many lessons to be learnt from the Photonics CRC story of interest to Parliament, governments, research organisations and businesses. There are some particular matters that have been recently raised by the media in an unnecessary and provocative manner¹ that will be addressed herein by way of explanation. However, I believe that the story outlined below provides insights for Parliamentarians and others that are relevant to the Terms of Reference.

The views below are not those of any organisation with which I have been associated, and I have consulted with none of them in the preparation of this submission. The task of presenting the story is challenging because of the legal complexities and limitations imposed on confidentiality, but the facts below are drawn from publicly available information – from annual reports of the Photonics CRC and its Major National Research Facility (the Bandwidth Foundry), media reports and other sources available to the public.

¹ ABC Lateline 6th April 2005 www.abc.net.au/lateline/content/2005/s1339855.htm

² ABC PM Radio 7th May, 2004 www.abc.net.au/pm/content/2004/s1103898.htm

³ Ministerial Release:

www.dest.gov.au/Ministers/Media/McGauran/2004/05/mcg001130504.asp

THE REASON FOR PUBLIC INTEREST

In the period 1992-2006, the Commonwealth will have invested \$55.4 million from the CRC Program for the Photonics CRC, \$9.5 million from its Major National Research Facility (MNRF) Program for the Photonics CRC's Bandwidth Foundry, and its spin off companies will have received substantial funding from the Commonwealth through START and other programs that I have estimated to be about \$15 million. That is, a total direct Commonwealth investment of about \$80 million in the Photonics CRC and its enterprises over 14 years.

The Photonics CRC evolved to be the body that coordinated photonics research and commercialisation in Australia, and it has largely collapsed as a result of the failure of the Commonwealth to invite the Photonics CRC to submit a Stage 2 application for ongoing funding.

The media reports infer that the Photonics CRC may have squandered the Commonwealth's investments, and this would be matter of significant public interest, if true.

THE PHOTONICS STORY

What is Photonics?

Photonics is the use of photons, the fundamental particles of light, to transmit, process and store information. Albert Einstein was awarded the Nobel Prize in 1921 for his discovery that light was composed of "photons". There is an analogy between photons/electrons and photonics/electronics in terms of physics, technologies and markets.

It was the discovery of the laser in the 1960s that lifted the profile of photonics from classical optics, the oldest of all scientific disciplines. Lasers are a powerful source of light that have many applications, but it was the development of optical fibres in the period of 1965-1975 to transmit light over long distances, which brought about the first major commercial application of photonics, in the telecommunications markets. More on this market below, however...

It was the advent in the 1990's of CD and DVDs as optical storage devices, and more recently LCD display screens, which have provided "photonics enabled" consumer devices. It has been stated that some 35% of all consumer electronics products released in 2004 were "photonics enabled"⁴ with a market of US\$138 billion in 2003. The global market segment for the enabling photonics components was US\$60 billion in 2003⁵, and has been growing at an average of 15% pa⁶. The rapid transition of photonics from being a niche technology in the 1970s to a pervasive technology in the 2000s provides an excellent case study for tracking the pathways of innovation. Photonics, like electronics some 30 years earlier, has become an enabling technology, and will become embedded in many industry sectors⁷. It will lose its identity.

⁴ OIDA statement at the ICOIA 2004 (Denver, Colo, USA)

⁵ Market reports from Optoelectronics Industry Development Association 1998-2003 (USA)

⁶ Market research from the Photonics Industry Development Association 2004 (Taiwan)

⁷ Department of Industry, Tourism and Resources' Electronics Industry Action Agenda, www.industry.gov.au/content/itrinternet/cmscontent.cfm?ObjectID=D410D561-7918-44EC-9961611F3988ABAA

The pace of innovation has not changed. For example, the major semiconductor companies have signalled a change in the strategy for the next generation computer chips – namely distributed electronic processors⁸ to bypass Moore's Law. The end game in this strategy is likely to see multiprocessor chips linked by photonics circuits to solve the timing and input/output problems – the so-called "last micron" problem or "Fibre to the Processor"⁹. Thus photonics will be used from the tiniest computer chip in one place to generate information to deliver that information across the globe to another processor. Photonics has quickly become a pervasive technology, and one of the enabling technologies of the US\$1.5 trillion global information industry.

Photonics, as a telecommunications technology, began to be deployed in the 1980s, and delivered in the 1990s more than expected in terms of bandwidth. However, the business models of the telecommunications companies in the late 1990's failed to recognise the pricing impact of the widespread deployment of optical fibres, and many shareholders lost money as a result of the turmoil. Suddenly, the carriage of information became a commodity because of photonics, reversing over 100 years of telecommunications engineering wisdom. Photonics is a victim of its own success, and I believe the telecommunications crash was largely the result of this disruptive technology.

Today, optical fibre is used to transmit virtually all international and inter-exchange communications, and telecommunications companies are now focussed on the delivery of services rather than carriage of communications. In North America, optical fibre (Fibre to the premises - FTTP) is emerging as the delivery infrastructure to residential customers for the "triple play" – the delivery of future proofed voice, data and video services. The deployment of optical fibre to replace the aging copper networks in the "last mile" to the consumer has been stimulated in the North American markets. The FCC ruling on deregulation of this infrastructure is aimed at maximising the telecommunications companies' investments in infrastructure¹⁰. The roll out of FTTP infrastructure in Australia may take place over the next decade, at a cost that has been estimated to be as high as \$30 billion, and as little as \$7 billion for non-metropolitan areas¹¹. This is a matter of public interest as the sale of Telstra and the need and costs for "real future-proofed" broadband¹² infrastructure are debated.

What is Australia's Competitive Advantage?

The Photonics CRC story discussed below suggests that photonics in Australia is at a tipping point. In the early 2000s, Australia was recognised as being a photonics "hot spot":-

"I consider Australia to be among the top ten global centres of excellence in photonics" says Steven G Duvall, PhD, Intel Fellow, June 2002¹³

⁸ Intel announcement: www.intel.com/cd/ids/developer/asmo-na/eng/201969.htm?page=6

⁹ Publications eg A J Levi et al 2005 www.usc.edu/dept/engineering/eleceng/Adv_Network_Tech/Html/publications/JLT2004.pdf

¹⁰ Federal Communications Commission (USA), see www.fcc.gov; see eg www.convergedigest.com/blueprints/ttp03/z1catena1.asp?ID=3&ctgy=Market

¹¹ Future-Proofing Telecommunications in Non-Metropolitan Australia; A position paper from Page Research Centre Limited, Telecommunications Advisory Group www.page.org.au

¹² Broadband communications is defined as 500kbit/s as a minimum. This is not even delivered today by most ADSL connections in Australia. The marketing of "broadband as ADSL" has lead to concerns in the UK eg

www.ecorridors.vt.edu/news/topic/?article_id=107&cat_type=topic&cat_id=3

¹³ Photonics CRC website, www.photonics.crc.org.au

and

"The Australian Photonics CRC supplies us with advanced technologies that we cannot source from our allies" Dr Roger Lough, DSTO Chief Defence Scientist ¹⁴ in June 2004.

In our Universities, we have concentrations of research and teaching skills in photonics that attract the top international recognition from peer reviews and other metrics. At the commercial level, our experience is mixed. There was a massive retreat of manufacturing from Australia by the big multinational corporations in photonics following the telecommunications crash (JDS Uniphase, Nortel Networks, ADC). However, we have largely maintained our strong SME base, exemplified by one of the largest private capital raisings in Australia ¹⁵. These companies were largely born prior to the crash, were forced to downsize during the slump, but most have survived. I have estimated that there is over a 80% survival rate of these companies, whereas worldwide the survival of similar companies has been about 10%. I will refer back to this point later. But will they prosper?

We are at a tipping point – at the same position similar faced by our electronics industry in the 1950s-1960s, where the misguided decisions of a few people in leadership in government, research organisations and industry meant that Australia dissipated its leadership position in the global race in microelectronics. Following WWII, Australia had a very high level of skills in materials science and the adjacent areas that became the core of microelectronics – the heart of modern Information Technology (IT). Since the collapse of Australia's microelectronics industry in the 1960's, there has been a gloomy view that Australia cannot compete globally in any "high" technology area, principally because of our distance from global markets. This undercurrent is often felt in the contests for public sector funding, and amplified by an arrogant Treasury view that government funding of research is a luxury, and not a necessary investment for economic growth. The conclusions that Australia cannot compete in high-tech manufacturing does not take into account the impact of global communications and rapid freight; the mindset of global companies (and financiers), to access and fund innovation wherever it occurs; and the impact of the uptake of innovation in long term wealth generation. The seeming collapse of the Photonics CRC has occurred at an inopportune time because as a consequence, and we have lost the coordination capacity – the "glue" that held the interested parties together, at a time when cohesion will have a large impact on the future. Unless there is some remedial action, the coordination will fragment and the parties will go their separate ways, dissipating the critical mass required for growth. I am convinced that this outcome is not in the national interest.

History is important in looking at the future. The focus of photonics research and commercial activities in Australia was rooted in telecommunications. The background is set out in a recent article ¹⁶. It arose from the strong sponsorship of research by OTC and Telecom in the 1980's and their roles in maintaining close linkages to its technology suppliers. That is, these government owned organisations were able to guide both university research and product development by their suppliers. With the formation and privatisation of Telstra, both of these leadership positions were vacated as a result of Telstra's policy and commitment. The legacy was an established innovation capacity, and the Photonics CRC emerged as the

¹⁴ Australian Photonics CRC Annual Report 2003/04

¹⁵ Redfern Photonics 2000 eg www.ferret.com.au/articles/23/0c003c23.asp

¹⁶ Mark Sceats and Elizabeth Elenius, "Innovation in the Australian Photonics Industry", Telecommunications Journal of Australia 52, 12-22 (2003).

entity that took over the leadership role in photonics. Niche markets for the applications of photonics – in defence and the power industry, were established within the Photonics CRC, but were of secondary importance. In the 1990's, there was very little interest/expertise in Australia in areas that were to become the consumer markets for photonics (CD/DVDs, LCDs, LEDs), and which have driven global industry growth for the last decade. The focus on telecommunications research in Australia may not, however, have been the strategic mistake it might seem:-

- In the USA, the FCC deregulated¹⁷ the access rights of competitors to optical fibre infrastructure in customer access networks, and this is expected to drive the roll out of FTTP to residential customers. The global markets for FTTP are estimated to be as large as \$3.2 billion by 2009¹⁸, with an annual growth rate of 54%. Thus FTTP will also become a large consumer market for photonics.
- There are new markets emerging for photonics developed initially for telecommunications applications – in sensor networks, defence, aerospace, manufacturing and medicine. Australia has focussed on a few core technologies in photonics, and it is likely that these will underpin many applications outside of telecommunications. This was the central tenant of the Photonics CRC's unsuccessful application for ongoing funding. This trend for photonics has been recognised by the Electronics Industry Action Agenda¹⁹.

In summary, the Photonics CRC inherited the role of OTC-Telecom in guiding photonics research and commercialisation in Australia. It had a well-established vision for technology development, and it used significant public funding to do this, but was it effective?

What has been the Performance of the Photonics CRC?

Recall that the Commonwealth has invested some \$80 million in the Photonics CRC and its related entities in the period 1992-2006. The performance test is the return on investment to the Commonwealth in terms of tax revenue.

- JDS Uniphase Australia (JDSU) paid company taxes in excess of \$60 million from profits²⁰. JDSU was created in Australia from the Photonics CRC's first spin-off company, Indx through an acquisition in 1996. This company grew to just under 300 staff in North Ryde by 2002, and was recognised within the JDS Uniphase group, the largest manufacturer of photonics sub-systems worldwide, as having the best manufacturing processes of all its divisions with, it is believed, gross margins well in excess of 60%. The parent company invested \$40 million in Australia²¹. JDSU itself claimed \$500 million

¹⁷ Federal Communications Commission (USA) www.fcc.gov; see eg www.convergedigest.com/blueprints/ttp03/z1catena1.asp?ID=3&ctgy=Market

¹⁸ RHK USA eg www.kmi.pennnet.com/press_display.cfm?ARTICLE_ID=211004

¹⁹ Department of Industry, Tourism and Resources, Electronics Industry Action Agenda, www.industry.gov.au/content/itrinternet/cmscontent.cfm?ObjectID=D410D561-7918-44EC-9961611F3988ABAA

²⁰ This cannot be verified directly, but has been widely reported, eg Senior Officials Meeting, DCITA 12th Aug 2002

²¹ Tony Muller, CFO, JDS Uniphase, at the official opening of the Ryde factory, 6th April, 2001

pa of economic activity including spillovers²² at its peak.

- The Photonics CRC's investment arm, Redfern Photonics raised over \$230 million from the private sector for investment into its start-up companies²³, and JDSU raised \$40 million from its parent (see above). My estimate of the income tax paid by employees in and contractors to these companies to the Commonwealth exceeds \$70 million when account is taken of overseas investments and imports of equipment and components.

Therefore, without even adding the revenue to the Commonwealth from sales of products and spillover multipliers, the investments in the Photonics CRC and its spin-offs by the Commonwealth of about \$80 million have yielded taxation income to the Commonwealth well in excess of \$130 million. The Commonwealth's investment has been recovered. And there is profit to come ... Worldwide, I estimate that only about 10% of the photonics companies that existed in 2000 survived in the wake of the telecommunications crash²⁴, yet the survival rate of the Photonics CRC's spin-offs is closer to 80%²⁵. These survivors are well poised for success, and the long-term tax returns to the Commonwealth will be all profit.

The positive return on Commonwealth investments to date and the high relative survival rate of spin-offs that may generate future returns comprise the ultimate answer to the question of whether the Commonwealth's funds provided to the Photonics CRC and its related entities have been well spent²⁶.

However, the ABC Lateline program¹ dealing with the Photonics CRC makes a number of claims dealing with:-

- Finances and Governance of the Photonics CRC
- The Bandwidth Foundry, a Major National Research Facility

These are addressed below by way of explanation:-

Finances and Governance of the Photonics CRC

The Photonics CRC submitted in 1999 an application for second phase funding for 1999-2006 from the CRC Program in 1999 for \$7 million pa²⁷. It was awarded a grant of less than \$4.0 million pa. The Commonwealth refused to allow the Photonics CRC

²² As reported in the media www.ferret.com.au/articles/0d/0c00f70d.asp

²³ Redfern Photonics 2000 eg www.ferret.com.au/articles/2370c003c23.asp and updates through reports to shareholders, Photonics CRC Annual Reports

²⁴ There is only anecdotal reports for this assertion.

²⁵ Surviving spin-off manufacturing companies that were trading as at May 2005 are ROC, RIO, RPO, RBN, Adaptif, Fasten Photonics, Nufern, VPI Systems, Bandwidth Foundry and, say, Centaurus and Cactus Fibers (the last two are in prefunding start-up or suspense); and companies that are no longer trading are Indx (ex JDSU) and Kadence. Some of the survivors have operations overseas, and foreign investors, which will limit taxpayers returns.

²⁶ There are a number of studies pointing to "spin-off survival" as a metric for the effectiveness of public sector funding. eg in Canada - see Clayman and Holbrook "Surviving spin-offs as a measure of research funding effectiveness Surviving spin-offs as a measure of research funding effectiveness" May 2005.

www.sfu.ca/cprost/docs/CF1%20spinoffs%20March2.doc

²⁷ Photonics CRC Funding 1992-1999 was \$28.3 million (Phase 1), 1999-2006 was \$27.4 million (Phase 2) and what was proposed for 2006-1013 was \$49 million (Phase 3).

to scale back the program of work. But the Commonwealth²⁸ conceded that the \$3.0 million annual “budget hole” could be filled by the sale of assets (eg equipment), from commercialisation income, and substitution by other Commonwealth funding grants²⁹. This intent was captured in the schedules to the Commonwealth Agreement.

It was this ongoing “budget hole” that created major challenges to the Photonics CRC management team, because it required the Photonics CRC to operate as a small business in managing cash flow. With an annual cash budget of about \$10 million, this represented 30% of the income budget. With governments pressing research agencies and universities to increase their external earnings, the Photonics CRC’s efforts to deal with this uncertainty should be of interest to Parliamentarians.

At a Governance level, it meant that the Photonics CRC Governing Board was required to approve both an Income Budget and an Expenditure Budget. It was then up to the Photonics CRC management to match expenditure with income during the year. Thus there was, each year from 1999, a substantial part of the total cash budget (~30%) that was uncertain at the commencement of the year. The uncertainty was large because the sale of shares to provide commercialisation funds and the winning of grants are inherently unpredictable and opportunistic. This goal to survive put great pressures on generating income from the commercialisation team, and encouraged researchers to raise substitutional funds through other Commonwealth funding schemes such as the ARC and MNRF.

- It was a motivation to succeed.
- It was a great tribute to the excellence of the researchers that they were very successful in winning ARC and MNRF funds. However, some of the larger research groups in the CRC Universities³⁰ were unable or unwilling to use this funding to substitute for the “budget hole” as a budget offset³¹.
- It was a tribute to the commercialisation team to be able to raise some \$8 million from commercialisation in 2000-2003 even when the markets were collapsing. These struggles are reported in the Photonics CRC Annual Reports.

However, the telecommunications crash of April 2001 eventually turned off the tap of funds that could be raised from commercialisation by mid 2003. The Commonwealth

²⁸ The CRC Program was then under the management of the Department of Industry, Science and Resources

²⁹ In effect, the Photonics CRC interpreted this to mean that relief from the “double-dipping” rules for competitive Commonwealth grants would be relaxed. This was later to become a major frustration, which the CRC was unable to manage with either the Commonwealth or the CRC Universities.

³⁰ The CRC Universities are the University of Sydney, Australian National University, the University of Melbourne, the University of NSW and RMIT University.

³¹ DEST and the ARC now seem relaxed about this approach, provided that there is a formal separation between ARC Projects (that may have CRC funding support) and CRC Projects (funded by the CRC). The Photonics CRC arrangement was that the proceeds from commercialisation from CRC supported ARC project would flow back to the CRC and the Universities in proportion to their relative inputs to the ARC Project, and APPL acquired the rights to commercialise that IP. The net effect was the CRC direct funding of the project would be reduced, but rights and prior investments and involvement would endure. Implementation required the consent of the ARC grant winners, and it was not always forthcoming, and if not, the ARC grant did not contribute to the CRC income budget.

greatly assisted by “reprofiling” the CRC Grant to bring forward funds, and the researchers all stepped up their search for alternative funding to fill the gap. In May 2003, I wrote to the University of Sydney, the major Photonics CRC Participant and the largest cost centre (consuming ~50% of the R&D funds) to open up negotiations for loan funding to fill the anticipated budget gap in 2003/04, on the basis that I could see very limited prospects in raising funds from commercialisation returns for some time. The CRC Governing Board was warned of the difficulties ahead when the 2003/04 income and expenditure budgets were approved in June 2003.

To compound this, the University has just won a new ARC Centre of Excellence in Photonics – CUDOS – in a way that would and did close off the transfer of staff from CRC funding to ARC funding³².

With the encouragement of the Vice Chancellor of the University of Sydney, a proposal was developed that Australian Photonics Pty Ltd (APPL), the Photonics CRC’s agent, would grant the University securities over its own assets that had not otherwise been encumbered, in return for a commercial loan. A proposal was put to the University in August 2003, but it was only in April 2004, after considerable due diligence, that a terms sheet for the loan was agreed³³. This was to provide working capital for APPL, as well as funding for the Photonics CRC’s research programs, principally at the University of Sydney, and the MNRF. This was a purely commercial transaction. Of course, by that time, the financial year was 75% completed, and APPL had been reliant on the loan proceeding – the unfilled “budget hole” foreshadowed some 12 months earlier had become a reality. Despite repeated requests from the APPL to cut expenditure (and staff) to fit the realities of income, the University of Sydney group only made token cuts in expenditure. The major rationale for the University of Sydney to provide this funding was to bridge the Photonics CRC through to a renewal of funding from the CRC Program. That application for new funding was not successful (see below), and when this was announced in April 2004, the University terminated the negotiations for loan funding on the principal basis that the risk profile for a commercial transaction had changed. This then put great pressure on APPL with regard to solvency because, as the Photonics CRC’s agent, it was also reliant on the Photonics CRC’s funds for its operations. The then Minister responsible for the CRC Program, Hon Peter McGauran, was informed in writing that the failure of the Commonwealth to invite the Photonics CRC to submit the Stage 2 submission would likely lead to the collapse of the loan finance, and that there would be very difficult times ahead.

The CRC Governing Board and APPL agreed to a restructuring of APPL (which was essentially owned by the Photonics CRC Participants). ASIC was alerted to the problems facing APPL and the restructuring, and tracked the processes with the full cooperation of the APPL directors³⁴. The Commonwealth was also kept informed of these processes. The complexity of the Photonics CRC made a simple restructuring very difficult to achieve, especially on terms that would allow APPL’s assets to be

³² CUDOS is an ARC Centre of Excellence. The CRC’s researchers at the University and the MNRF has supported another bid for funding against my advice, rather than collaborating with the CUDOS advocates at the time of preparation of the bids. This was a strategic mistake.

³³ The ABC Lateline reported the University response that “a loan has not been agreed”. This is correct. What had been agreed were the terms for the loan. The University had every right not to proceed with the loan funding when it believed the risk profile had changed.

³⁴ ASIC took no action on any possible insolvent trading. The APPL directors were meeting weekly with respect to cash flow, and were working closely with their advisors. The ABC Lateline report infers insolvent trading may have taken place, and the directors are on record that they would vigorously defend any such imputation. The creditors approved a Deed of Company Arrangement which, when finalised, will terminate this as an issue.

linked to the Photonics CRC's "budget hole". The CRC Universities³⁵ constantly advised the directors of Australian Photonics enter Voluntary Administration (VA), and their support for the alternative of a voluntary restructuring was limited by a refusal to provide financial support to APPL for its restructuring costs. This refusal to provide funds, when combined with repeated entreaties by the CRC Universities for the directors to put APPL into VA, was a clear signal of their intent³⁶. The directors of APPL responded that the entering of VA would not be in the interests of the Photonics CRC Participants or the creditors because this event would crystallise a number of long-term liabilities and the CRC Universities might lose their assets. The directors' preferred option was for the CRC Universities to provide financial support through a loan to enable APPL to scale down its operations and trade out of the cash flow problems. This was also the preferred option of APPL's third party creditors. It was firmly rejected.

The CRC Universities declared that they had lost confidence in the Photonics CRC management (broadly interpreted to be the CRC Executive headed by myself and the directors of Australian Photonics). The Commonwealth's view was that the Photonics CRC Participants must take, and be seen to take, control of the situation if they believed they had not previously been in such control. The Governing Board did not act on the proposal of the APPL directors that they be replaced by a new team, a power and responsibility given to the CRC Governors under the CRC Agreements. When that option, and the final calls for the provision of finance were not acted upon by the CRC Governors, the APPL directors had no recourse other than to put the APPL into VA – the preferred option of the CRC Universities from the outset. This triggered the loss of a major research contract with the Department of Defence, which further reduced the cash income, and the VA crystallised the long-term liabilities.

As a result the CRC Universities have lost³⁷ the majority of their interests in the commercialisation outcomes of the Photonics CRC. This is the outcome that was foreshadowed by the APPL directors at the beginning. The loss removed the only mechanism which the Photonics CRC had of filling in the medium term the "budget hole" that had emerged during 2003/04 through the Photonics CRC. In the long term, it can now only be filled by new commercialisation of CRC Intellectual Property, (that which has not yet been licensed).

In financial terms, the CRC Universities were not willing to risk the provision of funding to APPL in order to protect their interests in APPL's assets. This was a commercial judgement – namely that APPL, a company they substantially owned and controlled, was not worth saving. APPL's assets have passed across principally to another Photonics CRC Participant, whose principal investors are connected to the finance sector. The assets to be transferred are shares in start-up companies. The ownership of the Photonics CRC's Intellectual Property, by and large held by the CRC Universities, could not have been affected by any of these events, and the ABC Lateline report of the "research outcomes will end up in the hands of private sector banks and institutions whose role in life is not to commercialise technology" is nonsense at many levels. Furthermore, many of the financiers are venture capitalists whose sole role is commercialisation. In the telecommunications crash, any

³⁵ The University of Sydney claimed to represent all the CRC Universities in the dealings with APPL.

³⁷ This assertion assumes that the enabling agreements of the Deed of Company Arrangement, approved by the creditors, will be completed so that the Administration of APPL is terminated.

organisation that was not willing to protect its assets by further investment ultimately lost its interests in these assets. What has played out in the Photonics CRC is, albeit indirectly, this process. There is no wrongdoing, just commercial decision-making of risk and reward, in a complex situation.

This sequence of events raises a number of issues:-

Will the assets lost to the CRC Universities return a benefit to its new owners and to Australia?

The majority of the ultimate beneficiaries of the transfer of APPL's assets are Australian entities. The media report labelled these parties as "private sector banks and institutions whose role in life is not to commercialise technology". It has to be recalled that they invested at over \$60 million into these enterprises, and they have every right to expect a return. They made an investment, and it is naïve, absurd, and damaging to Australia for others to represent to the Australian public that they have a lesser right to any outcome. Even the Photonics CRC staff stand to benefit from the CRC Universities' loss, through their interests in a number of trusts.

The surviving spin-off companies, thanks to the Photonics CRC direct and indirect interventions (in many cases), are now exceedingly well positioned to take advantage of the market recovery. This is a great tribute to the stewardship of those involved in managing these assets, the employees in those companies, and their research "mates" in the universities. The Photonics CRC has played a pivotal leadership role in this through its "hibernation strategy"³⁸. The Photonics CRC's motivation was twofold:-

- Firstly, the Photonics CRC objective was to build a photonics industry in Australia, and I had come to a view that Australia, unlike Silicon Valley, would not be able to resurrect the pieces if there was a wholesale closure of companies³⁹. Silicon Valley can reassemble the pieces and finance new ventures rapidly, but I believed that Australia did not possess either the will power or the expertise to restructure quickly enough before assets were dissipated. We were convinced that a collapse would see Australian expertise and intellectual property evaporate or migrate.
- Secondly, I recognised that it was important that the Photonics CRC retain its interests in these companies, and do this without suffering massive dilution in down-round fund raisings characteristic of any fund raisings during the market downturn. Therefore, the hibernation strategy was developed in which several companies, which represented the fruits of years of Photonics CRC research amounting to about \$20 million, would be reabsorbed within the Photonics CRC to be revived only when the markets returned. They became "defacto" CRC Participants. Hibernation gave the key people in these companies, our graduates, and the time to explore new markets and regroup. Today, a number of these companies have re-emerged, and they now find themselves in an environment with very few competitors, valuable technology and skills, and new markets to address. It is a pity that the CRC Universities will not significantly benefit if they are commercially successful. Hibernation

³⁸ This strategy is not unique to Australia, eg www.shnwood.com/media_pt_0206.html, but it is the Photonics CRC approach that is probably unique. Most of the Photonics CRC companies could hibernate themselves because they had raised sufficient cash, but others required the Photonics CRC because they did not have sufficient critical mass to survive otherwise.

³⁹ CRC Annual Report 2002/03

was not envisaged to be a financial burden to the Photonics CRC, but gradually became so during 2004⁴⁰.

Will there ultimately be further flow of benefits to Australian taxpayers from these companies? This is, of course, unknown. The "hibernation strategy" was predicated on the reasonable assumption that those companies left standing with the right technologies after the crash will be very well placed to capture market share when recovery takes place. They have de-risked their manufacturing processes, and targeted emerging opportunities. The track record to date, detailed elsewhere in this submission, indicates that there will be further returns in the future from such companies.

Could the CRC Universities have acted differently?

The answer to this is certainly – yes. I respect their conservative approach, and yet I am concerned it was not the right approach.

It is my estimate that the provision of about \$0.25 million⁴¹ could have averted the loss of assets valued even conservatively at about \$3 million⁴², and a saving on legal and accounting expenses that now approaches \$1 million⁴³. The complexity of APPL's shareholdings, trustee relationships, and encumbrances were significant, and the powers to disclose information were limited. The CRC Universities had lost confidence in the management, and were in no mood to accept management's advice on these matters. The advice of APPL's directors was, in retrospect, substantially correct⁴⁴.

Universities spend enormous resources on research, and this is the most risky investment imaginable. That the funds spent are substantially from governments, and often provided without an obligation to commercialise, is not really the point. To realise a benefit to Australia from research requires investment and engagement in the downstream activities. This "hand over" is a worldwide issue for Universities and publicly funded research organisations, and relates to the stewardship of outcomes of research. Australia established the CRC Program to address the gaps in the

⁴⁰ There were two companies formally involved in the hibernation strategy – in one case the strategy was overall cash positive for the Photonics CRC because one of the CRC Universities assisted the company through a commercial "sale and lease back" of equipment to provide operating funds, whereas the other became a cash drain because a similar arrangement with a different university could not be executed because such a use of funds was "outside of the risk profile of the university". Each company had strong links to the respective CRC University, though its graduates and research collaborations. This demonstrates that there was a wide variation of responses by the CRC Universities, but this sent mixed messages to the Photonics CRC management as to what was possible. These relationships took a long time to negotiate and settle or terminate.

⁴¹ This was based on cash flow projections that were provided to the CRC Universities. There were, of course, many assumptions in assessing the risks.

⁴² This valuation was based on the conservative methodologies of the Australian Venture Capital Association (AVCAL), for reporting to fund managers. APPL was approached in mid-2004 by a third party to sell its shares for about \$1.5 million. The CRC Universities were consulted, and were of a view that such a sale was not in their interests. This cash could have paid APPL's creditors, but were not sufficient to fill the complete "budget hole" in the CR Account. The value placed on the shares was based on a "distressed asset" pricing, at about 30-50% of the AVCAL valuation. The execution of this sale would not have been straightforward because it would have required the consent of other parties.

⁴³ This is my estimate of the costs to date.

⁴⁴ I am an APPL director. I believe any review of the directors' advices at the time, in the light of what subsequently transpired, would demonstrate this assertion to be correct.

innovation system, and it has been quite successful overall. The Photonics CRC story just illustrates that ownership of Intellectual Property by itself is not sufficient to realise a return for its owners. The downstream benefits will always flow to financiers. Universities, if they wish to receive an income stream from the commercialisation of their innovation, must be prepared to become financiers with their own funds, with all the risks that this entails.

The Universities must protect their names from failures, but this is at odds with the commercial risk required. There are mechanisms for this to occur such as pre-seed funds and the like, but these are small and underdeveloped in Australia. The connection to the national interest arises because Universities are largely taxpayer funded, and any returns to the Universities constitute a national benefit. If taxpayers' funds are used for the research, then who has the responsibility to achieve a national benefit, and who has the intent and capacity to do so? It is not an easy problem to solve. The ABC Lateline report is a good example of the role the media can play in guiding the Universities to adopt a very low risk path.

Comments on the Photonics CRC Governance Structure

The Photonics CRC Governance Structure could NEVER have provided the forum for investment and financial decisions to be made. The Photonics CRC was established as an unincorporated entity, and such an entity cannot make commercial decisions without creating unlimited liabilities for the Photonics CRC Participants that the Governors represent.

The ABC media report¹ had inputs from several CRC Governors, who seem rather fazed at the apparently dysfunctional processes. They are CRC Governors whose institutions vigorously opposed the establishment of an incorporated structure⁴⁵. The Photonics CRC Governing Board has some 27 Governors, many of whom would have a conflict of interest if they ever had been required to make a commercial decision.

The Photonics CRC's success has come from the formation of spin-off companies that often compete with the larger transnational Industry Partners. The Photonics CRC created and owned APPL, which was licensed to make these decisions, and the latent powers of the Governing Board were to appoint and dismiss the Photonics CRC CEO, and the directors of APPL. The Photonics CRC Governing Board chose not to replace the APPL directors after they had lost their confidence. Indeed, the CRC Universities pressured their own nominee directors on APPL to resign, thereby setting up the framework of dissonance with the remaining directors, who had their fiduciary responsibilities under the Corporations Law. I believe that this was not best practice.

No Photonics CRC Participant, nor the Commonwealth, in the 12 years of the Photonics CRC triggered the dispute resolution clauses of the CRC agreements available to resolve any matters. APPL, in desperation to avoid VA, launched such a dispute with the CRC Universities in an effort to trigger mediation as a resolution framework, but it was too late to have an impact. The CRC Universities were unrelenting in their advice that the APPL directors put APPL into VA⁴⁶.

⁴⁵ The Commonwealth now requires that all new CRCs be incorporated, for good reasons.

⁴⁶ The benefit to the University of VA was that it provided an ability of the University to terminate APPL's licence to commercialise the University's IP. Since this IP is encumbered as Background IP to the CRC, it is unclear that this was an advantage.

The Photonics CRC had many conduits for information flow into the CRC Universities – from CRC Governors, the CRC Executive, the Universities' individual nominee directors to APPL, and their observers at the APPL board meetings who were provided with the Board papers. The CRC Governors had formal access to the APPL and Photonics CRC accounts via their CRC Audit Committee, and as CEO, I had an informal open-policy of briefings to any individual Governor or their nominees (eg their accountants). My observation is that – when the problems were becoming clear – the Universities actively reduced their engagement with APPL and took defensive positions. They “ring-fenced” the problem, which cut off their access of information, and the ultimate cost of this strategy was a loss of the assets. I believe that the claimed lack of information was self induced at one level, and possibly symptomatic of poor internal flows of information at another level. It is true that CRC Governors were not able to formally receive the same information at their Board meetings as the APPL directors had, and even if they had acted, any such actions may have made them shadow directors of APPL with consequent possible liability. The APPL Administrator, in his report, alludes to the possibility that this may have occurred⁴⁷.

The Bandwidth Foundry MNRF

The allegations raised by ABC Lateline in this respect mainly related to industry contributions.

The Photonics CRC applied for funding under the Commonwealth's Major National Research Facilities (MNRF) program in June 2001. The submission was made on behalf of the Photonics CRC by its agent, APPL, with a number of companies and the NSW Government providing additional support. The CRC Governors were informed. There was very little time to organise the submission – some 6 weeks - and some details had not been completed at the time of submission. Foreshadowed contributions from the NSW Government could not be lodged as binding commitments (as a matter of policy), and industry commitments or foreshadowed commitments were qualified by concerns such as ownership and Intellectual Property rights. The Photonics CRC was invited to defend its submission in an interview panel in July 2001, and the defence of the submission was made under the name of the Photonics CRC. I recall that few questions were asked at the time about the status of commitments. At that time, the Department of Industry, Science and Tourism administered the Photonics CRC and the MNRF Programs, and its officers were aware that this proposal was part of the Photonics CRC's unfunded Program in Advanced Manufacturing. The submission was an attempt to fill the foreshadowed Photonics CRC “budget” hole, principally by dealing with the fact that the research infrastructure had not been able to keep up with the Photonics CRC's needs to remain at the forefront of research. The Photonics CRC's reviews clearly demonstrated that problem. This was the basis for the defence of the Photonics CRC's application for MNRF funds. The Photonics CRC had ideas and no equipment to reduce them to practice.

The Minister for Science announced in August 2001 that the Photonics CRC bid for MNRF funding was successful. However, the Commonwealth Government then moved the control of the Photonics CRC and MNRF Program from Industry (DITR) to Education (DEST), and there was a discontinuity of the staff engaged in management of these programs, and the Commonwealth's corporate knowledge was lost. It took 15 months for the MNRF contract to be signed, in November 2002. I recall that over 17 iterations of the MNRF “Business Plan” were ultimately required by

⁴⁷ If the DOCA is completed, this finding has no effect.

the Commonwealth – with constantly changing goalposts. The Photonics CRC, through APPL, had provided start-up funds on the basis that the contract would be settled within weeks of August 2001. The Photonics industry worldwide was then dealing with the ICT market collapse. This provided both threats and opportunities for the MNRF, as explained below. The Commonwealth proceeded with its funding, well aware that industry contributions as stated were reliant on successful commercialisation to raise the funds.

But DEST would not accept that the MNRF funds were to fill the Photonics CRC “budget hole” as had been previously acknowledged by DISR, and APPL was forced to double up on its commitments – to separately fund both the Photonics CRC and the MNRF. APPL by that time had no choice but to execute the MNRF contract. It had financed the start-up MNRF for 15 months from the announcement with a facility of about \$1 million, which had been fully expended. APPL was only prepared to provide these funds as an MNRF contribution if and only if it were granted the right to commercialise the MNRF IP (its mandate under the CRC Agreements), and as this was not agreed by the Commonwealth and the loan funds were recovered. A skilled and committed team was assembled in the MNRF using APPL’s funds, but a disconnection grew between the Bandwidth Foundry’s senior management and its Photonics CRC stakeholders, including APPL, on this and every other front. The Board of the company, Bandwidth Foundry Pty Ltd⁴⁸ required management to put forward an operational plan that conformed to the Commonwealth contract and the Photonics CRC stakeholders’ expectations, and this did not eventuate. This management group had raised matters of industry commitments directly with DEST in mid 2003, and made various serious allegations against its directors without their knowledge. After discussions with the Commonwealth as to the resolution process, the directors commissioned an independent review, and the senior management group was subsequently terminated as a result of its findings.

DEST conducted its own detailed review of the allegations. As part of that, I was interviewed by DEST’s audit team, along with many others who were involved. This was an intensive review, as far as I could judge. I was advised at the outset of my interview that the severest of the allegations had failed to be substantiated, and the most likely outcome would be an internal report on the administrative processes within the Departments⁴⁹. The CRC Governing Board was advised of the DEST review, and its likely outcome. DEST received the Annual Report from the MNRF and the CRC and has maintained its funding of both. No dispute was registered. It would simply seem that DEST provided no response to the former staff of the Commonwealth’s investigation of their allegations, and these people decided to go public through the ABC Lateline Program – some two years later.

My observation is that the Commonwealth, at the senior levels, has been understanding of the impact of the global downturn of the ICT industry, and this has been shown by their continued support of the Photonics CRC and its MNRF, after due diligence of any claims. This has been a very difficult time for all concerned – and the focus of Government funded programs on “inputs” rather than “outcomes” made it difficult to account for at the operational levels of departments. To give examples of the practical issues of accounting:

- The MNRF was able to acquire equipment at auctions worldwide at a discount of about 95% to the budgeted costs because of the collapse of many

⁴⁸ I was a director of Bandwidth Foundry Pty Ltd at the time.

⁴⁹ My observation was that DEST had, well before the investigation, implemented very strict internal processes that would have avoided the problems at the outset.

companies. This greatly offset the need for direct industry funding, and from an “outcomes” perspective, it was realised that the MNRF could be established at a fraction of the budget proposed in 2000. From an “inputs” perspective, industry was not seen to have made its individual contributions on the basis of transactions, but the resources required had nonetheless been acquired from the industry collapse (generally overseas).

- To give a concrete example that relates to Australia: JDS Uniphase Australia⁵⁰ (JDSU), the former Photonics CRC start-up Indx, had become a Photonics CRC Participant. The parent company, in the face of the downturn, resolved to close down every manufacturing site that was not in North America or China. The Photonics CRC negotiated a settlement with JDSU in July 2003 in which it paid \$485,000 to exit the Photonics CRC, and this cash was used by the Photonics CRC to acquire state-of-the-art equipment from the JDSU ultimately for the MNRF at a total cost of \$450,000⁵¹. This equipment had the benefit of the \$40 million investment from JDSU⁵², and when reduced to parts, had a replacement value estimated to be \$10.35 million⁵³. In addition, the Intellectual Property licensed to JDSU was repatriated to the Photonics CRC, and has recently been licensed to the MNRF. The Photonics CRC strategy was reasonably simple – in Australia we are world-renowned for our research and industry expertise in “diffractive structures” – essentially filters that can control photons on the basis of small difference in their wavelength. JDSU in Ryde was then the world’s largest manufacturer of these devices. The Photonics CRC had invested over \$20 million in this area in research⁵⁴ and JDSU had invested about \$40 million in its development⁵⁵. While JDSU’s market had evaporated in the downturn, the Photonics CRC saw that this was a generic enabling technology of critical importance to Australia. I met with senior officials of government departments in an ad-hoc committee assembled by the Department of Prime Minister and Cabinet to review what could be done to save JDSU⁵⁶.

The MNRF used its resources to focus the use of the equipment on the development of the next generation of this manufacturing technology for research using patented CRC innovations. The Photonics CRC’s spin-off company Redfern Optical Components had developed the manufacturing process for mass manufacturing, also based on the Photonics CRC research. In summary, the Photonics CRC/MNRF was able to retain the core infrastructure and expertise resulting from the retreat of JDSU from Australia. All parties, to my mind, have acted appropriately in this process, each doing what they were authorised to do⁵⁷. While the Commonwealth did not intervene to save JDSU directly, I was of a view that the Commonwealth was always very supportive of our “self help” strategy. We used existing funding mechanisms (Photonics CRC, MNRF) to achieve the objective as best we

⁵⁰ See the earlier section on the performance of this company as a former CRC start-up.

⁵¹ The CRC acquired equipment for \$200,000 through one of its University Participants, and the MNRF acquired other equipment for \$250,000 using its Grant funds, that was later refunded by the CRC as a cash contribution through APPL. The timing of these transactions was not in the logical order, but this is the net accounting of a deliberate strategy.

⁵² Tony Muller, CFO, JDS Uniphase, at the official opening of the Ryde factory, 6th April, 2001

⁵³ From an internal report, based on prices in catalogues, provided by university staff

⁵⁴ CRC Annual Reports 1992-2004, and Project Budgets.

⁵⁵ Tony Muller, CFO, JDS Uniphase, at the official opening of the Ryde factory, 6th April, 2001

⁵⁶ eg Senior Officials Meeting, DCITA 12th Aug 2002.

⁵⁷ It is my view that JDS Uniphase will ultimately require these components for its products, and will re-engage with these companies as a market channel.

could, which was the take-home message from meeting with senior officials. The accounting for such created problems for the officials running these programs, but I believe that the national interest was well served.

The applications of these “diffractive structures” are diverse, and access to this leading edge technology will advance many industry sectors throughout Australia, including defence and security. The spill-over benefits in our science efforts are becoming apparent – the Anglo Australian Telescope has developed an application of the technology – the Sky Filter - which will allow ground based telescopes to look farther back in time than ever before⁵⁸. This whole technology domain could well be the enduring legacy of the Photonics CRC. We have a commercial track record, unique intellectual property, manufacturing skills and a very high international profile.

While the ABC Lateline program focussed a several people’s angst onto my leadership of the Photonics CRC, I believe that my eye was always fixed on the end game. It was a great satisfaction that the Korean Government agreed in principle to co-invest about \$30 million into the Photonics CRC to access our “diffractive structures” capabilities, with a binding first year commitment of \$4.5 million subject to matching from the Australian Government⁵⁹. I was less than impressed that the Commonwealth did not engage with us to take advantage of this strong Korean interest. The marketplace is now speaking – increasingly loudly. The MNRF is now operational and has a bright future, if properly supported.

What Went Wrong?

From an external viewpoint in Australia and overseas, the Photonics CRC is seen as a great Australian success. Its spin-off companies have paid from tax on profits and income tax from their staff of more than \$130 million, which exceeds the Commonwealth’s investments of \$80 million. Over \$230 million was raised in finance from investors, which, when income tax and spillovers are considered, means that the whole process has been a profitable investment for the Australian taxpayers. The first spin-off generated economic activity at its peak of \$500 million pa. What is the beef?

The dissonance is that the Photonics CRC now finds itself in a winding-up mode, triggered by the rejection of its Phase 3, Stage 1 funding application to the Commonwealth⁶⁰, amplified by the subsequent collapse of a proposal for bridging finance from the University of Sydney, knee-capped by the consequential loss of assets by the CRC Universities, and humiliated by the potential loss of the Korean co-investment⁶¹.

Clearly the trigger was the failure of the Photonics CRC to be invited by the Commonwealth to submit in June 2003 a Stage 2 proposal for ongoing funding, on the basis that its Stage 1 submission in January 2004 was, unbelievably, “not commercial”⁶². Was it uncommercial? The Phase 3 Stage 1 Proposal was submitted with cash and in-kind commitments from Universities and TAFEs in 5

⁵⁸ Anglo Australian Telescope Publication, to be published (2005)

⁵⁹ The binding commitment was made by the Korean Ministry’s Institute for Information Technology Assessment and tabled to the Commonwealth on 29th Nov 2005.

⁶⁰ CRC3 Submission dated 24th March 2004

⁶¹ Co-funding for the Australian co-investment was sought from the CRC Program as an Extension Grant for \$4.5 million submitted on 28th June 2004, and this was rejected by the CRC Committee on 21st Dec 2004.

⁶² CRC 3 Submission rejection dated 30th April 2004

states and territories totalling \$61 million, probably the largest marshalling of research resources in Australian history. The CRC Committee then used an “uncommercial and trivial metric” of evaluation of proposals being “commercial”, and its use of this metric was not disclosed in the Application Guidelines. Simply, we had not, at Stage 1, locked in the industry support. The Stage 1 submission clearly articulated clearly the strategy for building industry support between the time of the Stage 1 and Stage 2 submissions. This was disregarded.

The reality is that the rejection was an assessment by the CRC Committee that was trying to wrestle with an unexpected reduction in the funding of the CRC Program by the Commonwealth to a level, which required surgery of applications. The powerful advocates from the established mining, agricultural and health sectors on the Committee were in the ascendancy. The back-door message was to us was quite clear – get out of the CRC program and find your own way forward. The CRC Committee has no responsibility for “life after CRC funding”, and could wash its hands. The Minister, Hon Peter McGauran, chose not to intervene.

However, the failure of the Photonics CRC submission was not entirely unanticipated. In 2001, the Photonics CRC provided a briefing paper⁶³ to the advisors of the responsible Minister, the Hon Senator Minchin, urging that consideration be given to the development of a “Graduation Mechanism” for successful CRCs. The need for such mechanism has been long debated within the CRC community since 1991, and no mechanism has ever emerged. The only mechanism to graduate is either voluntarily, or by the loss of a bid. It is not a system that allows for consultation and finesse. The Photonics CRC was acknowledged as the leading CRC, and its graduation was always likely to be the first⁶⁴.

For an emerging industry, like photonics, it can be a 20-year process to reach a point of stability from which explicit government support might not be required, and we were only halfway along that path. The CRC Program required locked-in industry commitments, generally from large corporates, yet the successes of the Photonics CRC had been through the growth of spin-off companies, often in competition with such corporates. It was reasonably clear that the Photonics CRC had outgrown the numerous limitations of the CRC Program, but there were no alternatives in place. The Photonics CRC is not in a marginal electorate, and could not draw on Parliamentarians for expressions of strong support to intervene to fix the problem.

The Photonics CRC researchers have been remarkably successful in attracting research grants from other government agencies (eg ARC, NICTA, Defence) and their need for Photonics CRC funding was diminishing (in most cases, as an agreed strategy to reduce the risk associated with the Photonics CRC “budget hole”). Not all approaches for alternative funding were successful. For example, the previous MNRF management had submitted⁶⁵ application for a new ARC funded research centre with several Photonics CRC researchers from the University of Sydney, in competition with another ultimately successful, University of Sydney bid, which had strong support. I was adamant that they should join forces in one bid, but the University leadership would not intervene. Their bid ultimately and predictably failed, thus hampering a managed transition process for the larger University of Sydney

⁶³ CRC Graduation Paper submitted on 13th August 2001 to the Minister's Chief of Staff.

⁶⁴ Many CRCs have terminated, but most of these were “projects” that had come to an end of the need for support from the CRC Program, or else had failed in bids for ongoing funding. The Photonics CRC was focused on the development of an emerging industry, and longer term support was always required, but not necessarily from the CRC Program.

⁶⁵ This submission was made without consent of the Bandwidth Foundry Board.

group in the Photonics CRC, which were left out in the cold. The veneer of the culture of collaboration is exceeding thin, and a cohesive strategy was essential in difficult times. My ability to influence the players was reduced by the funding squeeze, and the stresses were breeding such disintegration.

The Photonics CRC on any measure was overstretched as a result of the market collapse, and it was a finely balanced act every year to balance the budgets. All the parties involved in the Photonics CRC, including the Commonwealth, knew this. There was recognition by the Commonwealth that a heavy investment in research during the downturn (counter-cyclical investment) was important for the future industry, and hence the agreement by the Commonwealth to "reprofile" the Photonics CRC Grant was warmly welcomed.

I cannot fault the Commonwealth in its overall support from 1992-2004, but was disappointed that it had allowed the trigger event for the collapse to occur, without any consultation initially, and with no action when the impacts were clear. This was actually the result of a competitive process governed by a strong application of probity rules that rules out any such discussions. I believe that a managed process involving the Commonwealth as a partner, would have been of better national interest compared to what transpired. Our Photonics CRC had been formed in 1992 as the result of the Commonwealth brokering a marriage between two large groups. Even that process is now forbidden in the current competitive regime. I understand the reasons for probity, but I believe the end result is not the best outcome for the Australian people. It ends up being a "box-ticking" exercise that cannot tease out what will succeed in the long-term in generating national benefit.

SUMMARY

The elements from the Photonics CRC story that may be relevant to the Inquiry are set out below.

Pathways to Commercialisation

The CRC Program clearly provided a successful pathway to commercialisation – filling the gap vacated by OTC and Telecom, with the formation of Telstra. It enabled a consortium of companies and universities to come together to work for commercial outcomes, which have been very successful. Some observations are:-

Transnational Companies: The engagement of transnational companies in the Photonics CRC was never critical to their principal business interests, and they were initially encouraged and engaged because of the need to retain business linkages to Telstra. Telstra gradually adopted a "hands off" approach to engineering developments, and when the telecommunications crash of April 2000 occurred, most closed down their Australian R&D operations and evaporated within two years. My general observation is that the involvement of these companies in CRCs is not driven by their necessity, and therefore their involvement is often ephemeral. There are Australian patriots in these companies whose hearts are in the right place, but unless they have real influence in the R&D headquarters (generally overseas), then market access for commercialisation is not greatly facilitated by their involvement. There is probably no correlation between commitments of transnational companies to research in Australia and commercial success.

* Unincorporated Organisations: The Photonics CRC's pathway to commercialisation has been through the formation of start-up companies. The unincorporated structure was, by design, dysfunctional for not only any decision-making, but also for

information dissemination on commercial activities. This was the preference for the structure of the CRC Universities, who were reluctant to concede power and local control of research resources to an incorporated entity. The Photonics CRC managed within this framework for many years through commercial decisions being made by a single company, APPL. The CRC Universities were always aware of business activities through a multitude of formal and informal channels. The CRC Governors were largely silent when things were working well, but as the financial problems emerged, the CRC Universities did not exert the controls under their powers to rectify their supposed concerns. An unincorporated CRC is not capable of handling commercialisation, and not capable of dealing with complex financial matters requiring disclosures. The disclosure of something that is commercially sensitive to some 27 Governors and some 8 Observers, constitutes, in my view, effectively a public disclosure⁶⁶, notwithstanding matters of conflicts of interest among Governors.

* Networking: The Photonics CRC was not fully funded, and filling the "budget hole" required great effort and many tactics to raise the funds – from other Commonwealth programs (ARC, MNRF), to the trading of assets. Overall, I believe that this approach worked quite well simply because it forced the management to focus on commercialisation as part of the culture, and in setting up collaborations with all parties to win additional funds. The CRC Executive was able to coordinate these activities, and there have been some exceptional outcomes. The media portrays this structure in terms of power and control, but the reality is that it operated as a network. The desperation and survival was the positive flip-side of the unincorporated structure.

* Arbitration and Mediation: The approach for loan funding in 2003/04 collapsed when the risk profile for a loan unexpectedly changed, and the knock-on effects have been that the CRC Universities have lost their interests in shares in the spin-off companies. While regrettable, the efforts to convince the CRC Universities to resolve the problems in another way (arbitration) went unheeded. They set out to use the processes of the Corporations Law to solve matters that were part of a Contract Law. It was flawed.

* Flexibility: The pathways to commercialisation are often complex and opportunistic. The Commonwealth has had a view that a 5-7 year business plan has real meaning, and can be negotiated over long periods (eg 15 months). The business reality is that plans have to be very flexible, just to survive as well as to capture unexpected opportunities. Delays create losses. One spin-off company changed its business plan within weeks as a result of a company seeking a solution to an intractable problem coming across the spin-off through a web search. Some of the MNRF experiences arise from operating in this milieu.

* Investment in Commercialisation: In a market collapse, the parties that wish to retain a benefit in the long term must invest cash to protect their position. There is risk in research, and there is risk in commercialisation. The best combination is the mixture of cash and intellectual property rights, and Australian institutions seem reluctant to use their own finances to back their people and ideas. It relies on outside

⁶⁶ Confidential CRC Governing Board papers were leaked to the media twice, in 2002 and 2004, and in both cases the interests of the Photonics CRC were damaged. Had Governors investigated these breeches with vigour, then I might have had a different view. I could not seriously propose to a third party that its interests would be protected, notwithstanding that all the Governors and Observers were bound by Confidentiality Agreements.

parties for seed funding, and that places an unnecessary layer into the picture.

* Intent of Research: The grant mentality in universities is definitely a strong culture. In retrospect, most of the CRC Universities at a high level never saw the Photonics CRC funding as anything other than a "pot of gold". This was the tension that the Photonics CRC had to mitigate – the contest of research excellence and research application, and we were largely successful at the Executive level, but not beyond. With the disappearance of the Photonics CRC, the old habits will be on the ascendency. I am sure that Australia will continue to pump out excellent research in photonics, but to what end? The students are the creative force, and they must be placed in an environment that celebrates commercialisation.

Intellectual Property and Patents

The Photonics CRC has achieved significant accomplishments since its inception through the development and protection of a significant portfolio of patented intellectual property – some 100 inventions patented at a cost of \$3.47 million, and over 60% of these licensed to Australian companies for cash income of about \$8 million. Its spin-off companies generated corporate and personal income tax returns to the Commonwealth well in excess of the Commonwealth's investments in research. The Photonics CRC's hibernation and MNR strategies have positioned Australian industry to prosper from the recovery of the global markets.

Loss of IP: Contrary to media speculation, the Photonics CRC Intellectual Property is not at risk. The commercialisation of the Photonics CRC's (unlicensed) and strong IP portfolio will be the principal task for the Photonics CRC in its final stages. Whether it can do this, having dispersed the commercialisation expertise, and with its limited financial resources, is a moot point. However, the Photonics CRC Participants own the IP, and can control its commercialisation through the appointment of another agent. In hindsight, the fact that the Photonics CRC cannot readily assign IP has served to ensure that the IP has not been lost. However, investors do not like this situation, and regard this as an impediment to commercialisation. It was prescient.

Risk Management: It is my contention that universities do not have the resources and skills to protect and commercialise valuable IP. The Photonics CRC succeeded because of the specific market and technology knowledge and expertise of its staff (mainly in APPL and Redfern Photonics). We were able to patent IP years before a clear commercial opportunity formed, and we built patent portfolios that were ultimately attractive. This specialist expertise is simply not available within university business arms to any depth in any technology area. I am concerned that the CRC Universities have demonstrated their risk-averse nature, and the risk is what technology commercialisation is all about. However, there are differences between Universities in their approaches.

Skills and Business Knowledge

The Photonics CRC's successes have greatly relied on mentors, rather than formal training in getting business knowledge. The biggest difference between Australia and Silicon Valley is that we have been through the innovation cycle maybe just once, whereas Silicon Valley is on its 10th cycle. This lack of experience can generate inappropriate responses to events, such as copycat approaches not appropriate to the actual situation faced by a particular company. The risks are consequently higher, and failure more likely. The risk averseness of some, but not all of our institutions is demonstrably an issue. The Photonics CRC has had two very

different experiences. A breed of entrepreneurs have been through the whole cycle – from boom through bust, and most are still in Australia and engaged in photonics, as “serial entrepreneurs”. Australia still lacks expertise in management of manufacturing, yet there are hopeful examples. Future innovation will come from these individuals, and a healthy innovation system does not require all innovation take place in the public sector organisations. Australia is still too reliant on these organisations for research. We have a cohort that has been through the mill, and are not suited to organisational constraints of institutions.

Capital and Risk Investment

The unexpected failure of the Commonwealth to invite the Photonics CRC to submit its Phase 3 Stage 2 funding application triggered the collapse of loan funding negotiations to fill an historical budget hole in the Photonics CRC Accounts. The loss consequent loss of assets by the CRC Universities to the Photonics CRC financiers arose from an unwillingness of these universities to provide funding to support their investments. This is a natural process, common in the commercial world. At times of a market crash, the assets will migrate to those willing to provide the finance. The risk profile for the CRC Universities was clearly too high. The pressure of the media on failures, of University Councils and state auditors on use of scarce funds, present major barriers to institutional risk.

Business and Scientific Regulatory Issues

N/A

Research and Market Linkages

The markets for photonics are global, and the supply chains are international. The long distance from Australia is an impediment, but not impossible to manage. The Photonics CRC's research was focussed on its calibration by international metrics, and its researchers had international recognition. A recent study⁶⁷ of the Photonics CRC's international linkages showed their strength and diversity. The international standing of the Photonics CRC researchers was a factor in attracting investments, through the technical due diligence.

For start-up companies, the markets that are sustainable are those involving large customers, and not other start-up companies. What becomes critical are the personal linkages into those customers. This was one area in which the Photonics CRC's engagement with transnational companies showed some initial promise. However, in the market crash, those companies had a high turnover of staff, and corporate memory was largely lost. However, over a long time, linkages forged by students and researchers at conferences, and exchange programs, can develop into important commercial contacts.

The migration of the Photonics CRC researchers into a number of new research centres was well executed in most cases. There was a failure in one case discussed above⁶⁸ which has had knock-on effects. It is possible that Australia will prosper from this, yet I believe that “taking the foot off the commercialisation imperative” in many of these new centres will diminish commercial outcomes. Research is risky but easy for skilled people, whereas commercialisation at every step is difficult at any level. In

⁶⁷ A Review of International Science and Technology Policy and Programs, the Allen Consulting Group. Report to DEST, August 2003, pp 147-149

⁶⁸ See Page 17m with reference to footnote 65

addition, the Government funding available to these centres is generally at a sub-critical level to enable investment in early stage commercialisation. IP commercialisation is an unfunded and a minor mandate. My observation is that market linkages need to be developed with the highest levels of support, and small centres are not able to project the power required to attract linkages that leverage access to global markets.

Factors Determining Success (or otherwise)

It is too early to declare any long-term success, other than to say the survival of the crash by companies with technology and skills intact has been a major achievement.

* Structure: The paradox of an unincorporated structure being a network for collaborative ventures, while being dysfunctional from a perspective of commercialisation, is yet to be fully understood. A hybrid model is required, but the Photonics CRC version clearly failed.

* Survival and Motivation: The need to fill the "budget hole" created a drive for successful commercialisation that was pervasive in the Photonics CRC. This worked well until the problem became too severe, and the Photonics CRC imploded. A middle ground is required, because commercialisation requires pressure.

* Excellence in research was critical. The Photonics CRC funded a mixture of fundamental research in selected areas, and applied research driven by industry. The best outcomes were from groups that carried out this range of activities. There was no sterile separation of research categories, in engineering or science.

* Mentoring was important at many levels. The early termination of the Photonics CRC in its industry development activities broke many linkages between our first generation of entrepreneurs and the future generations. Without the CRC, will the linkages survive?

* Commonwealth Support: The continued support of the Commonwealth during the time of the global collapse of the telecommunications industry was welcomed by all concerned. I believe that there was an understanding at the top level in the Commonwealth of what the Photonics CRC was attempting to accomplish in a difficult commercial climate - for example, the JDSU equipment for the MNRFF, and invest in R&D during the downturn to retain core skills from companies. The "tribe" was important.

Strategies in Other Countries that may be of Instruction in Australia

It has been the failure of the Commonwealth, through the CRC Program, to assist the Photonics CRC in working collaboratively with Korea that has been extremely disappointing to all concerned⁶⁹, and the source of embarrassment with Korean.

The Korean Government, after a very extensive and expensive due diligence (~\$0.4 million), had made a firm pledge of \$4.5 million for the first year, and \$30 million overall as their contributions towards a joint program in Ubiquitous Sensor Networks. What was initially sought was the first year of matching funds from the Australian Government. The JDS Uniphase story demonstrates that Australians are good at manufacturing, and we have the innovation skills for mass manufacturing. Combined

⁶⁹ This explicitly deals with a CRC Supplementary Funding Proposal rejected by the Commonwealth on 21st December 2004.

with the research innovation, it is a powerful combination for photonics that has attracted this interest. The Photonics CRC was never able to get the Australian Government to our side of the table to hammer out an equitable deal on the exploitation of Intellectual Property. We were put into a contest with other research organisations in Australia, in which probity rules forbade any contact with our government. We then failed because this IP agreement was not in place!!! Other countries do seem to be able to develop and implement a coherent strategy for industry sectors. It was, again, a naïve outcome that was NOT in the national interest. Australia lost its microelectronics industry in the 1950-1960s through the decisions of about four people, and I wonder whether the same fate will now befall the photonics industry. This is not to say that the Photonics CRC had to be saved, but there is now a vacuum that might not get filled by anything substantive.

CALL TO ACTION?

The Korean Government approach to the Australian Government at a Ministerial level to engage in significant research collaborations in Ubiquitous Sensor Networks, should be progressed, because the market access that is possible to leverage from this collaboration could be immense. While it is not the brief of the Inquiry to address this matter, it is nonetheless of public importance. There has been a loss of face in Korea by the many people involved, and those advocates in Australia are also embarrassed.

CONCLUSION

I set out in this submission to make that points that the Photonics CRC has been a success on any metric, and its "holding-out" for four years from the impact of the market collapse is also likely to generate future successes and returns.

I set out to demonstrate that much has been achieved, with the understanding and assistance of the Commonwealth. The faltering of the Photonics CRC at the finishing line (of the market comeback) was triggered in a competitive box-ticking probity-bound process. The CRC Universities made commercial judgements, based on risk assessments, that I believe were ultimately not in their interests as events unfolded.

The last chapter for photonics in Australia is not yet written, but I fear it could be a repeat of the collapse of our electronics industry some forty years ago. That loss was haphazard, whereas this is a fragmentation that is deterministic and stoppable. The loss of electronics happened because we didn't understand the consequences, and this might well happen even though we do.

From the details and the rise and fall and the future, there have been and will be a great many lessons that relate to the Inquiry, and which may have applicability in other emerging industry sectors.

MGS 2 May 2005