

Australian Academy of Technological Sciences and Engineering

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John W Zillman AO FTSE

27 April 2005

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

Dear Dr Dacre

In response to your invitation of 23 March 2005, I am pleased to enclose a submission from the Australian Academy of Technological Sciences and Engineering (ATSE).

Our submission has been prepared by a Working Group of our New South Wales Division composed of:

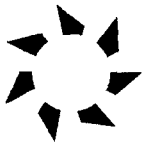
Dr John Nutt AM FTSE	Chair, NSW Division former Chair, Ove Arup and Partners, Consulting Engineers
Professor Trevor Cole FTSE	PNR Professor of Electrical Engineering, Sydney University
Mr Martin Thomas AM FTSE	Director, EnvrioMission Pty Ltd, former Director, Sinclair Knight Merz, Consulting Engineers
Dr John Sligar FTSE	Director, Sligar and Associates
Dr Dennis Cooper FTSE	VP Engineering & IT, Ambri Limited
Professor Rolf Prince AO FTSE	Emeritus Professor of Chemical Engineering, Sydney University
Professor Keeva Vozoff FTSE	V&A Geoscience, (Editor)

As indicated in our submission, representatives of the Academy would be pleased to appear before the Committee to elaborate on the views we have expressed. The contact in the Academy is our Chief Executive Officer, Dr John Dodgson telephone (03) 9347 0622 email johnfd@atse.org.au

Yours sincerely

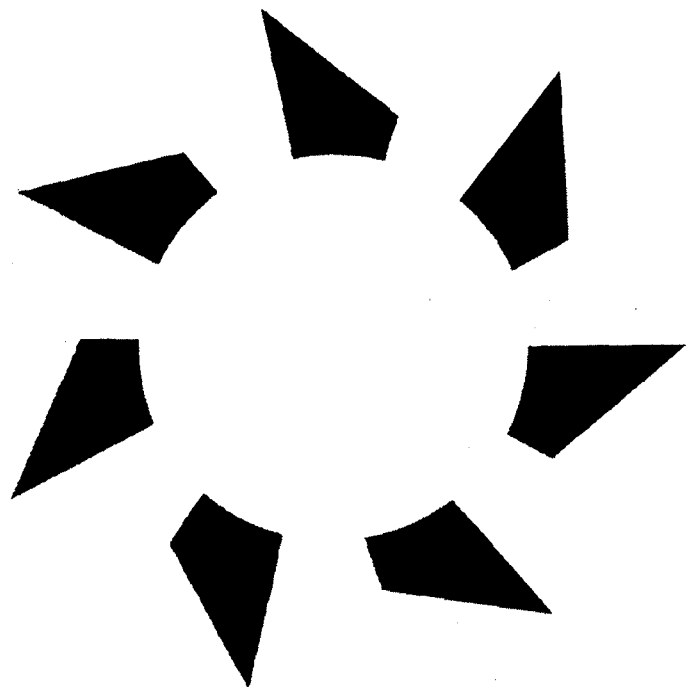
John W Zillman

The Australian Academy of Technological Sciences and Engineering (ATSE)
promotes the application of scientific and engineering knowledge to practical purposes



Submission No.49.....

AUSTRALIAN ACADEMY OF TECHNOLOGICAL SCIENCES AND ENGINEERING



SUBMISSION to

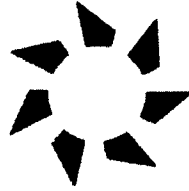
Inquiry:

"PATHWAYS TO TECHNOLOGICAL INNOVATION"

**House of Representatives Standing Committee on Science and Innovation,
Australian Parliament**

29 April 2005

Australian Academy of Technological Sciences and Engineering



AUSTRALIAN ACADEMY OF TECHNOLOGICAL SCIENCES AND ENGINEERING

The Academy (ATSE) is an independent, non-government organisation dedicated to the promotion of scientific and engineering knowledge to practical purposes for the benefit of Australia. The ATSE unites Australia's most eminent engineers and applied technologists in an unrivalled academic and advisory institution for the engineering and technological sciences. It encourages excellence, the growth of outstanding talent, and the study and discussion of issues of importance to formulate informed public debate and policies, and interaction with like-minded bodies overseas. The ATSE is a body of 700 Fellows of proven ability and experience, elected to membership through leadership and individual achievement.

The Academy provides a unique resource of proven Australian skills and experience in the physical technologies, biological technologies, engineering including infrastructure, and management of technological industries.

Australian Academy of Technological Sciences and Engineering

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**RESPONSE TO
Australian Parliament
House of Representatives
Standing Committee on Science and Innovation,**

Inquiry: "Pathways to Technological Innovation"

INTRODUCTION. The Academy of Technological Sciences and Engineering (ATSE) welcomes the opportunity to make this submission to the House of Representatives Standing Committee on Science and Innovation's Inquiry: *"Pathways to Technological Innovation"*

The ATSE unites Australia's most eminent engineers and applied technologists.

We hope this Inquiry will be the catalyst for a major boost to the momentum, size and level of achievement of the technology industry in Australia, in turn resulting in more high quality jobs and increased prosperity for this nation.

The ATSE has long had a mission for understanding and promoting new technology in industry in Australia. It has organised the following annual seminars on the theme of technological innovation:

The ATSE has organised a series of seminars on the theme of technological innovation..... which... focused on investment and delivery.

- ATSE Seminar 2001 - *"Commercialising Innovation"*;
- ATSE National Symposium 2002 - *"Owning Innovation"*.
- ATSE Seminar 2002 - *"Living with Risk in our Society"*
- ATSE Seminar 2003 - *"Technology Entrepreneurs"*
- ATSE Seminar 2004 - *"Disruptive Technologies"*

The international and Australian speakers and the invited audiences have made these successful in providing perceptive insights based of vast knowledge and direct experience. All have focused on the issues relating to industrial innovation and sought to influence industry and others in their attitude to investment and delivery of innovation and new technology.

This Submission draws directly upon the views of these distinguished practitioners, business leaders, and eminent researchers (Appendix A). An experienced working group from within the ATSE (Appendix B) has analysed each set of papers and identified key issues, drawn conclusions, and made recommendations. The Executive Summaries of these Seminars are in the Appendices C to F.

"In industry R & D, Australia ranks very poorly".

Such strengths of innovation are easier to lose than create'

Australia has had some notable successes but it falls short in making innovation work for industry when compared to other countries. At one recent ATSE symposium, **Dr Robin Batterham**, Australia's Chief Scientist, said: *"Innovative culture in Australia needs strengthening."* and went on to say *"This will require cultural changes, particularly with respect to entrepreneurship"*. **Lord Robert May**, President of the Royal Society, London and an Australian, was more blunt: *"In industry R & D, Australia ranks very poorly"*, and went on to say *"Such strengths (of innovation) are easier to lose than create"*

The key to an innovative nation is a strong partnership between industry, research, government and the community. Each has a vital role to play. In

addition and of equal importance is the development and encouragement of the entrepreneurs who drive the process.

The Academy wishes to address the Standing Committee to expand on this submission and make its considerable experience available.

Submission Framework.

In this Submission we have used selected quotations from eminent practitioners who have spoken at the Academy's Symposia. We have grouped them into the eight key issues requested in the Department's invitation. This has distilled the positive lessons learnt. There is particular reference to examples of successful Australian technological innovation that demonstrate strategies to overcome potential impediments and factors determining success. A list of those speakers quoted is given at the end of the Submission.

Innovation: *"The process by which ideas are transformed through economic activity into sustainable, value creating outcomes, that is, inter-tradeable product, processes and services"*

David Miles, Chair, National Innovation Council

Pathways to Commercialisation.

"You need to be able to commercialise ideas as much as you need to be able to have the ideas in the first place" said Dr **Brendan Nelson** in a Keynote Address to the ATSE.

Champions have to be trained as in any other field of endeavour

The problem in Australia is deep-seated. In a competitive business environment, while business innovation is strong, technological innovation requires special support and a change of attitude. Champions have to be trained as in any other field of endeavour - early identification, coaching and training, opportunities for participation, and suitable rewards for success, financed by programmes, which underpin national priorities. These skills are significantly different to science, being focused on commercial application rather than discovery.

"The guys we look for are guys that have an appropriate technical background, have worked for a large organisation, got thoroughly dissatisfied, and gone and got an MBA so they are ready to hit the ground running . . . They do not expect (initially) to run anything—they come to learn".

Peter Farrell, CEO, Resmed

"Established businesses should harness some of their annual cash flow surpluses towards continued innovation. That requires a sustained effort", said Dr **John Nutt**, citing the long timeframe to bring innovation on stream, and the ongoing need to stay competitive. *"If they do not, a new disruptive technology will roll over them and they will struggle to survive."*

"Established business should harness some of their annual cash flow surpluses towards continued innovation. That requires a sustained effort".

The Seminars highlighted clustering and partnering as a preferred means of delivery. Government can influence industry and the developers of intellectual property to create positive outcomes in the commercialising of science and technological innovation. Clustering creates high quality employment prospects. New products and services often do not rely on research outcomes alone but use well-known technologies, often licensed from elsewhere in the world, in new and innovative applications. It is the creation and sustaining of a competitive knowledge intensive industry base, rather than just a research base, which underpins the creation of wealth and meaningful jobs.

There are many partnering arrangements which facilitate innovation by

bringing external ideas to good internal networks and practices. **Graeme Nelmes** describes the highly successful partnership between Sydney University and Patrick Technology thus: “*I was introduced to the research groups, Mechatronic Group University of Sydney and the Australian Centre of Field Robotics.....Their work produced results beyond expectations. The next step was ... full scale development and ...a large capital expenditure program. ... As we owned the intellectual (property), ...this required a partnership approach with supplier*”.

“Collaboration between organizations ...often.. involves results that are both strategically determined and emergent”.

Small businesses with innovative products have difficulties of bringing about cooperation with large established companies with assured cash flows. “*Firms need to share but they cannot (do so) efficiently and not at the early stages*”, said **Prof John Wolpert**, “*The trusted intermediary model (InnovationXchange) is very similar to executive recruiters..... intermediaries search for connections with others representing different firms.*” The results are well worth while. **Prof Stewart Clegg** reinforced these arrangements “*Collaboration between organizations ...often produces long-lasting relationships. It usually involves results that are both strategically determined and emergent*”

Recommendations *Industry and governments should jointly support and fund intermediaries along the lines of the InnovationXchange BRIDGE model.*

Industry associations and governments should encourage a change of attitude amongst Australian businesses and investors by running campaigns in support of a culture of business innovation. This will require support from the highest level of politicians in all parties.

Intellectual Property and Patents.

The process of protecting innovation has been described by several speakers and covers both conventional legal means (eg patents) and secrets. Whatever means of protection is adopted, it should suit the business strategy of the entity.

On the one hand, much is spoken of intellectual property and patents. The strategic management of IP is important in some market sectors, especially in biotech and product development in established industries. However, the strategy of speed to market is often commercially more successful.

“Bishop had strong patents... having the IP puts one in a very strong negotiating position with both customers and partners”.

Bruce Grey, MD, Bishop Technologies

“Technology transfer in information and communication technologies almost always occurs via people transfer. In our experience (University of California, Berkeley), protecting and limiting access to the intellectual property in ICT is a losing proposition.

Richard Newton, Dean of Engineering, Berkeley.

In another sector, two speakers at North American universities drew attention to their experiences in transfer of knowledge from the academic to the industrial sector.

Transfer of staff is an important mechanism for disseminating IP and speeding the commercialising process. Some industries, especially

construction, rarely patent innovation due to the mobility of staff from project to project.

Recommendation	<i>Alternative models for deriving national benefit from public sector intellectual property generation beyond licensing should be developed. Universities should be encouraged to explore other strategies with assistance from governments to facilitate intellectual property protection.</i>
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Skills and Business Knowledge

The leaders of the innovation process are special people; champion is a term often used. Venture Capitalists at the 2003 ATSE Symposium highlighted that the "important deficiency was the lack of a pool of experienced entrepreneurs." Given the identified shortage of entrepreneurial skills in Australia, it is of concern that "First and foremost there is very little entrepreneur education in Australia." Other countries recognise the need for selection and development of entrepreneurial management skills.

"Learning on the job" was emphasised .

"Learning on the job" was emphasised by most of the speakers. Engineering and Technology require a different mindset to that of Science. "The process of going from need to global market is a process distinct from research, having its own inputs, processes, outputs and skill base" said **Prof. Trevor Cole**, University of Sydney. **Roger Allen**, Founder, Computer Power Group, reinforced that by saying "The only way to learn the stuff is to go through it. It is pretty hard to teach, it is pretty hard to absorb—you really learn it by getting out there and doing it". **Peter Farrell** identified the specific shortages as being in the fields of CTOs and CFOs with the necessary experience in technology companies.

Government policies for encouraging innovation can focus financial support on designated fields of technology or on bright early career people, or perhaps a mix of both. Key speakers reported that both the UK and US Government approach was to give higher priority in their innovation support to bright early career people than to designated fields of technology. This approach was commended to Australia, where currently the bias was considered to be towards supporting a few research leaders to pursue specific technologies, ie by picking winners.

To rectify the deficiency the Government can initiate actions with limited cost implications:

- Send young technology graduates overseas for experience, and have policies in place to get them back.
 - Provide incentives for established overseas companies to provide training opportunities for technological management.
 - Establish an expatriate register, sponsored by the Government.
 - Provide assistance to companies to repatriate Australians back to Australia.
 - Have policies to boost training and mentoring of technological entrepreneurs.
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Recommendations	<p><i>The Federal Government should establish mechanisms to support early career creative people, in line with other innovative economies, to complement its present emphasis on designated fields of technology with support for a limited number of creative leaders.</i></p> <p><i>The Federal Government, in partnership with industry, should initiate an entrepreneurship mentoring or "apprentice" programme in industry.</i></p> <p><i>Governments should overcome the shortage of technological entrepreneurs by creating the equivalent of the ARC Federation Fellowships to return gifted individuals from overseas.</i></p>
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Capital and Risk Investment. *"The ability to foresee the commercial possibilities of emerging technologies is ... the foundation of entrepreneurship, ... coupled with tenacity to pursue a strategic vision"* said **Gerry Moriarty**, who now invests heavily in the ICT field.

The commercialisation of scientific discoveries proceeds in a number of well recognised stages, with associated funding needs. At the 2003 ATSE Symposium, **Lord May** described them thus: *"...for every \$1 spent on basic science, ...\$10 needs to be spent to explore if the idea is commercial,and approximately \$100 is needed to bring a costed proposal to a business board before beginning to tool-up."*

The delivery process takes time, some 12 years on average. Most venture capitalists cannot invest in Year One. They prefer to invest at Year Twelve minus three. They pay the higher price and get involved only when they see reality in marketplace terms.

There is a gap in the development continuum which causes many start ups to fail.

There is a gap in the development continuum which causes many start ups to fail. This lies between the research and the first significant injection of capital . **Prof John Wolpert** gave the results of studies - *"Real returns ..(of) ...innovation programmes come after seven years of incubation, and that's seven years after core technologies have emerged from the laboratory."*

Venture capital availability in Australia has increased due to superannuation and institution funds investing in the sector. **James Graham** (MD, Gresham Partners, Investment Bankers) reported that \$1.3 billion of venture capital was invested in 512 companies in 2000-01. He believes there is adequate venture capital in Australia – but too few investment quality proposals.

Recommendations	<i>The Federal Government should recognise that the successful innovation process requires greater support towards the end of the science, engineering and technology chain, and not only at the start.</i>
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Research and Market Linkages. Effective product development is an integrated process in which business technology and market aspects must be considered together. **Graeme Barnett** gave some sound advice:

- *"Get new ideas and their needs from customers, and try to predict the future,*
- *Predictable marketing requires an understanding of the circumstances in which customers buy or use things."*

Incubator and clustering networks create informal environments where attitudes are shared and skills fostered. Programmes within such clusters need to focus on bringing marketing and management together with researchers to encourage multi-skilling.

Australia already uses forms of clusters extensively through the CRC program, and that some of the additional steps proposed, such as innovation entrepreneur apprenticeships, could be neatly fitted into that program. This might be done in conjunction with a few selected tertiary management programs.

Recommendations	<i>Governments should encourage the creation of physical clusters where innovators may flourish and network.</i>
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Business and Scientific Regulatory Issues. The whole regulatory framework for small business is arduous, fragmented, complex and inhibiting. That requires significant government leadership and tangible and intangible assistance at the highest levels.

Early Education. The school system in Australia, at all levels, still fails to stimulate students to study science, engineering and technology related subjects. The consequences of this trend are very serious indeed for Australia's future ability to commercialise technology. There are also concerns that levels of scientific and technological literacy are inadequate in the community generally. ATSE has been concerned with these deficiencies throughout Australia for some time.

The school system in Australia, at all levels, is failing to stimulate students to study science and technology related subject.

The basis of a strong science and engineering based community is a sound foundation at primary school, building on it at secondary school with further extension at the tertiary level. Without this, there is little hope of producing entrepreneurs to commercialise scientific discoveries. Reforms at the primary levels are desperately needed.

Recommendations *Support the reform of the school system of Australia for the study of science, engineering and technology related subjects*

Strategies in other countries that may be of instruction to Australia. Long term commitment is needed as, for example, is taken by Israel. *"The policy (of the Israel Government) is that money should be put in R&D of small companies and small firms. The only criteria needed to win a 'research grant' was to come up with a technically viable idea, and to be an honest person. Later a third criterion of commercial viability is added."* Peretz Lavie, Vice President for Resource Development and External relations at the Technion University. The investment has continued for 30 years and was probably the highest rate of R & D investment in the world. By contrast, Ireland attracted international companies with low corporate tax.

"The policy (Israel) was that money should be put in R&D of small companies and small firms."

The University's role in attracting technology clusters to the Cambridge region is ... pivotal"

The environment for innovation contributes at a formal and informal level. Innovation is stimulated through association, in incubators or in technology parks. *"Less than 7% of the companies in Cambridge's Silicon Fen are direct spin-offs from Cambridge University. But the University's role in attracting technology clusters to the Cambridge region is ... pivotal"* reported

David Newland, Deputy Vice Chancellor and Executive Director, Cambridge-MIT Institute.

Also in Israel this characteristic was noticed and acted upon - *"Government supported technology incubators were established....These are soon to be privatised"* (**Lavie**). Israel recognised the need for a proper supply of trained leaders in the field. As the demand developed, *"There is a program to strengthen managerial skills - three streams for companies depending on stage and size. Each group has a business coach, a corporate mentor, and a tutor. The program includes overseas visits."* (**Lavie**)

Factors Determining Success.

"Innovation almost invariably threatens..... consequently, it is a political activity".

Technology is the delivery of science to the community, and innovation is new technology which adds value. *"Any significant technology is, by definition, disruptive"*, said **Gerry Moriarty**, Communications Infrastructure Group, Macquarie Bank, and went on to say that ...*"generally we over estimate the early adoption and impact of new technologies and dramatically under estimate their long term uptake and consequence"*. It was reported that 75 per cent of innovation results in failure. Innovation, by its very nature, involves newness and hence greater risk. But there have been some great success stories and **Graeme Nelmes**, Patrick Corporation, and **Bruce Grey**, Bishop Technologies, reported that they now lead the world in their respective spheres. Good leadership and clear vision can thrive in Australia, and an important issue is the attitude of industry leaders. *"Innovation almost invariably threatens the status quo, and consequently, innovation is an inherently political activity"*, reported **Prof Stewart Clegg**.

Wal King, Leightons, has no such problems (i.e. lack of innovatory thinking) in an established, successful, forward looking corporation which is a lesson in itself. *"Innovation means renewal and improvement. The organisation must allow a culture that enables people to innovate within the framework of values. People must be motivated and rewarded. Our structure of Leighton Holdings and subsidiaries allows innovation that happens every day, over and over and over again. We acknowledge we are in the risk-taking business, but we are not in the unlimited risk-taking business."*

Recommendations

Australian Governments should encourage, and if possible, adopt a policy of government buying from selected Australian innovative industries.

Closure

Wal King articulates a philosophy which would apply to the nation as well as to individual companies:

"Innovation: to summarise, it is taking calculated risks, investing in people, investing in technology, being able to adapt to a changing market place.

"We need to innovate every day of our lives, we need to keep running that race—that race will never end. I would say not to take risks, not to innovate in the end will prove an even greater risk for those organisations that do not push the boundaries . . .

"Unless you innovate, people will leave, the organisations will wither."

APPENDIX A

ATSE SEMINARS / SYMPOSIA

ATSE Seminar 2001 - "*Commercialising Innovation*"
ATSE National Symposium 2002 - "*Owning Innovation*".
ATSE Seminar 2002 – "*Living with Risk in our Society*"
ATSE Seminar 2003 - "*Technology Entrepreneurs*"
ATSE Seminar 2004 - "*Disruptive Technologies*"

All Proceedings can be found on the ATSE website – www.atse.org.au
Executive Summaries in Appendices D – H (Separate Attachments)

APPENDIX B

LIST OF SEMINAR / SYMPOSIA SPEAKERS QUOTED IN THIS SUBMISSION

Mr Roger Allen, Founder, Computer Power Group
Dr Graeme Barnett, CEO, BioChip Innovations Pty Ltd
Dr Robin Batterham, Chief Scientist, Commonwealth of Australia
Prof Stewart Clegg, Prof of Management, University of Technology Sydney
Prof Trevor Cole, PNR Professor of Electrical Engineering, Sydney University
Dr Peter Farrell, Chairman & CEO ResMed Inc
Mr James Graham, Managing Director, Gresham Partners Ltd
Mr Bruce Grey, Group Managing Director, Bishop Technology Group Ltd
Mr Wal King, CEO, Leighton Holdings Ltd
Dr Peretz Lavie, Vice President, Technion-Israel Institute of Technology.
Lord Robert May of Oxford, President, Royal Society
Mr Gerry Moriarty, Chair, Macquarie Communications Infrastructure Group, Macquarie Bank
Mr Graeme Nelmes, Technology Director, Patrick Technology
Prof David Newland, Dep Vice Chancellor, Cambridge University, England
The Hon. Dr Brendan Nelson MP, Minister for Education, Science and Training.
Prof Richard Newton, Dean of College of Engineering, University of California, Berkeley
Dr John Nutt, former Chairman Ove Arup, Consulting Engineers
Prof John Wolpert, U.NSW, Executive, Bridge Services, Aust. Industry InnovationXchange

APPENDIX C

SUBMISSION WORKING GROUP.

Dr John Nutt AM	Chair, NSW Division ATSE, fmr Chair, Ove Arup and Partners, Consulting Engineers. (C)
Prof Trevor Cole	PNR Professor of Electrical Engineering, Sydney University
Mr Martin Thomas AM	Director, EnviroMission Pty Ltd, fmr Director, Sinclair Knight Merz, Consulting Engineers
Dr John Sligar	Director, Sligar and Associates
Dr Dennis Cooper	VP Engineering & IT, Ambri Limited
Prof Rolf Prince AO	Emeritus Professor of Chemical Engineering, Sydney University
Prof Keeva Vozoff	V&A Geoscience, (Editor)

APPENDICES D – H (Separate Attachments)