The Australian experience

Brian D. O. Anderson
President, Australian Academy of Science

I have been asked to talk about the Australian experience, but I am also here to learn about the New Zealand experience. There may, of course, be some valuable things that we can teach you, but I have appreciated learning from the two talks that I have already heard. In my talk I plan, first, to make specific points, then to give a few figures. I will then discuss what I call "blockers" and "drivers", describe some Australian Government mechanisms, and conclude with the biggest lessons that I have learned in Australia. But first, three important points:

(1) What works for Australia will not necessarily work for Austria, or Zimbabwe or New Zealand. This is so, even if New Zealand and Australia still owe an allegiance to one Queen and draw much (of course, not all) of our heritage from 20,000 kilometres away.

(2) This talk will focus more on industry-university collaboration. I was asked to talk about the Australian experience, not just in relation to universities and industry, but also to Crown Research Institutes. Your institutes are, however, so different from our government research laboratories that it seems to me that the safest course is to stay clear, even of the CSIRO, and certainly not to try to talk about the CRI concept.

(3) The big unremarked industry-university interaction is the flow of knowledge arising when a student moves from university to industry. I think that most of the public policy debate takes a major part of industry-university interaction for granted; it fails to remark upon the fact that one of the great flows that occurs—the flow of knowledge and people that drives this interaction—arises when a new graduate marches off with a degree and gets a job in industry.

SOME FIGURES

When you look at Table 1, you see that Australia is sitting right on the OECD average of 0.024% of GDP, while New Zealand is sitting 16% above that figure, and that looks pretty good. One might look at these figures and say that the linkages are running very satisfactorily (at least if one believed the figures really compared like with like). However, I think that in New Zealand, as in Australia, there is concern that those linkages have not run closely or deeply enough.

Table 1 Percent of GDP spent by industry in universities (from the Australian Department of Industry, Science and Resources).

Korea	0.049	United Kingdom	0.024
Belgium	0.047	Norway	0.023
Canada	0.038	United States	0.021
Sweden	0.036	Ireland	0.018
Germany	0.034	Japan	0.015
New Zealand	0.028	Italy	0.014
Finland	0.026	France	0.013
Netherlands	0.024	Switzerland	0.011
OECD Average	0.024	Austria	0.010
Australia	0.024	Denmark	0.009

Table 2 gives another way of looking at these same figures. Here we see Sweden, the leader in business expenditure on research and development, at the top, with 3.95% of GDP represented by BERD. However, only a fraction, less than 2%, of the research dollars sourced from industry goes to universities. Australia and New Zealand, at the bottom of the table, do not have proud records, as we all know—despite the fact that the fraction that industry apparently spends in universities is higher for Australia and New Zealand than for many other countries. However, as I shall suggest later, the real reason for this higher spend in universities is that business as a whole in our countries is expending so little on R&D, and it has a fairly low level of skills; it is this lack of commitment and expertise that drives businesses to engaging in more interaction with universities than in a country

Table 2 Overall industry spend and fraction spent in universities.

	BERD* as GDP %	Fraction of industry spend in universities
Sweden	3.95	0.017
Finland	2.8	0.018
Korea	2.6	0.031
Switzerland	2.8	0.007
Japan	2.4	0.009
United States	2.35	0.014
Germany	2.2	0.027
Denmark	2.05	0.009
France	2.0	0.012
United Kingdom	1.8	0.024
Canada	1.4	0.046
Norway	1.4	0.031
Netherlands	1.4	0.028
Belgium	1.4	0.056
Ireland	1.3	0.023
Austria	1.2	0.016
Australia	0.8	0.038
Italy	0.75	0.032
Spain	0.6	0.065
New Zealand	0.35	0.137

*Business expenditure on research and development

Table 3 Authorship of scientific papers.

	UK originating paper	Australia originating paper
University participation	58%	70%
Industry participation	8%	2%

like Sweden. So, although these figures at first suggest that there is a healthy relationship between industry and universities in our countries, they do not look so good when you go into them.

Table 3 looks at yet another angle from the point of view of Australian science (I do not have corresponding data for New Zealand).

From these figures you can see that industry is much more involved in authorship or co-authorship of scientific papers originating from the UK than in papers originating from Australia.

BLOCKERS

These figures tell an interesting story, but what are some of the "blockers" that affect the situation in Australia? I suspect that a number of these blockers also apply in this country.

(1) Low level of technical sophistication, especially in small- and medium-sized enterprises

In Australia, small and medium enterprises are often so busy worrying about where their next dollar is coming from, or filling out the myriad of government forms that they are required to file, that they do not have terribly much time to be technically sophisticated. Often the level of technical sophistication is very low—so low in fact that it is hard for them to sustain an interaction with a university, or with CSIRO.

(2) Failure by senior company management and boards to understand the contribution of R&D generally to global corporate competitiveness

When you look at big companies, at least in Australia, you find another very serious situation. An Arthur D. Little survey of Pacific Rim countries that came out about a year ago showed that Australian business senior company managers are about the least alert in the world to the need to underpin entry into the global market with innovation. They had the least understanding of the importance of research and development and of innovation to the future success of their company. This is a

serious problem, and a recent survey of science awareness in the Australian community showed that the two groups which were least aware were senior business people and politicians. This is very serious. Those two groups have their hands on most of the purse strings. It is a challenge to the people in the science and technology communities in the universities to reverse that attitude.

(3) The view by researchers that curiosity-motivated research and use-driven research are always antithetical notions

As an engineer, I know that this is not the case. But I am also aware that when Dr Vannevar Bush, who drove the US science effort in World War 2, wrote the material that gave rise to the National Science Foundation he drew up an intellectual schema that had curiosity-motivated research on one side and applications-driven research on the other, suggesting that they were there at opposite ends of some spectrum. I think that that is an unfortunate metaphor, or an unfortunate way to think about these things, because there is a great deal of research that is aimed at both improving knowledge and contributing to economic outcomes, especially, of course, in engineering schools.

(4) Mismatch of risk level (technical and time) associated with many student projects, and company requirements

Another blocker, at least on the university side, and especially where students are involved, is that the risk level is mismatched to company requirements. The company often wants things done on a very precise time-scale with milestone points where you can turn the project off if you want to, and so on. There is almost a generic distinction between the companies' requirements and the universities' requirements that I do not think one can do a great deal about.

(5) University management deficiencies

In Australia, our universities differ in the skills with which they can interface with industry. Some of them are very naive and have great difficulties in handling intellectual property, but many of them have set up commercial companies. My own university has such a company with a turnover of about $40m a year. The company is primarily for handling contracts, so that the normal grants that the university gets do not go through the company.

(6) Lack of predictability of government policies

It is a fact of life, at least in Australia, that most ministers want to make a monument to what they have done in their portfolio. To make a monument you have to do something new, which means that you have to make changes. A series of too many ministers means too many changes in a short time and a lack of predictability of government policies, with the result that we now have a situation where industry is distrustful of the government in relation to science and technology policies. This becomes important when we remember that the time-scales of R&D are time-scales of years, not months.

DRIVERS

Here are some of the drivers that I think are important in promoting university and industry interaction.

(1) Industry recognises that they can get some expertise from a university

As I have already pointed out, there is a proviso to this. Industry may recognise that it can get some expertise from a university, but a prerequisite that is often lacking is that there must be adequate technical sophistication in the industry to recognise the dimensions of the problem and to understand where they might be able to get a solution. This can be a real blocker for some small and medium enterprises.

(2) Universities want to feel loved and to ease their financial pressures

Another driver is that, at least in Australia and I guess in New Zealand, the government funding for universities has been severely decreased. Unfortunately at times, in order to defend government actions, government-linked individuals have been publicly scornful of universities. Universities do want to feel loved and they do want to ease their financial pressures so, of course, they see it as helpful if they can both earn the money and have people say that the university did a great job. The challenge, of course, is to avoid taking money for things, such as routine testing, that are largely irrelevant to the key missions of the university of teaching and research.

(3) Individuals in universities want to get tenure, be promoted and receive market loadings on their salary

(4) University departments want to earn credibility in the eyes of the profession, improve training opportunities for some students, and make selection of long-term research objectives with knowledge of industrial problems

In Australian universities, or at least in many of them, tenuring, promotion, market loadings and performance bonuses are applied to different degrees in order to recognise that it is an appropriate dimension of university activity that academics engage in some outside interactions. University departments as a whole are subject to assessments and review, often in a competitive context. Any engineering or economics department that does not have outside interactions would lose credibility in the eyes of the profession. Outside involvements often do improve the training opportunities for some students. Coming from a background of engineering, I know that my colleagues and myself have often found that involvement with commercial problems over, say, a 3 year time-scale has influenced the choice of long-term research objectives in a positive way that has underpinned the papers produced 8 years or so further down the track.

SOME AUSTRALIAN GOVERNMENT MECHANISMS

What are some Australian Government mechanisms designed to promote some this interaction, especially between business and the universities?

General R&D tax concession of 125%

In Australia, there is a general tax concession of 125%. If you spend a dollar on R&D, you can deduct $1.25 in computing that part of your profit that is subject to company tax. This is very easily understood by senior managers, even if they have say a law degree. However, when you multiply 0.25 by the company tax rate, which is about 36%, you get a much smaller percentage than 25%. And when you take off the compliance cost it goes down again. The result is that many companies say that the game is not really worth the candle. Just getting the accounting systems in place and being prepared to be inspected and so on is too much hassle. In addition, the 125% is not helpful if you are making a loss, which is the situation for many start-up businesses. Furthermore, there is nothing in it to specifically promote a university connection—you do not have a 150% concession, for example, if you contract to a university. You still just get 125%.

Cooperative Research Centres programme

The Cooperative Research Centres programme set up by the Australian Government is something that seems to me to have some of the great elements that Vice-Chancellor Dr Hood was talking about in his opening address. Any Cooperative Research Centre is required to involve an industry and a university as a minimum—often there are several universities, several companies and government laboratories involved. A 7-year contract is drawn up, with a number of reviews including a major mid-term review. The advertising says that for each dollar put in by the partners the Government will put in up to a dollar. In practice, you never get up to a dollar. The Government might give maybe 70 cents, or even 50 cents for each dollar that you put in. Each CRC has a board with an independent chair and an executive director. There is a collection of goals: research, training, achieving economies of scale through the co-operation, and end user benefit and commercialisation. Having four goals introduces difficulties, especially when the four goals are associated with typically three cultures: university culture, company culture and sometimes government laboratory culture. It is a hard ask of an executive director and a CRC board. The programme has been running now for about 7 years. It has been reviewed to death but seems to have got a tick each time, even though I know that some ministers have come into the portfolio with great reservations but have been converted in the end. There have been some outstanding successes in terms of dollars. I cannot give a precise figure, but I am aware that some CRCs have given rise to businesses for which a turnover of several hundred million dollars is seen in the very near future.

SPIRT (Strategic Partnerships with Industry—Research and Training)

This is a concept that is rather like the arrangement that the National Science Foundation runs in the US. It is run by the Australian Research Council which, among other things, respond to proposals from individual investigators. Under this programme, you can seek support for work that covers the

spectrum of basic research through to development, and there is a training component as well as a research component. Money or resources are put up by both the university and by industry. On the university side, however, a crucial point is that the time that faculty members spend on the programme is not reimbursed, so the universities make that input (which is, of course, considerable and is their principal input) in kind. In 1999 there were 810 continuing grants, involving 19 Postdoctoral Industry Awards (although these are rare), and 559 Postgraduate Industry Awards, costing a total of $33.8 m. In 1999 there was an interesting initiative. The Australian Research Council has largely set its face against any disciplinary priorities but our situation with respect to information technology and communications is very, very weak. We have only two computer science professors in the Australian Academy of Science (one of those is now at Oxford University) and it is generally acknowledged that we have done very badly in that area in quality and quantity terms. As a result, somewhat contrary to past policy, the Australian Research Council was given the task by the Government of allocating 50 Australian Postgraduate Industry Awards specifically for the support of information technology and communications.

Substantial increase in funds for medical research, with a condition
The Australian Government is committed to a very substantial increase in funds for medical research. There is a condition that the increase will not be continuing unless, in several years' time, there is a clear demonstration of increased commercialisation/linkages.

Australian Research Council to have two broad programmes
The Australian Research Council is reshaping its organisation and has proposed two broad programmes: discovery and linkage. There is great symbolism in using these words. I do not think that a body like the Australian Research Council would have said 15 years ago that it had two main programmes, one called "discovery", the other called "linkage". Linkage, of course, includes university-industry linkage, but it does also include linkage abroad to the best research laboratories. We are, after all, another corner of the world (the second last, next to New Zealand), and it is very important to remain plugged-in, internationally.

THE BIGGEST LESSONS LEARNED

(1) We have not worked enough on attitudinal change in industry
I do not think that academics and governments, in particular in Australia, have worked enough on attitudinal change in industry. (Many would say, with less justice now than a few years' ago, that academics need an attitudinal change too.) I was truly shocked when I learned from the Arthur D. Little and the other survey that I mentioned earlier that the two least sensitive groups to the importance of innovation were politicians and big business.

(2) Government intervention/subsidy is justified by the need to change attitudes, the spill-over benefits, and the need to ensure that there is a supportive institutional/regulatory framework
You have to have an intellectual framework for government intervention and subsidy that rests principally on economic considerations and considerations of appropriate long-term and social aspects. In Australia, this means reducing everything to three points. The first is the need to change attitudes. Although I think that the habits in universities have changed or are well along with the process of change, I do think that we need to work with a higher level of commitment than we have at the moment to change the habits, especially, of senior business people. Second, it is clear from the work of people like Michael Porter and professors at Berkeley that there are demonstrable spill-over benefits (not straightforward or appropriate) from private performance of R&D and from the Government paying for research to go on in universities. What is not yet clear from that work is precisely what the best instruments are and how the spill-over changes with the type of policy instrument. But it is absolutely clear that there are spill-over benefits. To say that "companies alone should be responsible for their R&D" is to make an economically less-than-wise statement than the statement that "it is a good idea for governments, through tax or some other mechanism, to promote industrial R&D".

The third thing that I think that governments must do is to ensure a supportive institutional and regulatory framework and not put barriers in the way of companies and universities. I think that I have heard the comment that there are various institutional barriers in this country and that the

level of competition that is being introduced between CRIs and universities may have caused a lack of interaction because they are all fighting hard over a small bone. Certainly, it is the Government's job to listen to the proponents of R&D when they say that a certain policy is counterproductive for "the same set of" reasons.

(3) Human relationships are an extremely important ingredient of cross-sector collaborations

The last big lesson that I have learned is that human relationships are an extremely important ingredient of cross-sector collaborations. I have a colleague in telecommunications engineering who came back from the US recently with a legal document drawn up by a US lawyer for proposals for a company that has a European multi-national, an Australian/US multinational, and two Australian universities (ANU was one) to set up a Delaware company. ANU will have one-sixth share and there is very big business at the end of that particular activity. The proposal grew out of some contacts that were made because my colleague once was a working colleague of a person now working in one of the multi-nationals. Those human relationships were one of the underpinning aspects of the proposal; I should note, though, that the excellence of the work, of course, was another, and the preparedness of the ANU and the culture of the ANU to encourage its staff to do this sort of thing (and to reward them properly when they do it) was another.