Have Research and Innovation Failed Australia?

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OVER the last 20 years, we have been invited to get up early to stand on the summit of innovation and watch the sunrise industries rise.

The road map has been laid out for us. Australia has a perceived *market investment failure* because it has spawned so few high technology businesses—a consequence of low business research and development expenditure compared with many OECD countries. Industry does not do enough, so governments—both Federal and State—must help. Universities and research institutes are to be the vehicles to carry the load. The start-up ideas are to carry Australia to an increased standard of living and protect us from the decay of our present economic base.

Our policy-makers consider our universities 'golden geese'. The golden eggs of technical innovation are expected to hatch and grow to be new, high-tech and dynamic businesses. The process is called research and development (R&D) or sometimes, 'industry policy'. Further, our universities are expected to help solve important issues of the day, such as global warming.

Yet, after many years of effort, what has been accomplished? Within the OECD, Australia has remained in the lower third of business expenditure on research and development for the last sixteen years. But, despite this failure, the country has enjoyed dramatic and sustained economic growth.

Could it be that all our hand-wringing to the siren's song of R&D has been completely beside the point? We have had endless repetition of the theme, but could it be that none of it—including the apparent failures of university or commercial R&D—has anything to do with the real economy in Australia?

SOME FACTS

In 2001, the total R & D expenditure for Australia was 1.53 per cent of GDP with the business contribution at 0.72 per cent of GDP. The equivalents for Finland were 3.40 per cent and 2.40 per cent.

Are we in trouble? No, the explanation for the difference is structural. In Finland, the electronics industry's R&D is 1.3 per cent of GDP. It is a technology-intensive business and the major contribution comes from one business, Nokia.

Table 1: Countries arranged by Business R&D

	GDP % Growth 1992 to 2002	Total R&D % GDP 2001	Business R&D % GDP 2001	Business R&D % Business R&D 2001				Higher Education R&D % GDP 2001
				High-tech	Medium high-tech	Low-tech	Service	
Sweden	29	4.27	3.31	49.1	29.1	7.1	12.8	0.83
Finland	38	3.40	2.42	57.0	15.3	12.8	12.0	0.61
Japan	12	3.09	2.28	41.8	39.8	13.4	2.1	0.45
United States	37	2.82	2.10	39.4	19.4	6.1	34.4	0.40
Germany	14	2.49	1.76	30.1	53.8	7.3	7.8	0.40
Denmark	28	2.19	1.42	35.9	17.9	10.3	35.2	0.45
United Kingdom	32	1.90	1.28	48.3	24.6	7.4	16.6	0.41
Canada	41	1.94	1.12	53.4	6.9	7.0	29.0	0.59
Norway	38	1.62	0.97	21.4	15.8	17.2	48.0	0.42
Ireland	114	1.17	0.80	51.5	11.8	11.7	24.6	0.26
Australia	47	1.53	0.72	21.4	15.4	13.7	39.9	0.41
Italy	17	1.07	0.54	42.3	31.2	6.4	19.7	0.33

Source: OECD in Figures 2003: Selected data from Tables on pages 14, 70 & 72

By way of comparison, Merck, Intel and IBM each spend more on R&D than the sum of all Australian businesses.

The R&D figures are based on an OECD definition which excludes the exploration and development expenses of the mineral and petroleum industries. Yet this expenditure on exploration and development is the exact equivalent of manufacturing R&D. Exploration and development requires graduates and post-graduates as a professional group, and frequently operates at the leading edge of technology, using exotic sensors, satellites and computers—all perfect for the 'high tech' world. A mineral or petroleum discovery comes as much from someone's head in terms of conceptual thinking as any invention. After all, a deposit only gains value by its discovery and subsequent development to the point where it can be exploited.

So depending on what year is selected and the accounting method chosen, another one billion dollars could be added to Australia's R&D account, giving it a 0.2 per cent of GDP boost.

Australia's R & D performance has to be understood by looking at our industrial structure compared with other countries.

Table 1, taken from the OECD's Figures Report for 2003, shows countries ordered by business R&D expenditure. It also shows growth in GDP and higher education expenditure on R&D.

A number of observations can be made from this table:

- Australia's higher education R&D is not out of line with most of the major developed countries. So universities are not disadvantaged in Australia.
- There is little to demonstrate a connection between the levels of higher education and industrial R&D. Increased high-tech R&D levels are not matched by increased higher education R&D levels. There should be a time lag of some five to 15 years for feedthrough from higher education to business.
- Australia's industrial structure is very different from that of high-tech Europe and America. In the Pacific, we are very different from Japan. This is reflected in the R & D spending pattern.

A comparison with our performance in the 1980s shows that along with other low-tech countries, we have lifted our industrial R&D expenditure significantly. Perhaps this represents no more than the general industrial shift to the use of more advanced technology. Variations in the performance of European countries reflect their different industrial development histories. This would be mirrored by regional variations within the United States.

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R&D IS NOT INNOVATION

One reason for the interminable discussion about university and commercial R&D is the belief—not discouraged by research institutes and universities—that they are the source of innovations. In a very important way they are (see below) but they are not the direct source of innovation. Studies of European and United States innovation in the 1980s (confirmed by United Kingdom data in 2001) showed that universities contributed 4 per cent and research organizations accounted for 2 per cent of innovations. The remainder was made up from industry with 80 per cent and the balance from its customers, competitors and inventors. Within companies, the commercial staff was twice as successful as the technical staff in choosing winners but still had a success rate of only 55 per cent. (The worst hit rate from a limited assessment came from the CEOs).

Of course, innovation does not have to be technical or science-based. Service industries thrive on innovation, supplying new products to customers. The banking, insurance and broking sectors have pioneered new products. It is even arguable that News Corporation is Australia's greatest technical success, using everything from satellites to the most advanced printing presses. Macquarie Bank has grown on its ability to pioneer new financial offerings that facilitate resource allocation. All this, however, is excluded from the debate.

POLITICIANS AND TECHNOLOGISTS

At present, our politicians are focused on biotechnology. It is difficult to identify the probable cause of this love affair, but it may be the business equivalent of kissing babies!

Nonetheless, universities that accept government funds are told to strive to commercialize their research, matched to the needs of the country. A report of the Business Council of Australia recently suggested a target of 10 per cent of university revenue from this activity. A sobering comparison is to look at the CSIRO. Revenue from royalties and licensing has just reached 1.5 per cent of total income of near one billion dollars. This is after 70 years of practice!

At the present time, we have concerns about global warming, depleting energy resources, renewable

energy, viral plagues, genetic manipulation and finally destruction by rogue asteroids. All this is amplified by pressure groups, be they environmentalists, NGOs or those seeking funds for their own investigations. So we find that scientific breakthroughs are being replaced by impending 'disasters'. The confounding problem is the politicization of these issues and partisan science.

This has led universities and research institutions to chase funds to investigate these issues. By entering areas of partisan science, they risk reputations and may do long-term damage to their institutions.

The greater danger is that precipitate action, taken against these supposed approaching disasters, costs the economy billions of dollars and achieves little.

If we are to see a repeat of governments attempting to pick business winners, then we are in trouble. There is a long and well-documented history of failure in this from many countries and by many governments. George Pompidou is supposed to have counselled Valery Giscard d'Estaing that the three great dangers for politicians were wine, women and technologists.

WHY ASK UNIVERSITIES TO PRODUCE THE IMPOSSIBLE?

How the universities influence economic performance is clearly difficult to track if the important factors are 'being there' and understanding markets—not parts of general university experience. It is the skills and training of graduates that constitute the great contribution that universities make to the economy. It is those trained to understand, interpret and explain who will carry that background in their work (whether in commerce, law, arts, engineering or science) to the issues and problems of their business. They are the likely innovators.

The importance of knowledge-seeking research and the unpredictable consequences of such work is another, but equally important, aspect. A local illustration of this is to be found in the long-running research of Professor Donald Metcalf at the Walter and Eliza Hall Institute in Melbourne. This led to the discovery of Colony Stimulating Factors (CSFs). This discovery was the key to the success of the US corporation, Amgen, which has grown from a million dollar start-up of the 1980s to a ten billion dollar giant.

Universities are not driven and ordered institutions. They reflect their origins as associations of scholars, and those who choose to be academics would not necessarily fit easily into more ordered institutions nor take the entrepreneurial risks of starting a company and leaving their university. Moreover, the research conducted in universities, particularly in science, is determined by goals set by international competition and relevance. So if research is to be directed at 'commercial needs', those receiving the direction may not readily accept it. The more seriously the science and the scientist are limited and constrained in their chosen fields, the greater the consequent loss of the real excitement of science and the loss of talent from the country. An interesting aside to this problem is that applied science problems can be quite as intractable as the problems of pure science, but whereas the pure scientist may have freedom of choice to avoid these, the applied scientist often does not. Intractable problems do not lead to academic promotion.

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The most sensible research directions for Australian tertiary institutions must be those where excellence is affordable. Thus it would make little sense to support programmes that require instruments costing tens to hundreds of millions of dollars unless the country and its scientists possess or create some extraordinary advantages. This has been the case in astronomy, where instrumentation is expensive, but where Australia has excellent astronomers and access to the skies of the Southern Hemisphere. But no advantage lasts forever, and orbiting satellite telescopes will finally deprive us of this advantage. Meanwhile, the astronomers have achieved such eminence in their field that access to the new observatories should be assured.

CONCLUSION

There is no compelling evidence that our obsession with research and development is really the critical determinant for the economic well-being of the country. In fact, it is arguable that marketing and selling are more important, and that the interaction with customers and markets sets the direction for innovation.

We are following a path with our universities that will lead to disappointment. Inappropriate tasks are being put upon them and in their willingness to obtain funds they readily agree that they are capable of delivery.

Instead we should allow them to do what they do best: teach and research.

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