Submission

House Standing Committee on Industry, Science and Innovation

Inquiry into research training and research workforce issues in Australian universities

I: Contribution of Australian universities

Strong research and development partnerships between universities and industry underpin innovation in every advanced or developing economy. For Australia to match this requires a greater commitment from both industry and university partners. However, a competitive international standard of research training is clearly vital to Australia's future. Many Australians imagine that we are competitive now. *This is far from the truth.*

The problem areas needing immediate improvement are listed in the subheadings below:

The contribution of research training programs to Australia's competitiveness in the areas of science, research and innovation

Australia has what can only be called an obsolete postgraduate degree structure, with short undergraduate degrees and inadequate coursework requirements at the Ph.D. level.

In the Asia-Pacific region where our main competitors and trading partners are, all the large industrialized nations have education systems far more advanced than ours. Their system is completely different to Australia's. Undergraduate education typically involves a relatively broadly based, four year undergraduate degree. The first degree is followed by two years of advanced coursework, allowing mobility and specialized education relevant to a specific research area. This leads either to a masters degree, or to entry into the research component of a Ph.D. Finally, there is a three to four year research doctorate. In many cases these longer degrees can also include short industry or research projects. Examples of our international competitors with this 4-2-3 system include China, Taiwan, Japan, USA, Canada and Brazil, as well as many smaller countries.

In Europe and Russia, the most common system for many years was the German-Russian 5-3 or 6-3 Diplom system, in which the first two stages were combined together. The recently adopted EU Bologna system is now changing this throughout the EU, to give greater uniformity with the Asia-Pacific degree structures. Today, the Bologna system leads to either a 3-2-3 or a 4-2-3 degree structure. Our Australian system is largely copied from obsolete prewar education systems with a 3-1-3 structure. This has proved inadequate even in the UK, as shown by the general failure of UK industry to remain competitive in almost any area requiring innovative technology. As a result, the UK is gradually starting to modernize its degree structures to align with European standards.

The effectiveness of current Commonwealth research training schemes

A change to the current European Bologna approach is already commencing at Melbourne University, owing to a farsighted Vice-Chancellor. It has not happened elsewhere here, largely due to funding difficulties caused by the funding models used in Canberra to fund advanced research training degrees. These restrict funding to short degrees that follow the traditional Australian 3-1-3 system. **This is two or three years shorter than international norms.**

The adequacy of current research training schemes to support Australia's anticipated future requirements for tertiary-qualified professionals in a wide range of disciplines

An advanced innovation partnership with industry is only possible if the university partner provides an internationally competitive education and research environment. This certainly exists today in countries like China, Japan and the USA, to name only three examples. In order to support the educational requirements needed for advanced technological research, their universities offer more than just advanced degree structures. They also have far larger permanent staff levels in science and engineering than we have. This is essential to innovation. It allows teaching staff more time to innovate and develop research programs, with the results being fed back into the postgraduate education system. This means there is a student base available to enter the workforce with the necessary technical knowledge.

To give a specific example, Tsing-Hua University in Beijing - China's major engineering and technology powerhouse - has over 100 permanent physics staff who are available for both postgraduate teaching and research. There are similar numbers in many other famous universities, from MIT in the USA to Tokyo University in Japan. By comparison, Melbourne University - Australia's best - currently has only 16 teaching and research positions in physics, not counting pure research positions. This enormous disparity is simply unacceptable. It has led to a situation where we are no longer competitive even with small Asian countries like Singapore, which now have much larger university staff levels than we do in their major science research universities.

We need a modern degree structure, with enough staff to teach postgraduate courses at an advanced level. This is essential in the physical sciences, where Australia is going backwards.

II: The challenges Australian universities face in training, recruiting and retaining high quality research graduates and staff

Education shortcomings are critical to Australia's future. We can expect major developments in energy and environmental research due to climate change issues and energy cost increases. Australia has a great potential in these areas, but any innovation must rest on a world-class science education. These are quantitative fields, requiring accurate computer modeling and a deep understanding of physical science. Our current education system will not be able to supply the graduates needed, unless an urgent overhaul is provided, without further delays.

An essential challenge in the current climate is the over-emphasis on short-term positions, without essential guarantees on employment quality issues of central importance, like:

- academic freedom to allow curiosity driven science,
- freedom of speech so researchers can communicate to the press
- long-term tenure so that outspoken staff are not summarily sacked
- freedom from discrimination that is enforceable in practical terms
- affirmative action to eliminate `glass ceilings' for female researchers
- reasonable teaching loads to allow research time in teaching positions

Without these guarantees, considered normal practise in most industrialized nations, we will remain something of a research backwater. This is unnecessary and counterproductive.

If it were not for poor working conditions, Australia could easily attract some of the world's best researchers. In a competitive world, this is essential to guarantee our future.

Adequacy of training and support available to research graduates in Australia

The main training ground for research graduates are in postdoctoral positions. Here, training is provided through exposure to more senior teaching /research staff working on projects at the leading edge of world science. However, there is a critical shortage of senior teaching/research staff in Australia, due to funding cuts and reductions in permanent staff numbers, especially in the crucially important mathematical and physical sciences. In many cases, the qualified staff that are needed are in Australia, but are under-employed, working in temporary positions on contracts as short as six months. This appalling situation must be reviewed. The excessive use of temporary positions for academics discourages excellent scientists, and reduces their ability to mentor others.

Factors for graduates that determine pursuit of a career in research

Although salaries are important, equally significant issues include income security, freedom of speech and equal opportunities. There are significant problems in all of these areas in Australia. The elimination of tenure – a unique development in Australia – means that the attractiveness of research careers in Australia has been greatly reduced. Tenure is essential to academic freedom. Without this, many prospective scientists would prefer to pursue more financially rewarding careers in the financial sector, which has many career opportunities for intelligent and numerate individuals.

Another obvious problem is the structural issue: there is a clear gender imbalance in many of the physical sciences and engineering. This, unfortunately, is often combined with discriminatory policies and a general attitude that levels of female participation as low as 8% are somehow regarded as acceptable or even inevitable. The effect of this is to dissuade nearly 50% of the available skilled workforce from entering research careers in these areas.

Without stronger policies to provide some degree of affirmative action to compensate for these injustices, we will continue to see very low levels of female participation. It is important for the ARC, for one, to start using measures of gender and age equity as issues that require attention and reporting from grant-holders.

Opportunities for career advancement for research graduates and staff;

This is a serious issue in Australia today. Many University departments have the majority of staff employed in temporary positions, with durations lasting from a few months up to five years. While a five year position sounds like a long time, in reality it is a small fraction of a career that would last forty years or more in most professions.

As an example, the current `research career' path of APD, QEII Fellow and Professorial Fellow lasts thirteen years. The end of this path can be reached by a researcher in his or her late thirties. For more senior staff, there is no continuing research career. Even Federation Fellowships have explicit discrimination against senior researchers.

Of course, this career path, limited though it is, is only available to a very small and fortunate few. It is anomalous, to say the least, to find researchers who have attained these high levels of competitive positions being under-employed as temporary lecturers after finishing an APF award.

Factors determining pursuit of research opportunities overseas

The single most important factor is the ability to find employment at a senior level. As an example, one former APF holder at a GO8 University was offered a series of temporary six-month long lecturing positions, even after fifteen years of service, together with many books, citations and well-known publications. He is naturally moving overseas as a full professor.

It should be strongly emphasized that the prevalent short-term research positions do not provide a career in science. Even Federation Fellowships are essentially temporary positions. People who hold Federation Fellowships will be very likely to leave Australia at the end of the position, as they simply do not provide a long term future.

Even if a former Federation Fellow or APF holder is able to obtain permanent academic employment in a teaching position, the high teaching loads caused by the low staff/student ratios, makes these much less attractive than comparable positions in Europe or the USA, where teaching loads are much lower at most universities.

Australia's ability to compete internationally for high quality researchers

Without substantial changes in university employment, and the provision of long-term career structures, Australia will not be internationally competitive in this area. To give one example, a GO8 University in Australia recently failed to hire an outstanding international computational scientist. He is pursuing, instead, a position in Singapore. The reasons include:

- Higher salaries
- Lower taxes
- Better job security and tenure conditions
- More research funding
- Much better staff/student ratios
- Closer ties with international partners.

Whether Australia's academic workforce is ageing, andthe impact this may have on Australia's research capacity.

Australia's academic workforce is certainly ageing. There have been nearly 20 years with very low levels of recruitment in many fields of science, due to funding cuts. The low level of funding and staff recruitment into teaching positions during the stagnant years of the 1990's has led to a situation where many essential fields of science cannot be taught at any level in major universities. This leaves Australia very exposed to future shocks: we do not have the breadth of training we need.

A cure of this problem is self-evident. We need a strong program of federally funded recruitment of new staff into both tenure-track and fully tenured teaching and research positions. This should not be age-tested, as this would not only be illegal under Australian anti-discrimination laws, but also unfair to senior researchers in Australia.

In new recruitment to revitalize our universities it is important to broaden the fields taught, so we can compete in new areas of the future, not just teach in narrow, pre-existing fields.

Summary

A research training review must logically involve a modernization of Australia's antiquated tertiary science and engineering education. To catch up with our international competitors, we must upgrade and lengthen our postgraduate degree programs, provide adequate student funding for longer degrees, and employ more staff in permanent teaching/research positions rather than in a series of temporary jobs leading nowhere.

Action is proposed as follows:

- **Initiate Australia wide policy to encourage universities to transition to Bologna (EU) and US type degrees, as currently offered internationally.**
- **Provide federal funding for places at all Australian universities in modern 3-2-3 and 4-2-3 degree structures, funding two years of master's degree training prior to the PhD.**
- **New, federally funded research positions should follow the Canada research chair model, and be integrated into Departments as 50:50 research/teaching positions.**
- **Require federally funded institutions to guarantee freedom of speech for employees.**
- **Require research Centres to report on equity issues and develop affirmative action.**
- **Introduce US-style tenured academic positions with 9-month teaching pay and summer salaries paid from research grants, to encourage life-long research.**

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