Submission to consultation on the Commonwealth's discussion paper: "Boosting the commercial returns from research."

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I have a background in developing advanced instrumentation and techniques for fundamental physics research, having contributed to R&D for the ATLAS experiment at the Large Hadron Collider, several other High Energy Physics Experiments, and more recently the Maia advanced synchrotron X-ray Fluroescence Microscopy detector system for the Australian Synchrotron (winner of an RD100 award in 2011.) Some ten years ago I moved from the university sector to CSIRO, where I have worked on a range of advanced instrumentation projects and techniques for both applied synchrotron and more conventional industrial applications.

From this experience I would make three important observations:

(1) The innovation and technological advances fostered in the large experiment sector of international research is very, very similar to the innovation and technological advances that are pursued by ambitiously innovative companies and instrumentalities. There are many directly translatable skills, experiences and attitudes that arise from an environment of technological challenge (the driver) and technological ambition (the attitudes.)

(2) Research generally, but I note in particular the large experiments in fundamental research, is mostly actually carried out by young people: by post-graduate students and post-docs who form the great bulk of the active research population, whereas tenured academic staff tend play an important steering role, generating ideas or suggesting solutions. Such young students and post-docs are very often primarily motivated more by exciting challenges and technological ambition than they are by the exigencies of success in a research career; they are often much more open to risk taking and therefore to innovation, not yet having the pressures of family, mortgages and job security. Very often students and post-docs find themselvs working on projects that have been funded through the normal course of science secured by their seniors with establishhed careers (the contination of which is a priority for them), but in reality, the younger people are more motived by wanting to make a difference than by careers and money.

(3) Science is international. Many of the drivers, the setting of agendas, the measures of personal and career success, are set within an international, or really non-national global ecosystem. Many, if not most, of the career job openings in Australia science are open to, and very often filled by, foreigners who bring that international culture and international measures of career success. Any Australian strategy that focuses on the behaviours of established Australian scientists is effectively attempting to modify a global culture. One might argue that many other developed countries are demonstrably better at realising commercial returns from reserach investment, as shown by the

poor metrics quoted in the discussion paper. I would argue that this arises primarily from their non-science cultures.

From these insights I would like to submit that if the challenge to the Australian research sector is to boost the visible, measurable returns from our investment in research, then strategy to achieve this should give very strong weight to

(a) **harnessing the attitudes and motivations of younger people within the research population as a means of creating change in the national innovation culture.** Provide young people who have that strong research training with effective career pathways towards commercial innovation, so that people with serious research training pursue careers in commercial innovation, as an alternative to international science careers where they are very often lost to overseas anyway. Get them young; incentives directed at established scientists will always be facing much stronger head winds.

The reason for doing this is partly to embed more people with the training and background themselves into commercial environments, but I think as importantly, it is to foster networks across to the publicly funded research sector because:

(b) innovation is not generally linear. It does not go: idea or problem -> research and development, -> product or solution. It is much more like a braided river, with cross-connections and complexity in relationships between the research community and the commercial community. Scientists need continuous exposure to the problems, markets, opportunities; commercial innovators need to have eyes opened to new technologies where they can see new applications or new ways of doing things. (The special case of software-based technologies is a little a different, because it is often not limited by difficult to understand physical, chemical or biological realities.) This interplay provides the channels that steer effort in directions that eventually come together as a product or solution. That interplay is almost always through personal connections and personal networks, where there is trust and familiarity. ECRs following this pathway ina research organisation wil lstill be building all their personal networks, but they'll also be doing it within the innovation sector, to become those points of connection back across to the research sector.

Possible actions:

Young people, whether post-graduate students or, more likely, post-docs or other early-career position holders, are frequently frustrated by lack of access to project funding to support their own ideas. The ARC DECRAs have been particularly valuable, but far too few, in assisting Australian ECRs to boot-strap their own research careers. But such proposals are assessed primarily against traditional metrics of scientific excellence. That certainly has a place. One could imagine a parallel program, perhaps funded by the Department of Industry:

(i) IECRAs, Innovation (or Industry or Impact) Early Career Researcher Awards, where the proponent is required to have a research organisation as host, but is assessed against criteria that have a strong focus on "path to impact". If the idea in the proposal proves feasible, would it create significant economic return for Australia ? Assessors would include representatives of both the science and industrial communities. The ideal outcomes of a four-year IECRA would be a piece of technology or at least valuable experience, that would be strongly attractive to industry. In this way, career pathways into industry for people with serious research training are created. And, significant new ideas with great potential but insufficient science would get a chance to be tested against reaslisation. IECRAs would also participate in entrepreneurship and mentoring, and would benefit from active networking with the innovation community. Australia would be investing in the passion, the ideas, and the desire 'to make a difference' of its expensively trained ECRs just at the moment

they would otherwise be captured into traditional science career pathways, more than likely overseas. Any IP generated would be primarily the property of the grant holder who does not otherwise have an indefinite position at the host institution, creating a strong motivation to realise wealth from their IP when they are a few years further along towards mature financial responsibilities. Or, perhaps the funding agency would retain ownership of a small share of the IP from which to derive future returns for re-investment.

(ii) Following the same principle, one can also imagine other Innovation grant schemes aimed more at established researchers, but (as most ARC Discovery projects do) largely spent on employing post-docs, but in impact-focused projects. Those post-docs would also then be intimately associated with the technology and then readily employed or eager to create start-ups with something already developed to a demonstration of feasibility.

Summary

In order to create long term, structural change in the Australian innovation system through strong and effective interplay between the research sector and the commercial sector:

- capture the passion and desire to 'make a difference' of young people, by
- creating next stage career pathways towards commercial innovation as an alternative option at the right stage of their careers; and
- investing in the great ideas such young people often have, but only once they are at a certain level of expertise to be productively innovative at the leading edge of science, to
- embed many more people with serious research training and excellent, diverse personal networks, into the commercial world, to foster the "braided river" model of innovation.