

A proposal for the HMR Review

Abstract

A funding scheme is proposed for a large collection of modest research institutes that operate under a “*tax-and-compete*” scheme. The funding scheme would require less management than at present but would guarantee a limited term for non-competitive institutes. Successful institutes could be relatively stable providing both centres of research excellence and entities that business could confidently invest in. The Centres would also make it easier for talented scientists who take time out from research to act as carers, or to engage with industry, to maintain a career in science rather than being inefficiently lost to the system. Importantly the tax-and-compete scheme would permit evolutionary redistribution of funding to emerging areas. Critically the funding model would allow the institutes to respond rapidly to discovery. That capacity for rapid responses, and the attractiveness of stable successful institutes to industry, would enhance rapid translation of discoveries into practice, and promote new industries.

1. Introduction

The current review is timely and much can be done to enhance Medical Health and Research outcomes in Australia. I am currently Director of the ARC Centre of Excellence in Vision Science. The Centre was established in 2005 and has Chief Investigators at ANU, UQ, UMelb, USyd, and UWA. Our Centre is a multidisciplinary group focussing on basic vision science outcomes, innovations in diagnostic technologies, novel treatments, and machine vision. As such our Centre might represent a partial model of what the Review is looking for.

I came to the ANU thirty years ago on a PhD scholarship and have been at the ANU ever since. At that time the ANU was very well funded through the Institute of Advanced Studies (IAS) block grant. The IAS institutes were thus larger CoE-like organisations, *i.e.* block funded, collaborative research institutes. The ANU institutes I have worked in are the Research School of Biology (RSB, formerly RSBS) and the John Curtin School of Medical Research (JCSMR).

Although I operated within JCSMR and RSB I was often not primarily funded by them. Instead I was at different times funded by international fellowships and/or by Industry. My industry funding came from both Australian and International companies. These arrangements gave me something like independent observer status at the ANU. Commercial outcomes of my work include the FDT and Matrix perimeters (visual diagnostic devices). Those devices have produced \$250 million in sales for my commercial partners Carl Zeiss and Welch Allyn, and several million for the ANU. More recently a project with one of our Centre PIs, the Australian company Seeing Machines Ltd, has seen over \$5 million applied to the development of a new diagnostic technology. That technology now has FDA clearance and some may be sold in the USA in 2013. That research was partly funded by the now defunct Commercial Ready and Biotech Industry Fund schemes. I have also obtained several NHMRC grants since the time when ANU staff could hold them, and so have experienced that system also.

In short I have been closely involved in two experiments in large scale funding of research groupings: the IAS institutes and the ARC Centres of Excellence. I also have experience with the national competitive grants system, and have significant experience in commercialisation of research. I

believe my collective experience gives me a fairly unique perspective that has relevance for the present Review.

2. The good the bad and the ugly of the IAS

Up until the late 1980s the IAS was very well-funded and the working conditions for researchers were the envy of any other institution in Australia, and most overseas. This meant that the competition for tenured positions was extreme. Consequently many stellar research staff were attracted to the ANU. Insufficient indexing has seen the value of the block grant drop precipitously over time. One legacy of that past funding is that over half the Australian Fellows of the Royal Society of London, and a third of the Australian Fellows of the American Academy of Science, and a third of Fellows of the Australian Academy of Science are at the ANU. In the 2011 national competitive grant round the ANU won the most ARC DP grants, Future Fellows and DECRA Fellows of any Australian University. The ANU, by a substantial margin, also had the highest success rate for ARC and NHMRC grants applied for. So while the block grant now only pays the salaries of some senior staff, and so provides almost no research support, a positive legacy of the visionary funding of the past persists.

The IAS was not without problems however. For many years there was virtually no assessment of individual researchers', departments' performance. Fortunately, given the fierce entry criteria, dead wood was not a general problem. The more important problem was that *there was for many years no effective mechanism for program review*. Consequently there was little scope for shifting funding to follow new trends. Thus, like large companies, the large institutes of the IAS had some difficulty in remaining innovative. In the years around the turn of the millennium, however, an internal ANU process was created whereby all the IAS institutes were taxed at about 5% *p.a.* and they then had the opportunity to enter a competitive bidding process to win back funds from the resulting tax pool. Over a period of several years this "**tax-and-compete**" strategy saw a significant shift of funds from the traditional physical sciences to the emerging molecular-genetic sciences, and also the formation of the new Research School of Information Science and Engineering (Computer Science). Funding the cost of the "buy-in" by the ANU to the national competitive grants scheme contributed to that system being dropped.

The real advantage of the IAS block grant was that the highly talented people it attracted were free to modify their research topics to instantly follow leads as they discovered them.

By comparison the current Australian grant process means that several years can separate discovery and the time when new funding can be obtained and applied to the discovery. This is compounded by the emphasis on track record in the particular field (impossible for a truly innovative discovery), and the overall low success rate of grant proposals (rarely exceeding 50% for even the very best researchers). Thus many good ideas are never pursued or become old news before funding can be obtained. This is a break on translation. By contrast CoE funding permits some flexibility for rapid realigning of funding to react to discoveries. The same was true of the old IAS system.

So the lessons from the IAS block grant are that:-

- stable funding can attract the very best staff from around the world
- and can allow discoveries to be followed up rapidly and cost effectively

- with proper and uniform performance review across numerous institutes standards can be maintained
- with a system like the “tax-and-compete” model significant shifts of funding between institutes can allow research priorities to evolve efficiently. Like biological evolution the process can proceed with less micromanagement.

3. Another example

One other funding model I have observed in Australia should be mentioned at this point. The specific example is the Plant Sciences CRC that was formed between the ANU and the CSIRO in the 1990s. The CRC took a year or two to set up and then ran effectively for 5 years. A round of new bids for CRCs was then held. The result was that the quite successful Plant Sciences CRC was closed and another, with almost the identical research program, was set up in Adelaide. Five years later the same process saw the Adelaide institute closed and an almost identical one set up in Queensland.

Overall this was an extremely inefficient and costly process for Australia. Imagine running a government where every five years departments do not just merge or change name but where all the staff are sacked, some moved half way across the country and others recruited *de novo*, and new offices and infrastructure.

On balance it is very clear that the current research funding model in Australia often does not take into account the obvious cost of chopping and changing research programs, often in a seemingly random way. This problem also permeates the national competitive grants schemes. This does not encourage private sector investment.

4. A proposal

4.1

Taken together the above suggests a new funding model to support major research programs. The proposal is for a nation-wide set of research institutes operating under the tax-and-compete model. To operate effectively the budgets of these institutes should probably be in the range \$2 to \$20 million *p.a.* (median \$5 million *p.a.*). As well as pure medical research these could include institutes with significant multidisciplinary components from the physical and information sciences, economics and humanities - *whatever it takes to get the job done*. Initially some existing institutes could apply for accreditation into the program, perhaps rolling their existing funding into the pool. Other groups could then apply to enter in subsequent years. The entry mechanisms would be similar to the current ARC Centres of Excellence and NHMRC Program grant schemes. There should be no particular restriction on institutes being in any one location, only the workability of the proposed institutes should be considered.

The set of these National Institutes would be taxed annually and then allowed to compete for funds from the resulting tax pool in any year they choose. Initially the government would add to the funds in the pool to allow the number of institutes to grow. Individual labs, or collections of labs within institutes, should also be able to apply to move between institutes, or create new ones, and take some or all of their funding with them. Institutes who’s funding eventually falls below some minimum, say 60% of their initial funding (plus any indexing), should be reviewed to see if they need to be wound up (see section 4.5 for details) . Otherwise the Institutes would be auto-regulating, reducing the need for unnecessary reviews, which are costly to both the NHMRC and the instates

themselves. Individual institutes could manage performance review of their members according to agreed guidelines.

This model would permit institutes to grow and evolve with much less chopping and changing. Successful institutes would persist. Completely new institutes could appear and institutes with diminishing relevance would disappear. Importantly research within the institutes could be free to rapidly follow discoveries within reasonable limits of a predefined Institute remit, as can occur in CoEs, and as happened for a time in the IAS.

4.2 Industry Funding

Twenty years ago there was a handy fact that one could point to that still has relevance today. At that time the public-sector spend on research in Japan and Australia was a similar proportion of GDP. A major difference between the countries was that in booming Japan the private sector spent 9 times more than the public sector, while in Australia the private sector spent 9 times less. The problem of huge under-expenditure by the private sector on R&D in Australia remains. The example illustrates that even if the whole public-sector spend was diverted to applied research the funds available would be hugely inadequate and the exercise would destroy our future innovation capacity.

We must therefore get obtain better participation by industry.

The system of stable but evolving national research institutes outlined above would itself attract industry. *No business wants to invest in an intuition that might disappear tomorrow*, as can happen today with things like Program Grants, CoE grants, or other even less stable NHMRC grants. At the same time investors want to be sure that the institutions they are putting money into are of high quality, and are able to adapt to their needs rapidly, as the tax-and-compete model can provide.

A system like the Commercial Ready grant scheme needs to be reinstated. I have seen this work successfully myself (see above). Overly prescriptive programs like Climate Ready should not be entertained as they cannot anticipate the most valuable of innovations: new disruptive technologies. The Syndicated R&D scheme of many years ago was scrapped with some justification, but a well-managed scheme might permit buy-in from small players into larger projects, and so should be considered. This could boost the tax-and-compete pool of funds for the Institutes. Like the ARC CoEs the new National Institutes should be encouraged to have commercial Partner Investigators. Special tax arrangements might apply to such commercial partners. In addition to innovative funding from industry mechanisms like GST revenue, or the Minerals Resource Rent Tax should also be considered.

4.3 Innovation management

In respect of innovation and commercialisation a problem with the ARC CoE model arises from the fact that often several universities are involved. This means in most cases any new IP reverts to the parent universities and not to the CoE, even though a stated ARC objective is that CoE should become financially self-sustaining after ARC funding ceases. This is a logical disconnect. There are a few exceptions where prescient Centre Directors have negotiated deals with their participating universities, but this should be the norm. Under the new National Institutes a proportion of revenue arising from innovation should flow to the responsible Institute, this is reasonable given the convention that IP is owned by the entities that fostered its creation.

One difficulty that I experienced was that at the time I discovered the basis for the FDT/Matrix perimeters I was funded by an ANU block grant institute (RSB). As such my superiors had certain expectations about what I should work on. To pursue my discovery, and subsequent industry funding, I had to move away from their program. My superiors saw the potential benefits of the new IP as being too distant, or unlikely, and were unwilling to give me much room to move. Eventually my work earned the ANU several million dollars, however at the time I nearly lost my position several times. Basically the system did not allow my department to benefit from my discovery in the short term. The problem could have been averted if such young upstarts could be moved onto alternative funding for a period of a year or two, for example until a commercial partner was available. Therefore I would propose that within the “tax-and-compete” pool of funding a reserve of perhaps 10% of the total pool be set aside to fund Proof-of-Concept (PoC) grants. Of course senior staff might also have a commercial idea, and so should also have access to PoC funds. That fund might be linked to industry funds contributed to the pool, in exchange for things like first-refusal agreements and the like.

Proper due diligence would be needed to make such funding decisions. Such expertise is thin on the ground in the university sector so a central Agency dealing with such applications should be created. This could provide a service to the universities, who are often hard pressed to execute proper due diligence. As such the universities might feel that the future revenue they give up to a National Institute might be offset by greater surety of commercial outcomes from the IP selected for support. Also their university would receive extra short-term funding and presumably infrastructure support funding.

To insure a timely response to discovery applications for PoC funding should be processed at least monthly. The IP Agency might also provide a one-stop-shop for investors to inspect the Agency’s catalogue of IP. Smaller universities might like to contract the Agency to do some or all of the IP management or promotion, which might help fund the Agency.

4.4 Standard research grants

The review document states that *“Twenty years ago, individuals and small groups could initiate and carry out meaningful research. This has changed, and in most cases significantly larger groups, often interdisciplinary in nature, are now required.”* This text is an overstatement, implying as it does that small groups cannot undertake meaningful research. Many a Noble prize, even recent ones, was driven by the ideas of a small number of individuals, often operating at odds with the prevailing opinion of large, monolithic, research hierarchies.

Something like the current NHMRC Project, and Development grants must therefore persist in order to capture innovation by small groups and individuals. The program(s) could be smaller than at present. Often applicants would be talented early career researchers, or perhaps persons coming back into work after a period of parenting or commercial commitment. The grants could be the seeds of new institutes. In some cases applicants for these grants may be operating within the proposed National Institutes, but who are proposing something new, perhaps with a commercial partner. Importantly the emphasis should be changed towards innovation (scientific and commercial) and not a track record in the precise area of the proposal. Research success should be considered but the grants would not be designed to perpetuate established research themes.

Similarly a system of individual Fellowships should also be maintained. Funds obtained for the small grant scheme and Fellowships would add to the assessable bottom line of institutes.

It is perhaps worth mentioning at this point that the current NHMRC grant schemes have three pay scales for post-doctoral research staff (PSP 3 to 5). The stated function of these three funding levels is to fund early to late stage postdoctoral researchers. In fact the highest scale (PSP5) is insufficient to hire even entry level staff, fresh from their PhD.

The new National Institute scheme should not eliminate the current grants scheme, instead it needs to have new funds, as much as possible derived from industry and possibly philanthropy.

4.5 The competitive mechanism

Annual applications for more funding from the tax pool would not necessarily be for completely new programs, evidence of continuing excellence in high impact research (relative to the research area) should also be sufficient for funding success. Substantially new research directions would mean a redraft of the initial remit of the institute. Funding obtained from alternative sources, including industry, philanthropy or host universities would also add to an institute's bottom line and so avert review.

The annual tax on government supplied funds should be about 9.5% *p.a.*, representing exponential decay with a time constant of 10 years. Thus, without success in the competitive process or other injections of funds, institutes would reach 60% of their initial funding after 5 years and so would be automatically be reviewed with closure as a possibility. Alternatively such an institute might be given 1 to 3 years to continue to reapply. Institutes should be allowed to carry forward a reasonable proportion of funding to insure funding stability for 3 to 5 years. Rather than exponential decay linear decay, falling to 0 after 13 years, would also reduce funding to 60% after 5 years but would provide more rapid closure afterwards. Loss of a substantial proportion of an Institute's staff, due to retirement or transfer, would also trigger a review. Mergers of institutes that were (all) on the threshold of review, would also trigger a reviews. Without such mergers being reviewed mergers could become the refuge of waning institutes. Entry into the scheme should be staged so that after 5 years about 20% of Institutes would potentially be reviewed. In practice many Institutes would have grant success under the tax-and-compete scheme and so many fewer would need to be reviewed. This would reduce the management burden on the funding body and also reduced time wasted on unnecessary reviews for successful institutes. Some indexing of the pool of government funding for the institutes would also be required, however, to maintain the real value of grants unless alternative funding, from something like the Syndicated R&D system could do the job.

4.6 Performance relative to opportunity

A problem with the current grant scheme is that it does not properly account for diminished performance by individuals due to essential imposts on researchers' time like child rearing. At present performance in the national grant scheme is based on research outputs over a 5 or 6 year period. This means that persons who act as carers for family members for a few years are severely disadvantaged. Once their performance transiently drops below the standard in a 5 year period they are unlikely to obtain future grant funding. This leads many of our best female researchers to drop out of the system. It is inefficient to first fund highly talented researchers, and then cause them to quit.

The solution is simple. Researchers should be allowed have agreed proportions of their time recognised. So for example if they are on half-time for a period then the period for assessment of their outputs should be extended to cover 5 *effective years* of available work time. It would not be that difficult to establish reasonable standards for things like child rearing by simply measuring the drop in efficiency displayed by researchers who have achieved success despite acting as carers.

The assessment of performance *relative to opportunity* also would be needed for the new small grants scheme. Within the tax-and-compete institutes such things would be less needed because the primary measure is first the collective performance of the institute not that of individuals within the institute. An institute could afford to let an individual take some time off for a period, and then allow them back to work. This would serve the interests of the institute and the individual. In the end excellent researchers would be less often driven out of the system just because they temporarily chose to act as a carer. Other reasons for taking time off, such as a period in industry, could be useful for the individual, the institute and the country. Thus researchers should not be punished if they take some time out to learn how to interact with commercial partners.

5. Summary

The terms of reference for the Review emphasise “*the importance of translating discoveries from basic research into treatment rapidly, and ensuring that research breakthroughs become clinical practice*” and the need to turn “*these discoveries into outcomes, including commercial ventures*”. To achieve this outcome we need to get away from a situation where major research funding is dished out or withdrawn in fits and starts.

Instead for many good reasons we need a system of a large number of efficient, largely block-funded, National Institutes that are potentially stable over time, but also free to evolve or become extinct. This would provide better targets for investors and to research staff, and long-term efficiency in research expenditure. The tax-and-compete mechanism combined with efficient industry funding, and small grants schemes that reward innovation, would insure that the National Institutes would be as scientifically current as possible. Less prescribed funding would permit researchers to respond more quickly to discoveries, increasing the rate of translation. A collective IP Agency could make technology transfer more efficient. The need for costly and time-consuming reviews would be reduced. Stable, cost effective, rapidly responding, current institutes would serve society well.

6. Recommendations

1. That a collection of modest national research institutes be established with initial budgets of \$20 million *p.a.* (median \$5 million *p.a.*)
2. The research agenda of these institutes should be within specific themes but not be so prescriptive as to limit funding being directed to investigate discoveries in order to enhance the rate at which translation can occur.
3. That these National Institutes operate under a *tax-and-compete* scheme under which the institutes’ budgets would decline at about 9.5% per annum, the taxed funds contributing to the pool of funds from which institutes could re-apply for extra funding. This would provide strategic transfer of funds to new areas of science as they arise.
4. Institute income could be bolstered by small grants, Fellowships, industry funding, income from commercialisation, philanthropy, and occasional further funding from the Institute pool based on success.

5. Incentives and mechanisms for participation by industry are urgently needed
6. If an institute's funding drops below 60% of the initial grant the would be reviewed with an eye to winding it up institutes (e.g. after 5 years at 9.5% decline). Similarly, proposed mergers of two institutes whose budgets had declined to near review levels would be a trigger for review, to prevent merger being a refuge for unsuccessful institutes. Where a merger is likely to put the resultant institute on an upward trajectory, however, it should be considered.
7. Successful institutes would provide a stable target for commercial investment and also enhance career prospects for talented scientists. Similarly successful institutes would have the drawing power to attract and keep the best staff.
8. Relatively stable institutes would also permit staff to take time out to act as carers or to work with industry without endangering their scientific careers.
9. A central body to provide due-diligence for IP should be established. It might offer other commercialisation services to some universities or to the institutes themselves.
10. Individual Institutes must be guaranteed a proportion of income arising from their innovation, not only the universities participating. This would again provide funding stability for the institutes.
11. Part of the tax-and-compete pool should be available for short term Proof-of-Concept (PoC) grants that would allow institute staff to pursue discoveries with commercial potential but which are possibly outside the remit of their host lab.
12. A system of small grants similar to the NHMRC Project and Development schemes should be maintained but where the emphasis is on innovative ideas rather than supporting established research programs. This would support early career researchers and or provide the seeds for new Institutes.

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