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Clever Country in a Changed World: Re-Thinking Australian Science Policy

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Key points

- The global science and technology system has undergone massive change since 2000 and is now a key site of geoeconomic competition between states.
- For the first time in Australia's history, its most significant partner for science collaboration will be a country other than its Western military ally.
- Australia's successful model for science has relied upon uncommonly high levels of international engagement, but in this new world that model also brings new risks.
- There is a need to systematically re-think how the Australian science system engages with the rest of the world and delivers value to the nation.

Policy recommendations

- Australia's intelligence and science communities should work together to create a new open-source science and technology analysis capability to inform policy and strategy.
- Australia's Chief Scientist and Chief Defence Scientist should jointly lead a systematic review of the national science system to evaluate how current investments and institutions should be adjusted given changes in the global system.
- The Department of Foreign Affairs and Trade should lead the development of a science diplomacy strategy for international engagement in the national interest.

Australia is a "clever country". The Australian science system produces new knowledge and Nobel Laureates at a high rate. It underpins critical sovereign capabilities and the development and application of new technologies. Most importantly, it has delivered significant benefits to Australia's economy, society and national security.

Australia's successful model of science has relied upon unusually high levels of integration with the international system, anchored by America's leadership of the post-WWII liberal order and its dominance in all fields of science and technology. But that world is over and a new approach is required.

Over just the last twenty years since 2000, total global investment in research and development (R&D) has tripled to $2.2 trillion per annum. This rapid growth has been accompanied by a "remaking of the map of world science". The "centre of gravity of the global distribution of knowledge" has moved east and south.[1]

These trends should in theory be good for Australia, bringing new opportunities closer to home. But they also bring significant new security risks, as science and technology are increasingly seen by governments as key tools in economic, strategic and military competition.

Science policy: an enduring national priority

The story of Australian science has two strands – a steady growth in national capability through the 20th century, combined with rapidly increasing levels of international collaboration since the 1990s. This has brought significant benefits to Australia, as a small nation that has been able to build upon its domestic capabilities and leverage wide networks to access talent, knowledge and technologies.

After Federation, the national government quickly came to see science policy among its key functions. The first national defence scientist was appointed in 1907 and the foundations of our national laboratories (now CSIRO) were laid between 1916 and 1920. After WWII, Australia's national science effort boomed, with the expansion of CSIRO, new civilian and defence labs, new research grants to universities and the establishment of the ANU.

But Australia's national science mission has never been a solo one. While initial collaboration focused on the UK, by the 1930s the US was already Australia's largest partner for collaborative science. Following the signing of the ANZUS treaty in 1951, Australian science collaboration with the US grew.

Australia didn't create its own NASA or DARPA in the 1950s like America did. In many ways, it didn't need to. Anchored by its partnership with the US, the Australian system could focus on its strengths and benefit from collaboration with the world's best scientists, driving quality and impact.

The logic of openness

Since the 1990s, there have been two bipartisan principles of Australian science policy. First, that Australia benefits from internationalisation, with the movement of people and ideas delivering a boost to the economy. Second, that science policy should be subsumed within a broader narrative about innovation and economic growth.[2] Successive governments have pursued policies to drive economic liberalisation and to internationalise universities and science. As of 2019, Australia had the highest rate globally of international students in higher education.[3] And Australia is second only to the UK in the proportion of scientific publications produced with international collaboration. 60% of Australia's output involves international partners, compared with 39% in the US and a global average of 23%.[4]

The new world order for science

Over the last two decades, a new world order for science and technology has emerged.

America's waning influence

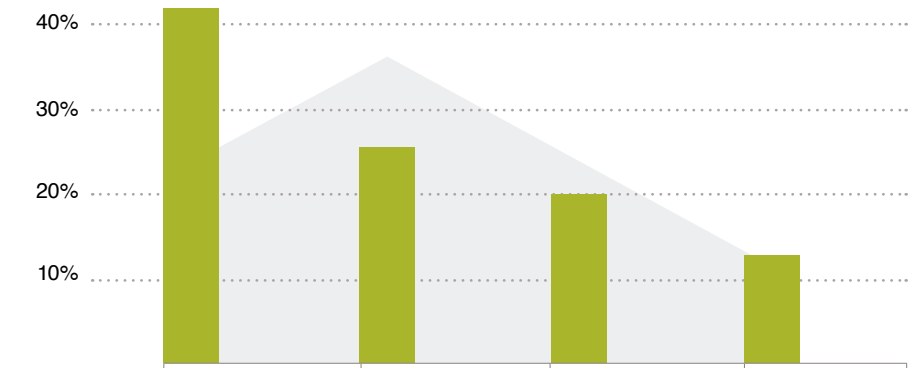
In 1960, American R&D accounted for almost 70% of the world total. By 1995, it was down to 40% and it is now close to 25%. Even so, in 2017 the US R&D system was still twenty times bigger than Australia's. China now accounts for roughly the same share of global science as the US and is challenging US leadership in key areas such as space, artificial intelligence, energy and communications technology. The relative decline of America's science and technology dominance will continue. China is expected to overtake the US as the world's largest economy by 2030 – if not sooner.[5]

Forecasts for global investments in science and technology mirror that shift. One forecast of international R&D investment in 2050 predicts that the US will account for 14.4% and China for 28.9%, with a general growth trend across Asia.[6] The Chinese science system still lags behind the US in measures of quality, but this too could change. China is already America's largest partner for international cooperation in science. But as this collaboration has grown, relations between the two powers have deteriorated. Depending on which data you use, China is about to become – or has already become – Australia's largest partner too.[7]

Multipolar science

The new world order for science and technology is not, however, bipolar. Focusing just on the US and China now misses half of the global system, with Japan at 8% of global R&D, followed by Germany (6%) and South Korea (4%). Then comes a diverse group, each contributing 1-3%: France, India, the UK, Russia, Brazil, Taiwan, Italy, Canada, Spain, Turkey and Australia.[4]

Share of Global R&D Expenditure: 2000 vs 2017[4]



	Asia	US	EU	Rest of world
2000	25%	37%	25%	12%
2017	42%	26%	20%	13%

Each of these countries has their own capabilities, cultures, priorities and global science and technology networks. Governments increasingly see science and technology as tools in geoeconomic competition, blurring traditional lines between economics and security. And not all countries are willing to work within the norms of open science internationalised in the post-WWII liberal order.

The globalisation of science and technology also brings new risks to national security. Governments and research institutions are right to increasingly focus on the challenges of "illiberal innovation" in China and elsewhere,[8] the risks of foreign interference and intellectual property theft, and the application of science and technology by authoritarian governments to uses contrary to democratic values and human rights.

These concerns are not going away. They are bipartisan in Australia and the US. But even if the Biden Administration increases government funding for R&D as it has pledged to do, it cannot significantly change the contours of the new globalised system.[9] US government funding for R&D now accounts for just 25% of total US investment, which is itself now only 25% of the global total. While China will never dominate global science in all fields like the US did in the 20th century, it already leads the world in some fields. Governments everywhere will increasingly see science through a national security lens. And there is serious consideration of "de-coupling" between the US and China – a systematic bifurcation in key fields of technology.

A new approach for Australia

A key challenge for 21st century policy and diplomacy will be how to remain connected to the cutting-edge of global science and technology – wherever it might now be – without compromising national security, sovereignty or values.

An open-source evidence base

In an increasingly multipolar system, the first question for science policy is how do we know who is doing what? The days of individual scientists knowing all the best people and most important papers in their field are over, as new knowledge and new centres of global science proliferate. But by pulling together global data-sets on scientific publications, partnerships and patents, Australia could build a new open-source analysis capability to help us keep up.

Leading global companies do this, and the public sector should too if it is to remain competitive. An analysis capability would include classified information about particular institutions and areas of science that are of specific security concern. It should also go much broader and include information that could be shared with universities and industry. It would build upon the foresighting work of the National Security Science and Technology Centre (NSSTC) and expand it for use across the entire science system.

This would provide an evidence base for government-to-government discussions about bilateral science collaboration and help universities and researchers know where Australia has world-leading capabilities, where it should partner to access them, where the real risks are and where international collaboration really matters. It could also provide a platform for better information-sharing with allies and like-minded partners.

An open-source capability would be a new kind of partnership between the intelligence and science communities, which would enable government to more readily tap into high quality and up-to-date technical knowledge. By leveraging data that already exists, improved analysis would support better decisions about the benefits and risks of science engagement.

Sovereign capabilities in global context

COVID-19 has renewed focus on sovereign capabilities. As in other sectors, we now need a systematic assessment of the international strengths and dependencies of the Australian science system.

Australia's total R&D investment has declined over the last decade. Some researchers have argued that this diminishes Australia's competitiveness and security.[10] But any increase in investment would need to be guided by an evidence-based assessment of the relative costs and benefits of investing at home versus leveraging the global system.

The Australian Government's 2017 *National Science Strategy* provides a good starting point for re-evaluating current investments and institutions in light of global changes. Elements of current Australian science policy, such as the collaborative national roadmap for investment in research infrastructure, are envied by other countries. But the Statement makes little mention of new security risks and the connections between civilian and defence science.

The Australian Government has demonstrated its willingness to experiment with science policy, establishing a new national space agency in 2018, sixty years after NASA was established. The Australian Space Agency is working to strengthen collaboration with allies, but also recognises that the global system will have many more players in 2030 and that to drive cutting-edge science and economic growth requires a new approach.

This begs a bigger question: why isn't Australia innovating in other areas of science policy? Australia's Chief Scientist and Chief Defence Scientist should jointly lead a systematic review of current investments and institutions to ensure they are fit-for-purpose to support Australian competitiveness, security and wellbeing. A more systematic approach would allow Australia to maintain as many of the benefits as possible of open science, collaboration and international engagement, while securing the people and projects that require greater protection.

We already have some pieces of the puzzle. For example, since the 1990s, the uniquely Australian Cooperative Research Centres (CRC) program has supported collaboration between universities, government science agencies and industry in a range of areas, now including defence. But the Australian system doesn't have facilities like the Lincoln Lab at MIT – which allow university researchers to work on secure projects, separate from the main campus. Australia should be experimenting with models like this to allow universities to stay as open as possible to international talent and ideas, while also protecting what needs to be protected.

Prioritising engagement

The Australian Government currently invests in a range of programs to support international science collaboration, including bilateral funds with China and India and regional programs for the Asia-Pacific that include multilateral and research-industry collaboration.[11] However, these lack an overarching strategy for how and where Australia should invest for maximum impact, as well as how to negotiate very real risks of engagement with non-democratic countries.

In response to China's growing power in science and technology, ASPI researchers have proposed a university research partnership among Five Eyes nations.[12] Similarly, US commentators have called for a new "alliance innovation base".[13] Researchers in the 'Quad Tech Network' have called for deeper technology collaboration among Quad countries, a position reflected in the first Quad Leaders' Joint Statement in 2021.[14]

Strengthening strategic scientific collaboration among like-minded democratic countries should be our first priority, but will require new policies and programs. At the same time, we should be wary of locking ourselves in with a small number of partners who represent a declining share of global science, and shutting ourselves off from other parts of the system. It is in Australia's interests to find ways to continue engagement and science collaboration with China, but to make sure that does not compromise our security or values. That will require a better evidence base and greater coordination across government and with the science community.

The Department of Foreign Affairs and Trade should lead the development of a new Australian science diplomacy strategy, which was previously underway but stopped in 2018. This should review existing programs and would provide an opportunity for greater coordination across a range of government departments and agencies.

Successful 21st century science diplomacy will require not just STEM disciplines, but also strengthened capabilities in languages, politics, social and behavioural sciences, law, ethics and culture. These skills will help Australia understand how other countries seek to use science for "smart" (and "sharp") power, and how Australia should engage.

Back in 1990, Prime Minister Hawke said that if Australia was to be more than just the lucky country, it would have to become the "clever country". To continue to be a clever country in the new world order of the 21st century will require not just more scientists, but new ways of thinking about science.

Notes

1. "The Geography of Knowledge", *Science Business*, 23 February 2010.
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11. Department of Industry, Science, Energy and Resources, "Funding and Incentives" (Accessed 24 January 2021).
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