

Australia – ROK Science and Technology Collaboration and Diplomacy

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Abstract

Australia has a strong research foundation with the world's 7th largest research publications per capita. Australia also has a history of producing transformative inventions including the black box flight recorder, electronic pacemaker, cochlear implant, and WiFi. Strategic and robust investment in research and development at the national level has contributed to the outcome.

Australia has also been deeply engaged with the international system to collaborate on talent, investment, knowledge, and technologies from other countries. International engagement in science and technology is becoming more critical in the changing global and geopolitical landscape as we witness disruptions to supply chains and competition for critical technologies.

Australia and the Republic of Korea (RoK) enjoy a Comprehensive Strategic Partnership level relationship, and leaders of both countries affirmed their support for collaborative research and development in the fields of defence, vaccines, space, and clean technology. The Australia-RoK Joint Committee on Science and Technology (JCST) meets every 2 to 3 years to discuss and agree the priority areas for collaboration for the coming years. The next JCST is planned for early 2024.

Apart from the officials' level dialogue, Australia also facilitates international science and technology engagement through various programs including the Australian Research Council's National Competitive Grants Program (NGCP), Tech Bridge, Global Science and Technology Diplomacy Fund (GSTDF), and the Australia-Korea Foundation grants.

The RoK has strengths in certain specialisation areas where Australia does not, and it goes the same to the way around. This complementarity offers an opportunity to mutually leverage each other's capability and to collaborate on global challenges such as technology to achieve net zero and decarbonisation.

1. Introduction

Australia is a significant contributor to world leading research and has a strong history of producing major innovations across a wide spectrum of fields from cancer treatment to quantum technology.

While continuous investment in research and

development by both government and industry has contributed to this outcome, engagement with the international system has also been important. Australia has historically drawn on talent, investment, knowledge, and technologies from other countries, to go with its own, to help grow its science system. With a relatively small population, Australia also relies on international

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markets to generate demand for its technologies. International engagement in science and technology is expected to become more critical to Australia's policy goals as it seeks to revitalise a globally competitive economy that harnesses new and emerging technologies. The changing global and geopolitical landscape in recent years – marked by the COVID pandemic, disruptions to supply chains and competition for critical technologies – has also demonstrated how international engagement in science and technology is an increasingly vital part of governments' international toolkit to achieve not just economic but also social, strategic and security policy outcomes. In this complex and evolving international environment, Australia's international engagement in science and technology can be understood as a policy response to harness and deploy all available resources, including our scientific and technological resources, to influence the world in a way that protects our interest. Facilitation of scientific collaboration occurs as a result of top-down and bottom-up influences, and in many cases, both are required to support successful and enduring collaboration. Government policies and programs are top-down influences, whereas bottom-up influences are researcher-based decisions, such as who to collaborate with. It is well recognised that national policy initiatives enhance the level of international collaboration², and when coupled with the facilitation of people-to-people interaction, will become increasingly valuable as we seek to advance our science and technology capabilities. Australia and the Republic of Korea (ROK) are both middle-power countries that are recognised as centres of research and development in Asia and the Pacific region³, with complementary specialisation areas, rather than shared strengths. The ROK is highly specialised in areas such as chemical engineering, chemistry, computer science, engineering, whereas Australia is highly specialised in agricultural and biological sciences, earth and planetary sciences, environmental science, and neuroscience⁴. While there may not be a shared field of excellence, complementarity offers an opportunity to

mutually leverage each other's capability.

In addition to the initiatives highlighted in this paper outlining the growing strength of the science and technology engagement between Australia and the ROK, the Department of Industry, Science and Resources has established a new counsellor position at the Australian Embassy in Seoul. Having commenced in October 2023, this position will provide further expert capacity to shape Australia's relationship with the ROK to support bilateral space, critical technology and science interests.

2. Australia's position in the global scientific community

Australia is often referred to as punching above its weight in research output and effective use of investment in research and development (R&D). Although it is ranked 55th for population size, Australia had the 10th largest research output over the 2018-22 period and was 7th in the world for research publications per capita over 2017-2021⁵. This outcome was supported by per capita gross expenditure on R&D that was ranked 21st in the world over the period 2015-19⁶. These rankings indicate a strong effectiveness in the use of investment in R&D when measured in terms of research publications. Put another way, with only 0.33% of the world's population, Australia produces approximately 3.71% of the world's research output.

In addition to its proportionally high contribution to the world's basic research, Australia has long maintained a strong track record as a nation of inventors and innovators. Several transformative inventions developed by in Australia include (to name a few) the black box flight recorder, electronic pacemaker, cochlear implant (bionic ear), WiFi, and even the humble electric drill. Other inventions include the ultrasound scanner, the HPV (cervical cancer) vaccine, as well medical applications of penicillin⁷. More recently, Australia's

² Choi, M., Lee, H. & Zoo, H. Scientific knowledge production and research collaboration between Australia and South Korea: patterns and dynamics based on co-authorship. *Scientometrics* 126, 683–706 (2021). <https://doi.org/10.1007/s11192-020-03765-2>

³ *ibid*

⁴ *ibid*

⁵ Statistics on research output cited in this paragraph were calculated by the author with data sourced from Clarivate InCites. Population statistics were extracted from World Bank data.

⁶ Statistics on R&D investment cited in this paragraph were calculated by the author using data sourced from UNESCO and the OECD.

⁷ <https://www.australiangeographic.com.au/topics/history-culture/2010/06/australian-inventions-that-changed-the-world/>

contribution to research quantum technology has been internationally recognised.

The Australian Government is also contributing to the resurgent interest worldwide in indigenous knowledge. This can be seen in Australia's approach to developing its new National Science and Research Priorities and National Science Statement⁸.

3. Australia's National Science and Research Priorities

The Australian Government's policies for science and technology are guided by the National Science and Research Priorities and National Science Statement. The government is in the process of revitalising these documents. They will provide a long-term vision for the science system by reflecting the country's biggest challenges and opportunities and identifying the role of science in addressing these issues⁹. They will help to align efforts and investments in science to deliver social, economic, and environmental benefits for all Australians. The National Science and Research Priorities will work with other policy vehicles such as the National Reconstruction Fund focused on industry transformation and the targeted National Quantum Strategy to focus efforts and drive outcomes in science and technology from research to market. International engagement activities emerging from these policy vehicles in turn help to support these outcomes, and contribute to the country's national resilience, prosperity, welfare, and security.

4. Why engage internationally on science and technology?

Australia's international engagement on science and technology is intended to underpin a strong science system for Australia, supporting Australia to deliver its National Science and Research Priorities, with tangible immediate outcomes:

- Australia engages with international stakeholders to identify opportunities to foster international collaboration in science and technology as it recognises the inherent value in bringing diverse perspectives to research and innovation to produce better outcomes.
- Australia also seeks to advocate for and promote Australian science and technology in order to attract investments and secure access to emerging and critical technologies and knowledge. This is achieved by fostering goodwill, strengthening relationships, and building trust with international stakeholders.
- Given its relative size in the global economy, Australian firms rely on international markets to support its growth and development. International engagement in science and technology contribute to securing and maintaining access to global markets for Australian firms by building market intelligence, facilitating discussions, and maintaining relationships.
- In addition to market access, global events in recent years have demonstrated the value and importance of being connected to and having secure access to global supply chains. Engagement with international stakeholders helps build an understanding of the complex nature global supply chains, identify opportunities for Australia, and developing relationships to foster strategic commitments.
- International engagement contributes to the maintenance and improvement of the international visibility and reputation of Australia's science system, and indirectly also Australia's education and training sectors, thus helping to promote its services internationally. Before the COVID pandemic, education services were frequently ranked as Australia's top export after natural resources¹⁰.
- Australia seeks to leverage its relationship with international stakeholders to secure its influence over the development and maintenance of international standards. According to the OECD, 80 per cent of global trade is affected by standards. Australia can improve its trade outcomes by exercising leadership and influence on the development and enforcement of international standards. This is particularly relevant to emerging

⁸ <https://www.industry.gov.au/science-technology-and-innovation/revitalising-australias-vision-science-and-research/terms-reference>

⁹ These were last set in 2015 and 2017 respectively.

¹⁰ See for instance Australian Government (2021), Trade and Investment at a Glance 2020. Available at <https://www.dfat.gov.au/sites/default/files/trade-and-investment-glance-2021.pdf>

technologies such as quantum and artificial intelligence where standards are not yet settled and where future economic, security and social benefits are expected to be significant.

- International engagement also serves to promote Australian science and technology that could help to address pressing global issues such as climate change, natural disasters, and public health.

5. International engagement and the Australia–Korea relationship

One of the most common forms of international engagement is an agreement between two or more countries. These international agreements serve to outline areas of mutual interest, articulate visions and ambitions for the bilateral or multilateral relationships and establish frameworks for collaboration.

Scientific collaboration between Australia and the ROK is underpinned by a treaty level agreement on Scientific and Technological Cooperation¹¹. This agreement, in effect since 2000, recognises the “need for effective co-operation in the scientific research and technical fields which will enhance the economic and social development of both countries”. The Agreement identifies a variety of science and technology fields for cooperative activities. To advance these areas, a Joint Science and Technology Committee (JSTC) meets every 2 to 3 years to discuss and agree the priority areas for collaboration between our two countries for the coming years. The next JSTC is planned for early 2024.

Australia’s international engagement in science and technology with the Republic of Korea was most recently articulated in the Comprehensive Strategic Partnership (CSP) statement signed in December 2021. The CSP acknowledges the common history between the two countries since the Korean War and articulates the shared vision for an open and inclusive Indo-Pacific region, underpinned by shared values and principles¹². Leaders of both countries affirmed their support for collaboration in the field of defence science and technology, closer

cooperation on vaccine research and development, and joint work in the space sector. Both leaders also committed to providing funding to support the development and commercialisation of technologies to reduce emissions and create new economic opportunities. Oversight of initiatives are facilitated by regular meetings between the leaders, Trade Ministers, as well as Foreign and Defence Ministers of the two countries.

As the leaders acknowledged in the CSP, the bilateral relationship between Australia and the ROK is strong. The ROK was ranked as the fourth largest two-way trading partner with Australia in 2022, after China, Japan, and the United States¹³. Similarly, Australia features in the top 10 of the Republic of Korea’s bilateral trade partners.

Engagement in science and technology has deepened alongside the growth in trade between the two countries. Korea is Australia’s 23rd highest ranked country for research collaborations, with over 7,431 joint research publications between 2020–22. The top collaborating disciplines are Medicine, Engineering and Physics and Astronomy.

Science and technology are areas that both Australia and Korea seek to further our collaborative relationship. Since 2008 both countries have hosted biannual joint committee meetings to strengthen cooperation in science and technology, as well as research and education. Work is currently underway to plan and organise the next Joint Science and Technology Committee meeting for early 2024, which will focus on the key areas for collaboration between the two countries.

The Australian Research Council’s National Competitive Grants Program (NGCP) also supports projects with international collaboration components¹⁴. Since 2002, there has been 452 projects (1.4% of total projects) involving ROK collaboration. The ROK ranks 17th for collaboration on NCGP-funded projects. The figure below illustrates the areas of collaboration for ARC NCGP grants with ROK Collaborators.

These ARC collaborations are indicative of broader collaboration between Australia and the ROK. The number of institutions involved in Australian–ROK collaboration is wide and varied in both countries. The

¹¹ <https://info.dfat.gov.au/Info/Treaties/treaties.nsf/AllDocIDs/2B59BD5C9CF1175ACA256B1E007F6D1D>

¹² A copy of this statement is available at <https://www.dfat.gov.au/geo/republic-of-korea/republic-korea-south-korea/australia-republic-korea-comprehensive-strategic-partnership>.

¹³ Australia’s trade in goods and services 2022 | Australian Government Department of Foreign Affairs and Trade [dfat.gov.au]

¹⁴ <https://www.arc.gov.au/funding-research/funding-outcome/grants-dataset/trend-visualisation/ngcp-trends-international-collaboration>

Figure 1 ARC NCGP Australia–Korea Science Collaborations (2002 – current)

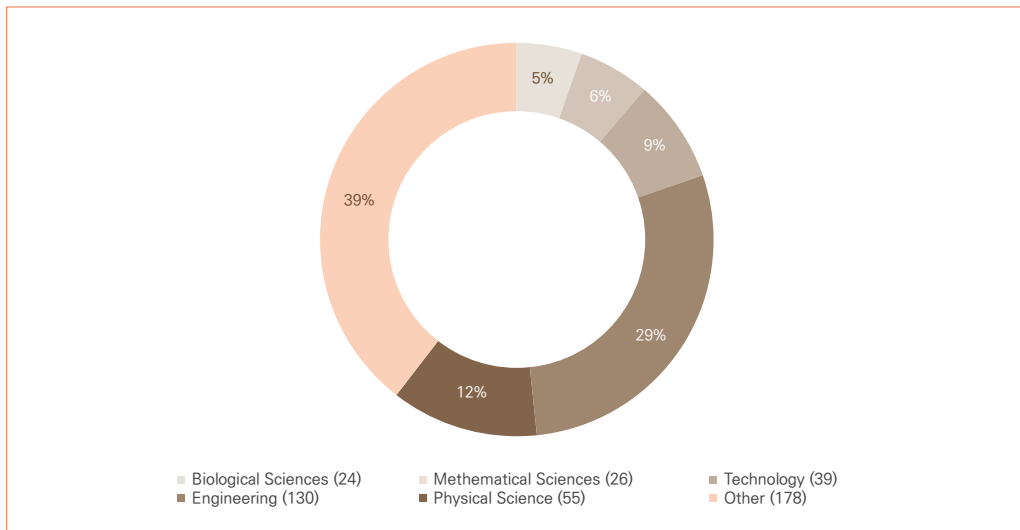


Figure 2 Australian organisations collaborating with South Korea (2017 – 21)

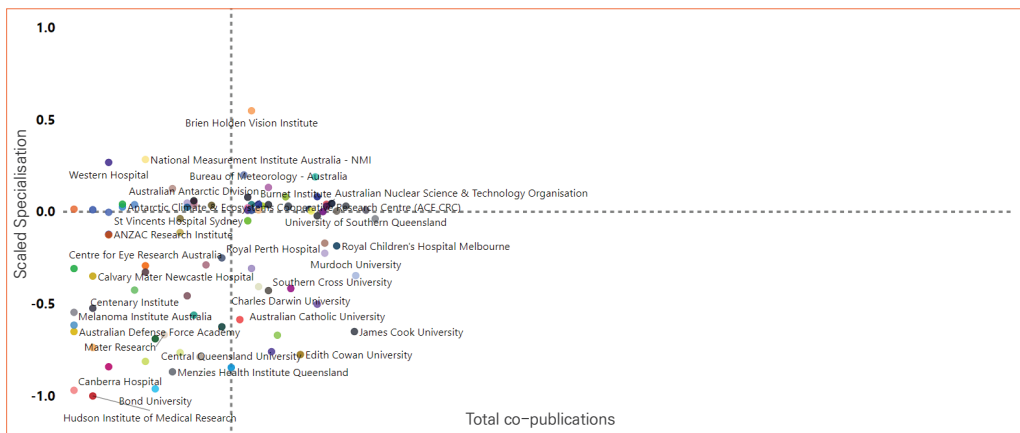
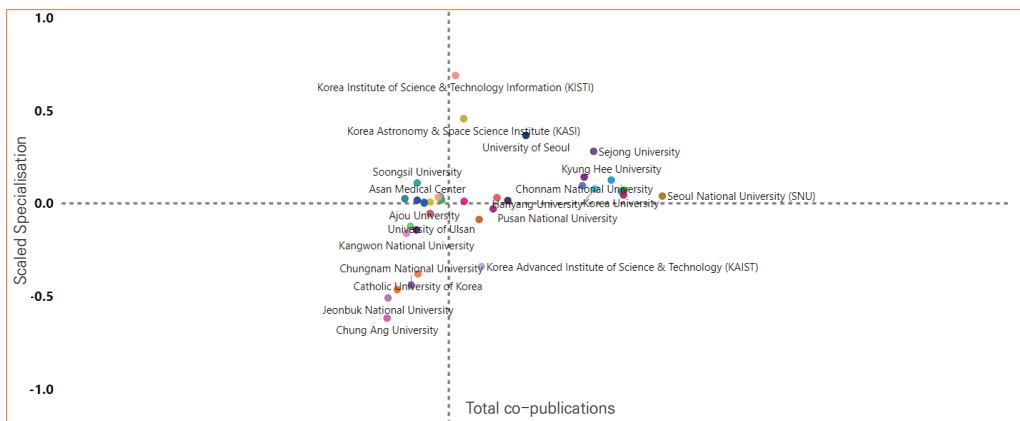


Figure 3 South Korea organisations collaborating with Australian (2017 – 21)



following charts illustrate the distribution of institutes with greater than 20 collaborative publications in each country for the period 2017 - 2021¹⁵.

As part of this growing science and technology collaboration between Australia and the ROK, the Australian¹⁶ and Korean governments jointly fund a programme known as 'Tech-Bridge'. Tech-Bridge was aimed at building people-to-people links in science and technology fields of mutual national interests.

Outcomes of the two workshops conducted under this programme are highlighted on the ATSE website¹⁷.

Tech-Bridge

Workshop 1

focused on the application of artificial intelligence to counter infectious diseases. This workshop, in 2021, brought together Australia and Korean researchers in technology and public health together to look at ways to help manage COVID-19 and prepare us for any future pandemics. From this workshop, two bilateral research projects emerged.

Workshop 2

Australian and Korean experts from small satellite research along with the Australian Space Agency and industry participants came together in a workshop in 2022 to discuss cutting edge developments and collaborative opportunities in the field of cube satellites. The workshop helped to build strong personal linkages between research, government and industry working on this cutting-edge technology¹⁸.

Similar to many developed economies, Australia funds programmes and initiatives as vehicles to achieve objectives for international engagement identified in the previous section. These help to facilitate collaboration and support the mutual development of scientific capabilities with international partners. The **Global Science and Technology Diplomacy Fund (GSTDF)**¹⁹ is Australia's

major initiative for international science engagement. The strategic element of the GSTDF identifies priority themes and partners and supports Australia's national science interests. It also provides a mechanism to boost Australia's strategic international science diplomacy and research capabilities and promote Australia's scientific international expertise and reputation. The ROK is recognised as a partner country for the GSTDF, and the current priority themes are advanced manufacturing, artificial intelligence, hydrogen production, quantum computing and RNA (including mRNA) vaccines and therapies.

Beyond the GSTDF, the **Australia-Korea Foundation**²⁰ offers grants to support technological, scientific and education innovation, among other areas, to help increase public awareness of Australia in the ROK, and of the ROK in Australia, develop partnerships in areas of shared interest and increase Australians' capacity to effectively engage with the ROK²¹. Grants were awarded to 4 projects in 2022-23 to support collaborative teaching using Design Thinking Model to achieve United Nations Sustainable Development Goals; an Australia-Korea industry forum to connect Space and AI technologies; a project to showcase each country's activities in processing and recycling rare earth metals; and an Australia-Korea collaborative effort to promote global citizenship of healthcare workforce.

Rare earth mineral recovery from primary and secondary sources²²

AKF00866; A CSIRO – Korea research initiative

Rare earth minerals are vital for renewable power generation in a world which is becoming increasingly decarbonised. By continuing with the traditional approach to mining such critical minerals, research has demonstrated that as demand surges, markets will be dominated by countries that have access to available resources. In comparison to other countries (e.g Australia), Korea is resource constrained and to

¹⁵ Data collated from Web of Science InCites 26 October 2023.

¹⁶ Funding was provided by the Department of Industry, Science and Resources (DISR), and the Defence Science and Technology Group (DSTG).

¹⁷ <https://www.atse.org.au/news-and-events/article/techbridge/>

¹⁸ <https://www.atse.org.au/research-and-policy/publications/publication/impact-214/>

¹⁹ <https://www.industry.gov.au/science-technology-and-innovation/international-collaboration-science-and-research>

²⁰ <https://www.dfat.gov.au/people-to-people/foundations-councils-institutes/australia-korea-foundation>

²¹ <https://www.dfat.gov.au/people-to-people/foundations-councils-institutes/australia-korea-foundation/grants>

²² <https://www.dfat.gov.au/people-to-people/foundations-councils-institutes/australia-korea-foundation/grant-recipients/australia-korea-foundation-2022-2023-grant-recipients#AKF00935>



Rare earth mineral recovery from primary and secondary sources

Image courtesy of Mark Pownceby.

reduce the dependence on imports, Korea adopts an aggressive approach to recycling rare earth metals through innovative science and technological solutions. This project seeks to showcase each country's activities, excellence and directions in characterising, processing and recycling rare earth metals, to share knowledge, and to develop and strengthen partnerships. The proposed bilateral symposium, workshop and field excursions will provide an ideal platform to initiate further planning activities that will be of mutual benefit to both Korea and Australia.

6. A valued partner for education

The Comprehensive Strategic Partnership Agreement and over 60 years of diplomatic relations also underpins a deep bilateral education relationship. For the year to date to July 2023, there were 12,278 South Korean students studying Australian courses across the higher education, vocational education, schools, and English language sectors. Students from the ROK make up 2% of all international students in Australia. In 2020, there were 236 'university to university' agreements reported between the ROK and Australia, enabling academic and research collaboration, staff and student exchange, study abroad and other short-term mobility programs.

The Australian Department of Education is committed to driving ongoing education cooperation with the ROK Ministry of Education (MoE) under the Memorandum

of Understanding in Education. The Department of Education and the MoE held the 6th Joint Committee for Education (JCE) meeting in March in Seoul, which marked an important step in our bilateral education relationship since the pandemic.

Under the 2008 MoU in Education, the Department of Education and MoE will continue to facilitate education cooperation including government-to-government policy and information sharing on education reforms; exchange of staff, academics, teachers and students; research collaboration between education; and joint conferences such as the JCE meetings. The Australian Department of Education also contributes to whole-of-government efforts to support implementation of the 2021 MoU on Socio-Cultural Cooperation through education initiatives with the ROK, noting the critical role of education in building socio-cultural links bilaterally. These education and socio-cultural linkages are vital for strengthening our science and technology collaborations into the future.

Korea Australia Researcher Network

Korea Australia Researcher Network (KARN) was launched on 31 May 2019, as an outcome of the bilateral joint research project between the Australian Department of Education and the Korean Ministry of Education titled "Research Collaboration between Australian and Korean Universities: A Social Network Analysis". KARN is managed by the Centre for Australian Studies (CAS), Yonsei University.

KARN is designed to bring Australian and Korean researchers together who are active in collaborative research. It is the only network in Korea that is dedicated to promoting further research collaboration between the two countries.

7. Standards Development

According to the OECD, 80 per cent of global trade is affected by standards. By exercising leadership on international standards and conformance, particularly in those areas that will be crucial to Australia's economic future (critical technologies, critical minerals, clean energy technologies) and by seeking to engage on global standards and conformance in a way that supports our commercial and industry interests, Australian industry has a chance of improved trade and market-share outcomes.

Australia recognises the ROK's leading capabilities in standards development and through the Critical Technology Knowledge Sharing Program between the ROK and Australia, led by the ANU Tech Policy Design Centre and the Korea Development Institute, identified areas for mutual collaboration in technology standards development.

Key findings of this joint Australia-Korea project identified that the ROK has significant strengths in standards development, including the prioritisation of the standards as a key component of competitive advantage, and as well-developed training curriculum that supports participation in international standards negotiations. The research also found that Australia has developed a whole-of-government approach to critical technology policy and standardisation, which the Korean Government would benefit considering. Both Australia and the ROK recognised the importance of developing early capability in quantum standards, and this project recommended that Australia and the ROK develop a partnership on quantum standards. It was also recommended that to foster greater cooperation, Australia and the ROK should develop a bi-lateral partnership on standardization collaboration like existing bi-lateral partnerships between the Korean Standards Association, Germany, and the United States.

8. Challenges and future prospects

Australia's international engagement for science and technology is centred on facilitating collaborative work, knowledge-sharing, securing access to international markets and supply chains., as outlined in Partnering with Australia²³. By actively engaging with the global scientific community and global partners, such as the ROK, Australia seeks to contribute to the advancement of knowledge and address some of the world's most pressing issues. Ultimately, Australia would like to ensure that its efforts in science and technology benefit not only Australia but also the world more broadly.

Australia continues to seek and grow collaborative research arrangements with the ROK, noting both countries have high-quality research capabilities and mutual research priorities. Australian universities are interested in increasing partnerships and research collaborations with Korean universities, noting the ROK's leading expertise in fields including engineering, medicine, and material science.

Our complementary strengths have us well placed to collaborate on global challenges, including technology to achieve net zero & industrial decarbonisation, as well as advancing digital technology. Aligning our collaborative efforts with goals in the Indo-Pacific region, will also ensure the region is collectively focused on addressing these challenges.

Australia, like the ROK, is mindful of the need to balance research, development and access to promising technologies and emerging science, with the potential risks and threats these may pose to national security. Working together with like-minded partners who share common values, principles, and concerns to develop appropriate frameworks for international collaboration in these areas is vital for safe and successful international collaboration. As like-minded partners with complementary specialisations, collaboration between Australia and the ROK, offers an opportunity to capitalise on each other's capabilities, while shaping and influencing the frameworks and standards around science and technology research and development.

The intensity of activity and initiatives between Australia and the ROK highlights the priority and importance the Australian Government places on collaboration with the Republic of Korea.

²³ <https://www.industry.gov.au/publications/partnering-australia-innovation-science-and-research>