

Unleashing Synergy or Accelerating Fragmentation?

South Korea's bold shift toward international science and technology collaboration—starting with Horizon Europe—requires transforming the weaknesses of the current system into future strengths.

Over the last 40 years, international collaboration has become an essential strategy for the global science and technology (S&T) enterprise. Collaboration enables countries to leverage foreign expertise and equipment and distributes the economic and industrial burdens associated with research and development, resulting in a lighter load for each nation involved. Collaboration also supports the diffusion of technological innovation, promoting cooperative international efforts to tackle global grand challenges. In comparison to isolated national endeavors, unified efforts reduce financial strain, mitigate risk, and enhance collective global security.

Today, however, escalating technological competition is changing the value proposition of international S&T cooperation. Tensions between China and the United States have complicated multilateral cooperation and open innovation, leaving South Korea—as well as many emerging countries—feeling pressure to align with one side or the other.

As the competition for technological supremacy takes on new dimensions, governments must carefully

evaluate the risks of collaboration against the risks of falling behind. Thus, for middle-power and emerging countries, it's crucial to strategically distinguish between areas of technological advantage in competition and areas where they should pursue collaboration. The course that these countries take—and each will be different—will profoundly remodel the landscape of global science.

An abrupt shift

South Korea, where I have served as a member of government advisory committees including the Ministry of Science and ICT (Information and Communication Technology) and the Ministry of Foreign Affairs, exemplifies how the map of global R&D is shifting. Once renowned for its substantial investment in science, last August the government unexpectedly proposed cuts in funding for the first time in three decades. About six months later, the country announced that it was joining the European Union's research and innovation program, Horizon Europe. With this initiative, South Korea is making a bold shift from an inward-looking, domestic

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R&D system to an international one that positions the country as what the government has termed a “global pivotal state” in the realms of science and technology.

Over the past half century, South Korea’s investment in R&D had grown from just \$20 million in 1964 to \$83.7 billion in 2022. By 2022, the country’s total R&D expenditure as a percentage of gross domestic product was 5.21%, ranking first among Organisation for Economic Co-operation and Development countries and second in the world after Israel. So the 2024 cuts marked a significant departure from this history, decreasing government R&D spending by approximately \$20 billion—16.6% compared to the previous fiscal year.

South Korean scientists and researchers immediately expressed concern that this unexpected shift could jeopardize the nation’s scientific progress and innovation. The collective anxiety within the scientific community was a response to the government’s top-down switch from funding basic research toward applied work and international collaboration without consulting researchers. The international community also spoke apprehensively about how the cuts might affect South Korea’s capabilities in artificial intelligence and other cutting-edge technologies, leading some observers to question the nation’s future position in global technology.

Shortly after, amid assurances from South Korean president Yoon Suk Yeol that his administration was committed to supporting R&D, a new policy direction became clear. The Ministry of Science and ICT adopted “the Global R&D Strategy,” which included a tripling of the international cooperation budget to \$1.31 billion year-on-year, signaling a shift away from collaborations driven by researchers and toward targeted collaborations aimed at developing relationships with leading global research institutions, enhancing joint research initiatives, and emphasizing outcomes. This showed an intent to reorient South Korea’s engagement with global R&D to reflect the nation’s strategic priorities, moving away from sporadic international cooperation efforts that were often fragmented across ministries. All of this provided the rationale for joining Horizon Europe, which was accomplished in about nine months.

In articulating this vision and putting it into practice, South Korea has embarked upon a policy experiment aimed at ensuring that international research collaboration focuses on the production of tangible research outcomes. Within the country, this shift stemmed from the realization that research quality had plateaued over the past decade. The global ranking for South Korean research papers falling within the top 1% of citation indices has stagnated, showing only a marginal progression from fifteenth place in 2012 to fourteenth in 2022. I think this is due to a failure to emphasize basic research and the development of next-generation technology in the context of an R&D ecosystem with a risk-averse culture. A change in direction of national R&D policy is clearly necessary, but transforming the weaknesses of the current system into future strengths will require careful attention and detailed strategies.

Joining Horizon Europe in search of outcomes

On March 25, 2024, South Korea officially completed negotiations to join Horizon Europe, making it the first Asian country outside the European region to join. This allows Korean researchers to apply for grants on an equal footing with EU researchers in Pillar II of the program, which emphasizes global challenges. The very act of creating a channel for cooperation outside of domestic government funds is a strong signal for researchers and institutes to consider changing the way they collaborate.

Joining Horizon Europe is part of the Korean government’s broader strategy to open up the country’s research and innovation system and reduce its dependence on domestic innovation. It is also a strategic diversification to create diplomatic ties that can be expanded to other areas of cooperation. If this is successful, Korea may even consider mimicking the European Union’s role in Horizon Europe and create a similar program of its own in Asia, further broadening global R&D’s collaborative portfolio.

However, joining Horizon Europe is not without risk. South Korea is not joining Horizon Europe on the same footing as EU members and may find that, unlike in sports, home games and away games are played



according to different rules. Even though joining Horizon Europe is expected to enhance Korea's global scientific collaborations and leverage, it does not include equal access to the European Research Council. Furthermore, the European Union is not a singular entity, but a community of nations with their own agendas, which may not always be in line with the policy directions of EU leadership in Brussels. Smaller EU nations may face fiercer competition for funds as non-EU countries join and take a share of the research funds. As countries establish different directions for industrial policy, new fault lines may emerge.

Additionally, at the outset, although the initiative's focus is not on facilitating cooperation only between "likeminded" nations, Chinese participation in Horizon Europe has fallen recently. If South Korea's inclusion in Horizon Europe is perceived as signaling increased barriers to collaboration with China, this may accelerate the fragmenting of the international scientific community. And as South Korea attempts to

a coherent strategy to manage uncertainties across multiple layers of the country's scientific enterprise. For example, is the new openness calibrated toward inbound or outbound collaborations? And will the new strategy focus on national competitiveness, or on increasing competition within the S&T enterprise, or on science diplomacy? Now that the general direction has been set, it's time to address the details.

The first step will be to develop guidance for decisionmaking about which S&T fields to pursue, and how they contribute to the overall strategy. Specifically, the coordinating agencies need to understand the Technology Readiness Level of each domestic research field so they can engineer research collaborations to enhance the country's industrial and strategic positioning in the global value chain. In particular, decisionmakers must determine which fields should focus on technology acquisition through cooperation with advanced institutes; which fields should prioritize technology transfer with developing countries to

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ameliorate isolation by joining the European Union's efforts, that may exacerbate tensions with China in unanticipated ways.

Given these many opportunities and uncertainties, a business-as-usual approach to S&T policy in South Korea will fail. The government must demonstrate that it has a clear agenda or risk appearing to be drifting in the wake of larger international currents. So far, from the perspective of the Korean scientific community, recent policy changes are difficult to interpret. When the strategy is unsettled, it is challenging for individual scientists—never mind whole institutions—to initiate truly transformative changes.

Conditions for success

South Korea's policy experiment is abrupt and bold—but in order to be successful, the government must now change the way it administers, guides, funds, and evaluates international cooperation in science and technology. This will be new territory for an S&T bureaucracy that is distributed across 25 government-funded research institutes and has historically been narrowly focused on national R&D. It must now create

establish long-term cooperative relationships; and which fields are ready to participate in multilateral collaboration and lead international joint initiatives to address global challenges. For example, sectors where South Korea may lead subfields in the future—such as secondary batteries and displays, lunar exploration, and small modular reactors—require carefully customized strategies. On the other hand, a different set of considerations are required in fields where the country currently lags in fundamental research but has manufacturing capacity that could assist in bringing new products to market—such as quantum technologies, pharmaceuticals, and hydrogen. Investments must be guided by frameworks that clarify fundamental questions around collaboration: why to engage in S&T cooperation, in which technological fields, with whom, and how.

Second, the dynamic nature of global R&D necessitates creating flexible budget practices that can adapt and respond to the way partner countries work. But to do this, decisionmakers need to clearly understand what their mission is. Is it to welcome researchers from overseas, or to facilitate long-term

international projects? Should adaptable R&D budgets be reciprocal with partner countries? If R&D projects have budgetary flexibility, shouldn't other budgets earmarked for international collaboration be managed in the same way? Answering such questions will set the mid- and long-term direction of R&D for years to come. And even after these policies are fine-tuned, the Herculean task of producing specific guidelines for institutions and researchers will remain. The ministry will need to create a comprehensive guide on joint intellectual property ownership, contracts, and research security—to name just a few.

Furthermore, policymakers need to be able to determine whether collaborative strategies are working, and if so, which ones work better than others. New ways to evaluate the effect of international research collaboration on science and technology and research productivity need to be developed. So far, bibliometric studies based on coauthorship analysis alone have been the dominant methodology. However, coauthorship data

An evolving ethos of collaboration

In 2024, the global S&T community stands at a crossroads, confronted by unprecedented challenges that necessitate concerted and collective strategies. These challenges extend far beyond the walls of laboratories and publications to include the uncertainties of the US presidential election, the destabilizing conflict between Ukraine and Russia, escalating geopolitical tensions in the Middle East, and the techno-ethical quandaries engendered by the rapid proliferation of generative artificial intelligence technologies.

In the face of these complex currents, countries that adopt isolationist or narrowly focused strategies are more likely to be poised for decline. Even as research collaboration between the United States and China has declined, other collaborative efforts across a spectrum of disciplines are proving resilient. In this evolving ecosystem, countries such as South Korea, which are actively interacting with the global S&T community, have an important role to play in fostering innovation

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are a partial or imperfect proxy for the very complex and multifaceted characteristics of international collaboration in S&T. Thus, an alternative approach should include analyzing the causal effects between R&D expenditure, intellectual property rights, and marketization; assessing the contextual effects of national innovation systems; addressing how gender disparities in international research collaboration are managed; and examining the long-term socioeconomic effects of South Korea's S&T-driven official development assistance (ODA) to developing countries.

Finally, a comprehensive strategy for intra-ministerial and governmental coordination will be critical. Multilateral cooperation in S&T often intersects significantly with S&T ODA. Although the Korean government increased the ODA budget by more than 31% in 2024, it has not modified the governance structure. With 46 aid agencies involved, fragmentation remains a major challenge. Moreover, as global R&D expands, 25 R&D government research institutes are currently performing overlapping tasks. Without effective cross-institutional coordination, even a significant budget increase can result in inefficiencies.

and norms and maintaining multilateral agreements across domains as diverse as sustainable development, industrial standardization, and the economy.

Although the Korean experience is rooted in a unique sociohistorical context, it provides insights into the complexity of formulating national strategies for international collaboration in science and technology in this new age. As the global system of S&T research collaboration that was established over the past half century shifts, the process of reconfiguring collaborations will present substantial complexities and challenges, necessitating extensive data to inform effective policymaking. South Korea's transition could provide lessons for how emerging countries can enhance the value of global public goods while promoting innovation. Amid global struggles for technological hegemony, balancing competition and collaboration within national innovation strategies is the most critical issue.

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