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# Science Diplomacy: A Pragmatic Perspective from the Inside

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Two lenses have typically defined international science cooperation: advancing knowledge and ensuring scientific capability, or advancing broader national interests. It is the latter perspective, advancing both direct and indirect national interests, that the evolving concept of science diplomacy primarily encompasses. This is also reflected in the creation by a growing number of foreign ministries of formal links to the science system by appointing science advisors or embedding science and technology (S&T) units within ministries. While there is no sharp distinction between the two spheres, they are often administered through different agencies and different funding streams, which can cause potential conflicts between—and confusion within—agencies. Indeed, better coordination could resolve such issues, while enhancing the value generated by such endeavors.

The concept of science diplomacy was given contemporary emphasis and currency by a meeting held in 2009 at Wilton House, United Kingdom, sponsored by the Royal Society, (London) and the American Association for the Advancement of Science (AAAS), publisher of *Science & Diplomacy*.[1] The most influential outcome of that meeting was the development of a taxonomy for science diplomacy that has come to be widely used:

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- **Science in diplomacy**: Science providing advice to inform and support foreign policy objectives
- **Diplomacy for science**: Diplomacy facilitating international scientific cooperation
- **Science for diplomacy**: Scientific cooperation improving international relations.

While this taxonomy has been useful for academic and theoretical discussions, any particular international science effort often serves multiple purposes, such as supporting better international relations as well as the goals of the scientific field itself. Such a reality has limited the impact of this traditional taxonomy on the core government agencies covering science and foreign affairs. Consider the issue of international action on climate change: it requires all three dimensions of this taxonomy. Diplomacy was needed to establish and sustain the process associated with the Intergovernmental Panel on Climate Change (IPCC) (i.e., diplomacy for science), international scientific cooperation was needed to advance our understandings of the global climate system and facilitate international agreements (science for diplomacy), and scientific measurement will be used to monitor progress against various agreements (science in diplomacy). Getting to the current juncture has required a massive joint scientific and diplomatic effort, and the science diplomacy taxonomy does not easily categorize such activities. While this discussion may seem to be one of semantics, it has a major impact on how relevant agencies view international science and science diplomacy.

Other important elements of science diplomacy simply do not fit within the traditional tripartite framing, such as the governance of nonjurisdictional spaces like Antarctica or the role of science in development assistance or in resolving trade disputes. Indeed, some of these gaps have been explored previously.[2]

From the perspective of foreign ministries and other agencies with international responsibilities, including science agencies, the traditional taxonomy may be viewed as somewhat academic and of limited practical application. Yet as the significance of science diplomacy grows, ministries and international agencies will have to consider their respective functions and the scope of needed interactions between two very different domains: diplomacy and science.

## Toward a Pragmatic Reframing of Science Diplomacy

In our experience, a focus on why a country might invest efforts and resources in science diplomacy and international science could be the basis for a more utilitarian framing of science diplomacy, and one that better resonates with government agencies. This alternative framing envisions three new categories for science diplomacy:

- Actions designed to directly advance a country's national needs
- Actions designed to address cross-border interests
- Actions primarily designed to meet global needs and challenges.

For a country to make any investment that supports science diplomacy, the actions must be seen to either directly or indirectly advance its national interest, but that national interest can be parsed according to motivations and intervention logic. The new distinctions are useful because they are guided by a spectrum of policy reasoning and political imperatives, and because they recognize that functions will be coordinated by different government agencies. This is the case even though each of the new categories stands on its own. exclusive Hence, clarity of expectation and role of agency ownership, as illustrated in this more practical framing of science diplomacy, can help produce effective initiatives and coordination.

The development of this new taxonomy for science diplomacy also highlights the need for ministries to ensure they are equipped with and have access to appropriate expertise. Relatively few ministries of foreign affairs have dedicated in-house scientific advisory mechanisms, although many diplomats have scientific backgrounds and larger ministries may have technical units. In the last year, a growing effort has been made both within governments and by external groups of stakeholders and experts to suggest to foreign ministries that they consider the need for formal scientific advisory mechanisms. For example, in 2016 the United States, New Zealand, the United Kingdom, and Japan joined together to formalize a Foreign Ministries Science and Technology Advisors Network aimed at elevating S&T inputs for diplomacy.

The role, description, and titles of those involved with their foreign ministries vary, but this paper will, for the sake of convenience, term them chief science advisors (CSAs). All such figures are involved in promoting the diplomatic function but are, to a greater or lesser extent, engaged in the more specific technical areas carried out by foreign ministries. In part, this reflects the different positioning of trade and foreign aid within specific foreign ministries.[3] Meanwhile, other countries have looked to develop their own capacities and are joining this network, which is convened as part of a larger set of activities undertaken by the International Network for Government Science Advice (INGSA).[4] As science becomes more integrated into foreign services, stakeholders will benefit from considering the key factors that can make the CSA role most effective. Based on our collective experience, we will now share those we consider most important. In total, they represent an ideal that any country would find it difficult to achieve. While a lack of adherence to one or some will not necessarily lead to failure, we believe all are valuable.

**Factors for Successful Science Chief Science Advisors in Foreign Ministries**

**1. Collaboration throughout government**: Strong strategic and operational communication between the chief science advisor within the foreign ministry and other government departments with responsibility for S&T policies—e.g., research, education, industry—is imperative for ensuring the effectiveness of the CSA. Foreign policy–related issues that demand scientific advice often involve actions by more than one government department. Yet certain departments may not fully understand the diplomatic dimension to a particular international engagement. Cooperative action by officials from relevant ministries can therefore be as important as the actions by foreign ministry officials in achieving foreign policy goals.

**2. Communication and support within the foreign ministry**: The CSA should be expected to engage regularly with key foreign ministry figures, providing counsel on diplomatic issues for which science can inform the dialogue. Personal interactions at both the political and civil service levels are always most helpful in enabling useful exchanges of information. Within the civil service, CSA activity covers a broad range of science-related foreign policy issues. Separately, the CSA might help identify and establish science relationships with partner countries. Whatever priorities a particular country might identify for its CSA, the position must have adequate resources to carry out its agenda.

**3. Relationship to the science community**: The CSA should be an established figure in the science community, sufficiently experienced to inspire confidence within the civil service. Ideally, qualifications should include connections with industry. Altogether, such attributes will allow the CSA to bring together scientific expertise from across the civil service, academia, and the private sector. Indeed, the success of the CSA depends on an ability to build a diverse network of teams from the science community. Further, the CSA should seek to maintain his or her personal credibility within the science establishment, either by assuming a particular leadership position outside the CSA role, leading on a policy issue, or remaining active as a research scientist. The CSA will, in turn, continue receiving requests to speak as a scientist when visiting foreign countries or at international meetings. Such status will facilitate the CSA's broad acceptance not only within the international scientific community but also by the specific part of the community the CSA may wish to influence. The CSA will be bolstered further through promotion by the network to which he or she belongs.

**4. Access to S&T teams**: Depending on the scope of his or her role, the CSA may need assistance from dedicated teams—e.g., to commission studies or write briefs for officials or ministers. Here, the need for access to exceptionally broad science support networks comes in, given the CSA's responsibility to provide advice, or access to advice, on a multiplicity of topics.

Under some circumstances, the CSA may need to help create an external advisory board, drawing from experts from different sectors—as with Japan's Advisory Board for the Promotion of Science and Technology Diplomacy—or via a relationship with national academies with responsibility for science, social sciences, engineering, and medicine. In general, the CSA should work to maintain a good relationship with key academies, while recognizing an academy's independence, depending on the specific context. The CSA can also extend the purview of the office by working and developing a close relationship with science attachés stationed at the country's embassies abroad. Similarly, the CSA should aim to build strong, constructive relationships with the full cohort of foreign science attachés residing in his or her own country, thus bolstering its science profile.

**Actions Designed to Advance Domestic Needs**

Science diplomacy can be enlisted to meet a range of national domestic needs, from exercising soft power to serving economic interests to promoting innovation.

*Exercising Soft Power*

The concept of "science for diplomacy" emerged originally to describe the aspiration by larger countries to project their culture and influence beyond their boundaries. Indeed, the subtext of the AAAS–Royal Society 2009 meeting on science diplomacy was the potential use of science to reduce tensions between Western and Muslim-majority countries, especially in the wake of the 9/11 attacks and the highly publicized war on terror. U.S. president Barack Obama's Cairo speech, delivered June 4, 2009, and aimed at reframing the relationship between the United States and the international Muslim communities, focused heavily on S&T, and highlighted these efforts at an official level.[5]

More recently, smaller countries have discovered the value of science in asserting themselves on a global stage and increasing their relevance to international policy discussions. Israel, for example, has used its S&T strengths in developing its start-up and innovation economy, including building relationships that transcend long-held frictions with its Middle East neighbors. New Zealand also has used science diplomacy to project its voice and interests successfully in many arenas.[6,7]

Countries are looking to become more strategic in identifying how science relationships can promote trade and advance broader diplomatic interests. Here, just as countries use science and innovation to project their national interests, they now increasingly acknowledge the scientific dimensions to development assistance. Central to the development of low- and middle-income countries

(LMICs) is the enhancement of science literacy and capacity through the promotion of science, technology, engineering, and mathematics (STEM) education. Indeed, the development of scientific expertise to inform policy, address crises, and advance economic human and environmental development applies even in the lowest-income countries. For example, the Canadian government's International Development Research Centre has recently partnered with INGSA to boost development of science advisory mechanisms in LMICs in Africa, Asia, and Latin America.[8] Further such attempts to connect science and innovation to development policy include the launch of the U.S. Agency for International Development's Global Development Lab, the partnership between the Japan Science and Technology Agency/Japan Agency for Medical Research and Development with the Japan International Cooperation Agency, and the CSA's active role in the UK Department for International Development.[9]

In line with such trends, development assistance benefits greatly when informed by science more directly. A great deal of aid has a technological dimension, whether to address water and other environmental and resource issues, public health, food and energy security, or to grow and diversify the economy. However, well-intended efforts can be counterproductive if they are not evidence based. Scientific input, therefore, needs to be incorporated into the evaluation and design of proposed programs. Moreover, science partnerships between donor and recipient countries must extend to include joint design, production, and evaluation of efforts. Entities such as the UK-based Newton Fund have engaged in such endeavors, as described elsewhere in this journal.[10]

### *National Security and Emergency Response*

National security needs are dominated by science, on a number of levels. After a natural or human-created disaster, for example, rescue often comes in the form of transnational scientific assistance. Thus, in 2010, following volcanic events in Iceland and the resulting ash cloud, international parties collaborated intensively in enacting a response.[11] To resolve a suspected Ebola case in 2014, New Zealand turned to Australia for expertise and testing capabilities. On occasion, New Zealand has also sought help from the United States or United Kingdom to address other potential animal or human infectious-disease episodes. The critical role of science cooperation between the UK and Japan was central in addressing the security and health risks associated with the 2011 Japanese earthquake and corresponding Fukushima nuclear power plant accident.[12]

Establishing and maintaining the confidence needed for many arms control treaties depends on scientific verification. In turn, national security decisions rest on the ability to verify claims scientifically. Equally, while cybersecurity at one level is a global concern, the growth of state and nonstate cyber espionage is driving states to pursue bilateral as well as international cybersecurity protocols. The rapid development of technologies such as gene editing, artificial intelligence, and machine learning are likewise presenting rapidly evolving challenges to foreign policy and national security systems on a national and global scale.

*Economic Dimensions*

In the twenty-first century, trade and diplomacy are intimately linked and, in many countries, organizationally linked within the same ministries. The World Trade Organization (WTO) system—particularly in areas related to food and agriculture—is heavily dependent on science. Further, the international trade system is underpinned by an array of agreements on phytosanitary[13] and other such issues. Many disputes handled through the WTO system have been based on scientific argument, frequently centering on whether the science is being applied properly or else being misused to create a non-tariff barrier.

Correspondingly, trade in advanced technologies and technology-based services is on the rise. Given the global value chain encompassing intellectual property, data, and manufacturing, multiple countries are often involved in developing a single product. In turn, innovative countries seek out one another to achieve synergy toward optimizing such products. At the same time, countries look for advantages regarding the sale and protection of products with a high intellectual component. Thus, recent trade negotiations have been heavily invested in debate and negotiation about intellectual property, copyright, software, and advanced biologics. Scientific input into such negotiations is critical to protect national positions.

As technologies develop in parallel across the world, successful export, as well as import, depends on common technical standards and definitions. In some cases, market dominance makes such standards easy to pinpoint; in others, state actors may need to play a more active role. In particular, varying definitions may create non-tariff barriers. For example, if genetic modification excludes gene editing in some jurisdictions but includes it in others, a significant potential exists for disruption as these techniques become more widely used in agriculture and medicine. This example helps explain why scientific discourse must be part of trade-related discussions on such matters.

*STI on the National Level*

In seeking to build their science, technology, and innovation (STI) infrastructure, many countries use diplomacy, whether to open doors to expertise in other countries, to foster relationships through partnership agreements at the national, university, or company level, or to reach out to scientists in their national diaspora. All such activities engage foreign ministries, often in partnership with their science and innovation agencies. Countries such as Ireland and New Zealand and an increasing number of African nations are investing heavily in outreach to their respective diasporas through agencies designed specifically for this task. To facilitate such connections, the U.S. Department of State, the U.S. National Academies of Science and Engineering, and AAAS launched the Networks of Diasporas in Engineering and Science (NODES),[14] with the goal of boosting economic growth across a wide range of countries, including countries of origin and destination for members of a given diaspora.

For many countries, partnership in mega science projects that cross national borders has the primary goal of assisting in national development. For example, some of the countries investing in the Square Kilometre Array project are doing so primarily because of its potential impact on national development (e.g., South Africa), whereas others (e.g., New Zealand) are taking part largely because of the potential impact on an emerging information and communications technology industry. Further, the New Zealand government's investment in a synchrotron in Australia reflects a need by scientists and industry for an instrumental capacity that a small country on its own could not justify.

**Science Diplomacy and National Boundaries**

In addition to engaging in the actions described above, a country can serve its national interests by using science to address specific bilateral or cross-boundary issues. One obvious case involves the management of ecosystems and resources that span jurisdictional borders. In the Great Rift Valley, for example, sections of which run through Jordan and Israel, the two countries have overcome occasional tensions to facilitate the science needed to sustain the area's agricultural potential. Today, in addition, efforts continue bilaterally and multilaterally to address the contraction of the Dead Sea. Elsewhere, science-based management plans among Rwanda, Uganda, and the Democratic Republic of the Congo have been critical in protecting the mountain gorilla, a vulnerable species that attracts invaluable tourist dollars.

Clearly, matters relating to transborder shared resources such as gas fields, fish stocks, rivers, and watersheds all have large scientific components, meaning that diplomatic efforts without adequate science can be ill-directed. In other cases, science itself may bring diplomatic attention to a boundaryspanning issue, as often happens with riverine systems. On the Danube River, between the former Czechoslovakia and Hungary, tensions over many years regarding the environmental impact of the Gabcikovo-Nagymaros Dams could well have been mitigated by bilateral scientific input: indeed, this was the first environmental case to end up before the International Court of Justice.[15]

Many technical services can likewise be shared between nations, such as food safety assessment, pharmaceutical regulation, or industrial standards. This is demonstrated well in the European Commission, wherein the Joint Research Centre and many other agencies, such as the European Food Safety Authority, demonstrate how bilateral or regional scientific services can be shared within a formal diplomatic envelope. Regional groupings can also play a role in promoting trade, facilitating agreement on standards and definitions, and engaging in emergency planning and crisis management, with the last of these issues being a major focus of the Asia-Pacific Economic Cooperation science advisors and equivalents group.

## Advancing Global Interests

In expanding the scope beyond national interests, one encounters truly global problems such as climate change, ozone depletion, global biodiversity, and marine pollution. On these topics, there is often greater focus on the perceived immediate interest versus longer-term implications that expand beyond traditional political timescales. For example, the challenge of eliciting commitments from countries to reduce greenhouse gas emissions has created tensions relating to jobs that rely on fossil fuels and the political impact of appearing to neglect various constituencies by pushing "green" policies.

### *Shared Challenges across Borders*

Many of the issues described above are the focus of the Sustainable Development Goals (SDGs),[16] and the 2030 UN agenda, a set of benchmarks to achieve the aspirational outcomes associated with broad sustainability. All require complex scientific input and many require new science and technologies in order to meet a given goal. Others call for considerable data collection and analysis, as well as careful scientific analysis of the policy options.

In situations of direct national interest, decision making is structured through a government's executive branch and increasingly informed by domestic science-advisory ecosystems. But the realm of international decision making and scientific input is more opaque. United Nations agencies and the UN itself are not autonomous but rather depend votes by member states to enact decisions. These votes are generally made via ministries of foreign affairs. The scientific input to UN bodies, however, generally comes from UN agency staff or advisory committees and is largely disconnected from the advice possessed by a national representative. For progress to be made on many of the issues discussed here, a strong linkage must be established between domestic science-advisory systems and international agencies on one hand, and domestic science-advisory systems and foreign affairs ministries on the other.

Moreover, progress will require that domestic science-advisory and diplomatic officials agree that their national interests are indeed served by achieving global solutions. To this end, the failure of the previously constituted UN secretary-general's Science Advisory Board to reach out to domestic science-advisory systems constitutes a disappointment. This deficit is not unique to the UN system. Other parts of the international science policy domain, including influential policy discussions on the Open Science Framework,[17] have not been inclusive. Yet one can find pushes for inclusivity elsewhere, such as in the ten-member advisory group to the Technology Facilitation Mechanism (TFM), established to support the SDGs. This entity has identified strengthening domestic science-advisory mechanisms as a prerequisite to progress on the SDGs. Indeed, the TFM itself represents an innovative approach to addressing a common global challenge: in seeking to achieve the SDGs, it focuses not on often-contentious discussions surrounding technology transfer but instead, more practically, on building cooperative, multi-stakeholder efforts to develop, adapt, and deploy technology based on national circumstances. In addition, the TFM places STI at the heart of the quest for sustainability. This represents a sea change in global development efforts and a recognition by the UN and its member states that science and its applications are necessary for resolving a broad set of priority challenges.

At the same time, while firmly placed within the context of development, the SDGs are universal in their application. Therefore, developed and developing countries alike have measurable goals for increasing both international and domestic development activities. The SDGs thus provide an important link between global interests and national priorities. Here, one sees further the way in which domestic priorities can be served by global institutions and international norms can be contoured to fit domestic priorities.

*Ungoverned Spaces*

About 70 percent of the planet's surface is not jurisdictionally controlled; this includes oceans outside exclusive economic zones and the polar regions. The Antarctic, in many ways, represents the apex of post–World War II science diplomacy. In 1959, the original signatories to the Antarctic Treaty agreed to suspend territorial claims, reject resource extraction, and promote the Antarctic for scientific research. The treaty now includes some fifty-three signatories and partners, and the Antarctic is de facto governed by a series of scientific committees working closely with diplomatic partners. Science is increasingly important in managing other ungoverned spaces as well, including the oceans and outer space. Whereas science has already played a major role in space governance, it must still be enlisted to address a range of emerging threats in global waters.

Meanwhile, the role of the European Organization for Nuclear Research (CERN) in developing the World Wide Web, which was formed as a scientific tool, is well documented. Rooted in such initiatives, the digital world has risen to dominance. Whereas initially science held a pseudo-governing role over cyberspace, that role has now largely been assumed by platform-technology companies. Given the vast opportunities created by digital technology, but also the threats to national authority and security, along with impacts on social organization and behaviors, both diplomats and scientists will inevitably become more engaged in cyber governance.

## The Future of Science Diplomacy

Almost a decade ago, in 2009, a group of stakeholders outlined terms for the concept of science diplomacy. Yet since then, understandings of the interface between the two disciplines have evolved, joined by a need to establish new categories. This paper illustrates such an alternative approach, which could prove useful in certain contexts. In particular, this new framework focuses on a government's own intervention logic and is thus aimed at helping responsible agencies operationalize common goals. If science diplomacy is to flourish, all relevant agencies involved in diplomacy, trade, developmental assistance, and security must view it as a major tool. Through the classification system proposed here, such domestic agencies can assess whether they have the internal expertise to address a given issue or whether they must instead seek assistance from the broader science community.

Science diplomacy should be a serious part of every nation's tool kit, whether the country is large or small, developing or wealthy. But it cannot be instituted capriciously. Science diplomacy requires a structure that must encompass not only promotion of international science, as covered by many science agencies, but also explicit attention to issues on the national, regional, and global levels. Technical ministries and foreign ministries thus have compelling reasons to work more closely, and with greater coordination, and to recognize the need for specific expertise—for the good of the planet and the reduction of transnational conflict.

## Box 1: A Taxonomy of Science Diplomacy

### National needs

*Voice/influence/soft power/reputation*
- Track 2 diplomacy
- Bilateral relations
- Projection
- Development assistance

*Security*
- Crisis, emergencies, disasters
- Technical aspects of treaties
- Threats (e.g., cyber)

*Economic*
- Trade
- Innovation
- Standards and definitions

*National need and capability*
- Technical capabilities
- Access to know-how, knowledge
- Development of domestic STI

### Common Interests across National Boundaries

*Resources*
- Transboundary/regional issues

– *Standards and definitions*

– *Shared technical services*

– *Crisis and disaster management*

– *Social licensing for new technologies*

– *Big science*

### Global Interest

– *Shared challenges across borders (e.g., SDGs)*

– *Ungoverned spaces*

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