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*OPINION*

# The Roles and Dimensions of Science and Technology in India's Foreign Policy

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The new millennium perspectives on science and technology and its role in India's foreign policy can be ascertained from a variety of instances. Former Prime Minister Manmohan Singh, during his visit to the US in September 2000 talked about the 'repositioning' of India in regional and world affairs. In January 2015, during his address to the Indian Science Congress, Prime Minister Narendra Modi talked about a growing trend of international collaboration in research and development that India should be able to take advantage of. It was primarily for this reason that PM Modi had placed science and technology at the forefront of India's diplomatic engagement. The fact that this address was made at the Indian Science Congress and not at a meeting of Indian ambassadors was in itself significant. Besides, the recent discourse in newspapers on India's membership to the Nuclear Suppliers Group (NSG) and the Missile Technology Control Regime (MTCR) has been led by the Ministry of External Affairs (MEA), rather than by the country's scientific community. This substantive involvement is indicative of the noticeable diffusion of science and technology into India's foreign policy-making.

The geopolitical 'repositioning' mentioned by PM Manmohan Singh is possible only if a significant part of India's S&T and related military capabilities (capabilities that are dual-use in a dual-usable environment) are grown and shaped to be globally deployable as instruments for India to become one of the top five energy producing countries with co-responsibilities for climate stewardship; one of the eight nuclear powers, and one of the six space powers that are ASAT-capable. Currently, there is no NPT-style regime for space. Nevertheless, the conduct of the ASAT test prior to an arbitrary date could become the fiducial event for a space regime that could segregate the 'space-haves' from the 'have-nots'. Also, the country's S&T and military capabilities will need to be grown to a size and capability so as to be make it inevitable that India becomes a permanent member of the UN Security Council, co-responsible with the other members, for the maintenance of international peace and security.

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A morphological distinction needs to be recognised between international collaborations in scientific and technological fields and S&T-in-foreign policy. While international collaborations in S&T usually take place between laboratories across different countries, the incorporation of S&T in foreign policy has wider connotations. Thus, when the findings of science or the potential use of technology could have ramifications for international relations beyond the 'S' or 'T' themselves, the pursuit of the 'S' or the use/denial-of-use of the 'T' influence are influenced by foreign policy.

S&T becomes an item of diplomatic engagement when a *quid pro quo* is negotiated for India in return for India's participation *as a state*, as distinct from being an international activity of the scientific community. It is necessary to make such a distinction because when participating as a state, foreign policy takes the 'pole position', so-to-speak, at the front-end of negotiations. Whereas, when the collaborative arrangements are settled between scientific communities, the primary driver of the relationship are the scientists themselves (A 'no objection' kind of approval from the MEA checks that there are no UN-mandated restrictions applicable to transactions envisaged in the collaboration. Any applicable restraints under Indian Export Control regulations always apply).

However, scientific engagements of the above kind are different from the use of S&T in diplomatic engagement which involves the proactive nature of the state using its S&T advantages. These advantages maybe locational, such as the UN-sponsored Thumba Equatorial Rocket Launching Station (TERLS) at the Magnetic Equator or the Laser Interferometer Gravitational-Wave Observatory (LIGO) experiment; they may be epidemiological, such as the WHO sponsored vaccine trials; they may also be technological, which include a contribution to sub-systems, such as the International Thermonuclear Experimental Reactor (ITER) project in France or the mirror actuators for the Thirty Meter Telescope (TMT) in Hawaii. Besides these, the reciprocal use of facilities such as those between Giant Meter-wave Radio Telescope (GMRT), in Khodad, near Pune, India and Arecibo in Puerto Rico, and the non-reciprocal offer for the use of unique Indian facilities such as the South Asian Satellite (SAS), or the infrared telescope in Ladakh are some other modes of scientific collaboration that carry foreign policy advantages. S&T collaborations and exchanges are thus a form of the country's 'gentle power'.

The Laser Interferometer Gravitational-Wave Observatory experiment is a case that highlights the exchange between India's foreign policy and S&T. LIGO is an international collaborative project that uses to foreign policy advantage India's location at the opposite end of the globe from the other LIGO detector in the US. It is an expensive project whose cost to India may well about go up to INR 2,000 crore by the time the facility is commissioned.

The Department of Atomic Energy (DAE) is funding the Indian component of LIGO. While there is no doubt that it has helped India garner foreign policy advantage, there are many significant voices in India's scientific community that have questioned the worthwhileness of LIGO even from a purely scientific point of view. Occasionally, the MEA drives some collaborations, notwithstanding a lack of domestic consensus on the scientific merits of the investments. For example, in 2016 India became an associate member of the CERN group. The associate membership would cost India approximately INR 78 crore annually though it still would not have voting rights on decisions of the Council. The DAE was not keen because India already had time-access to conduct experiments on the Large Hadron Collider (LHC) by virtue of India's association with CERNthat goes back decades and with an active involvement in the construction of the LHC, in the areas of design, development and supply of accelerator components/ systems and its commissioning, and software development and deployment in the machine. Associate membership of CERN therefore had nothing very tangible to add. The decision to become a member was evidently taken in view of Pakistan's associate membership of CERN. Pakistan gave itself bragging rights -- 'first Asian country'. India's re-visit of its earlier policy was, in this case, clearly foreign-policy driven.

As human threats to the global commons become ever more severe, global diplomatic negotiations over treaty-based national actions to mitigate them become increasingly underpinned by a common transnational appreciation of the underlying science. Equally, unilateral withdrawals from such treaties signify a lack of national appreciation of the underlying scientific drivers, leading to a breakdown of international diplomatic engagement.

There are two hardly-known Indian traces to international science-informed diplomatic negotiations. These include the Kothari-Krishnan-Parthasarathy report on the Effects of Nuclear Explosions, which subsequently formed the scientific foundation for the Limited Test Ban Treaty (LTBT), and the Kulkarni-Ramanathan papers from the late 1940s on the vertical transport of Ozone in the atmosphere which resulted in the Ozone-CFC chemistry that was fundamental to the framing of the Montreal Protocol.

High-technology engagements have dominated the exchange between S&T and foreign policy. Although the 'height of a technology' is really only an anthropological concept! Technologies that are controlled in respect of their international trade for foreign policy or national security reasons are referred to as 'high technology'. The development of high technology and engagement in this sector have transformed India's position from being a 'discriminatee' after the conduct of the 1974 nuclear test, to the status of a 'participant discriminator' at the threshold of NSG membership, supported by the very countries that sanctioned it severely in 1974. India's Augmented Satellite Launch Vehicle (ASLV) was launched in 1987 and this event triggered the formation of the MTCR, of which technology-denial regime India became a target. However, with the granting of MTCR membership in 2016, India has now become a participant-discriminator.

India was aware that to obtain high-technologies from abroad it was important to become a full member of international technology control regimes, as well as design a sound system domestically for a regulated control of full supply chain management from the source to the end-user. This was done to prevent a horizontal leakage of technology. Over the last two decades, Indian export control has evolved. In 1993, the first group was set up under the Department of Science and Technology, and by 2000, the Chemical Weapons Convention (CWC) Act was passed. As per the requirements under chapter 7 of the UN Security Council Resolution 1540, the Indian parliament passed the Weapons of Mass Destruction (WMD) Act in 2005. In 2013, India began a process of selective concordance with the regime lists, and by 2014, India had a wide extant-member support for India'smembership of export control regimes, including the NSG. Regulations notified under Indian laws pertaining to 'dual-use' and military materials and technology whose export is controlled by India were thus designed to advance India's foreign policy goals through trade in high-technology.

A data-supported article in the prestigious international scientific journal *Nature* published on 18 October 2012 draws attention to a very significant shift that is taking place in the geography of science. The article notes: "Networks of research collaboration are expanding in every region of the globe. US and Europe, the established science superpowers, have dominated the research world since 1945. Yet this Atlantic axis is unlikely to be the main focus of research by 2045, or perhaps even by 2020." This quote is indicative of a science 're-balance' to Asia. It is important to note the use of terms such as 'science superpowers' and 'Atlantic axis' which are commonly used in diplomatic parlance. However, they are not regularly used in the world of science.

As India enlarges its 'scientific presence' in more S&T fields, more entities from different countries with a similar 'scientific presence' will seek to collaborate with the state and non-state institutions of the country. As India's technological capabilities rise 'higher', in part through such collaborations themselves (a process known as 'boot-strapping'), the implications of these collaborations will increasingly lie at the confluence of S&T, foreign policy and national security.