Tech Diplomacy in An Era of Technology

Sanjay Bhattacharyya
Former Diplomat; Professor of Diplomatic Practice, Jindal School of International Affairs, O. P. Jindal Global University, Haryana, India
E-mail: sanjay.bhattacharyya@jgu.edu.in

India regards technology as a key vector for economic growth and national power. India's S&T policy framework highlighted education, R&D, and innovation while pursuing self-reliance. Technology helped leapfrog stages of development and built capability in strategic areas. The integration of S&T policy with development priorities optimised resource allocation, enhanced capacity, and advanced governance priorities. Technology diplomacy accessed technology developed overseas and established innovation bridges, as well as cooperation in multilateral fora.

Integration of Development and Technology Policy

In ancient India, seminal contributions in mathematics and philosophy fostered a scientific temperament that enabled advances in economics and governance. This made India a prosperous country, though much of the progress was lost during the colonial period.

In modern times, India's S&T policy evolved over three phases: the *post-independence* framing of S&T priorities and policy, establishing infrastructure for education and research, and focusing on development and strategic sectors; the *post-economic* reform's emphasis on technology for growth, integration in supply chains and improved governance; and the *post-digital* era's adjustments for globalisation with emphasis on knowledge economy and importance of critical materials and technologies, framing new rules and leveraging technology diplomacy.

India's S&T endeavour was visionary for a developing country. It aligned technology policy with development priorities, supported a brilliant scientific community, and expanded its overseas collaborations. The Scientific Policy Resolution (1958) and Technology Policy Statement (1983) reflected on the potential of S&T for economic growth, while specific approaches were developed in the Report on Developing S&T Clusters (2020), Semiconductor Mission (2021), Engagement Strategy for Quantum (2025), Nuclear Energy Mission (2025), etc. The diplomatic initiative was outlined in the S&T Policy (2003), the Report on International S&T Cooperation (2021), and the Raisina Science Diplomacy Initiative (2026).

Geopolitics and The Era of Technology

In an era when technology and innovation dominate transformation in the globalised world, it is necessary to adopt a dynamic approach and align development priorities with technology and diplomacy. It is recognised that scientific achievements benefit from collaboration, yet protectionism prevails as nations and corporations seek to maintain an edge in technology.

Technology is embedded in geopolitics and geoeconomics. Thus, technology diplomacy expands cooperation in technology and innovation by leveraging economic opportunity. It is shaped by the stage of development, citizens' aspirations, the extent of globalisation, and scientific collaborations. India's top priorities include strategic security, the knowledge sector, critical minerals, and critical technologies for resilient value and supply chains, and addressing global challenges.

Technology and Strategic Security

On strategic security, the thrust areas are defence, advanced nuclear technology, and space. In defence, where technology transfers are often resisted, DRDO led India's aspiration for indigenous technology and local manufacturing. It coexisted with technology collaborations, co-development, and licensed production with partner countries. Recent reforms encouraged partnerships between the public and private sectors and with foreign entities, promoted technology infusion, and fostered civilian-military engagement in the defence sector. It facilitated an ecosystem for start-ups and innovations in missiles, drones, electronic defence, lasers, metallurgy, etc.

In space, ISRO's success in launch capability, building a satellite network, and space exploration was achieved with tight budgets and high indigenous content, but also included foreign cooperation. ISRO's cooperation agreements with 61 countries and multilateral institutions improved technology, capability, and efficiency. In turn, ISRO extended its support to several developing countries. The entry of private entities has given new momentum to space development.

In atomic energy, India's early start faced technology denial after our peaceful nuclear explosions; Russia remained a significant partner. Only after the civil nuclear agreement with the USA and domestic civil liability legislation did it attract foreign partners. India plans to add an additional 100 gigawatts of generation capacity by 2047, and the recent Nuclear Energy Mission seeks public-private partnerships to set up small modular reactors, large nuclear plants, and advanced technologies. BARC's recent prototype SMR could have export potential. India is a key partner at CERN and ITER, and DAE has civil nuclear cooperation agreements with a dozen countries.

Technology and The Knowledge Sector

In an era of disruptive technology, the development of India Stack marked a transition to a digital knowledge economy. With the use of AI and quantum computing across new industries and services, and in IT applications in agriculture, fintech, edtech, medtech, and evidence-based development policy, India is uniquely placed at the heart of an AI revolution that promotes productivity and inclusivity while governing business concentration. Reliable partnerships across the different layers of the AI ecosystem, along with a governance model for the India Stack, can stimulate practical applications that improve human life and enable India to lead from the front. India's successful open-source Digital Physical Infrastructure can be effectively deployed in both developed and developing countries, providing an attractive alternative to meet both development and security objectives.

Critical Materials and Technology for Resilient Supply Chains

New and digital technology has permeated all spheres of activity in India. India's need for critical materials and technologies is crucial, and its policy approach is dynamic, tracking global trends and plugging into reliable, resilient value and supply chains.

The initial Critical Materials List (2023) included 31 items deemed essential for economic development and national security. Minerals and rare earths were assessed for economic importance and supply risk. The policy was for resilient supply arrangements from reliable partners, in view of disruptions by dominant players. Following the adoption of the National Critical Minerals Mission

(2025), a number of Centres of Excellence for Critical Minerals were established for R&D and robust external collaboration.

On critical technologies, India does not have a list but monitors the development of new technologies that are assuming importance, especially those linked to data and information systems, energy security, new industry, and national security. The policy advocates strong and enduring collaborations with reliable partners, both bilaterally as well as in groups such as BRICS, EU, and Quad, to establish reliable and resilient linkages in R&D and its outcomes, and to connect the production cycle.

Technology to Address Global Challenges

Technology cooperation is key to meeting targets on the Sustainable Development Goals and addressing challenges in development, climate change, energy transition, cybersecurity, and new rules. The global community risks serious disruption in the absence of reforms.

On climate change, India developed criteria for common but differentiated responsibility of developing countries, shared sustainable technologies, and promoted adaptation and mitigation measures. India's efforts to harness renewable energy and improve energy efficiency reduced its hydrocarbon dependency, while building disaster-resilient infrastructure increased its capacity to address non-traditional threats.

India also engaged in the triad of tech-digital-cyber diplomacy, for technology products and their regulatory environments. On cyber diplomacy, India attached importance to data sovereignty and security, shaping cyber norms and a rule-based order. India is actively engaged in the UN Global Digital Compact and regional initiatives at ARF, BRICS, G20, and SCO.

Expanding profile of Technology Diplomacy

India's technology diplomacy follows a whole-of-government approach that engages foreign governments, scientific establishments, and corporates in R&D and manufacturing to improve access to technology, minimise impediments to its free flow, and build resilience. India's matrix for priority technologies with key partners facilitates the strategy for engagement and collaboration.

New initiatives at regional or mini-lateral groupings supplement bilateral efforts. BRICS has been at the forefront of S&T collaboration with the BRICS Innovation Network, the Young Scientists Conclave, and cooperation in advanced materials, AI, and biotechnology. Similarly, Quad has forged S&T collaborations in critical technologies, cybersecurity, digital infrastructure, pandemic preparedness, and support for new-generation technology leaders. With the EU, identified areas of focus include digital governance, green energy, resilient supply chains, and strategic technology.

India has engaged the diaspora in scientific endeavours in national projects. Specific initiatives have focused on institutional linkages, exchange of researchers, participation in cutting-edge research in India, mentoring youth entrepreneurs in start-ups, and supporting leadership roles in S&T.

The start-up ecosystem has matured with a vibrant research environment, a supportive financing network, and a bullish capital market. The recognition of Indian start-ups in foreign markets can facilitate scaling up domestic operations and transboundary transactions. Diplomatic efforts to promote technology hubs and build innovation bridges are the way forward.

With economic development, R&D activities have expanded, but investment in R&D remains limited. The share of R&D investment to GDP was 0.64% in 2024 (2.4% in China and 3.5% in USA). Government R&D expenditure was the mainstay; the private sector contributed just 36% (77% in China and 75% in USA). Further, the link between higher education, industry, and research needs to be strengthened, and 'lab-to-land/market' time needs to be reduced.

India needs a cadre of technology ambassadors to manage external scientific interactions, engage in multilateral rulemaking negotiations, and focus on new and emerging technologies. More S&T

specialists are needed to work alongside diplomats in technical negotiations with multilateral bodies and in Free Trade Agreements. Multilateral negotiations on the blue economy, climate change, data and cyber issues, and space applications have reached a critical point that demands greater attention.

Conclusion

India is a significant technology power but needs to allot more resources to technology diplomacy to respond to geopolitical challenges. Technology cooperation, which initially grew with globalisation, has become challenging as nations and corporations seek to retain control with protectionist tendencies amidst geoeconomic flux. This makes the task of technology diplomacy both challenging and exciting.