India–US Defence Cooperation

Opportunity to Achieve Technological Superiority for Indian Armed Forces

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Over the years, India has set up comprehensive infrastructure for the manufacture of defence equipment. Although considerable growth has taken place in indigenous capabilities, India is largely dependent on foreign technologies for the high-tech equipment. However, despite Transfer of Technology from foreign countries, the development of indigenous technologies has met with limited success. In the last two decades, India's relations with the US have become stronger and India has been designated by the US as a 'Major Defence Partner'. There have been a number of agreements between the two countries for collaborations in various fields including defence technologies, with iCET being the most promising initiative. This provides India with an excellent opportunity to achieve technological excellence with collaboration and co-development with the US. However, there are many challenges which may be an impediment to such development. This article examines India's need for technology transfer, track record of technology transfers from the US,

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analyses the current agreements, identifies opportunities and challenges and recommends a way forward.

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In the present-day warfare, the importance of staying ahead in technology to maintain a competitive edge on the battlefield cannot be overemphasised. The Indian Defence Forces face a complex security scenario with multifarious threats. Technological advancements in niche areas are crucial for maintaining a technological edge over potential adversaries. In today's world with various conflict situations polarised democracies, it is imperative for India to develop indigenous technologies in the defence domain to attain meaningful strategic autonomy.

The Indian Armed Forces are continuously in the process of modernisation and upgradation of their capabilities to effectively address the changing nature of warfare and complex regional geo-political dynamics. Being one of the largest armed forces in the world, with the current strength of about 1.4 million personnel, they face diverse challenges due to the ever-evolving nature of war fighting and their wide-ranging role in dealing with conventional and unconventional security threats. At the annual Army press conference held on 12 January 2024, the then Chief of Army Staff (COAS), Gen Manoj Pande, mentioned that 2024 would be the year of technology absorption for the Indian Army. It may be recollected that the year 2023 was proclaimed as the 'year of transformation', and the new emphasis on technological absorption will be an enabling factor for the army's vision for transformation. This statement is seen as a follow-up to previous year's commitment to transformation. It also hints at the modus operandi of obtaining ToT and achieving effective integration into the indigenous systems.[1]

In the recent past, there have been tremendous changes happening across the world which are redefining the tenets of warfare. A small country like Ukraine has presented an astounding challenge to the mighty Russia, mostly based on technological support provided by the Western world. In Gaza, Hamas succeeded in breaching the Israeli defences and challenging the supremacy of Israel Defense Forces. Warfare is taking a new shape and major nations across the globe are going in for unprecedented levels of military modernisation. The key areas of such upgradation of military capabilities are based on ultra-advanced emerging and disruptive technologies which are becoming pivotal in warfare.

In India's context, China's growing capabilities, influence and developments close to the Line of Actual Control (LAC) are posing serious challenges. The threat has become more significant after the Galwan encounter with China employing subtle 'grey zone' aggression and hybrid warfare, which are increasingly becoming a preferred strategy of conflict.[2] The advanced technological developments make such warfare more implementable and effective.

Responding to these challenges, India's Armed Forces must provide highest priority to develop and integrate niche emerging and disruptive technologies to achieve desired levels of competitive edge over the adversaries. Though the ongoing collaborations with friendly foreign countries for technology will continue, India should not leave any stone unturned in exploring new avenues.

In the changing global order, India is recognised as a dominant player with the capability to evolve a multipolar world, owing to its growing economy, large population, democratic strength and geographical leadership. In the Indo-Pacific region, India is engaging with major powers, like the US, to counter China's growing influence. In the recent past, India and the US have developed a comprehensive global strategic partnership, driven by convergence of interests in all areas of human endeavour. The transformed India–US defence relationship provides an opportunity to obtain critical and emerging technologies that are essential for the enhancement of our technological capabilities. A technology-enabled Indian military enterprise will be in the interest of the US as it will greatly strengthen deterrence in the Indo-Pacific region. For India, the American technology prowess will be hugely useful for collaboration. The US appears to be guided by the Delaware spirit (investing in deep technologies in defence) rather than its deep state instincts. Therefore, the Indo-US technology relationship is likely to flourish, which will be advantageous to both sides.

Such emerging technologies duly integrated into our indigenous developments will provide the much-needed impetus to our efforts for achieving technological superiority over our adversaries. The India–US defence partnership has seen tremendous momentum since 2000, when President Bill Clinton's visit laid the ground for the resumption of normal relations following India's 1998 nuclear tests. Since then, the cooperation has developed into a comprehensive global strategic partnership. Both countries have finalised important agreements covering logistics, secure communications and requisite protocols. The political and bureaucratic structure for security cooperation has been given a shape, which includes the

2+2 Dialogue, Defense Policy Group (DPG) and several bilateral and Quad working groups. Defence agreements like Communications Compatibility and Security Agreement (COMCASA), Logistics Exchange Memorandum of Agreement (LEMOA) and Basic Exchange Cooperation Agreement (BECA) have been signed, further strengthening the strategic partnership and paving the way for improved technology sharing.[3]

The scope of collaborations has now been expanded to include multiple domains like Artificial Intelligence (AI), Information Warfare, Cyberspace, Quantum Technologies, Maritime Domain Awareness, Undersea Capabilities, Hypersonic Technologies and Space. The Initiative on Critical and Emerging Technology (iCET) aims at growing technological innovations through defence start-ups, working on a blueprint for India–US Defence Industrial Cooperation, scheduling of the Advanced Domains Defence Dialogue (AD3), and progressing the India–US Defense Acceleration Ecosystem (INDUS-X). These collaborations will provide a strong basis for co-development and co-production of defence technologies.[4]

Though the above agreements have reinforced the Indo-US partnership, the outcomes of these initiatives are yet to be assessed to see if the desired results are being achieved, since the earlier agreement, Defence Technology and Trade Initiative (DTTI) has not produced the intended results. There are views which indicate that the cooperation has generally translated into purchase of weapons and no tangible technology transfer has taken place. However, recent developments have thrown up promising opportunities. Several hurdles, including stringent export controls, inadequate binding agreements and lack of political commitment, have mostly been taken care of. On the Indian side, steps have been taken to create a more efficient ecosystem by making changes in industrial policy for involving the private sector, making attractive conditions for private investment and efficient supply chain integration. With the developments in India–US collaboration in the Indo-Pacific region, the geopolitical factors are more conducive. It is also opined that with Russia facing wartime challenges, the output of its 1,300 defence companies—that account for 20 per cent of the world's weapons sales—may get adversely affected, creating a partial vacuum in the global arms market. This may force India to look for alternatives. Considering the above factors, there is tremendous opportunity for India–US defence collaboration. However, tremendous efforts will be required at various levels to ensure concrete results. We should make all efforts to make sure that iCET and INDUS-X become highways of collaboration—we must get collaborative projects together and place orders at speed and scale.

The Need for Technology Transfer

As per reports, India is the biggest importer of arms in the world, by value, which stands at 10 per cent of global weapons imports for the period 2008–2023. India is likely to spend around US$ 200 billion in the next 10 years for the modernisation of its armed forces. Presently, Russia is the major supplier of arms to India, which since 2008 is about 62 per cent of India's total defence imports (by value). The other major suppliers are France (11 per cent), the US (10 per cent) and Israel (7 per cent).[5]

For achieving the desired technological capabilities, one key factor is the requirement of technology transfer from friendly foreign countries. It is a known fact that India does not have enough technological maturity in many fields in the military domain. We have not developed even those key technologies which were envisioned by Dr APJ Abdul Kalam in his book *India 2020*. He had laid great emphasis on materials and electronics, besides others, which are essential for the development of indigenous military technologies. As we know, so far, India has not been able to produce even a single successful barrel of a gun with indigenous metallurgy. Similarly, all indigenous electronic systems are mostly using imported designs and components.

Since independence, we have been importing military hardware predominantly from the USSR/Russia. Our ordnance factories, defence PSUs and lately private industry have been manufacturing military equipment based on ToT as laid down in Defence Procurement Procedure/Defence Acquisition Procedure from time to time. However, these have mostly been in the form of Fully Formed (FF), Semi Knocked Down (SKD), Completely Knocked Down (CKD) and Indigenous Manufacture (IM). Yet, these have been a form of 'buy' with hardly any real transfer of critical technologies being provided.

We must understand what the impediments to ToT for the military are. Technology is an asset of a nation, created with great efforts and expenditure, and is closely guarded as it creates wealth. Transfer of Technology enables a nation to achieve its technological goals in a cost-effective and faster way compared to developing the technology from scratch. There are many hurdles in ToT, like protection of Intellectual Property Rights (IPR), ability of a nation to buy critical technology which may be very expensive, geo-political relations between the countries and difference in technological capabilities between the country providing ToT and the one receiving it.

Though the Defence Acquisition Policy (DAP-2020) stipulates active obsolescence management through life-cycle support, including upgradation on completion of a fair life-cycle to be provided at no additional cost, this is not easily acceptable to an Original Equipment Manufacturer (OEM).[6] The Armed Forces need the latest technology—better than the adversary—to fight a war, as early as possible, whereas, designing and developing a technology requires large time-frames. The Government of India and Ministry of Defence are trying to encourage ToT by giving fillip to joint ventures and industry-friendly offset rules. Various government initiatives and factors include better ranking in ease of doing business, faster growth of Indian economy, inflow of FDI in defence manufacture, skilling the human resources, cultural shift in production standards, policy stability, protection of IPR and forming a national policy of ToT.[7]

Track Record of Technology Transfer from the US

India has had relations with the US dating back to India's struggle for independence. At present, there are close relations between India and the US and the two countries are engaged in collaboration on many issues, such as terrorism and security in the Indo-Pacific region.

In 1953, the US made Pakistan an ally as part of the Central Treaty Organization (CENTO). Consequently, India entered into strategic and military relations with the USSR to balance out Pakistan–US alignment. In 1961, India joined the Non-Aligned Movement (NAM) as a founding member and did not align with either the US or the USSR during the Cold War. In the Indo-Pak war of 1971, the US government supported Pakistan, which adversely affected India–US relations. After the dissolution of the USSR in 1991, however, India and the US made changes in their foreign policy and developed closer relations due to common strategic interests.

From the beginning of the 21st century, India's relations with the US have been gradually becoming stronger. The US government has shown outstanding concern for India's core national interests and has drastically increased bilateral trade, investment and cooperation on global security matters. India was included in many global decision-making processes and was given support for admission to the Nuclear Suppliers Group. India and the US also started joint-manufacturing through technology sharing, and the relations further deepened. Since 2014, strategic cooperation between India and the US has taken shape and India was declared a 'Major Defence

Partner' of the US. The two nations have also widened their cooperation in multilateral groups such as the Quad and I2U2. The bilateral defence trade between the two countries has commenced in a big way and bilateral military exercises have become a routine.[8]

Major Arms Transfers from the US to India[9]

Prior to 2008, US–India defence trade was quite limited. However, after 2008, the US sales of military articles has tremendously increased. To get an idea, major US defence sales to India over the past 15 years are mentioned in Table 1.

Table 1 US Defence Sales to India over the past 15 years

Air	Sea
• 28 AH-64 Apache combat helicopters • 1,354 AGM-114 Hellfire anti-tank missiles • 245 Stinger portable surface-to-air missiles • 12 APG-78 Longbow combat helicopter radars • 6 spare helicopter turboshafts • 15 CH-47 Chinook transport helicopters • 13 C-130 Hercules transport aircraft • 11 C-17 Globemaster III heavy transport aircraft • 2 MQ-9A Reaper UAVs • 512 CBU-97 guided bombs • 234 aircraft turboprops • 147 aircraft turbofans	• 1 Austin-class amphibious transport dock • 24 MH-60R Seahawk naval helicopters (6 delivered) • 12 P-8I Poseidon patrol and Anti-Submarine Warfare (ASW) aircraft • 48 Mk-54 ASW torpedoes • 6 S-61 Sea King ASW helicopters • 53 Harpoon anti-ship missiles and 1 Harpoon Joint Common Test Set • 24 naval gas turbines
	Land
	• 12 Firefinder counter battery radars • 145 M-777 towed 155 mm howitzers • 1,200+ M-982 Excalibur guided artillery shells • 72,400+ SIG Sauer SIG716 assault rifles

The US Administration continues to offer India 'state-of-the-art capabilities', including F-15EX Eagle II and F-21 Fighting Falcon combat aircraft for Indian Air Force.

A Review of Current Agreements

The India–US Defence Technology and Industrial Cooperation

In the past two decades, defence and security collaboration has been at the centre-stage in the framework of a broad-based strategic partnership between the US and India that incorporates a multi-domain cooperation. Though, while working on these partnerships, some differences did come up, but those were amicably resolved with maturity and mutual understanding by both sides. The state visit to the US by Indian Prime Minister, Narendra Modi, in June 2023 provided a tremendous boost to the partnership by bringing in higher prospects, greater strength and more enthusiasm on both sides. The joint statement at the end of the visit amply highlighted the focus on defence technology and industrial cooperation, which was titled 'Powering a Next Generation Defence Partnership'.

The comprehensive India–US defence and security cooperation encompasses three broad areas of mutual collaboration. These defined areas are—cooperation in regional and global security and development affairs, enhanced and institutionalised engagement between the armed forces (exercises, information sharing, training, other exchanges and programmes), and cooperation in defence technology and industry. It is the third area which requires special focus as it has not shown tangible results in the past due to various reasons.

Defence Technology Cooperation

Several measures have been adopted in the last decade to provide a fillip to the defence technology cooperation and bring it on track. The US–India Defence Technology and Trade Initiative was instituted during the period 2012–2014. However, it failed to deliver any meaningful results. The failure was generally attributed to the lack of proper joint frameworks and inordinate delays in the conclusion of foundational agreements. Additionally, there is a feeling that there was a lack of seriousness on the part of the US to share niche technologies. Efforts were made to bring about corrections by signing new agreements, which include the Framework for US–India Defence Relations (2015), designating India as a Major Defence Partner (2016) and signing of three foundational agreements (LEMOA in 2016, COMCASA in 2018, and BECA in 2020). The coordinators of DTTI from both countries were mandated to meet twice a year, a DTTI Inter-Agency Task Force and a DTTI Industry Collaboration Forum were set up, and four service-led joint working groups were formed (land systems, naval systems, air systems and

aircraft carrier technology cooperation). However, there was little progress in technology collaboration.

In a further attempt to provide stimulus to this vital area, the Initiative on Critical and Emerging Technology (iCET) was announced in May 2022 and launched in January 2023. It is a broad-based and comprehensive framework for technology collaboration and encompasses defence as well as commercial technologies. The Initiative on Critical and Emerging Technology comes under the umbrella of the India–US strategic trade dialogue.

It has given tremendous thrust to bilateral defence industrial cooperation. Important areas included in iCET are jet engines and munition-related technologies. The co-production will extend to anti-tank and anti-air missile systems, fixed-wing and rotary aircraft, armoured vehicles, artillery, small arms, maritime surveillance systems, drones and counter-unmanned aerial systems. It will also include maintenance, repair and overhaul (MRO) facilities and services. The two governments could take certain policy decisions to facilitate such cooperation. This would include: (a) translating political agreement into outcomes such as approvals and procurement requests; (b) ensuring a greater predictability for demand on the Indian side to accelerate investment and technology transfers; and (c) on the US side, improving public–private cooperation to ensure timely responses to proposals.[10]

Since the inception of iCET, structured meetings are taking place to address the challenges and to take the defence technology collaboration forward. The major challenges which need to be resolved include coordinating the R&D efforts of the private sector in the US with those of Defence Research & Development Organisation (DRDO) in India, tight control and strong safeguards in the US for sharing or working together on defence technologies, safeguarding of IPR, the strategic requirements to maintain technology leads, exclusivity in high-end defence technologies and the commercial considerations for leveraging key technologies. India had proposed co-development of technologies followed by co-production in the initial meetings of the DTTI. However, the response from the US on this proposal has so far been lukewarm.[11]

Cooperation in Defence Innovation

The India–US Defence Acceleration Ecosystem (INDUS-X) was instituted in June 2023 for coordination of efforts in defence innovation in the fields of technology, systems and products. Its aim is to link the defence ecosystems of the two countries, which are Innovation for Defence Excellence (iDEX) in India and the Defense Innovation Unit (DIU) in the US.

It now consists of a senior advisory group and the initial joint innovation challenges have been identified. The first challenge (undersea communications, oil spill detection/integration system) has been launched under the INDUS-X Mutual Promotion of Advanced Collaborative Technologies (IMPACT). Other activities include organisation of defence investor–start-up meetings and conducting workshops with academia and industry. These are supported by the US–India Business Council and the US–India Strategic Partnership Forum.

The initiative of defence innovation has taken off well and its implementation has to be proactively pursued. Some issues like joint funding support and commercialisation of successful innovations are being discussed for incorporation. INDUS-X incorporates a protégé–mentor concept, which needs to be formalised and suitably facilitated. Defence start-ups are going to be linked with defence manufacturers so that the innovations can be integrated into larger systems and platforms.

Defence Industrial Cooperation

The defence industrial cooperation has been instituted in June 2023 under the 'Roadmap for US–India Defence Industrial Cooperation'. The basic principles of cooperation are being worked out, which includes working on policies, technology transfers, licensing, export controls, security of supply arrangements and foreign direct investment (FDI). It aims to promote business-to-business interactions in the public and private sectors and to enhance the integration of the Indian defence industry into global supply chains.

In the ongoing collaborations, there are two important projects which have been taken up. The first one is the Memorandum of Understanding (MoU) between GE and HAL for co-production of GE-414 aero-engines which is likely to be finalised shortly. The second project is the procurement of 31 MQ9B drones which will include assembly and global MRO in India. For this project, a Letter of Request (LOR) has been initiated by India, and a Letter of Offer and Acceptance (LOA) is expected from the US soon.

Many private Indian defence and aerospace companies are now working with some big US companies for the design, manufacturing of components and assemblies and system integration for their global requirements. The two ecosystems are in a better position than a decade ago to take these arrangements to the next level of industrial cooperation. The roadmap for defence industrial cooperation is due for revision soon, along with the updating of the 2015 Framework for the US–India Defence

Relationship. It is essential to move ahead now and initiate programmes and projects.[12]

A Critical Analysis of Technological Cooperation from US to India

The iCET between India and the US is likely to be a serious effort as the agreement is based on the US's requirement of balancing China's influence in the region. iCET aims at cooperation in varied technological domains such as AI, High-Performance Computing (HPC), quantum technologies and supply chain resilience in the area of semiconductor cooperation. These are indeed new areas of cooperation that hold significant promise, especially in the emerging technologies such as AI and quantum technology, which can be of great advantage to India. Space cooperation is another important area which will see increased levels of bilateral cooperation. The agreement will also lead to the strengthening of the much-needed defence and scientific ecosystems in India.

Though iCET promises high levels of bilateral cooperation in niche technology areas, one must take a look at an earlier agreement, DTTI, which was launched in 2012 under the Obama Administration. This agreement aimed to deliver results in certain key conventional capabilities such as Land Systems, Naval Systems, Air Systems and Aircraft Carrier Technology Cooperation (ACTC), which are mainly led by the military services on each side. The DTTI promised considerable levels of cooperation and results, but very little crystallised on the ground and not much was achieved. The reason for failure was the low grade and outdated technology offered by the US that was not acceptable to the Indian Armed Forces, for instance, the next-generation Raven mini Unmanned Aerial Vehicles (UAVs). Another offer was Roll-Off (Ro-Ro) kits for the Indian Air Force (IAF) C-130 Hercules transport fleet and protection equipment against Nuclear, Biological, and Chemical (NBC) warfare, which was considered not very advanced in technological terms. There was also lack of interaction at apex levels, especially from the US side, which compounded the impediments and impeded the process. India wanted the jet engine technology for its native fighter aircraft development programme, which was not accepted by the US. Thus, the non-delivery of key technologies disappointed the Indian side and it is felt that the US is interested in selling their equipment and not ToT. One view expressed by experts is: 'While DTTI has served as a "silent enabler" to support greater defence technology cooperation between

the United States and India, it has also generated frustration as it has often been perceived, incorrectly, as a venue for fast-tracking sole-source contracts on major defence articles. Technologies identified for co-development and production were unviable and of questionable commercial potential and operational requirements.'[13]

To further understand and analyse the iCET, it is prudent to take a look at similar agreements that have been concluded between the US and its allies. One such arrangement is the Australia, United Kingdom and United States (AUKUS) agreement which was finalised in September 2021. It is a security agreement for the Indo-Pacific region against the perceived threat from China. The aim of this agreement is to jointly work on emerging technologies as part of trilateral defence cooperation.

The areas covered by the AUKUS initiative include Undersea Robotics Autonomous Systems (AURAS), with well-laid-out timelines for trials and experimentation of this capability. The next area under AUKUS is Quantum Arrangement (AQua), which will first concentrate on Position, Navigation and Timing (PNT) aiming to integrate quantum technologies by the end of 2025 after experimentation and trials. The third area under the AUKUS is Artificial Intelligence and autonomy which will roll out AI-enabled capability in decision-making. Other areas of the AUKUS initiative include joint efforts in cyber technology for the protection of operational communications and systems, hypersonic capabilities and the development of latest technologies for operating in highly dense and contested electromagnetic spectrum in operational conditions. The agreement also lays down the cooperation for mutual learning and sharing of experience in the areas of innovation and exploitation of new commercial technologies for defence applications. It has been opined by the analysts that the technological collaboration amongst the AUKUS countries will be of higher order compared to the level achieved by India through iCET.

This is because the three participating countries in AUKUS have long-standing close relations and deep mutual confidence. They are Five Eyes members, which is an intelligence-sharing alliance established during the Cold War that also includes New Zealand and Canada. All the three countries have well-established technological capabilities and can contribute effectively through their scientific and technological resources. AUKUS also has well-defined benchmarks and timelines, allowing for meticulous monitoring of progress. The US is known to provide tremendous support to other close allies in all spheres including technology, with Israel and South Korea being two examples.

In the case of iCET, military relations between India and the US have shown improvement over the last two decades. Historically, the relations have not been that strong, with India being a non-aligned nation and being perceived as having closer military relations with Russia. Therefore, the US will observe great caution while transferring any critical military technology to India. Another weak area is that India is likely to receive technology from the US, but has little to offer as a contributor to technological innovations under iCET. In the case of AUKUS, Australia and the UK are already fairly advanced technological states and can provide significant contributions in the development of emerging and disruptive technologies and therefore, the US also stands to gain from this agreement.[14]

The Gap Between Technology Transfer Requirements and the Actual Technology Transfers Received

India started developing the defence manufacturing capabilities in the 1950s. This included the establishment of DRDO and the setting up of several Defence Public Sector Undertakings (DPSUs). These DPSUs were meant to augment the capabilities of existing Ordnance Factories for the manufacture of defence equipment within the country. The DPSUs and the Ordnance Factories received technology from foreign countries, mainly in the form of licensed manufacturing, which continued in the later decades. There have been some successes in the development of indigenous systems like the Light Combat Aircraft (LCA) and the Main Battle Tank (MBT) Arjun. However, a major portion of the requirements of the defence forces continue to be imported. This has led to the conclusion that indigenous development and developments based on ToT from foreign countries have not achieved much success. There has also been only marginal success in indigenous research and development by the DRDO and other agencies. The limited success in indigenous defence R&D is generally attributed to a lack of focus and insufficient allocation of funds over the decades. The failure in development of indigenous systems through the ToT route is due to the fact that the Original Equipment Manufacturers did not share critical technologies and also because of lack of indigenous capabilities for effective technology absorption and reverse engineering. Having understood the pitfalls of the ongoing system, the government has started giving emphasis to self-reliance through indigenous design, development and manufacture, hoping that this method may provide better results than ToT from foreign countries. However, a balanced view needs to be taken, as the critical

defence technologies are difficult to develop from scratch and substantial R&D infrastructure is required.[15]

Measures Taken to Enhance Indigenous Capabilities and Technology Absorption

The Government of India has undertaken many policy decisions for indigenous manufacturing of technologically advanced defence products through application of science and technology in the defence sector. These initiatives include:[16]

- Giving highest priority to the 'Buy Indian IDDM' category for capital procurement of defence equipment as per Defence Acquisition Procedure 2020. Here IDDM stands for 'Indigenously Designed, Developed and Manufactured' and entails a minimum of 50 per cent to 60 per cent indigenous content in order to provide impetus to indigenous design and development capabilities.
- An initiative was launched for development of an innovation ecosystem for defence, named as Innovations for Defence Excellence (iDEX), in April 2018. The aim of iDEX is to create an ecosystem to encourage innovative ideas and development of technology in Defence and Aerospace. It engages industries, including MSMEs, start-ups, individual innovators, R&D organisations which are allocated funds and support for research and development in the field of technologies which can be of use in defence and aerospace domains.
- Recognising the growing importance of AI in most of the technology-related fields, two establishments have been set up, which are Defence AI Council (DAIC) and Defence AI Project Agency (DAIPA) to focus on development and adoption of this technology.
- To acquire state-of-the-art technologies, appropriate clauses have been introduced in the Defence Acquisition Procedure-2020 under 'Buy and Make (Indian)' and 'Buy (Global - Manufacture in India)' categories which stipulate indigenous manufacture with ToT from foreign OEMs.
- The offset obligations by foreign OEMs providing ToT to Indian industries have been made more specific, stringent and binding.
- DAP-2020 has also included 'Strategic Partnership (SP)' Model for procurement of equipment with advanced technologies. It aims at establishing long-term strategic partnerships between Indian companies and foreign OEMs. The Indian entities will get into an agreement with

the global OEMs for obtaining ToT and set up indigenous manufacturing infrastructure.

- In order to promote development of defence technologies within the country, defence research and development has been opened to industry, start-ups and academia. An allocation of 25 per cent of the defence R&D budget has been made for this purpose.
- DRDO has selected nine thrust areas for intensive research, which are: Strategic Systems, Platforms, Weapon System, Communication & Sensor Systems, Cyber Security, Artificial Intelligence & Robotics, Material & Devices, Soldier Support and Space.
- Similar to iDEX, Technology Development Fund (TDF) scheme has been instituted under the aegis of DRDO, which funds up to Rs 10 crore to industries, start-ups and MSMEs for innovation and R&D in defence technologies.

As a result of these initiatives, many state-of-the-art equipment have been produced in the country during the last few years. However, much more needs to be done for the development of India's indigenous technological capabilities.

Further Building Up Capabilities for Technology Absorption

For the development of state-of-the-art defence technologies, India needs to greatly strengthen indigenous R&D, design, development and manufacturing capabilities. However, such capability building will require considerable amount of time, funding and resources. Keeping the security challenges which India has to address, it has to at least keep itself technologically at par with its major adversary, China. As we are aware, China is making strides in technological developments and at present appears to be far ahead of India. Under such circumstances, India has to depend on technology transfer from friendly foreign countries in addition to its indigenous development, which may not be sufficient to meet the pressing requirements. Therefore, India has to plan out a multi-pronged approach to capability-building. Rapidly improving bilateral relations with the US and a shared willingness to work together on scientific and technological domains in both civil and military sectors is a welcome sign.

In the case of India, the import of technology from foreign countries has resulted in a significant level of competence in the building of India's domestic defence industry, but it has not succeeded in helping India in the

design, development and production of advanced weapons systems nor has it reduced dependence on foreign technologies for subsequent projects. However, some other countries like Israel, South Korea and China have been able to successfully build up their capability with the help of external assistance.

A recent study on the growth of the defence industrial capabilities of these countries concludes that they have received substantial technological assistance from their allies. However, they have put in significant and dedicated indigenous efforts to successfully get the most out of it. The United States provided advanced defence systems to Israel and South Korea, which was systematically followed by technology sharing through licensed manufacture, joint ventures for co-development and co-production and other collaborations for technology transfer over many decades. The US has also been providing large amounts of foreign aid to Israel with the mandate to purchase US arms. The foreign aid and technology transfer to Israel were less restrictive than those applied to other countries, making it more flexible. It has also been reported that Israel gained access to Russian technologies through Russian Jewish scientists and technocrats who immigrated after the collapse of the USSR in the early 1990s. The study also reveals that some countries made use of reverse engineering and espionage for acquiring foreign technology.

The study reveals that assistance from Russia and Israel enabled China to copy and imitate foreign technologies and systems. In addition, China devised ways and innovative means to absorb and upgrade imported technology with indigenous efforts. China has a technological development strategy which is a four-part process termed as 'Introduce, Digest, Absorb, and Reinnovate' (IDAR). This strategy aims at converting imported technology into a re-made domestic variant.[17]

Lessons can also be drawn from experiences with the technology in the civil domain. The United Nations Conference on Trade and Development (UNCTAD) published the detailed findings of three case studies of successful ToT ventures in the year 2003. The paper highlighted the importance of ToT and explained how economically weaker countries can build up if they learn from the experience and practice of the more advanced countries. The paper describes how the firms in the case studies acquired technology through various means and successfully adapted them to their requirements. It has also been brought out that building a country's defence systems' development and manufacturing capabilities to advanced levels is only possible after such capabilities have been acquired by the civil industry. In the past, it was the

advancement in the defence technologies that provided the knowledge base for the development of civil industry. However, in recent times it is the commercial technology that is taking a lead and being utilised gainfully in the defence sector. In the recent industrialised countries of Israel, South Korea and China, the developments in the civil industry to advanced levels has been instrumental in their success in the defence domain.

India has also made considerable progress in domains like automobile engineering and information technology, which can boost corresponding areas in the defence sectors. It can thus be inferred that India can also successfully absorb foreign technologies to build up indigenous defence capabilities and can reduce dependence on imports to a large extent as has been done by Israel, South Korea and China.[18]

Way Ahead

After one year of its incorporation, iCET is progressing well as there are structured interactions at higher levels and regular meetings among the non-governmental stakeholders. As India is synonymous with software, population, data, scaling solutions, market and US is synonymous with tech, inventions and innovations, iCET aims to bring both on the same page.[19]

There should be concerted efforts to ensure that both sides provide expeditious legal and administrative clearances to facilitate joint development and joint production so that iCET does not face the challenges that became hurdles in case of DTTI. There is also a requirement for governments on both sides to increase investments for early establishment of research and production collaboration.

As brought out earlier, the development of defence technology through technological collaborations is a faster route rather than starting from the scratch. Therefore, India must capitalise on the US offerings in order to address the geo-political challenges.

It must also be remembered that India is a friend of the US and not its ally. Therefore, all actions and expectations should be properly weighed. Also, the US has been hinting at reducing India's dependence on Russia for military requirements. India has been a non-aligned country and it should continue to maintain that status. India has to take its own decisions in respect of its position in the global geo-political environment. The US wants collaboration with India for addressing the security challenges in the Indo-Pacific region and it is in India's interest too.

The US is known to focus on the sale of its weapons and equipment rather than ToT. The willingness to collaborate in development of technology is a welcome change, but must deliver results in a time-bound manner.

India must focus on the development of its R&D base by committing more funds and resources to become an equal partner in technological collaborations. The pooling of talent including Indians working in foreign countries may be considered.

Such collaborative programmes have numerous other challenges, but the overall benefits for India and the US can outweigh the shortcomings. The opportunity should be taken forward by harnessing the strengths of both the countries and incorporating lessons from other similar programmes. Addressing the commercial and regulatory challenges will be of vital importance and starting some definite projects will instill confidence and enthusiasm on both sides.

There is incredible momentum and enthusiasm in India–US relations. As this article is being given a final touch, a headline in *The Times of India*, 14 August 2024, 'Eye on China & Pak, India fast-tracks deal for 31 U.S. hunter-killer drones' is an example of such momentum. India must ride the wave.

Conclusion

Over the years, India has set up comprehensive infrastructure for the manufacture of defence weapons and equipment. Though considerable development has taken place in indigenous design and development, India is largely dependent on foreign technologies for the high-tech equipment. In this endeavour, Russia has been a major contributor of ToT followed by France, US, Israel and South Korea. However, despite ToT from technologically advanced countries, the development of indigenous technologies has not succeeded due to various reasons. During the period after the Cold War era, India's relations with the US have become stronger and in recent years, India has been designated as a Major Defence Partner, by the US. There have been a number of agreements signed between the two countries for collaborations in diverse fields. There have also been agreements for collaborations in the field of defence technologies with iCET being the latest and most promising initiative. Close relations between India and the US have evolved due to common interest in the security of the Indo-Pacific region and fight against global terrorism. The US also wants India's dependence on Russia for military weapons and equipment to be reduced. iCET provides India with an excellent opportunity to jointly develop state-of-the-art technologies and integrate

them with the military requirements. The iCET agreement is taking shape with serious participation from both sides and its success needs to be seen. India has to tread cautiously as a similar agreement, DTTI, signed in 2012 failed to deliver results. India also needs to gear up its efficient technology absorption capability, which entails augmenting India's technological R&D base and ecosystems. A number of steps have been taken, but a lot more needs to be done, including copious funds for the R&D, both in the government and private sectors. With a close partnership with the US, it is hoped that India will become an industrialised country with indigenous capabilities similar to Israel, China and South Korea and will be capable of taking on the leadership role in the region.

Notes

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