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Technology Transfer in the Indian Defence Sector A Reality Check And Suggested Mechanisms

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Abstract
Any country that aspires to be a defence technology leader needs a well-developed industrial base. For a country like India, this necessitates building of the defence industrial base through technology transfer from countries that are more technologically advanced. The Indian experience of Technology Transfer in the Defence Sector, however, has not been very fruitful. While this is commonly attributed to our inability to absorb technology, a deeper analysis would reveal that a reluctance from defence majors in advanced countries to share technology has been a critical factor. This paper attempts to understand the contours of the defence technology transfer framework with particular reference to the Indian Defence Sector. It brings out the challenges India faces in acquiring and absorbing defence technology. At the end a framework of mechanisms to robustify defence technology transfer has been suggested.

Introduction

Technology transfer is the process of sharing, transmitting, or conveying technology, data, and information (intellectual property) between government agencies, industry, and academia. Technology transfer occurs indirectly through transfer of knowledge via conference presentations, journal articles, seminars, teaching, and other ways of communicating findings. It can also occur through the transfer of technology directly to the private sector or by way of networks with the goal of commercializing the technology. Commercial technology transfer is the transfer of technology from a Government laboratory or agency to a commercial entity that can improve technologies by undertaking the technical, business, and manufacturing research to bring them to market.

India's march towards the acquisition of globally competitive defence technology has essentially two routes. The first is indigenous capability development and the second, import. The first route that was paved with Defence Research and Development Organisation (DRDO), Defence Public Sector Undertakings (DPSUs) and Ordnance Factories (OFs) has met with limited success due to various reasons like limited budgets, sanctions, non-availability of a robust defence industrial base etc. This slow progress coupled with faster evolution of defence technology the world over has forced the defence forces to depend more on import of competitive defence technology systems.

The second route to acquire competitive defence technology is their import. Executed under the rubric of 'Transfer of Technology' (ToT), this comprises of arrangements wherein foreign supplier firms provide 'technology' for enabling the buyer to manufacture defence systems. Since indigenous capability was limited, India has been using ToT to shore up its defence production capabilities from as far back as the 1960s and 1970s.

Achieving self-reliance in defence technology, a national goal pursued by India from the mid-1960s, was quantified by the Dr A.P.J. Kalam committee in 1992 by introducing the Self Reliance Index (SRI), which indicated the proportion of indigenously procured content against the total. An ambitious target of achieving SRI of 0.7 was set by the committee. Though vigorous efforts have been made to 'indigenise' a larger number of foreign parts of the various systems being manufactured, the moot question is whether even if an SRI of 70 per cent were to be achieved, dependence on imports for the remaining 30 percent of parts can be critical. While the need for this 30% can be scientifically predicted, stocked and replenished in sufficient quantities, global geopolitical events like the ongoing conflicts in the Middle East and in Russia-Ukraine can bring in significant uncertainties into the Supply Chain. A larger question is whether Self Reliance should be the ultimate goal or Technological Sovereignty / Superiority.

Self Reliance vs Technological Superiority

Self-Reliance merely addresses a gap in manufacturing and sustenance which is filled by Production ToT or licenced manufacture contracts. These arrangements provide only the know-hows of manufacturing specific parts and systems. The know-whys of the design are either not provided or simply unaffordable. The key to this problem is to raise the current technological level of the defence industrial base.

Raising such levels, hence, requires a wide and deep knowledge as well as skills base, which does not get built up by a narrow focus on engineering-based indigenisation of foreign parts. Raising the technological level provides the benefits of not only being able to absorb a larger quantum of higher-level technology but also offer opportunities for exports, thereby bringing in much needed profits through enhanced competitiveness. Such action to develop global competitiveness cannot be inspired by the goal of achieving self-reliance but by that of achieving technological superiority

Technological Sovereignty and Superiority can only be achieved by acquisition of technology. This is the reason behind ToT being a crucial aspect in successive editions of the Defence Acquisition Procedure (previously Defence Procurement Procedure) since the opening up of the Defence Sector to private industry in 2001. However, despite vigorous efforts in this direction, the Transfer of Technology (ToT) obtained from various foreign OEMs over the years has not succeeded in advancing the objectives of self-reliance or technological superiority in the manufacturing of defence equipment. It has merely facilitated the assembly and integration of various subsystems while manufacturing some non-IPR components under license. The OEMs do not share any inputs on material, technology or insights into manufacturing processes. Furthermore, the Defence Offsets Policy has not yielded the desired results and may have inflated acquisition costs. Therefore, a de novo approach must be adopted when inducting any foreign weapon system or platform; it may be time to pivot from ToT to Absorption of Technologies (AoT) along with innovative technology upgrades.

Indian Defence Technology Acquisition – An Evolutionary Perspective

India has a long-standing history of acquiring defence technology for the production of defence systems. From as far back as the 1950s, contracts with foreign firms have enabled the production of vehicles and guns, followed by main battle tanks and infantry combat vehicles, fighter and trainer aircraft, frigates and submarines, in the state-run production agencies comprising of ordnance factories (OFs) and defence public sector undertakings (DPSUs). These contracts were executed in the licensed production mode where foreign firms provided a licence for locally manufacturing a specified number of systems. Alongside, they also provided the design and production documents, special machinery, industrial training (know-how), as well as the systems themselves in a suitable proportion and sequentially delivered in fully formed state, semi-knocked down (SKD) kits and completely knocked down (CKD) kits. While receipt of fully formed systems enabled an understanding of their operation, maintenance and testing aspects, the SKD and CKD kits enabled the Indian workforce to absorb the assembly and integration of various parts of the system to progressively greater depths.

The licensed production mode of the 1950s to the 1970s then evolved into the indigenous manufacture (IM) phase. This phase entailed the transfer of technology for local manufacture of a substantive portion of the assemblies/sub-assemblies and even discrete parts. The manufacturing technology of some critical parts of the systems termed 'proprietary' were, however, never shared and these were delivered in what are called IM kits. The kits along with the indigenously manufactured parts would then be put together to produce the whole system. Thus, licensed production came to be known as licensed production with IM or simply licensed manufacture (LM) which in turn evolved into LM with transfer of technology (ToT) to simply ToT.

The LM mode, currently being referred to as ToT in the Defence Procurement Procedure, essentially delivers the capability to manufacture or produce defence systems through the acquisition of necessary know-hows. However, for upgrading the system or designing, developing and manufacturing new variants independently of the foreign technology seller firms, the know-whys are needed. These know-whys are never provided for established reasons and huge costs, leaving us considerably dependent on the seller firm for our futuristic needs.

Why is Technology Transfer Important?

To answer this question, we need to relate this issue to the larger issue of national goals. The acquisition of superior military capability vis-a-vis our adversaries is an obvious overarching goal. The mode of capability acquisition, be it outright purchase or ToT would give rise to secondary goals. Some goals, such as increased economic/industrial growth, generation of employment and savings in foreign exchange, are of a general nature, common to all spheres. But to be more focused, is the secondary goal self-reliance or technological superiority?

At this point, let us re-examine the definition of self-reliance advocated by Mr K Subrahmanyam, that is, 'the operational exploitation and maintenance of the foreign equipment must not be held hostage under any circumstance'. If this were the definition, an argument for import dependence could be that it would be cheaper and more effective to scientifically predict the exploitation and the number of likely failures in the systems in the future and then purchase and stock the needed fuels, material and spare parts in appropriate quantities including safety stocks, as is done in lifetime buys. So, instead of just self-reliance, we need to ensure that technology transfer can also build world-class design, development and manufacture capability, thereby helping to achieve a more productive and profitable goal of 'technology superiority'.

Or, coming down a notch, technology transfer can at least make Indian firms capable of competing with the rest of the world as part of global supply chains. Such technology competence, aside from helping in providing weapons systems with a superior edge, would bring in much-needed profits and build foreign country interdependence, thereby strengthening India's bargaining power for complementary technologies.

The Down Side of ToT – The Indian Experience Thus Far

While it is popularly perceived that 'Transfer of Technology' will magically elevate defence production capabilities to cutting-edge levels, the Indian experience is that our largely publicly owned defence industry has not been able to absorb and build on the received technologies. This inability to absorb technology may be, on the surface, attributed to incompetence, poor management and short-sightedness, digging a little deeper reveals a whole plethora of factors linked mainly to the legal clauses protecting the rights to industrial/intellectual property (IPR) of technology sellers.

Foreign OEMs mainly offer an incomplete ToT, withholding critical technological design know-how and protecting their intellectual property rights (IPR). Technology seller firms have also been known to: impose restrictions on field of use, volume and territory; ask for prolonged periods of validity (thus precluding its further development by the buyer); restrict any research and development in the field; impose non-competition clauses on the buyers; tie down the buyer to purchase material and parts from the seller; fix their own prices; impose restrictions in the event of the expiry or loss of secret technical knowhow; prevent challenges to the validity of the rights of the seller; impose grant-back provisions which force the buyer to transfer back to the seller, any improvements, inventions, etc.; and lastly, restrict exports. In addition to these, numerous export control arrangements and non-proliferation treaties such as the Wassenaar arrangement, Nuclear Non-Proliferation Treaty (NPT), Missile Technology Control Regime (MTCR), the Australia Group, etc. impose additional restrictions on export and transfers.

One debatable issue of ToT is the cost angle. ToTs enabling indigenous manufacture of defence systems appear, prima facie, to be cheaper than outright purchase of the system, given, the availability of cheaper labour and use of existing infrastructure. Paradoxically, however, it maybe the other way around. In the 1970s and ‘80s, it was noticed that the cost of making the Jaguar aircraft in India would be twice that of buying finished planes from Britain. Reasons for higher costs have been attributed to the costs imposed by the seller firms on patents, licenses, know-how, trademarks, over-pricing of capital goods and equipment supplied, and many others. However, it can be argued that Supply Chains built around ToT have greater resilience that those depending upon outright imports.

Role of Domestic R & D in the Technology Transfer Framework

Weapon systems and platforms required by the defence forces invariably involve a convergence of cutting-edge technologies. Most platforms be they fighter aircraft, armoured fighyting vehicles or aircraft carriers are essentially system-of-systems, integrating mechanical engineering (power pack), armament technology, fire control system, sighting system, gun control system, communication system, NBC protection, etc. It is difficult, if not impossible, for a single manufacturer or entity to have all the capabilities required to produce or integrate such a system of systems. In this aspect, there is a need for domestic R & D and Technology Transfer to go hand in hand.

One critical factor in developing new technologies and their employment in the design and manufacture of defence equipment is the investment in R&D. Currently, India spends only approximately 0.7% of its GDP on R&D, much lower than the world average of 1.8%. Countries like the US and China reportedly spend about 2.8% to 3.5% of their GDP on R&D. Israel, a major exporter of defence technologies is the top spender, almost 6% of GDP on R&D. China is continuously increasing its R&D investments for the last 25 years and is expected to surpass the US by 2026. Because the GDP of the US and China is 6 to 8 times bigger, the enormity of asymmetry in defence R&D spending can be comprehended. Consequently, as per the Global Innovation Index 2025, India’s global ranking is at 38^{th} (amongst 133 global economies), an improvement from the rank of 48 five years back.

A helpful comparison for R&D spending can be made with South Korea, a nation that used to have an agricultural economy like India, with a low-skilled and labour-intensive industry. However, in the 70s, Korea shifted gears, investing heavily in R&D, sending the economy into higher orbit. Today, it spends 5% of GDP on R&D, 79% of which is from the private sector. Compared to India's R&D spend of 0.7% of GDP, of which only 37% comes from the private sector, Samsung spends 8-11% on R&D, while Reliance spends a paltry 0.6%. Tata Steel, ITC and Maruti have cut down R&D spends in the last 5 years. It is clear that R&D not only bolsters corporate houses but also energises industries.
Another indicator of focus on R&D is the number of scientific papers published in international journals and the number of patents granted. This results in innovation and the development of new technologies. Here, the asymmetry gets further skewed as India has a minuscule number of patents granted over the years. The corollary is that an increase in R&D budget is an indispensable component of the strategy, which must be implemented to achieve a higher self-reliance quotient. Overall, if spending on R&D is enhanced to about 2% of GDP, it will be a big boost towards the quest of being Atma Nirbhar. A welcome development, announced last year by the government, is the setting up of a National Research Foundation (NRF) with a corpus of Rs 50,000 crore for R&D over five years. This will foster a culture of R&D in Universities. Colleges, Research Institutions and R&D labs.

Modes of Technology Transfer

We have seen earlier that ToT in the LM mode, or production ToT (PToT) does not facilitate the acquiring of know-whys. There are, however, other modes or avenues, that do not explicitly mention technology but nevertheless involve the transfer of knowledge which could contain the know-whys.
Joint Ventures. After PToT, the most common of the conventional modes being linked to ToT is joint ventures (JVs) for co-development and co production (JVs CD–CP). As the name suggests, JVs are independent entities formed from the contribution of two or more agencies or companies to achieve common goals. For such an arrangement to be successful, it is necessary that both partners contribute by bringing in complementary technologies, in addition to funding. India has used this arrangement through collaborations with Russia for developing and producing the successful Brahmos missile; and with Israel for the medium-range surface-to-air missile system (MRSAM). From the self-reliance perspective, JVs CD–CP do not appear to be overly beneficial. The fact is that India or Indian firms will remain dependent on the foreign partners for their portion of the system until an indigenous version is developed. The development of the indigenous version too is very likely to be restricted by contractual clauses inserted by the foreign firm to protect their business interests.
Strategic Partnership. The strategic partnership arrangement as envisioned in the DPP-2016 (and in DAP 2020) also appears useful especially if some amount of capability already exists within the country, as is the case with India. It is, however, unlikely that foreign partners will be open to eventually assigning/transferring the IPR of their part of the system, though they may be open to licensing them for manufacture. Here too, self-reliance and technology competence appear achievable on similar grounds as that of the JV CP, though the quantum of technology transfer is likely to be much lower. Encouraging foreign direct investment (FDI) is a common policy used by governments to facilitate technology transfer into JVs with local firms. Usually, the foreign investor offers the technology whose value makes up part or whole of his investment, while the local partner offers the infrastructure, workforce, management, etc. The foreign investor becomes the technology partner/supplier, while the local firm absorbs it. The technology could be transferred in a number of ways, such as the LM mode or through contract

manufacturing/sub contracting using documents for build to print (B2P), build to design (B2D) or build to specifications (B2S).

Build To Print. In a B2P contract, the foreign firm provides the technical specifications, engineering documents and manufacturing process documents. The manufacturing process documents would include manufacturing drawings, detailed work instructions/manufacturing practices, quality requirements, detailed specifications of the product at intermediate stages, test methods and acceptance/rejection criteria, while the know-how would cover procedures taught through training sessions and tacit knowledge embodied in the technical consultants of the foreign firm. The local firm executes the task strictly as per the above documents/instructions and using material or parts from sources recommended by the foreign firm. Since a few proprietary components of the seller firm are invariably required, thus leading to a dependence. Another disadvantage is that the arrangement provides the know-hows of the manufacture process but not the know-whys.

Build To Design. In a B2D contract, the foreign firm provides the technical specifications and engineering documents. The engineering documents cover the drawings, acceptable tolerances, material compositions, surface finish required or, in the case of electronic modules, the circuit diagrams, net list showing connections between all components of printed circuit board (PCB) and Gerber diagram showing layout of components on PCB. The local firm is now required to develop or use its own process to manufacture the part. The advantage here is that an indigenously available manufacturing process technology is being utilised, thereby avoiding the cost of purchasing a licence for a new one or the royalties for using it repeatedly. The product design, however, is considered intellectual property (IP) and royalties will need to be paid for its use.

Build To Specifications. The B2S contract is, strictly speaking, not a ToT. but is invariably combined with B2P and B2D ones to produce the different parts of a system under PToT. The foreign firm provides the specifications which may include the detailed dimensions, acceptable clearances, performance characteristics, reliability, etc., of the product. It is now left to the local firm to design, develop, manufacture and supply the product. For successfully achieving this, the phases of prototyping, user trials, evaluation, etc., may be required and will therefore take considerably more time, effort and money as compared to B2P or B2D. However, since the B2S mode is not a ToT, it doesn't require export permissions of the foreign government or international export control regimes. Also, since the local firm has developed the product on its own, it holds the IP rights and the know whys, and is therefore free, as well as capable, of exploiting them for producing product upgrades or variants, or for that matter, applying the technology for other purposes.

Defence Offsets. Another facilitator that is being pursued in India for the acquisition of technology is 'defence offsets'. Here, a foreign OEM, to whom a large contract for the manufacture and supply of systems has been awarded, is obligated, in return, to use any of six avenues for benefiting India's defence and allied industry. Out of these six, four pertain to technology transfer in their different modes. This is in keeping with the worldwide trend of using offsets as a potential source of ToT. The transfer could be by sub-contracting or PToT, through direct contracts or JVs with private firms (non-equity or equity), or PToT with government agencies and finally, acquisition of critical technologies by Indian DRDO. For enabling the last option (which has not been analysed so far), the DPP provides a list of 20 critical technologies, such as MEMS-based sensors, actuators, radio frequency (RF) devices, focal plane arrays, and nanotechnology-based sensors and displays.

Expanding the Depth of Technology Transfer

The depth of Technology Transfer needs to be widened to include much more than merely the knowledge of use/operation, maintenance, repair, overhaul or production (or manufacture) of a defence system and its component parts, but all the knowledge that is generated and transferred in the path to system realization. This can be achieved by proceeding in a sequential manner as brought out below: -

Step 1 (Discovery of New Material / Phenomena). This is undertaken at Universities through fundamental research which is by nature low cost and mostly government funded but high risk with a success rate of pick up for applied research not exceeding 30%. This requires vigorous participation of Indian academia in partnership with foreign academia and industry.

Step 2 (Development of its Application and Prototyping). This involves government or private research establishments picking up the discovery of the academia for applied research. This is a high investment - high risk step. About 30 % of the applied research undertaken offer the promise of commercial viability and are picked up by manufacturing firms. DRDO laboratories can use transfers of the findings of fundamental research (through licences) to develop products which are patentable.

Step 3 (Development of the Manufacturing Process). This step involves manufacturing firms and is a moderate investment - moderate risk step. About 70% of the projects yield successful processes. This step represents the highest jump in the value chain. In this step, Indian industry needs to actively collaborate with academia as well enter into agreements with foreign firms to develop manufacturing systems and processes. There would be participation of the DRDO teams in this step too.

Step 4 (Mass Manufacturing). This step involves mass production of the parts. Initially, the process has a low rate of production with moderate quality. However, continuous process improvement is undertaken to achieve high rate of production with nearly 6 sigma quality.

Step 5 (System Design and Integration). This step brings in the defence integrator firms that are involved in design of the larger system and integration of the manufactured parts. The outcome of this step needs to be globally competitive for the project to remain viable. Therefore, this is a high investment high risk step. This is an activity which the DRDO, and now the private sector, has been doing for quite some time through JVs for co-development and co-production. This would be the stage when the benefits of this arrangement in terms of obtaining world-class know-hows of system design and the know-whys of the developed systems can be consolidated. Instead of co-development and co-production, co-opting of brilliant Indian scientists into foreign projects may provide a win-win situation for India and the foreign partner.

Step 6 (Mass Production). This step represents the culmination of the development and productionisation process. It is a moderate investment - low risk step since the production and integration processes are mature. Indian industries including the private sector could demonstrate their capacity and capability to mass produce systems with six sigma quality.

Best Practices in Defence Technology Transfer

Several critical factors for a successful technology transfer program include an effective Research and Technology Administration framework, engaged researchers, well-managed intellectual property, using technology transfer mechanisms to their full potential, efficient technology transfer processes, and meaningful interaction with industry through marketing or partnerships.

Some of the best practices in defence technology transfer include the following: -

- Ensuring effective Research and Technology Administration and Staffing.

- Empowering, training, and rewarding researchers.
- Capturing and managing intellectual property.
- Using technology transfer mechanisms to their full potential.
- Managing and monitoring technology transfer processes.
- Marketing laboratory technologies and capabilities to industry.
- Building partnerships.

Ensuring effective Research and Technology Administration and Staffing

This encompasses the following practices: -

1. Decentralise the Research and Technology Administration function by technical subject area or business area
2. Building robust interfaces between Research and Technology Administration function and the legal function.
3. Investing in technology transfer pilot programs

Empowering Training and Rewarding Researchers

To encourage and empower scientists and engineers to pursue technology transfer, MoD may consider adoption of the following practices: -

1. Training researchers about technology transfer mechanisms, how to work with companies, and the process of transferring inventions from the laboratory to the marketplace can be in the form of training capsules / workshops, Seminars, Lectures by Subject Matter Experts etc. Such training sessions result in increased visibility of technology transfer and revenues from licensing patents.
2. Recognizing researchers for their efforts to bring technologies to market not only raises the visibility of technology transfer to other researchers, but also encourages them to participate in technology transfer activities as well. At the same time, learning about industry needs may inspire researchers to envision commercialization possibilities for their technologies. Such recognition can be in the form of awards, cash incentives and /or research grants to further the research work.
3. Training technology transfer staff about intellectual property and acquisition issues. There is a need for fundamental information about intellectual property and the effective management of rights in technical data.

Capturing and Managing Intellectual Property

Intellectual property must be captured and managed by the following ways: -

- **Identifying IP during Research and Development Phases.** Intellectual Property is normally identified and documented during R and D phase as invention disclosures or provided appropriate protection in the form of copyrights or patents.
- **Evaluating Invention Disclosures for Licensing or Commercialization**. Most Defence laboratories undergo some type of IP evaluation to determine what to protect. Many Research and Technology administrators use some form of an invention review board process to determine whether to patent technologies from invention disclosures. Invention Disclosures must not be evaluated solely from a technical angle but also from the productionisation, commercialisation and military utilisation angles.

Using Technology Transfer Mechanisms to their Fullest Potential

There are several ways to utilise Technology Transfer Mechanisms to their Fullest potential. Some of the them are enumerated below: -

Invention Licensing Agreements. Invention licensing agreements are used for two primary reasons. First, they may help transfer technologies that are not patented, such as software. Second, licensing an unpatented invention is less expensive and frequently quicker than licensing a patented invention.

Joint Ownership Agreements. JOAs are set up after a technology is jointly developed with a partner, a university, or private company. The parties agree on a strategy for licensing the joint intellectual property to a third party. JOAs facilitate the business relationship between a DoD laboratory and its partner and define roles and responsibilities for patenting and commercializing the jointly developed technology. The terms and conditions of a JOA address such issues as patent prosecution, licensing, marketing, and royalty distribution.

Cooperative Research and Development Agreements. CRADAs are effective mechanisms to collaboratively address technological challenges with private companies and universities and to participate in material or data transfer, material evaluation and device evaluation.

Foreign government CRADAs Previously, Defence R & D agencies had to rely on inter-government agreements to perform dual-country research and development, and such agreements often took years to establish. On the other hand foreign CRADAs take less than one month to set up. However, not all military departments have adopted the use of foreign CRADAs. When negotiating foreign CRADAs, care must be taken to ensure that an export-controlled technology is not compromised.

Facility CRADAs. Most R & D laboratories have elaborate test setups that are quite expensive to build and operate by private firms. However, private firms may require use of these test facilities to evaluate their new products. In many cases, these test facilities are operated and maintained by contractors. A facility CRADA is an agreement between an R & D laboratory and a contractor that allows the contractor use of the specialized facility on behalf of third parties. The laboratory receives a portion of the money charged to the third party for facility usage, which can then be used for facility maintenance and operations or improving laboratory capabilities.

Managing and Monitoring Technology Transfer Processes

This set of practices includes the following activities: -

- Standardisation of change processes.
- Tracking of agreements and contracts such as licenses and CRADAs.
- Streamlining licenses.
- Developing handbooks for commonly executed agreements and contracts.
- Developing databases and checklists for technology transfer processes.
- Checking status of regular CRADAs.

Marketing Laboratory Technologies and Capabilities to Industry

R & D laboratories use multiple approaches to market laboratory technologies and capabilities to industry. The exemplar practices described in this chapter are: -

Advertising laboratory technologies. Trade shows and other industry events increases communication between R & D labs and companies about available technologies from the labs and about industry needs.

Providing industry training about technology transfer. Briefings and training discussions increase industry's awareness about the availability of technologies at laboratories that can be licensed or further developed through CRADAs.

Commercialisation Assistance from Academia. Working with students at universities leverages lab resources and ultimately results in deploying more technologies to the market. Students can provide additional insights and ideas for commercializing lab grown technologies.

Conducting technology showcases. Technology showcases provide an opportunity for laboratory researchers to discuss their technologies with industry researchers and entrepreneurs and for companies to talk directly to inventors.

Building Partnerships

R & D Labs need to build and sustain partnerships with various types of organisations in industry and academia in order to accomplish Technology Transfer.

Intermediaries. These partnerships can be with intermediaries that connect labs with the industry. The broad role of these partnership intermediaries is to connect laboratories with potential customers and licensees. Intermediaries can also help in IP management and finalization of technology transfer contracts.

Universities. Partnerships can also be established with universities that can aid in incubating new ideas to make them market ready in short timeframes. These partnerships are aided by researchers, faculty, and students who perform technology transfer functions for the laboratories. In return, universities benefit from access to laboratory resources and technologies.

Venture Capital Organizations. Laboratories tend to partner with venture capital organizations when the technology development strategy involves setting up a start-up company. These venture capital firms identify technologies with commercialization potential, locate potential licensees, facilitate business start-up development, and fund technology development.

Economic and Technology Development Organizations. Laboratories partner with economic and technology development organizations to locate partners and licensees, develop prototypes, fund startups, and perform other activities that support the mission of the organizations. Laboratories may also use economic and technology development organizations to help fund and organize technology transfer activities and events.

Conclusion

Nations working towards achieving technological superiority assisted by technology transfers is not a new phenomenon. Technology has been acquired through numerous means and successfully adapted them to local conditions. These means included licencing arrangements, collaboration with foreign firms, and foreign direct investment, all of which thrived on protection of intellectual property rights (IPRs) enforced by local regulation. Though each case described faced different paths and hurdles, all achieved success through a gradual leaning away from traditional import substitution, which was focused on meeting domestic demand, to achieving international competitiveness.

The Indian defence industry too needs to move up the capability curve through learning which is the key source of change and the most important mechanism for knowledge accumulation, innovation and growth. This can be facilitated first by interaction with other organisations dealing with such aspects as education, training, research and development (R&D), financing and policy support. And secondly, it can be facilitated by a national system of innovation founded on a strong IPR regime, which encourages, rewards and protects original innovators in a domestic competitive environment.

India needs to leverage the strengths of its R and D framework combined with optimally arranged foreign collaborations for profits, risk-sharing and a common goal of achieving technological superiority to break into the global market in select areas. Such a breakthrough should then initiate a chain of other breakthroughs through the leveraging of greater bargaining power for technology-sharing with foreign collaborators. The Indian defence industry would then be able to deliver systems which the armed forces would find capable of meeting their needs.

References

1. MacPherson, Mary, Jordan, David and Miller, Chad, "Defense Labs Best Practices in Technology Transfer and Community Engagement" (2018), Mississippi Defense Diversification Initiative, University of Mississippi. Accessed on www.researchgate.net.
2. Saha, Loknath, "Assessing the Effectiveness of India's Technology Transfer Initiative to Foster Innovation", (2023). Accessed on www.nititantra.com
3. Howieson, Susannah.V, Shipp, Stephanie.S, Walejko, Gina.K, Rambow, Pamela. B, .Pena, Vanessa, Holloman, Sherrica, S., Miller, Philip.N. "Exemplar Practices for Department of Defense Technology Transfer",(2013), Institute of Defense Analyses, Virginia.
4. MP-IDSA Issue Brief "Transfer of Defence Technology – Moving from Self Reliance to Technological Superiority" (2017). Accessed on www.idsa.in.
5. De Souza, Kevin.A, "Transfer of Defence Technology : Exploring the Avenues of India" (2017), Journal of Defence Studies, Vol. 11 No. 3, July – Sep 2017. Accessed on www.idsa.in.
6. Trexler, David.C, "Technology Transfer: A Qualitative Analysis of Air Force Office of Research and Technology Applications" (2006), Thesis submitted at Air Force Institute of Technology, Wright-Patterson Air Force Base Ohio. Accessed at https://scholar.afit.edu.
7. Sezal, Mustafa Ali and Giumelli, Francesco, "Technology Transfer and Defence Sector Dynamics – The Case of Netherlands" (2022). Published on www.tandfonline.com.
8. De Souza, Kevin.A, "Transfer of Defence Technology : A Critical Analysis" (2016). Accessed on www.idsa.in.
9. Srinath, T.M., "Transfer of Technology in Indian Defence Manufacture - Elements and Challenges", (2020), Journal of Management Research and Analysis, January-March 2020. Accessed on www.jmra.in.