DEFENSE AND AEROSPACE INDUSTRY PROGRAM

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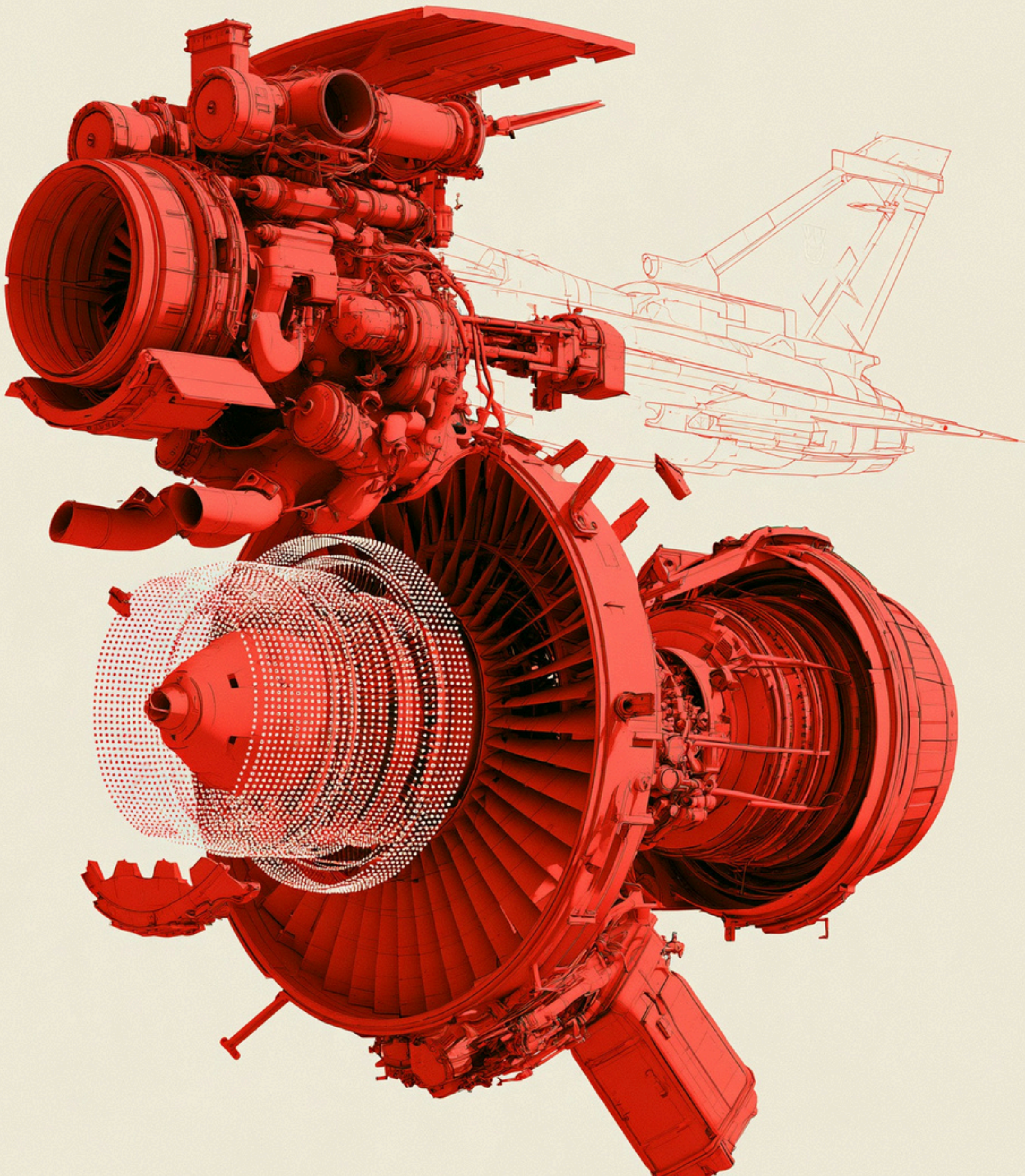
The Illusion of Technology Transfer

The Missing Ingredients of India's Defense Industrialization



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ABOUT THIS REPORT

India has produced foreign-designed weapons under license for six decades. The volume of that production has not been matched by a comparable growth in independent design capability. The Illusion of Technology Transfer argues that part of the reason lies in how Indian procurement understands transfer itself: as a contractual deliverable, rather than as a process of learning that has to be organized, measured and owned.

The report reads nine procurement procedures from DPP 2002 to the draft DAP 2026, sets out a ladder of technological depth and a five-stage technology-to-capability chain, and applies both to four programs: the T-90S Bhishma, the Su-30MKI, the K9 Vajra-T and BrahMos. It is diagnostic rather than prescriptive. Its central caution is that a higher share of a weapon being made in India is not evidence that India has acquired the technology behind it.

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EXECUTIVE SUMMARY

Between 2004 and 2023, Hindustan Aeronautics Limited built 222 Su-30MKI fighters at Nashik under license from Russia. It is among the largest licensed-production runs of a modern combat aircraft undertaken outside the country that designed it. Two decades of that work have not given India unrestricted design authority over the aircraft. The Su-30MKI is not an isolated case. India has assembled fighters, tanks, submarines, helicopters and missiles under transfer-of-technology arrangements for six decades, and the same pattern recurs.

This report asks why. Its argument is that much of the explanation lies in how India has understood technology transfer. The system treats it as something a contract can deliver, and Indian procurement has become steadily better at specifying what is to be handed over. What a contract cannot do is ensure that Indian engineers understand the technology, that the organization keeps the people who learned it, that the knowledge is improved on, or that it is used again in the next program. The distinction that matters is between receiving technology and absorbing it.

To make that distinction usable, the report sets out a ladder of technological depth. It runs from assembly of imported kits, through licensed manufacture and mastery of production processes, to design participation and, at the top, design authority: the right and the technical ability to change a design without the originator's permission or assistance. Production depth and technological depth are separate axes. A program can climb one a long way without climbing the other.

The report then sorts the conditions for absorption into three groups. Some are directly contractible: documentation scope, license terms, tooling, training hours, indigenous-content thresholds, IP and source-code rights, penalties. Some can be specified but not guaranteed: the quality of training, export releasability, supplier-ecosystem development, liaison mechanisms. The rest sit outside a contract altogether, among them the recipient's prior technological baseline, the absorption of tacit knowledge, workforce retention across programs lasting decades, the supplier's incentive not to create a future competitor, and institutional continuity. Most of what decides the outcome lies in the last two groups.

The policy record, read across nine procurement procedures from DPP 2002 to the draft DAP 2026, shows three things. Transfer of technology is never clearly defined in twenty-four years of procedure, and functions as a label in contracts rather than as a technical category. Indigenous content rose without design control following it. And no institution is made responsible for absorption, so procurement rules improved while learning outcomes did not.

The audit record is consistent with this. The Comptroller and Auditor General's performance audit of defense offsets covering 2007 to March 2018, Report No. 20 of 2019, examined 46 contracts carrying obligations of ₹66,427 crore (about USD 7.62 billion). Of the ₹19,223 crore (about USD 2.21 billion) that had fallen due by December 2018, vendors claimed ₹11,396 crore (about USD 1.31 billion) and the

government accepted ₹5,457 crore (about USD 626 million). The audit did not find a single case in which a foreign vendor had transferred high technology to Indian industry.

Four programs are then scored on a five-stage chain: access, transfer, assimilation, reapplication and authority. The T-90S Bhishma shows deep assimilation, with AVNL stating in 2026 that the 1000th India-built tank had been delivered from Avadi at around 80 percent indigenous content, alongside little evidence that two decades of that work built a broader Indian tank-design ecosystem. The Su-30MKI shows the trade made explicit: a 2006 schedule compression cut fully indigenized Phase IV aircraft from 114 to 60 and raised fully imported Phase I and II aircraft from 8 to 34, while the project cost rose from ₹22,122.78 crore to ₹39,605.95 crore, an increase of 79 percent. Against that, HAL integrated the 2.5-tonne BrahMos onto the same airframe without the original designer, which is the real integration authority. The K9 Vajra-T traveled furthest short of design participation: more than 80 percent indigenous work packages, and a Hazira industrial base that went on to feed the DRDO and L&T Zorawar prototype, with design authority still resting with Hanwha. BrahMos climbed highest and is the least representative, because it was a joint development rather than a transfer.

Five findings follow. Technology transfer is not one thing, and Indian policy has used the term without separating its levels. More local production has not meant more technological capability. Many of the factors that decide whether technology is absorbed lie outside the contract. The weakness appears after production begins, where knowledge stays tied to the line, the factory or the program that acquired it. And that failure to travel persists because no authority is tasked with making it travel.

The report is diagnostic, and a later report in the series carries the detailed recommendations. Four implications follow directly from the findings. Someone has to be responsible for absorption, connecting the organizations that buy, produce, and design. India should measure absorption rather than localization, asking what its engineers can now do independently and which technologies have moved into other programs. Where the objective is technological capability rather than domestic manufacture, deeper participation in development is better supported by the evidence than deeper transfer. And, most cheaply of all, the procurement procedure should stop using transfer of technology as a single undifferentiated term, so that a contract can state which level it is buying and an auditor can say whether it was delivered.

INTRODUCTION: THE GAP BETWEEN BUILDING AND KNOWING

Between 2004 and 2023, Hindustan Aeronautics Limited built 222 Su-30MKI fighters at Nashik under license from Russia.[1] It is among the largest licensed-production runs of a modern combat aircraft undertaken anywhere outside the country that designed it. Yet two decades of licensed production have not given India unrestricted design authority over the aircraft. Major modifications still require access to Russian design authority, technical data and, where applicable, Russian cooperation. Two decades on, the Super Sukhoi upgrade, a mid-life modernization of the fleet covering radar, avionics, mission computer and weapons integration, is being planned around HAL-led avionics and mission-system integration, while a parallel Russian-assisted upgrade route is also under consideration, and the program is still awaiting Cabinet Committee on Security clearance in September 2026.[2]

SU-30MKI
Source: HAL

The Su-30MKI is not an isolated case. India has assembled fighters, tanks, submarines, helicopters, and missiles under transfer-of-technology arrangements for six decades. It is among the largest accumulated volumes of licensed manufacture in any developing-country defense industry. What has not accumulated is design authority: the right and technical ability to change a system's design without the originator's permission or assistance. This report, and the series it introduces, examines the gap between industrial volume and technological capability.

The standard explanations, and why they are incomplete

Three explanations are customarily offered.

Bureaucratic delay: Indian defense procurement is slow, and this is well documented. But delay explains why platforms arrive late; it does not explain why platforms that arrived on schedule left no transferable capability behind.

Underperformance of defense institutions: Difficulties in absorbing transferred technology are visible across projects implemented by DRDO, defense public sector undertakings, the erstwhile Ordnance Factory Board, and, more recently, private-sector firms.

Inadequate funding: India's defense R&D institutions and indigenous development programs have historically operated under significant resource constraints. Funding shortfalls can therefore limit Indian institutions' ability to absorb and build on imported technologies.

While all three reasons stand true they explain part of the problem, but they miss the big picture. Successful technology transfer requires moving from basic manufacturing to independent engineering control. Yet, this transition fails everywhere regardless of whether the manufacturer is public or private, which military branch is involved, or whether foreign supplies are scarce or abundant.

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The question to ask instead

This series asks why technology transferred to India does not become capability held by India.

India's procurement system treats technology transfer primarily as a contractual deliverable. Indigenous-content requirements, licensing arrangements and, historically, offset obligations are contractual instruments. But what a contract governs is principally the formal transmission of knowledge. Whether that knowledge becomes technological capability depends on conditions that procurement cannot directly purchase. These are the recipient's absorptive capacity, institutional continuity on the receiving side, retention of trained personnel, and a domestic research ecosystem capable of taking a technology from receipt to adaptation and, ultimately, reapplication. India has spent six decades repeatedly reforming the terms through which it acquires technology. It has paid less systematic attention to the conditions under which acquired knowledge is actually learned, adapted, and extended.

Why this matters now

The draft Defense Acquisition Procedure 2026 marks a significant shift in how India approaches indigenous technological capability. The draft places greater emphasis on indigenous design, domestic control over intellectual property and the ability to retain greater technological authority over acquired systems. The implications of the draft's provisions on offsets, source code, design data and upgrade authority require assessment against the final text and the relevant clauses. Yet the shift is significant because it recognizes a problem the previous model did not address: manufacturing capability and technological ownership are not the same thing. India could manufacture a foreign-designed aircraft without acquiring the authority to redesign it. It could produce a platform under license without acquiring the knowledge required to develop its successor. The policy question is therefore moving from how much technology India receives to how much technological authority India actually possesses. However, the shift is only indicative. On its own, it will not solve problems that require an overhaul in how defense production is understood.

This report is the foundation for a series of reports on technology transfer in India's defense sector. It has two purposes: first, to establish a framework for explaining the historical gap between technology transfer and technological capability; and second, to provide a framework for analyzing later case studies.

The report has five parts. Section 1 defines technology transfer and distinguishes between assembly, licensed production, co-development, and independent design. Section 2 reviews how Indian policy has treated technology transfer over time. Section 3 builds the analytical framework, separating supplier-side and recipient-side factors and what contracts can and cannot fix. Section 4 applies this to India's acquisition system. Section 5 draws out implications for current policy and future studies.

A key limitation is that most defense transfer contracts are not public. The subsequent reports will rely on official procedures, audit reports, parliamentary records, program documents, and interviews with practitioners. This report attempts to identify when and how transferred technology becomes real capability, and whether India's system enables that process.

SECTION 1 — WHAT TECHNOLOGY TRANSFER ACTUALLY IS

A technology transfer arrangement can involve at least three distinct components: codified knowledge, physical production assets, and human and organizational knowledge.

Codified knowledge is the component most people picture when they hear “transfer of technology.” It contains technical drawings, specifications, manuals, software, design data and process documentation. Contracts handle it most easily because it can be verified against contractual requirements.

The second is **physical production capability:** machinery, tooling, jigs, test equipment, production infrastructure and specialized materials. These can also be transferred, although their use depends on conditions such as appropriate industrial infrastructure, supporting equipment, and trained personnel within the recipient organization. In Transfer of Defence Technology (IDSA / KW Publishers, 2020), Kevin A. Desouza points to an important problem in the Indian experience. The recipients have at times economized on production equipment, substituting older or cheaper, labor-intensive machinery for the capital-intensive equipment around which the transferred production process was designed. The consequence, he argues, is that nominal possession of a transferred production process does not necessarily amount to mastery of that process.[3]

The third is **human and organizational knowledge**: engineering skills, troubleshooting experience, production judgment, design intuition and the accumulated practices of the people who developed and manufactured the system. Data and machinery can be transported and installed, but skills and abilities can only be carried, transferred, and absorbed by humans. This component is the least reducible to a contractual package, and the knowledge-transfer literature has long distinguished it as tacit knowledge.

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Product technology and process technology

A second distinction cuts across these components. Product technology concerns knowledge about the thing being produced: its materials, dimensions, architecture, configuration and design characteristics. In defense, this might include the architecture of an airframe, engine, radar, missile seeker or submarine.

Process technology concerns knowledge about how that product is made: machining, welding, casting, composite layup, electronics assembly, quality control and testing.

The two forms of technology can be transferred separately and can generate different capabilities. Process-technology transfers are less frequent and generally more expensive than product-technology transfers.[4] Technology transfer arrangements often provide access to product technologies along with production processes that do not already exist in the recipient country.

Mastery of process technology can substantially improve a country's ability to manufacture a foreign-designed system. Mastery of product and design technology is more directly relevant to acquiring the authority to modify and develop the next generation. This helps explain the Indian paradox identified in the introduction: India has become considerably better at manufacturing foreign-designed defense products without correspondingly acquiring the ability to design the next generation of those products. Process capability can accumulate without equivalent accumulation of product-design capability.

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From KNOW-WHAT to KNOW-HOW to KNOW-WHY

Know-what is knowledge of the product, its characteristics, and its performance. Know-how is the ability to execute: to manufacture, assemble, test, maintain, and operate it. Know-why is an understanding of the underlying design logic: why a particular material, geometry, or engineering solution was selected, and how changing one element affects the wider system.

Know-how can enable reproduction. Know-why is more directly relevant to adaptation and independent redesign. It is also generally harder to transfer because it may never have been codified. It may be embedded in engineering practice and accumulated through repeated experimentation rather than documented. Moreover, because it enables a recipient to alter or develop the underlying technology, it is often more commercially and strategically sensitive. Suppliers therefore have little reason to disclose design knowledge that could enable recipients to develop competing products.

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Horizontal and vertical transfer

Technology can also move in different directions. Horizontal transfer moves a technology between organizations, locations or production settings: for example, from a foreign original equipment manufacturer to an Indian production agency. Vertical transfer moves knowledge across stages of technological development, from research and development through design, engineering and production, and subsequently into modification and upgrade. The important point is that horizontal transfer does not guarantee vertical progression. The recipient must build the engineering, organizational, and R&D capabilities required to move upward through the development chain.

A ladder of technological depth

For the purposes of this report, technology-transfer arrangements can be placed on a ladder of increasing potential technological depth. This analytical device is synthesized from Indian production practice and the literature (e.g., Behera, 2013; Cowshish, 2022; Cohen and Dasgupta 2010).

Production depth is not technological depth

What each kind of arrangement gives the recipient, and what it does not

Design authority	Ability to modify, extend and originate the technology
Co-development	Shared design and development participation but not full unilateral design authority
Licensed manufacture	Production processes and manufacturing know-how but not independent redesign authority
Indigenous manufacture kits	Component manufacture against proprietary specifications but not design authority over what is manufactured
Completely-knocked-down assembly	Deeper assembly and integration practice but not full manufacturing capability
Semi-knocked-down assembly	Final assembly capability but not production knowledge
Finished form	A completed system but not manufacturing capability

Read from the bottom up. The block on the left widens with depth; the grey line is what the rung still does not confer.

In this taxonomy, the production depth is not technological depth. A recipient can move deeply into manufacturing while remaining dependent on the original designer for fundamental design changes. India has repeatedly accumulated substantial production experience without a commensurate accumulation of independent design authority.

Another important point is that at the lower rungs, the supplier can limit what the recipient is permitted to do with the technology. This commonly manifests as Intellectual Property (IP) or licensing rights. A technically capable recipient may be constrained by an IP restriction while a technically weak recipient may remain unable to exploit the technology even where contractual restrictions are less severe.

It is tempting to assume that sufficient access to technology, combined with sufficient institutional effort, will necessarily produce technological catch-up. A nuanced look at the imitation literature will help understand this.[5]

Andrea Gilli and Mauro Gilli's article, Why China Has Not Caught Up Yet, is particularly relevant.[6] Modern military platforms depend on complex technological ecosystems, accumulated engineering experience, integration knowledge, specialized supply chains, and organizational capabilities that cannot simply be extracted from an existing platform or its documentation.

Where India sits

Keith Krause's study of arms production offers a useful comparative starting point because it distinguishes producer states by the technological and industrial capabilities underpinning their defense production.[7] His typology broadly separates states that innovate at or near the technological frontier from those that adapt and produce advanced systems while struggling to keep pace, and from those whose production remains heavily dependent on foreign technologies. He categorizes arms producers into three tiers. First-tier nations innovate at the technological frontier with self-sustaining defense bases. Second-tier countries produce advanced weaponry but rely heavily on exports for financial viability. Third-tier nations depend on copying, modifying, or license-manufacturing foreign technologies rather than independent innovation.

India sits in Krause's third tier, among producers whose output depends substantially on foreign technology. Laxman Kumar Behera, in Indian Defence Industry: Issues of Self-Reliance (2013), observes that India is probably the only country in the world that, despite a vast defense industrial base, still imports the majority of its armaments, including low-technology items such as military transport vehicles.[8] This indicates that India's production capability and technological authority have accumulated at different rates. This formulation takes us back to the introduction.

ToT is an input, not an outcome

A transfer can be complete in contractual terms and incomplete in technological terms. The recipient may possess the drawings, operate the machinery and manufacture the product to the required standard while remaining unable to modify, redesign or independently reproduce the underlying technology. Receipt can therefore be fully discharged without absorption.

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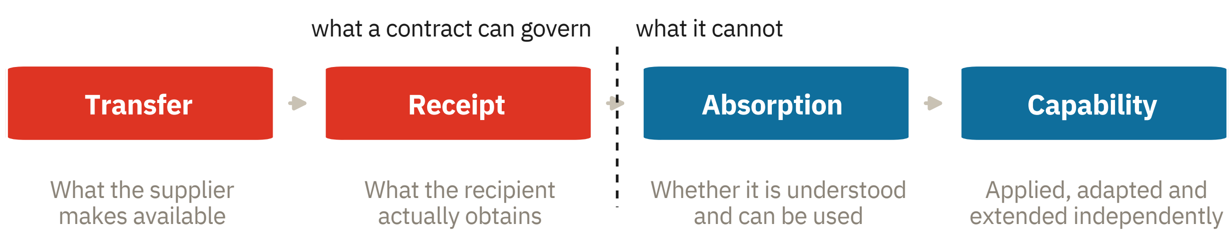
This report consequently distinguishes four stages that are often collapsed into one:

transfer → receipt → absorption → capability.

Transfer concerns what the supplier makes available. Receipt concerns what the recipient actually obtains. Absorption concerns whether the recipient understands, internalizes, and can use what it has obtained. Capability exists when that knowledge can be applied, adapted, and extended independently.

The four stages of a transfer

A contract ends two stages before capability begins



SECTION 2 — HOW INDIA HAS UNDERSTOOD TOT: DPP 2002 TO DRAFT DAP 2026

India's first consolidated Defense Procurement Procedure took effect on 30 December 2002, covering purchases flowing from the Defense Acquisition Council's "Buy" decision.[9] Within six months, in June 2003, its scope expanded to cover "Buy and Make"—purchase from a foreign vendor followed by licensed production under transferred technology. This initial step set the tone for many later policies. Technology transfer (ToT) entered Indian defense procurement not as a clearly defined or well-explained concept, but mainly as a procurement category. The procedure did not clearly explain what exactly was being transferred, which parts of the technology would move, or how deep that transfer would go. In practice, "Buy and Make through ToT" usually followed a simple step-by-step pattern, similar to the lower and middle levels of the ladder explained in Section 1. First, India would receive fully built systems from abroad. Then, India would assemble some parts from imported kits. Finally, production would shift to India under a license, using kits or components supplied by the foreign company.

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The inducement mechanism came three years later. In April 2005, the Kelkar Committee released a report called Towards Strengthening Self-Reliance in Defense Preparedness.[10] It suggested using "offsets" to address India's weak technology-transfer problem. Following this, DPP 2005 introduced India's first offset policy: any defense contract above ₹ 300 crore (about USD 34 million)[11] would require the foreign company to reinvest at least 30 percent of the contract value back into India.[12] In practice, the 2005 policy yielded no results, which contemporary assessments attributed to unclear guidelines and the absence of a designated implementing agency.[13] So, even though this system was created to improve technology transfer, it did not really get used at all in its early years and had to be changed before it could properly start working.

The proliferation of instruments: 2006–2013

What followed was a period of intense procedural elaboration that can be understood as India trying, step by step, to refine how defense procurement should work on paper. DPP 2006 reorganized the main procurement categories into clearer labels — Buy (Indian), Buy (Global), Buy and Make, and an expanded Make category — and, for the first time, introduced a formal requirement for indigenous content.[14] This meant that certain purchases had to include a minimum share of value created within India, set at 30% for the Buy (Indian) category. In simple terms, the government was now trying to ensure that not everything was simply imported, and that at least part of the production process involved Indian firms and facilities.

Two years later, DPP 2008 added another layer of complexity by introducing offset banking.[15] This allowed foreign vendors to “save up” credits from fulfilling offset obligations and use them later to meet future requirements. The Buy and Make (Indian) category came a year later, in the amendment to DPP 2008 notified on 2 November 2009. However, one of the most revealing decisions in this period was what the policy explicitly refused: it would not allow ToT to count as a way of fulfilling offset obligations.[16] The Ministry of Defense at the time reasoned that simply transferring technology on paper would not automatically benefit Indian companies in a meaningful way. The November 2009 amendment and DPP 2011 followed, each adjusting the same machinery without altering what was being transferred.

This position changed significantly in the revised Defense Offset Guidelines of August 2012. In this version, the government reversed its earlier stance and allowed both Transfer of Technology and transfer of equipment to count as valid ways of meeting offset obligations.[17] Importantly, it expanded the list of eligible recipients to include DRDO and other government institutions, meaning that public research bodies could now directly receive offset-linked benefits. On this report’s reading, the 2012 mechanism comes closer than anything else in the policy record to addressing the absorption problem directly. In theory, this was the exact point where the gap between “getting technology” and “being able to use it effectively” could have been tested in a structured way. As the later sections will show, however, what actually happened with this mechanism tells a very different story.

DPP 2013 introduced a strict order of preference for how different types of procurement should be considered. The sequence was clear: Buy (Indian) first, followed by Buy and Make (Indian), then Make, then Buy and Make with Transfer of Technology, and finally Buy (Global) as the least preferred option.[18] If officials chose a lower-ranked option, they had to provide a written justification explaining why they did not use a more preferred category. On the surface, this looked like a strong step toward encouraging indigenization, since it formally pushed decision-makers to prefer domestic options over foreign ones.

However, a closer look at this hierarchy reveals a subtler issue. The preference order ranks where the product comes from, not how much knowledge is actually transferred or how deep that knowledge goes. For example, a Buy (Indian) purchase could still involve a system fully designed abroad but assembled in India, yet it would rank higher than a Buy and Make arrangement that includes some level of technology transfer. In other words, the system prioritizes the label of “Indian content” over the substance of technological learning. Even more importantly, none of the categories that involve a foreign supplier oblige that supplier to hand over design knowledge. They can be satisfied entirely through production and assembly activities.

Make in India codified: 2016–2020

DPP 2016, built on the Dhirendra Singh Committee's recommendations, created the category that has since sat atop the preference order: Buy (Indian – IDDM), covering products indigenously designed, developed and manufactured with at least 40 percent indigenous content, or 60 percent where the design was not indigenous.[19]

The period's second experiment was the Strategic Partnership Model, promulgated as Chapter VII in May 2017 on the recommendations of the Aatre Task Force.[20] One private Indian strategic partner per segment (fighter aircraft, helicopters, submarines, armored fighting vehicles) paired with a foreign OEM obliged to transfer technology and hand-hold the partner's capability development. As of August 2026, no Strategic Partnership project had reached a production contract. The P-75I submarine program, the furthest advanced, was still awaiting Cabinet Committee on Security clearance in August 2026, nine years after the model was approved.[21]

Then, in DAP 2020, offset obligations were removed from all inter-governmental agreements, government-to-government deals and ab initio single-vendor cases surviving only in multi-vendor competitive tenders.[22] The Director General (Acquisition), Apurva Chandra, stated the reason publicly when the procedure was released: “No offset contract has led to transfer of technology into the country.”[23]

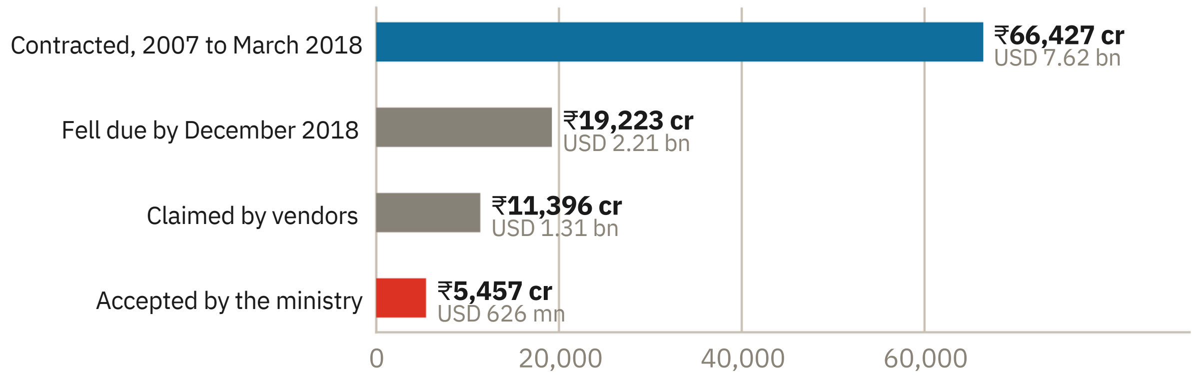
The audit behind the retreat

The Comptroller and Auditor General (CAG) of India conducted a detailed review of defense offset contracts in its performance audit report (Report No. 20 of 2019, tabled in September 2020). The report examined the entire offset program from 2007 to March 2018, covering 46 contracts with total obligations worth ₹ 66,427 crore (about USD 7.62 billion). Of the ₹ 19,223 crore (about USD 2.21 billion) due by December 2018, companies claimed to have completed ₹ 11,396 crore (about USD 1.31 billion) worth of obligations, but the government accepted only ₹ 5,457 crore (about USD 626 million). This means that less than half of the claimed amount was actually approved,[24] and the accepted sum was about 28 percent of what had fallen due by December 2018, or about 8 percent of the full contracted obligation. The audit also found that nearly 90 percent of offset value was contracted through the simplest route, direct purchase of goods and services, of which only about 36percent had actually been claimed, rather than through technology transfer. Most importantly for this report, the CAG did not find a single case in which a foreign vendor had transferred high technology to Indian industry. On the Rafale offset, DRDO had sought technical assistance for the Kaveri engine and the vendor had not confirmed that it would be provided.

Indian defense offsets, 2007 to March 2018

Of everything contracted, 8 percent was accepted

Indian defense offsets, 46 contracts, ₹ crore



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Dollar values at ₹87.16, the 2025 average.

Source: Comptroller and Auditor General of India, Report No. 20 of 2019, Management of Defence Offsets, as reported in the secondary literature.

Parliamentary scrutiny had anticipated the result. The Standing Committee on Defense's 33rd Report, in December 2008 — three years into the offset era — had already flagged poor technology transfer by foreign companies and, more damningly, the absence of any scientific system for assessing the level of indigenization actually achieved.[25] That second observation, largely unremarked at the time, is the precise institutional gap this report's thesis names.

The audit record extends to the flagship licensed-production program. The CAG's examination of Su-30MKI manufacture (Report No. 35 of 2014) found indigenization had not proceeded as envisaged.[26] A Ministry of Defense review reported in October 2018 put a Russian-built aircraft at ₹269.77 crore against ₹417.69 crore built by HAL, about 55 percent more. The Minister of State for Defense gave the same comparison in a parliamentary reply as about USD 40 million against about USD 62 million, which is those rupee figures at the exchange rate of the day; at the 2025 average they are about USD 31 million and about USD 48 million.[27] The audit itself records the project cost rising from ₹22,122.78 crore to ₹39,605.95 crore (about USD 2.54 billion to about USD 4.54 billion), an increase of 79 percent, with dependence on Russian raw materials and proprietary components persisting two decades into the program.

“Owned by India”: The draft DAP 2026

The draft Defense Acquisition Procedure (DAP) 2026, released in February 2026, is expected to replace DAP 2020, though it is not yet officially in force. It marks a shift from “Make in India” to “Owned by India,” meaning Indian firms should control key technologies like design, software, and source code. It also increases indigenous content requirements and introduces new rules like Technology Readiness Levels. Notably, offsets are largely removed.

This is a major change because it focuses on knowledge ownership, not just production. However, it still does not clearly assign responsibility for how this knowledge will be absorbed or used effectively. So, while the draft improves control over technology, it still lacks a system to ensure real learning and capability building.

The procurement record, 2002 to 2026

Nine procurement procedures in twenty-four years

What each instrument did about transfer of technology

Blue: an instrument was added. Red: the treatment of ToT was reversed. Grey: machinery adjusted. Positions are to scale on the year axis.

What the policy record shows

Three key findings come from the policy documents.

First, “Transfer of Technology” is never clearly defined across nine defense procurement procedures over twenty-four years. It is treated more like a label in contracts than a real technical process. As a result, the system does not clearly separate simple manufacturing knowledge from deeper design knowledge, which limits understanding of what is actually being transferred.

Second, India has moved up in the technology ladder but not consistently. Although policies emphasized self-reliance and advanced capability, most deals still focused on licensed production, where India assembles or manufactures foreign-designed systems. The main change was increasing local content, not gaining real design control. The Strategic Partnership Model and later reforms tried to go deeper, but results were limited or untested. Where programs did climb, as Section 4 shows for BrahMos and, in part, for the Su-30MKI, they did so through arrangements that were not conventional licensed production.

Third, no clear system ensures technology absorption. Policies encourage transfer but do not assign responsibility for learning or measuring whether knowledge is actually absorbed. As a result, India improved procurement rules but not learning outcomes.

> Policies encourage transfer but do not assign responsibility for learning or measuring whether knowledge is actually absorbed.

SECTION 3 — THE FRAMEWORK: ENABLERS AND BARRIERS ON BOTH SIDES OF THE TRANSFER

Section 2 demonstrates a persistent practice of contracting for transfer without contracting for absorption; and the framework below explains why absorption cannot be contracted for in the first place. Every technology transfer has two sides. On the receiving side is absorptive capacity. In Wesley Cohen and Daniel Levinthal's canonical formulation ('Absorptive Capacity: A New Perspective on Learning and Innovation,' 1990), this is the ability to recognize the value of new external knowledge, assimilate it, and apply it.[28] Importantly, that ability depends partly on the recipient's prior related knowledge. A recipient cannot simply purchase absorptive capacity when a technology arrives because much of what determines whether it can understand and exploit the technology has been accumulated beforehand.

> A recipient cannot simply purchase absorptive capacity when a technology arrives because much of what determines whether it can understand and exploit the technology has been accumulated beforehand.

On the supplying side, this report uses Lichtenthaler and Lichtenthaler's term desorptive capability to describe the supplier's ability to identify, codify, package, and teach technology outward.[29] Desorptive capability, however, should be distinguished from willingness to transfer. A supplier may possess extensive knowledge and the ability to teach it while having little commercial or strategic incentive to disclose. Conversely, a supplier may be willing to assist but lack the organizational machinery required to transfer tacit knowledge.

The two sides are not symmetrical. The supplier side contains a volitional element that the recipient side lacks: a supplier decides how much to disclose, whereas a recipient cannot decide to have accumulated prior knowledge it does not have. Export controls and political restrictions can intervene before either side's willingness becomes relevant. The outcome is consequently not determined by the contract alone. Transfer outcomes are therefore an interaction and not a purchase.

The comparative record used in this report identifies five broad clusters of conditions on each side.

The supplier chooses. The recipient cannot choose what it already knows.

Five clusters of conditions on each side of a technology transfer

THE SUPPLIER SIDE	THE RECIPIENT SIDE
What the supplier can and will give	What the recipient can take in and keep
1 **Desorptive capability** Whether it can codify, document and teach what it knows, and has done so before	1 **Absorptive capacity** The prior technological baseline against which the new knowledge is received
2 **Transfer willingness** Whether it has any incentive to disclose more than the minimum production needs	2 **Workforce capability and retention** Engineering depth, and keeping the people who acquire tacit knowledge
3 **Export-control releasability** Whether its own government will permit the technology to be released at all	3 **R&D ecosystem** Institutions able to adapt and carry the technology past the production run
4 **Transfer execution** The quality and duration of engineering interaction, training and liaison	4 **Financial commitment** Sustained money for development, testing and iteration, not only for production
5 **Supply-chain assistance** Help in building the local firms, tooling and quality systems to reproduce it	5 **Program management and continuity** Stable objectives, milestones and memory across leadership and personnel change

> These conditions do not operate independently. A strong supplier can compensate for some recipient-side weakness through intensive training and engineering support, and a strong recipient can extract more from a constrained transfer than a weaker one. The same transfer package can produce very different results in different recipients.

These factors do not operate independently. A strong supplier can compensate for some recipient-side weaknesses through intensive training and engineering support; a strong recipient can extract more value from a constrained transfer than a less capable recipient. But neither side can be reduced to the other. The same transfer package can therefore produce substantially different results in different recipients.

The contractibility sort

The next question is whether procurement contracts can actually secure these conditions. This report divides them into three categories: directly contractible, partially contractible and fundamentally non-contractible.

Directly contractible factors are those that can be specified, delivered, and reasonably verified. These include the scope of documentation, license terms, physical equipment and tooling, training hours, indigenous-content percentages, IP assignments, source-code access, delivery schedules and penalty provisions.

Partially contractible factors can be specified but cannot be guaranteed by specification alone. For example, training can be measured in hours and staff, but not in quality or depth of learning. Liaison systems can be set up, but trust and openness cannot be enforced.

> Liaison systems can be set up, but trust and openness cannot be enforced.

The third category consists of fundamentally non-contractible conditions. These include the recipient's prior technological baseline, the ability to absorb tacit knowledge, workforce retention across programs lasting decades, the supplier's underlying incentive to create a future competitor, accumulated inter-institutional trust, the existence of a mature R&D ecosystem, and institutional continuity across leadership and program changes.

What a procurement contract can and cannot secure

Directly contractible	Partially contractible	Fundamentally non-contractible
Documentation scope and license terms (S)	Training investment — hours specifiable, quality not (S)	Recipient's prior technological baseline (D)
Deliverable hardware, tooling and test equipment (S)	Export releasability — vendor commitment, government decision (S)	Tacit-knowledge absorption (D)
Indigenous-content thresholds (D)	Supply-chain assistance and MSME development (S)	Workforce retention across program decades (D)
IP assignment and source-code access rights (S)	Industrial and cyber-security frameworks (S/D)	Supplier's incentive to create a competitor (S)
Offset obligations and penalty clauses (S)	Liaison and technical-interaction mechanisms (S/D)	Multi-decade inter-institutional trust (S/D)
Delivery schedules and milestones (S)	Scheduling, work plans and local-production planning (D)	R&D ecosystem capable of carrying knowledge forward (D)

(S) marks a condition that sits on the supplier side, (D) one on the recipient side, and (S/D) one that sits on both.

Directly contractible	Partially contractible	Fundamentally non-contractible
		Institutional continuity and a durable absorption mandate (D)
		Geopolitical alignment lasting beyond the production run (S/D)

(S) marks a condition that sits on the supplier side, (D) one on the recipient side, and (S/D) one that sits on both.

Comparative cases

The comparative cases illustrate how the two sides interact. Where high supplier desorption meets high recipient absorption, transfer can become capability. South Korea's experience provides the clearest example in the source record. The country moved from licensed production and technology acquisition through programs such as the KF-16 toward increasingly sophisticated indigenous development. Substantial state investment, engineering depth, and accumulated industrial experience supported it.

The US-Japan FS-X/F-2 program demonstrates a different point. The relationship was politically contentious and access to some technologies remained restricted, but Japan entered the program with a deep industrial and technological base and extensive prior experience with US licensing arrangements. Liaison mechanisms and sustained technical interaction allowed substantial learning despite restrictions. A high recipient baseline therefore altered the value of what was made available.

The reverse combination — high supplier desorption but weak recipient absorption — produces a different outcome. Indian licensed-production programs discussed in Section 4 illustrate the problem, where the technology was made available, but the receiving organization did not convert it into independent design capability.

Where supplier desorption is low, recipient readiness can only partially compensate. Export controls and proprietary restrictions can prevent access to the knowledge required for genuine adaptation. Two cases illustrate this boundary. Japanese industrial capacity did not remove all restrictions on sensitive US technologies in the FS-X program. Türkiye’s Altay tank is the sharper instance: Hyundai Rotem provided design assistance from 2008, but a German arms embargo in 2018 cut off the MTU engine and RENK transmission after five powerpacks had been delivered, halting the program for years. Türkiye substituted a Korean powerpack, began serial production in late 2025, and is developing an indigenous powerpack, which suggests the binding constraint was releasability rather than absorption.[30] A capable recipient can extract considerable value from constrained access, but it cannot absorb knowledge that it is never permitted to receive.

Finally, where both sides are weak, the result is durable dependence. The Indian experience with several foreign-origin defense programs illustrates this condition more closely than any single case can capture. Licensed production may proceed, sometimes at substantial scale, while critical components, proprietary inputs, design authority or upgrade permissions remain external. The result is not zero capability; India can and does acquire significant manufacturing and maintenance capability. The problem is that production-level capability does not consistently translate into independent authority at the design level.

The framework can now be reduced to two master variables: supplier desorption and recipient absorption.

Supplier desorption against recipient absorption

Two variables account for the four outcomes

	Recipient absorption: HIGH	Recipient absorption: LOW
Supplier desorption: HIGH	**Capability transfer** Knowledge is made available and converted into domestic capability; the recipient moves up the ladder. *US–Korea: KF-16 → F414 → KF-21*	**Manufacture without learning** Technology is genuinely transferred but not converted into independent capability. Localization rises without ascent. *India: Su-30MKI*
Supplier desorption: LOW	**Blocked ascent** The recipient can learn, but access to critical knowledge is restricted by releasability, IP or supplier incentive. *US–Japan FS-X · Türkiye: Altay*	**Durable dependence** The recipient stays dependent for critical knowledge and its own capacity to absorb and extend is weak. *Hungary under Soviet control · several Indian programs*

India is closer to the low-desorption/low-absorption quadrant. This is not because India lacks absorptive capacity. Its record in missiles, shipbuilding, space-related technologies, electronics, and selected defense-production programs shows it can absorb and extend complex technologies under favorable conditions. Nor is supplier behavior uniform. Russia, the United States, France, Israel, South Korea and other partners have differed considerably in what they have been willing and able to transfer.

The more specific claim is that in many of the major procurement systems examined in this report, India often received limited access to the most important design knowledge, while its own institutions did not always have the long-term stability, technical foundation, or clear mandate needed to turn production experience into fully independent design capability. That diagnosis also explains why contractual reform alone has produced limited returns.

The K9 Vajra experience is useful precisely because it provides a potential counterexample. A high-desorption partner combined with a capable Indian private-sector production organization produced deeper localization and wider learning than earlier licensed-production programs, without producing design authority. L&T reported more than 80 percent indigenous work packages and above 50 percent indigenization by value on the first hundred guns, and the Hazira workforce and supplier base carried into the Zorawar light tank. The follow-on order signed in December 2024 nonetheless routed a further contract worth about USD 253 million back to Hanwha, the clearest available indication of where design and core-element authority still sits.[31] The GE F414 arrangement, still unsigned as of mid-2026, provides a forward test: the relevant question is not simply whether India receives the promised technology, but whether the receiving ecosystem can convert that access into independent engineering and future design capability.

The framework therefore changes the unit of analysis. The relevant question is whether the supplier possesses the capability and incentive to transmit the relevant knowledge, whether the recipient possesses the conditions required to absorb it, and whether the contract successfully connects the two.

SECTION 4 — FROM TECHNOLOGY TRANSFER TO TECHNOLOGICAL CAPABILITY

The earlier sections examined what India's procurement system contracts for. This section shifts the focus. The procurement process exists to acquire weapons, and technology transfer is only one of its objects. Section 3 therefore judged the system against a purpose it shares with others, not its only purpose. The key question is what happens to the technology after India acquires it, and which institutions help turn it into something India can use again in the future. To understand this, we need to follow the technology itself, not just the buying process.

The Technology-to-Capability Chain

Five analytically distinct stages lie between a foreign technology and an Indian capability.

Access asks whether India can obtain the technology at all. Is it releasable, export-controlled or proprietary? Does the supplier have an incentive to disclose it? Does the bilateral relationship support the request?

Transfer asks what actually moves: documentation, tooling, processes, training, design data, source code, IP.

Assimilation asks whether the recipient internalizes what it receives: can Indian engineers manufacture to standard, localize components, sustain quality, troubleshoot problems — and, at a deeper level, understand what they are building?

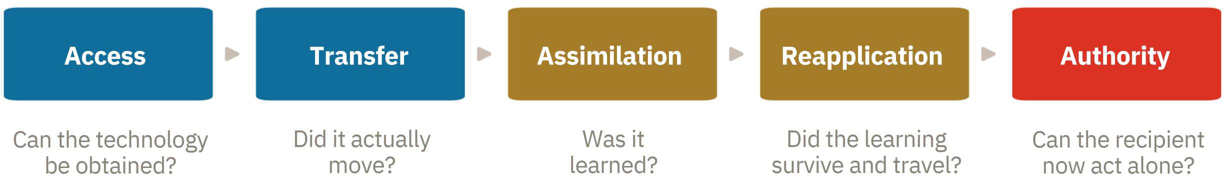
Reapplication asks whether the learning survives the program and travels: can knowledge acquired on Program A be used on Program B?

Authority asks whether the recipient can now act independently on the technology, along an ascending scale: **maintain → manufacture → modify → upgrade → redesign → develop.**

In other words, Access asks whether technology can be obtained. Transfer asks whether it moved. Assimilation asks whether it was learned. Reapplication asks whether the learning survived and traveled. Authority asks whether the recipient can now act independently.

The technology-to-capability chain

Five stages lie between a foreign technology and an Indian capability



Authority is a scale, not a state

Institutional ownership of the technology-to-capability chain

Stage	Core question	Principal Indian actors	Institutional position
Access	Can India obtain the technology?	MEA, MoD/DDP, Defense Acquisition Council, supplier government	Owned — dense diplomatic and procedural architecture
Transfer	What reaches India?	Acquisition Wing, contract, OEM, production agency	Owned — extensive contractual machinery
Assimilation	Is it internalized within the program?	Production agencies, HAL, AVNL, L&T and others; DRDO where relevant	Partially owned — program-level learning exists, but production remains the principal mandate
Reapplication	Does learning survive and travel?	—	No clear end-to-end owner — no common institutional mandate, budget line or performance metric
Authority	Can India act independently?	DRDO laboratories, ADA, GTRE, private-sector design organizations and others	Distributed — design authority exists, but is not systematically connected to knowledge accumulated in foreign-origin production programs

India operates an elaborate system for acquiring/transferring technology, and separate institutions for indigenous development, but no comparably coherent system governing the transition between the two. The gap is most visible at the reapplication stage, which requires knowledge to escape the program in which it was acquired and be used in others. No single institution is clearly responsible for ensuring that knowledge acquired under one foreign-origin program becomes an input into the next indigenous program.

Four programs on the Technology-to-Capability Chain, and one forward look

The weakness is not in transfer; it is in what happens after it

	Access	Transfer	Assimilation	Reapplication	Authority
T-90S Bhishma	● selected	◐ restricted	● production	○ weak	○
Su-30MKI	●	◐ deep license	● production	◐ sustainment	◐ subsystem
K9 Vajra-T	●	●	● manufacture	◐ ecosystem	○
BrahMos (control case)	● joint dev.	— co-generation	●	●	◐ shared
GE F414 (forward look)	●	— in negotiation	?	?	?

Filled: demonstrated by the evidence. Half-filled: partial or bounded. Open: evidence that it was not achieved.
Dash: not applicable to a joint development. ?: not yet knowable.

T-90S Bhishma

The T-90S illustrates the distinction between production assimilation and technological authority. Access was itself selective. India reduced the scope of the system it acquired, including the Shtora protection system and the number of Invar missiles, to contain costs. Transfer was subsequently constrained at some of the most technologically important points. Indian officials reported that technologies related to the tank's main gun and a key section of the turret armor were not transferred, while the Invar missiles supplied proved unusable and were returned to Russia.[32] Assimilation, however, was genuine. India went on to produce the tank domestically at scale, and AVNL stated in 2026 that the 1000th India-built T-90 had been delivered from Avadi, with around 80 percent indigenous content including a fully localized engine.[33] The more consequential question is what happened to that knowledge afterward.

The available record provides little evidence that two decades of T-90 production created a broader indigenous main-battle-tank design ecosystem at Avadi. The Arjun remained on a separate DRDO development track, while the Zorawar emerged through a different L&T-DRDO industrial configuration. Even ammunition indigenization has involved a fresh Russian license rather than an independently designed successor technology.

T-90 “Bhishma” at India’s annual Republic Day Parade
Source: AirPowerAsia

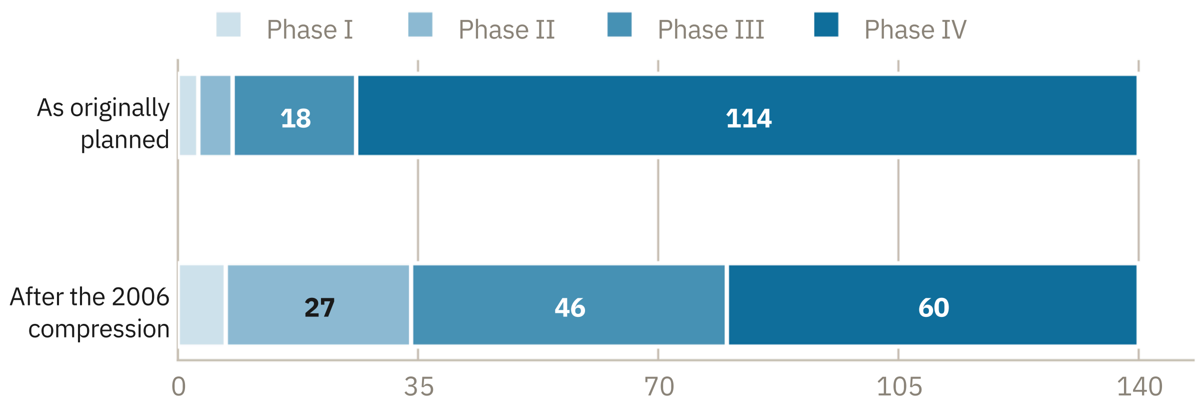
Su-30MKI

The production program created substantial Indian manufacturing capability. Yet the CAG record documented delays in license documentation, extensive drawing amendments, difficulties in achieving planned indigenization, and continued dependence on Russian-origin inputs. In March 2006, the Ministry compressed the delivery schedule to complete all 140 aircraft by 2014-15 instead of 2017-18, and changed the phase-wise composition to do it. Fully indigenized Phase IV aircraft fell from 114 to 60, while fully imported Phase I and II aircraft rose from 8 to 34. However, the program faced a conflict between the immediate requirement to deliver aircraft and the longer-term objective of deepening indigenous production. In effect, the planned production-localization path was sacrificed for faster delivery. There is evidence of limited reapplication. At Koraput, engine overhaul capability and test facilities improved beyond the original production role, showing that some skills and infrastructure persisted after the program ended. However, this is mainly sustainment reapplication, meaning it helps maintain and service existing systems, rather than showing that this knowledge moved into designing new Indian fighter aircraft.

The Su-30MKI production plan, before and after the 2006 compression

Fully indigenized aircraft fell from 114 to 60

Su-30MKI production plan, 140 aircraft, by phase



Phase I and II arrive fully built; Phase IV is manufactured in India from raw material.
Source: CAG Report No. 35 of 2014, para 9.1.2.3 and Table 63.

There is a counter-example as well. HAL independently integrated the 2.5-tonne BrahMos missile onto the Su-30MKI without the involvement of the foreign OEM.[34] It shows that HAL held enough integration authority over the airframe to carry out a major weapons fit without the original designer.

K9 Vajra-T

The hundredth system was delivered in February 2021, ahead of schedule, with L&T reporting more than 80 percent indigenous work packages and above 50 percent indigenization by value at program level. The program resulted in a domestic production ecosystem around a sophisticated artillery system. The same Hazira industrial complex, workforce and supplier ecosystem subsequently contributed to the DRDO–L&T Zorawar light tank prototype, rolled out in less than twenty-four months from sanction.[35] This is genuine evidence of organizational and ecosystem reapplication. Much of the authority, especially over design and core elements, remains with Hanwha. But K9 appears to have progressed further along the chain than many earlier licensed-production programs.

Indian Army's K9 Vajra howitzer deployed along the LAC
Source: ANI

BrahMos

BrahMos is not a conventional ToT program, but some analysis and learnings can be drawn from it, because Indian engineers were embedded in knowledge creation rather than being introduced after the technology had already matured elsewhere. The subsequent record provides evidence of reapplication. The air-launched BrahMos required substantial Indian integration and adaptation work, while subsequent variants have extended the technology into new configurations. The newer BrahMos-NG effort further demonstrates an attempt to carry accumulated knowledge into a successor system. Authority, however, remains shared with Russia.

An IAF Su-30MKI carrying a BrahMos missile
Source: X

What the four programs show together

The recurring weakness appears at the transition from program-specific assimilation to broader reapplication. India's absorption is therefore often production-specific rather than capable of generalizing across programs. What is learned can remain embedded in the production line, the factory, the supplier network, or the individual program without reliably becoming an input into the next generation of indigenous design. BrahMos, and the Su-30MKI in a narrower way, show that the chain can be climbed. The K9 Vajra-T shows how far a program can travel on assimilation and reapplication while authority stays with the supplier.

The Srijan portal provides an aggregate view of this problem's persistence. Created in 2020 to identify items previously imported by the defense public sector for possible domestic manufacture, the portal listed more than 38,000 items as of February 2025, of which more than 14,000 had been indigenized.[36] Srijan is an important indigenization instrument. A deeper look reveals that decades of domestic production have not eliminated dependence on foreign inputs across thousands of components. Localizing an imported component through a production mandate may reduce dependence on that component. It does not necessarily demonstrate that India has acquired the technology that generated it.

SECTION 5 — FINDINGS, LEARNING AND ROAD AHEAD

This report began with a simple puzzle: India has spent six decades producing foreign-designed weapons under license, yet this large volume of production has not produced a comparable level of independent design capability. The argument advanced here is that part of the explanation lies in how India has understood technology transfer. It has largely treated ToT as something that can be negotiated and delivered through a contract. But a contract can specify what technology is handed over. It cannot by itself ensure that Indian engineers and the R&D ecosystem understand it, retain the knowledge, improve it, or use it in another program.

Five findings

The analysis in the previous sections leads to five main findings.

Technology transfer is not one thing. It can range from assembling imported parts to manufacturing components, learning production processes, participating in development, and, ultimately, being able to independently design and modify a system. Indian policy has often used “technology transfer/Transfer of Technology” as a broad term without clearly distinguishing between these different levels.

More local production has not necessarily meant more technological capability. Successive procurement reforms have increased indigenous-content requirements and encouraged greater domestic production. But a higher share of a weapon being manufactured in India does not automatically mean that India controls the technology behind it. A program can become increasingly Indian in terms of where the components are made while remaining dependent on a foreign supplier for critical designs, upgrades, or technologies.

> A program can become increasingly Indian in terms of where the components are made while remaining dependent on a foreign supplier for critical designs, upgrades, or technologies.

Many of the factors that determine whether technology is actually absorbed lie outside the contract. India needs engineers with the right technical background, institutions capable of learning from foreign partners, long-term interaction between Indian and foreign engineers, retention of trained personnel, and an R&D system that can build on what has been learned. A contract can support these things, but it cannot create them on its own. This is where the distinction between receiving technology and absorbing it becomes essential.

The main weakness appears after production begins. The cases examined in Section 4 show that India can and does learn to manufacture foreign-designed systems. The problem is what happens to that knowledge afterward. In many cases, knowledge remains tied to the particular factory, production line, or weapon for which it was acquired. It does not consistently move into the next Indian-designed platform. India's absorption is therefore often program-specific rather than cumulative.

The failure of knowledge to travel between programs (Finding 4) occurs because no authority is tasked with making it travel. Different parts of the process have different owners. Acquisition authorities negotiate contracts. Production agencies manufacture equipment. DRDO and other design organizations develop indigenous systems. But no one has clear responsibility for ensuring that knowledge acquired in one program carries over to another. This helps explain why India can accumulate decades of production experience without necessarily accumulating the same level of design experience.

> The failure of knowledge to travel between programs (Finding 4) occurs because no authority is tasked with making it travel.

What this means for policy

This report is primarily diagnostic. A later report in this series will deal with the detailed policy recommendations. But four implications follow directly from the findings.

First, someone needs to be responsible for technology absorption. India has organizations responsible for buying equipment, producing it and designing indigenous systems. A clear institutional mechanism needs to connect these activities. Its exact form can be debated. What matters is that someone should be responsible for asking whether knowledge acquired through one program is being retained and used in the next.

Second, India needs to measure absorption rather than simply measuring localization. Indigenous content remains useful, but it should not be treated as a substitute for technological capability. India should also ask what its engineers can now do independently, which technologies have moved into other programs, whether it has retained trained personnel, and whether the infrastructure created for one program is being used for another.

Third, where the objective is technological capability, India should seek deeper participation rather than simply deeper transfer. Licensed production will continue to make sense when the immediate objective is to manufacture and maintain a weapon in India. But if the objective is to develop independent design capability, the evidence points to greater involvement in the development process itself, through co-development, joint engineering, and sustained interaction between Indian and foreign design teams. That evidence is thin, and the report should say so: BrahMos is the clearest case, and it is also the least representative, a joint development rather than a transfer. The K9 Vajra-T is the more instructive one, because it shows how much can be achieved short of design participation and exactly where that route stops.

Fourth, and most cheaply, the procurement procedure should stop using transfer of technology as a single undifferentiated term. Distinguishing assembly, licensed manufacture, process transfer, design participation and design authority inside the procedure itself would let a contract state which of them it is buying, and would let an auditor say whether it was delivered.

The series ahead

This report is the first in a series because the problem it identifies cannot be answered through one set of examples. The subsequent reports will examine the individual parts of the argument in greater detail. Some will look at the supplier side: what foreign companies and governments are willing to transfer, what they are reluctant to transfer, and why. Others will examine the Indian side: whether Indian organizations have the engineers, infrastructure and R&D capacity needed to absorb complex technologies. The series will also look more closely at reapplication. Other reports will examine co-development and deeper industrial partnerships, using cases such as BrahMos to understand why some arrangements have produced more substantial technological learning than conventional licensed production.

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[28] Wesley M. Cohen and Daniel A. Levinthal, “Absorptive Capacity: A New Perspective on Learning and Innovation”, Administrative Science Quarterly, vol. 35, no. 1, 1990, pp. 128–152.
[29] Ulrich Lichtenthaler and Eckhard Lichtenthaler, “A Capability-Based Framework for Open Innovation: Complementing Absorptive Capacity”, Journal of Management Studies, vol. 46, no. 8, 2009; and “Technology Transfer across Organizational Boundaries: Absorptive Capacity and Desorptive Capacity”, California Management Review, vol. 53, no. 1, Fall 2010, pp. 154–170.
[30] On the German embargo and the Korean powerpack, see European Security & Defence, “The long road to Altay”, July 2025, https://euro-sd.com/2025/07/articles/armament/45469/the-long-road-to-altay/ ; on serial production, Defence Security Asia, 2025.
[31] The Ministry signed the follow-on contract for 100 K9 Vajra-T with L&T on 20 December 2024 for ₹7,628.70 crore (about USD 875 million); Hanwha Aerospace announced a contract with L&T worth about USD 253 million in April 2025.
[32] Ajai Shukla, “T-90 tank: Technology transfer, supply of assemblies hit Russian stonewall”, 27 November 2011, https://www.ajaishukla.com/2011/11/t-90-tank-technology-transfer-supply-of.html
[33] “India produces 1,000th T-90 tank”, Militarnyi, https://militarnyi.com/en/news/india-produces-1-000th-t-90-tank/
[34] HAL’s Chairman and Managing Director, T. Suvarna Raju, described the work as follows: “This unique program was taken up by HAL as an indigenous challenge at its Nashik Division and the required data was generated without the assistance of OEM for the modification.” Defense Mirror, 27 June 2016, https://defensemirror.com/news/16446/BrahMos_Missile_Mounted_On_Su_30MKI_Without_Russian_Help__HAL_Chairm ; the OEM referred to is the Russian airframe designer
[35] “From K9 Vajra to Zorawar: why Hazira is India’s new armour hub”, Times Now, 18 Aug 2026, https://www.timesnownews.com/india/from-k9-vajra-to-zorawar-why-hazira-is-indias-new-armour-hub-article-154464984
[36] Press Information Bureau, Ministry of Defence, "Make in India Powers Defence Growth", 29 March 2025: "As of February 2025, over 38,000 items are available, with more than 14,000 successfully indigenised." https://www.pib.gov.in/PressReleasePage.aspx?PRID=2116612

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