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Policy Perspective

The business of defence: role of India's private sector

Summary

- Upgrading the country's military capabilities has become critical for India, in the context of the persistent border disputes with Pakistan and China, and the Chinese Navy's growing profile in the Indian Ocean region.

- The NDA government has acted expeditiously, clearing various long-pending demands of the Indian military for new weapons.

- Defence spending and investment will continue to increase as India fast-tracks its military modernisation; India is expected to spend more than $130 billion in the next decade on buying new weapons.

- Defence is included in the Modi government's 'Make in India' plans—with the objective of promoting domestic defence production and increasing the participation of private companies in big ticket production of submarines, helicopters, and aircraft.

- Foreign investment is critical: FDI in defence has been raised to 49% from the earlier cap of 26%. The focus will be on bringing capital and high technology to the industry.

- For immediate operational needs, imports will be necessary as evidenced by the outright purchase of Rafael aircraft from France in April 2015.

- But by 2020, India's component of arms imports—currently 60%—should be reduced to 30%, and India must shed its title of the world's largest arms importer.

- Policy changes are critical:

i. India needs a 'Defence White Paper' and the 2005 Kelkar Committee report on defence was the closest to being such a paper. It is a good time to make the report public—update it to a White Paper and implement its recommendations.

ii. Implement with rigour the Defence Procurement Procedure (DPP) 2013, which prioritises Indian equipment or equipment produced in India, over imported equipment.

iii. The Ministry of Defence, in consultation with the private and public sector, must:

a. Bring certainty to the defence procurement process and combat corruption by amending the DPP;

b. Define national technological priorities to leverage the private sector for meeting "jointness" in militaries (coordination between the armed forces) and for "network-centric warfare" capabilities;

c. Focus on private-sector led defence research and development (R&D), as is the trend worldwide;

d. Utilise the offsets arrangements smartly to enhance India's technological base.

Introduction

The government of Prime Minister Narendra Modi has pro-actively pursued India's agenda of modernising and indigenising its defence sector by clearing several long-pending demands of the Indian military for equipment.

Policy Perspectives from Gateway House give an overview of a global issue that has implications for India's policy-making and business community. Each perspective summarises the criticality of the issue, lists the dimensions to be considered for analysis, and outlines how a policy can be designed or executed.

India's rapidly-obsolescing military hardware has made this push imperative—the ageing of the hardware has been prominently highlighted by a string of naval accidents in the last two years and the rapidly depleting strength of the air force squadron, with the de-induction of old aircraft and delays in inducting replacements.

Externally, raging border disputes with China and Pakistan, and the growing presence of the Chinese Navy in the Indian Ocean region, continue to be threats that call for an updating of the Indian defence sector.

1. Current status: ambitious policies, dismal performance

1.1 Dominance of the public sector

Since Independence, India has made concerted efforts to promote indigenous defence production. Under the Industrial Policy Resolution of 1956, manufacturing of "Arms and ammunition and allied items of defence equipment" was to be an exclusive responsibility of the state—primarily because of the capital-intensive nature of the sector.[1]

This policy gave rise to nine Indian defence public sector units (DPSUs), including Hindustan Aeronautics Limited (HAL) and Bharat Electronics Limited (BEL). These DPSUs, along with 41 units of the Ordnance Factories Board (OFB), came to dominate India's defence sector. While the DPSUs and OFB engaged in defence manufacturing, to augment India's R&D capabilities the government set up the Defence Research and Development Organisation (DRDO) in 1958.

Despite their predominance, the performance of DPSUs and the OFB in meeting India's defence needs was mixed. They excelled in producing licensed versions of foreign weapons like MiG-21 jets, and T-72 and T-90 tanks, but they also became infamous for inefficient operations, cost over-runs, and missed deadlines. The DRDO faced serious challenges in indigenously developing equipment; this is exemplified by the Tejas Light Combat Aircraft and the Arjun tank—both of which took more than three decades for development. The organisation was often accused of overestimating India's technological abilities, thereby missing deadlines and escalating costs.[2]

1.2 Private sector restricted from playing a major role

In 2001, as part of economic liberalisation, the Department of Industrial Policy and Promotion, under a foreign direct investment (FDI) policy, opened the defence sector to private companies. The opening up allowed 100% participation by the Indian private sector and permitted FDI up to 26%, subject to licensing permits and security clearances.[3]

But stiff opposition from the DPSUs and the all-powerful bureaucracy in the Ministry of Defence (MoD) ensured that private companies were deliberately kept away from building and developing major platforms.

In 2004, the government appointed a committee headed by Vijay Kelkar, a former bureaucrat, to examine India's defence preparedness and recommend measures to enable greater involvement of the private sector. The committee submitted its report in two parts; the first part looked at achieving self-reliance in defence, while the second examined functioning of the DPSUs and OFB.[4]

These reports in their totality were never made public, and neither they were presented in Parliament. Only a few recommendations were made public, but the government did not give specifics about their implementation.[5]

From the private sector's point of view, the principal recommendations of the committee included: nominating private defence companies for Raksha Udyog Ratnas (RUR) status, which would allow them to be treated on a par with public sector defence companies; setting up a new professional agency for defence acquisition; pursuing an offsets policy; and providing defence R&D opportunities for the private and public sector through a 'Defence Technology Development Fund'.[6,7]

Among these, the proposal to grant RUR was scrapped by the MoD after the DPSUs and OFB opposed the provision,[8] while the technology development fund proposal never took off.

Consequently, the Indian private sector's share in defence production remained miniscule[9] and confined to building sub-systems such as rocket launchers, avionics, radars and sonars, and communications systems—all of which form parts of larger equipment.

1.3 International companies: limited participation

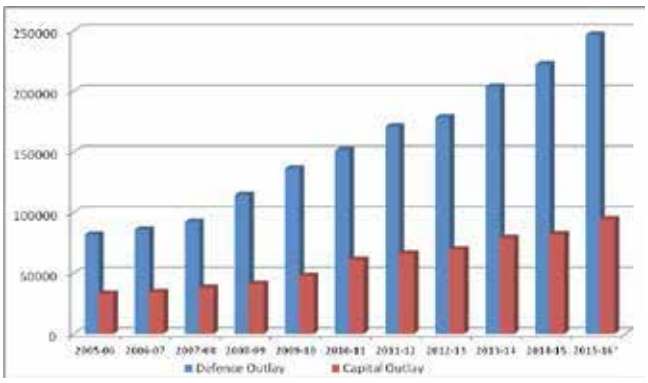
International defence companies, which could have brought capital and high technology to India, were not enthused by the 26% FDI on offer. Additionally, a restrictive regulatory framework, a complex business environment, a weak intellectual property rights (IPR) regime, and the protracted governmental decision-making process stymied their full participation.

As a result, India received FDI worth only Rs. 24.84 crores in the defence sector[10] between April 2000 to January 2015—this was a much smaller amount as compared to India's annual military spending (see Figure 1) and the overall FDI received during this period (see Figure 2).

1.4 Unrealised potential of the offsets policy

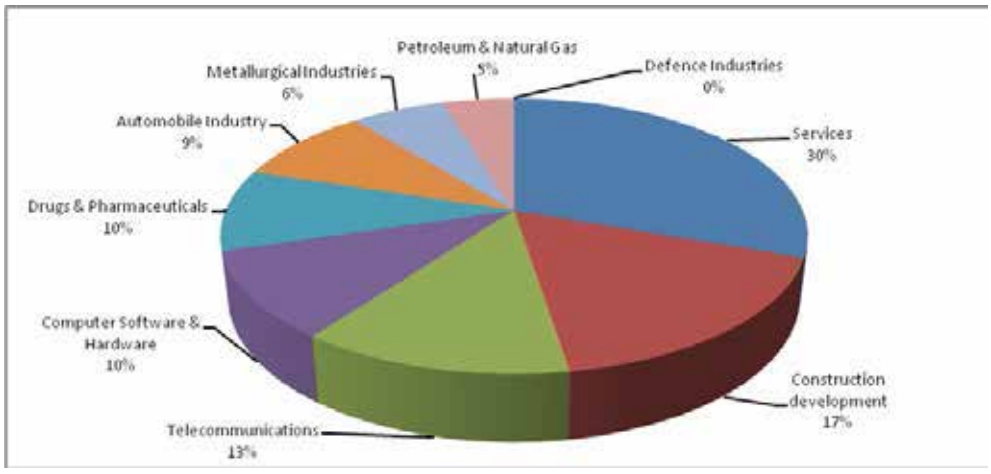
Currently, 60% of India's defence requirements are met through imported equipment.[11] However, the offsets policy, which has been linked to these imports, has not delivered.

Figure 1: India's defence budget and capital expenditure



Rs. in thousand crores
** Estimated*
Source: Ministry of Finance, Government of India

Figure 2: Sector-wise FDI equity inflows (April 2000-January 2015)



Source: Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, Government of India

First introduced in the Defence Procurement Procedure (DPP) 2005 as per the recommendation of the Kelkar Committee, it mandated that foreign defence vendors executing contracts worth Rs. 300 crores or more had to invest 30% of the total contract value in India's defence industry.[12] Figure 3 highlights the major developments in India's offsets policy.

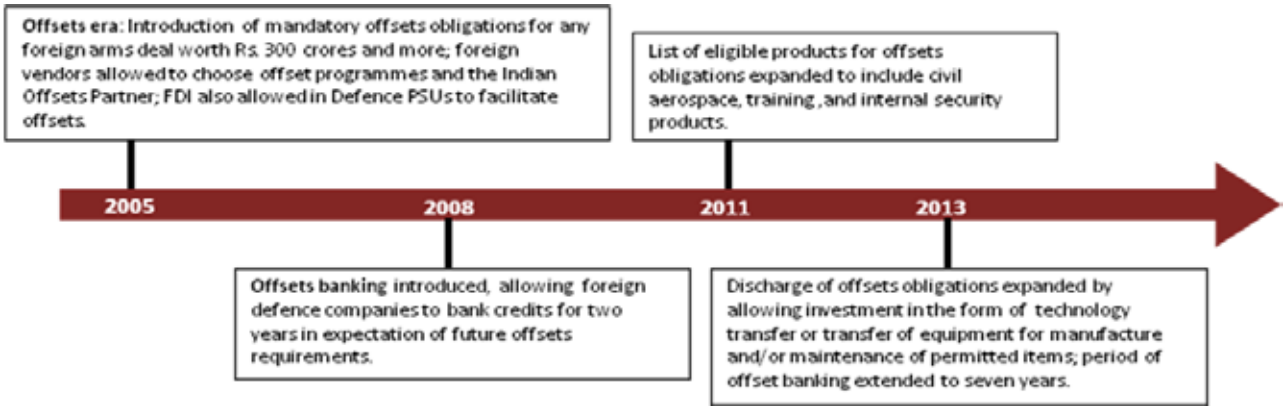
But India was unable to utilise offsets to develop the domestic defence industry. As against the MoD's estimates of $30 billion[13] of offsets opportunities, between 2005-2014 offsets contracts worth only $4.87 billion[14] were signed. The major area of offsets implementation was direct purchases and sub-contracting. These were easier to implement than investment in joint production or local R&D, which would have required more effort by the foreign companies.[15] Red tape and an inability to talk to the DPSUs, without a formal corridor of conversation being created, added to the problem.

India's record is in stark contrast to its strategic competitor China. Till a decade ago, China was in the same league of importers as India, but it has now emerged as the third largest arms exporter, accounting for 5% of global arms exports.[16] China achieved this by ending the monopoly of state enterprises, concentrating on R&D, and adopting a controversial path of "reverse engineering" of western and Russian equipment.[17]

If used properly, offsets can reduce a country's dependence on arms imports by opening up access to critical military technologies; this strengthens the domestic defence industry's R&D and progressively promotes local defence production. Cases in point are Israel, Brazil, and South Korea, which have benefitted immensely in the past by implementing various models of offsets to establish a strong local defence industrial base (see Table 9). These countries, even as they insisted on local defence production, focused on developing niche capabilities and emerged as defence exporters.

Table 1 and Table 2 enumerate what is produced in India and what is imported from abroad.

Figure 3: Evolution of India's offsets policy



Source: Based on Ministry of Defence data and Gateway House research

A larger problem is the powerful vested interests in the form of "middlemen", who are not interested in India's defence indigenisation project. Kickbacks from foreign arms deals reportedly serve as the single largest source of corruption in India—allegations of wrongdoing in the procurements of the Bofors artillery gun during the tenure of former prime minister Rajiv Gandhi in late the 1980s, and the AgustaWestland chopper deal in 2013, are prime examples.

The DPP-2013 requires foreign defence companies to provide details of the agents, technical consultants, and authorised vendors for marketing the defence equipment.[18] But this provision is half-baked as it does not elaborate on what are acceptable and unacceptable practices for these agents.

Table 1: Current domestic defence production

Service	Vendor/Manufacturer	Equipment produced	Associated entities
Strategic Forces Command	DRDO	Agni series of missiles; Prithvi series of missiles	Bharat Dynamics Limited
		Sagarika missile*	
Indian Army	BEL	Samyukta Electronic Warfare system; radar systems	Tata Power Strategic Engineering Division (SED) for Samyukta system
		Akash missile	DRDO, Bharat Dynamics Limited
	Heavy Vehicle Factory (HVF), Avadi (a part of OFB)	Arjun tanks; licensed production of T-90 tanks	DRDO
Indian Air Force	HAL	LCA, Advanced Light Helicopter (ALH); Rudra attack helicopter; licensed production of Sukhoi-30 MKI and Dornier aircraft; Chetak helicopters; Hawk jet trainers; upgrade of Jaguar aircraft	DRDO for LCA, ALH and Rudra helicopter
Indian Navy	Cochin Shipyard	Indigenous aircraft carrier	Millennium Aero Dynamics
	Mazagaon Dock Limited	Scorpène-class submarines, Kolkata and Vishakapatanam-class destroyers	
	HSL	Arihant nuclear submarine	L&T Shipbuilding, Walchandnagar Industries, Tata Group
	Garden Reach Shipbuilders & Engineers, Kolkata	Kamorta-class corvettes	
	Pipavav Defence and Offshore Engineering	Offshore patrol vessels	
	ABG Shipyard	Cadet training ships	
	Bharati Shipyard Limited	Interceptor boats for the Coast Guard	
Mixed users	DRDO	Brahmos cruise missiles	NPO Mashinostroeyenia
	OFB	Small arms; ammunition; rockets; military and armoured vehicles; armament for aircraft, helicopters and warships	

**Awaiting deployment*
Source: Gateway House research

Table 2: India's major arms imports

Service	Country	Vendor	Equipment imported
Indian Army	Germany	Diehl Remscheid	Tracks and accessories for Arjun tank
	Israel	Rafale Advanced Systems and Israel Aerospace Industries	Spyder mobile air defence system
		Elbit Systems	Fire control systems for T-72 tanks and BMP2 armoured vehicles; surveillance drones
	Poland	Polish Bumar	WZT-3 armoured vehicles
	United States	Raytheon	Firefinder AN-TPQ-37 weapon locating radars*
Indian Air Force	Brazil	Embraer	ERJ 145 aircraft
	France	Dassault Aviation	Mirage 2000 aircraft upgrade programme
		MBDA	Missile systems for Mirage 2000 upgrade
		Thales	Weapons systems integrator for Mirage 2000 upgrade
	Israel	Israel Aerospace Industries	Phalcon airborne early warning system; EL/M-2083 aerostat radars
	Russia	Mil Moscow Helicopter Plant; Kazan Helicopter Plant	Mi-17 V5 transport helicopter
		Russian Aircraft Corporation MiG	MiG-29 aircraft upgrade programme
		Sukhoi	Equipment for the Su-30 MKI aircraft
	Switzerland	Pilatus	PC-7 basic trainer aircraft
	Ukraine	Antonov	AN-32 transport aircraft upgrade programme
	United States	Boeing	C-17 transport aircraft*
		Lockheed Martin	C-130J transport aircraft*
		Pratt & Whitney	Engines for C-17 and C-130J aircraft
Indian Navy	Germany	ThyssenKrupp Marine Systems	Components for naval ships
	Israel	Rafale Advanced Systems	Barak-I missiles
	Ukraine	Zorya-Mashproekt	Gas turbine plants
	United States	Boeing	P-8I maritime patrol aircraft, Harpoon anti-ship missiles*
Mixed users	Germany	EADS	Components for the Dhruv helicopter
	Israel	Israel Aerospace Industries	Heron and Searcher UAVs
	Ukraine	Motor Sich	Helicopter engines
	United Kingdom	BAE Systems	Hawk Advanced Jet Trainer aircraft
	United States	Northrop Grumman	Radar and communication equipment

** Equipment sold by the U.S. to India under the Foreign Military Sales programme Source: Gateway House research*

The government has spoken about changing these DPP provisions and regularising the role of the "middlemen". No concrete steps have been taken yet on this front.

1.5 Import strategy: arms imports compensate for weak domestic production base

During the preceding five years, India has emerged as the world's largest arms importer, accounting for 15% of the global arms imports.[19] Despite the government's emphasis on domestic production, as the case of the purchase of Rafale aircraft from France for the Indian Air Force in April 2015 has shown, some high technology equipment will still need to be completely imported from abroad, at least in the foreseeable future, to fulfil the Indian military's immediate operational needs and to bridge gaps in domestic defence production (see Table 3 and Table 4).

This dependence also makes India susceptible to sanctions and technology denial regimes—such as the 'Strategic Export Controls' (SECs) which India witnessed after the 1974 and 1998 nuclear tests.

2. 'Make in India': attempting to achieve self-sufficiency in defence

Going forward, the government is hoping to shed the tag of being the world's largest arms importer by achieving 70% defence indigenisation by the end of this decade.[20]

Table 3: Cleared import proposals

Service	Country/ Region	Vendor	Equipment imported	Approximate cost
Indian Air Force	Europe	Airbus	Two A330 aircraft	Rs. 5113 crores
	France	Dassault Aviation	Rafale fighter jet	$4.25 billion
	Switzerland	Pilatus	38 PC-7 basic trainer aircraft	Rs. 2,900 crores
	United States	Boeing	15 Chinook CH-47 heavy-lift transport helicopters	Rs. 7000 crores
			22 AH-64E Apache attack helicopters	Rs. 8000 crores
		Lockheed Martin	1 C130J Hercules	Rs. 533 crores
Indian Navy	United States	United Technologies	16 multi-role helicopters	Rs. 1,800 crores

Source: Gateway House research

Table 4: India's imports backlog

Service	Equipment	Vendor	Approximate cost
Indian Army	66,000 Assault rifles	N.A.	Rs. 13,000 crores
Indian Air Force	6 Aerial tankers	Airbus	Rs. 8,500 crores
Indian Navy	12 US-2i amphibious aircraft	ShinMaywa	$1.65 billion

Source: Gateway House research

'Make in India' is an overarching programme for reviving the manufacturing sector, through which the government is encouraging businesses and tapping the potential of private defence companies to meet India's arms requirements. Specifically for the defence sector, the government has:

- Granted industrial licenses to 144 private companies for defence production and increased the initial validity of industrial licensing to three years;[21]
- Reviewed the FDI policy for the defence sector by raising the cap for composite foreign investment to 49% from 26%;[22] and
- De-licensed non-lethal and dual-use items by updating the 'Defence Products List'.[23]

Additionally, the Department of Defence Production of the MoD has announced a strategy for defence exports that aims to simplify the rules for export of military hardware by Indian enterprises.[24]If the potential of domestic manufacturing is realised fully, defence equipment can be the biggest exports from India, and the country can certainly go beyond the present mere Rs. 461 crores of defence exports.[25]

Complementing these measures, the Cabinet Committee on Security and the Defence Acquisition Council of the MoD have cleared proposals worth Rs. 225,000 crores for domestic production (see Table 5) since May 2014. Most of these orders have gone to the DPSUs, but at least three big ticket orders are expected to be netted by the private sector—the P75I submarine project, the light utility helicopters deal, and the project to replace the Avro transport aircraft fleet of the Indian Air Force.

Similarly, the production order for building four Landing Platform Docks has been split equally between Hindustan Shipyard Limited and a private shipyard, for which the government has requested proposals from Mumbai-based Pipavav, L&T, and ABG shipyards. Combined, these represent orders for more than Rs. 100,000 crores, but more significantly these will give an opportunity to private defence companies to produce major platforms for the Indian armed forces, unlike in the past. And more opportunities are awaiting the private sector with India expected to spend $130 billion in the next 7-8 years on buying new weapons.[26]

Since the actual awarding of many prospective contracts is some time away, the government must give an assurance to the private sector on certainty and transparency in these acquisitions, with stricter adherence to deadlines. In the past, businesses have suffered because of the ad-hoc functioning of the MoD. For instance, in the Future Infantry Combat Vehicle (FICV) project, in 2011, after inviting bids from the defence companies and finalising bidders, the MoD put the project in cold storage and instead decided to upgrade the existing fleet of BMP-2 combat vehicles of the Indian Army. This decision came after extensively testing the FICV prototypes from the OFB and three private companies—Mahindra Defence, Tata Group, and L&T, which had invested considerable time and money in the project, along with their foreign partners.

For producing existing platforms, pitching DPSUs against private companies for bagging a contract to produce equipment certainly makes sense; but in developing a new platform it is more useful to forge public-private collaboration.

This is easier said than done, as the DPSUs and the DRDO have been reluctant to cede space to private companies—the argument being that the private sector is guided by the profit motive and not by national interest. However, this is a specious argument, because the experience of public-private collaboration in the nuclear submarine project and the Samyukta electronic warfare system has been immensely beneficial for India. It therefore makes sense to leverage the experience and infrastructure of the DPSUs along with the manufacturing and managerial capabilities of the private sector.

3. The path to self-reliance

Surprisingly, the country's policy-makers have not yet comprehensively defined India's national priorities in the form of a 'Defence White Paper' or a 'National Security Strategy'. This lack of clarity has percolated to the indigenous defence production field.

So the foremost requirement for the government is to spell out its objectives and strategy for the defence sector. Now is an opportune time for the government to make public the Kelkar Committee's report and utilise its inputs in formulating a 'Defence White Paper'.

Table 5: Proposals for domestic production

Equipment	Weapon category	Vendor(s)	Approximate cost
Seven P17A stealth frigates	Ships	Mazgaon Docks; Garden Reach Shipbuilders and Engineers (GRSE)	Rs. 50,000 crores
Six P75I submarines	Submarines	N.A.*	Rs. 50,000 crores
Four Landing Platform Docks	Ships	Hindustan Shipyard Limited and a private shipyard*	Rs. 25,000 crores
Avro aircraft replacement programme	Aircraft	Tata-Airbus*	Rs 23,000 crores
362 infantry fighting vehicles	Military vehicles	OFB, Medak	Rs. 662 crores
12 Minesweeper vessels	Ships	Goa Shipyard Limited (GSL)	Rs. 32,000 crores
118 Arjun Mk II tanks	Tank	HVF, Avadi	Rs. 6,600 crores
197 Light utility helicopters	Helicopters	N.A.*	Rs. 6,000 crores
40 Arjun catapult guns	Artillery	Combat Vehicles R&D Establishment (a part of DRDO)	Rs. 820 crores
P7 Heavy drop system	Platform system	Aerial Delivery R&D Establishment (a part of DRDO)	Rs. 402 crores
Integrated anti-submarine suits	Radar and weapons system	DRDO	Rs. 1,770 crores
Mobile cellular communication system	Communication systems	BEL	Rs. 900 crores
Samyukta electronic warfare system upgrade	Communication systems	BEL	Rs. 1,682 crores
Five offshore patrol vessels	Ships	GSL	Rs. 2,000 crores
Five fast patrol vessels	Ships	GRSE	Rs. 360 crores
Five fleet support ships	Ships	N.A.	Rs. 9000 crore
32 Dhruv Advanced Light Helicopters	Helicopters	HAL	Rs. 7000 crores
Search and rescue equipment	--	N.A.	Rs. 900 crores
Five midget submarines	Submarines	HSL	Rs. 2000 crores
14 Dornier surveillance aircraft	Aircraft	HAL	Rs. 1,090 crores
Four survey vessels	Ships	Not available	Rs. 2,324 crores
30 weapon locating radars	Radars	BEL	Rs. 1,605 crores

** contract pending. Source: Gateway House research*

In doing this, India needs to follow its own template by picking best practices from other countries that have developed a robust defence industrial base.

Three things are critical in this endeavour: defence R&D, technology, and offsets.

3.1 Defence R&D

It is time to look beyond the DRDO and implement the Kelkar Committee's proposal for creating a 'Defence Technology Development Fund'. Worldwide too the trend is towards greater involvement of the private sector in national R&D efforts. One of India's largest weapons suppliers, Israel, has achieved this by encouraging the private sector to undertake R&D with the government's backing. The Indian Space Research Organisation has followed a similar model of involving private sector companies such as Godrej. Private sector companies such as L&T, Tata Power Strategic Engineering Division and Rolta have also been involved in the Army's Battlefield Management System and the Tactical Communication System projects, which are currently under development.

Similar initiatives must be fostered in the development of major weapons platforms, particularly in the aerospace sector, integrating commercial and manufacturing dimensions with the R&D efforts.

3.2 Technology

Any attempt to define technological priorities must be cognisant of the two broad global trends in warfare—a shift towards "jointness" in militaries involving greater co-ordination between the three wings of the armed forces, and a move towards network-centric warfare utilising the information infrastructure.

The private sector must be made a regular stakeholder in this exercise. This is particularly so because of the country's strengths in the IT sector and the expertise of IT companies such as Tech Mahindra, Tata Consultancy Services, Infosys, Rolta, Wipro, and HCL. Consultation with such business expertise will help the Ministry of Defence to better grasp global technological trends and identify critical technologies, especially those that may be denied to India as part of the Strategic Export Controls.

Technology can be prioritised through flagship programmes that will cater to future defence acquisitions. It is pertinent to note that the final clearance for sharing technologies is mostly with the government, even if the intellectual property right is held by the private company for that particular technology.

The 'Technology Perspective and Capability Roadmap' (TPCR), based on the armed forces' 'Long Term Integrated Perspective Plan 2012-27', has identified some high technologies related to sensors, propulsion, electronic communication, nano-materials, and other components. (see Table 6), where businesses can potentially contribute.[27] Separately, the DRDO regularly maintains a list for acquiring critical technologies—such as those related to lasers and hypersonic flights.

3.3 Offsets

A significant opportunity exists for the Indian business sector in the offsets obligation programmes in the form of arms imports particularly in aircraft and helicopter acquisitions—with expected offsets worth Rs. 25,000 crores.[28]

It is necessary for the government to bring back the focus of the offsets policy on direct offsets (related to the primary product being purchased) from indirect offsets (other economic activities and trading arrangements) in order to build the capacity of the Indian defence industry. These need to be utilised for the growth of the small and medium enterprises sector—a part of the larger eco-system—by expanding their access to capital, and offering long-term business opportunities and incentives for R&D, which will form the backbone of a vibrant defence industrial base.

Table 6: Key technology requirements identified by TPCR and DRDO

Category	Technologies	Remarks
Communication/ electronic systems	• Information integration and analysis systems; battlefield information systems • C3I systems • Mobile satellite terminals with systems and applications supporting Software Defined Radios, including man-pack versions • Electrically controlled antennae • Pulse Power network technologies • Terahertz technologies	• Immense opportunity for India's IT sector; • Private companies have participated in the R&D for the army's Battlefield Management System and the Tactical Communication System • Many U.S.-based companies such as Texas Instruments, Per Vices, and Ettus Research produce Software Defined Radios
Space-based equipment	• Satellites producing sub-metric resolution images • Space-based radars and electronic warfare systems	• Private companies play a significant role in India's space programme • It is necessary to increase the capacity in terms of launch pads, launch vehicles, satellites, and crews for integration • Military satellites for intelligence gathering purposes are also needed
Aerospace-related systems	• Long-range UAVs • Precision Air-Ground Weapons • Shared and Conformal Apertures • High performance turbo fan engines • Full Authority Digital Engine Control systems • Super Cavitations technology, • Super Cruise technology • Technologies for hypersonic flights (propulsion, aerodynamics, and structures)	• DRDO has an extensive UAV programme, including for the development of high-altitude, long-endurance UAVs • Many private companies also have UAV development programmes
Missiles	• BVR fire and forget air-to-air missiles • Surface-to-air missiles with electronic warfare capabilities • Anti-radiation missiles (air and ground launched varieties) • Stealth technology • Air-borne sensors and sensor fusion	• DRDO's Astra Beyond visual Range Air-to-Air Missile is currently being tested • DRDO developing anti-radiation missile, expected to be ready in the next 3-5 years • DRDO developing missile defence systems; also required are boost phased interception capabilities

Armament	• Electro-Magnetic Pulse weapons • Ammunition equipped with navigation and guidance systems • Electromagnetic Rail Gun technology • High-explosive squash head ammunition • Muzzle Reference System • Composite sabot manufacturing technology • Precision guided munitions • Advanced Recoil System • Gun barrel technologies	• Information regarding some of these technologies is closely guarded by countries doing the R&D • U.S. Navy has an active R&D programme on the Electromagnetic Rail Gun technology
Nano-technology	• Nano-technology based sensors and displays	• Nano-technology has emerged as the next area of innovation • In the U.S., the National Nanotechnology Initiative, which includes the Pentagon and the NASA, spearheads research • In India, the DRDO has around 30 of its laboratories pursuing research in nano-technology and its military application • Application of nano-technology also requires enhancing the manufacturing facilities; extensive R&D opportunities for private sector
Others	• Artificial intelligence and robotics • Diesel-electric propulsion of ships and integrated electric propulsion generator • Fibre Lasers technology • Sensor technologies • CBRN protection suite, collective protection equipment, decontamination systems and equipment • Miniature SAR & ISAR technologies • High efficiency flexible Solar Cells technology • Molecularly Imprinted Polymers • Low Observable technologies • Technologies for generating High Power Lasers	
	• Surface Coated Double Base Propellant • Titanium casting, forging, fabrication, and machining • Under water systems including communication, sonar, stealth etc.	

Source: DRDO, Ministry of Defence, and Gateway House research

Appendix

Table 7: Major Indian private defence companies

Equipment	Companies
Aerospace/UAVs/Air defence systems	Aequs, Alpha Design Technologies, Aurora Integrated Systems, Axis Aerospace, Dynamatic Technologies, Godrej Precision Systems, HCL, Idea Forge, Kalyani Strategic Systems, L&T, Mahindra & Mahindra, Max Aerospace and Aviation, Millennium Aero Dynamics, Punj Lloyd, Radel Advanced Technology, Ravilla Aerospace, Reliance Aerospace Technologies, Reliance Defence & Aerospace, Samtel Avionics, Sattva eTech, Taneja Aerospace, Tata Group, Wipro
Land/Artillery systems/Armoured and military vehicles	Ashok Leyland Defence, Idea Forge, Kalyani Group, L&T, Mahindra & Mahindra, Pipavav, Punj Lloyd, Reliance Defence Technologies, Reliance Defence Systems, Tata Group, Wipro
Shipbuilding/Naval systems	ABG Shipyard, Bharati Shipyard, Mahindra & Mahindra, Millennium Aero Dynamics, Pipavav
Communication/Electronic systems	Ametek India, Astra Microwave, Centum, L&T, Mahindra & Mahindra, Precision Electronics, Punj Lloyd, Radel Advanced Technology, Rolta, Samtel Avionics, Sattva eTech, Tata Group, Wipro
Manufacturing/Engineering services	HCL, Kirloskar, L&T Technology Services, Pipavav, Sattva eTech, Walchandnagar
Internal security solutions	Anjani Technoplast, Reliance Security Solutions
IT & ITES services/Software systems	Aurora Integrated Systems, Geometric (Godrej), HCL, Infosys, KPIT Technologies, Neilsoft, Tata Consultancy Services, Tech Mahindra, Plexion Technologies (Mahindra), Radel Advanced Technology, Sattva eTech, Wipro
Small arms/equipment/Training Systems	DefSys Solutions, Indian Eye Security, Zen Technologies

Source: Gateway House research

Table 8: Joint ventures in India with foreign defence companies

Indian Company	Foreign partner	Equipment offered
Alpha Design Technologies	Israel Aerospace Industries	UAVs
Ametek India	Enertec Management (Amertec Systems Pvt. Ltd.)	Electronic systems, simulators
Ashok Leyland Defence	Krauss-Maffei Wegmann	Artillery systems and armoured vehicles
	Saab	Military vehicles
	Paramount Group	Armoured vehicles
Axis Aerospace and Technologies	Thales	Aerospace equipment, flight simulators
Bharat Earth Movers India Ltd.	Tatra Trucks	Military trucks
Bharat Electronics Ltd.	Thales	Radar systems
	Terma	Naval radar systems
Dynamatic Technologies	AeroVironment	UAVs
	Boeing	P-8I aircraft components
	Textron Systems	Bell helicopter sub-systems
HAL	Snecma	Aerospace equipment
	BAE Systems	Aerospace equipment
	Rolls Royce	Aerospace equipment
Indian Eye Security	Saab	Marketing tactical simulation systems
India Forge	DIEHL Remscheid (Track Systems India Private Limited)	Tracks for armoured vehicles
Kalyani Group	Bharat Forge-Elbit	Artillery systems
	Rafale Advanced Defence Systems	Missiles, remote weapon systems and armour solutions
Larsen & Tubro	Boeing	Defence and aerospace components
	EADS (including Cassidian)	Aerospace and electronic equipment
	Nexter	Artillery systems
	Pratt & Whitney	Aircraft components
	Raytheon	T-72 tank components, infrared imaging, electronics
	Samsung Techwin	Artillery systems
	Thales	Avionics
Mahindra & Mahindra	Eurocopter	Helicopters and fixed wing aircraft
	Lockheed Martin	Simulators, radar and surveillance systems
	Rafale Advanced Defence Systems	Anti-torpedo defence systems, electronic warfare systems
	Ras Al-Khaimah, Arabia Holdings	Armored vehicles, ballistic kits
	Saab	Air defence systems
	Telephonics Corporation	Radar and electronic systems
Max Aerospace and Aviation	Snecma (Max Aero Engines Private Limited)	Maintenance of military aircraft engines

Millennium Aero Dynamics	International Institute of Advanced Aerospace Technologies	UAVs, fixed-wing aircraft and amphibian aircraft
Pipavav	Babcock	Aircraft carriers
	DCNS	Shipbuilding
	Saab	Naval systems
Precision Electronics	Raytheon	Communication systems
Reliance Aerospace Technologies	Dassault Aviation	
	Boeing	
Reliance Security Solutions	Raytheon	Homeland security systems
	Siemens	Homeland security systems
Samtel Avionics	General Dynamics	Digital displays
	Thales	
Tata Group	Airbus/EADS	Communication systems, proposal to produce C295 aircraft
	AGT International	Homeland security solutions
	Boeing	Aircraft components
	Elta Systems (Hela Systems Pvt. Ltd.)	Electronic and radar systems
	Honeywell Aerospace	Aerospace equipment
	Lockheed Martin (Tata Lockheed Martin Aerostructures Limited)	Components for C-130 aircraft
	Saab	Air defence systems
	Sikorsky (Tara Aerospace Systems Limited)	Aero-space components, S-92 helicopter cabins
	TCS-Rolls Royce	Engineering services
	Thales	Optronic solutions
Wipro	CAE	Simulation, C4ISRsystems
Zen Technologies	Rockwell Collins	Flight stimulators

Source: Gateway House Research, and Federation of Indian Chambers of Commerce and Industry (FICCI)

Table 9: Global defence industry and linkages to India

Country	Defence industry	Major enterprises	Cooperation with India	Bilateral treaties/ agreements with India
U.S.	• Largest global arms exporter with 31% share • Most of the defence manufacturing done by private sector	Lockheed Martin, Boeing, Raytheon, Northrop Grumman, BAE, United Technologies	• India-U.S. defence trade has exceeded $10 billion in the last decade • 2015 agreement involves defence technology cooperation	• 2015 New Framework for India-U.S. Defence Relationship • 2013 Joint Declaration on Defence Cooperation • 2012 Defence Technology and Trade Initiative
Russia	• Second-largest global arms exporter with a share of 27% • Defence industry dominated by state-owned enterprises	Russian Aircraft Corporation MiG, Sukhoi Aviation Military Industrial Combine, Sevmash shipyard, Uralvagonzavod	• A lot of Russian equipment is being produced under licence in India • Joint development projects including BrahMos, Fifth Generation Fighter Aircraft and Multi-role Transport Aircraft	• 2000 Declaration on the India-Russia Strategic Partnership • Inter-Governmental Commission on Military Technical Cooperation
Israel	• One of the most advanced defence industrial bases • Significant investments in R&D • Main customers include the U.S., Europe, India, Australia, and South America.	Israel Aerospace Industries, Rafale Advanced Systems, Elbit Systems	• Critical defence technologies sold to India • Many Israeli companies have JVs with Indian companies • Joint development projects include Barak 8 missile defence system and aerial defence system	Joint Working Group on Defence Cooperation
U.K.	• Large defence industry with heavy support from the government • Global share in arms exports is 5%.	BAE Systems	• Indian Navy operates BAE System's Sea Harrier aircraft • BAE's Hawk trainer jet is currently being produced under licence in India.	2004 Strategic Partnership Agreement
Germany	• 5% share in global arms exports • Recently, the German government has sought to cut defence exports, particularly to West Asia	Krauss-Maffei Wegmann, Diehl Remscheid GmbH, Rheinmetall AG,	• Ashok Leyland's JV with Krauss-Maffei Wegmann • Diehl Remscheid supplying tracks and accessories for the Arjun tank	• 2006 Bilateral Defence Cooperation Agreement • 2001 Strategic Partnership Agreement

	• Some defence companies part of the major European companies such as Airbus	ThyssenKrupp Marine Systems	• Rheinmetall blacklisted by India on corruption charges • Navy operates a fleet of HDW diesel-electric submarines	
France	• 5% share in global arms exports • Heavily dependent on government spending for R&D investment	Dassault Aviation, MBDA, Thales	• Extensive involvement in India • Many JVs with private defence companies	2006 Agreement on Defence Cooperation
Ukraine	• 3% share in global arms exports • Major defence exporters from Europe • China and India are traditional customers	Antonov	• India currently upgrading its fleet of An-32 aircraft with Antonov • India has also used Zorya M36E gas turbine plants for naval warships • Motor-Sich provides helicopter engines	• 2012 Agreement on Cooperation in the field of Defence • 2001 Agreement for the Promotion and Protection of Investments
Poland	• One of Eastern Europe's robust defence industries • Currently undergoing restructuring and consolidation • Major land equipment like tank, armoured vehicles, air systems • Many U.S. companies source their components from Poland	Polish Bumar (Polish Defence Holding)	Bharat Earth Movers Limited has a contract with Polish Bumar for procuring armoured vehicles	• 2003 MoU on Defence Cooperation with 2011 addendum • 1996 Agreement Between India and Poland for the Promotion and Protection of Investments
South Korea	• One of the fastest growing defence exporters • By 2016, South Korea is forecast to generate higher defence exports revenue in the region than China • Artillery systems, battle tanks, helicopters, tanks, fighter jets, submarines and ships	LIG Nex1, Samsung Techwin, Hyundai Rotem, Daewoo Shipbuilding, Korea Aerospace Industries	• Samsung Techwin has a JV with L&T; • Deal with South Korean Kangnam shipyard for procuring minesweepers was scrapped after allegations of irregularities	• 2010 MoUs on Defence Cooperation, as well as, between DRDO of India and Defence Acquisition Programme Administration of South Korea • 1996 Agreement on the Promotion and Protection of Investments
South Africa	• Most advanced defence industrial base in the African continent	Denel, Paramount Group	Denel had been blacklisted after allegations of kickbacks in its deal for	2000 MoU on Defence Cooperation

	• Attack helicopters, armoured vehicles, communication systems, aerospace systems • Many South African contractors are heavily involved in the Airbus military transport aircraft programme		supplying anti-material rifles to the Indian Army; ban removed last year	
Brazil	• Major arms exporter within South America • Focused on developing indigenous manufacturing capabilities by technology transfer through offsets • Aircraft and helicopters.	Embraer, Helibras	India has bought three aircraft from Embraer for airborne early warning system.	2003 Agreement on Cooperation in Defence-related Matters
Spain	• Major defence exporter in Europe • Government has encouraged domestic defence companies to partner with foreign companies • Companies including Airbus and General Dynamics have manufacturing facilities • The country has a 100% offsets policy.	Indra, Navantia	Navantia is part of the original contract awarded to the DCNS for the Scorpène submarines	2012 MoU on Defence Cooperation 1972; Agreement on Trade and Economic Cooperation
Turkey	• Turkey has focused on technology transfers and co-production agreements • Major customers are Pakistan, Azerbaijan, and Turkmenistan • The country is also a partner in the F-35 Joint Strike Fighter aircraft development programme and the Airbus military transport aircraft programme • UAVs, tanks, ships, communication systems	Otokar, Aselsan, FNSS Defence Systems.		

Source: Stockholm International Peace Research Institute (SIPRI); MEA; Gateway House research

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