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Indian Military Platform Modernisation: Uncertainties, Challenges, and Progress

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Introduction

Assessing the changes in India's military capabilities is not without its challenges, especially with regards to the three armed services securing their required needs in a timely manner. This report analyses the key platform acquisitions made by the Army, Navy, and Air Force between 2011 and 2021, and explores the trends for the forthcoming decade beginning 2021.

India faces a challenging strategic environment that encompasses a wide swathe of geography, from the Western Pacific to the Indian Ocean Region (IOR). Although not yet minatory, China's People's Liberation Army Navy (PLAN) is expanding and could soon pose real threats to India. On its land frontiers, India has been locked in a stand-off with China since May 2020, and a "hot" Line of Control (LoC) with Pakistan notwithstanding the current ceasefire. The balance of air power is also fragile and becoming increasingly adverse for India, given the two-front military challenge from Pakistan and China. Overall, the capabilities of the Indian military have not kept pace with the heightening threats confronting the country.

Each chapter in this special report draws attention to three central elements in the modernisation of India's military platforms: uncertainties, challenges, and opportunities.

The first section focuses on the Indian Army. In the first chapter, Maj Gen. B.S. Dhanoa discusses the difficult strategic environment confronting India for which the country requires Armoured Fighting Vehicles (AFVs). Dhanoa notes that night-fighting capabilities of the AFVs were the focus in the decade between 2011-2021. The forthcoming decade should witness, according to Dhanoa, improvements to the existing AFVs covering Software Defined Radios (SDRs), anti-drone protection suites, and improved stealth and navigation systems.

Javin Aryan and Pulkit Mohan, in the second chapter, survey the current procurement and upgrade status of infantry weapons for the Indian Army (IA). The authors draw attention to the painfully desultory process and inefficiencies plaguing the acquisition of infantry weapons for the Indian armed forces and the problems afflicting the services to secure infantry weapons for meeting their operational challenges. During the decade 2011-2021, the most significant acquisition was the SIG716 assault weapon and additional limited acquisitions for the Indian Special forces. The decade of 2021-2031 will see the INSAS assault weapon being replaced with the newer AK-203. Sniper rifles will also undergo upgrades.

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However, uncertainty looms over additional acquisitions during the next decade, such as the CAR 816 carbine, Joint Venture Protective Carbine (JVPC), and the ASMI sub-machine gun.

Amrita Jash rounds off the first section with an exploration of the current status of India's artillery systems. These systems cover towed artillery, Ultra-Light Weight Howitzers (ULH), Multibarrel Rocket Launcher (MBRLs), and land-based cruise and ballistic missiles. Jash shows that in the period 2011-2021, India acquired a mix of indigenous and foreign artillery systems. In addition, during this period there was greater investment in mediumisation and ammunition for artillery platforms. A catalyst for the acquisition of ULH777, Vajra K9 and the Dhanush towed artillery has been the increasing tensions with China along the disputed frontier. In the forthcoming decade, Jash ponders, new systems will be inducted such as the Autonomous Towed Howitzer Ordnance System (ATHOS), 155 MM and 52-calibre mounted gun system, and Pinaka Mk-II MBRLs.

The second section follows with three analytical pieces on India's naval platforms. Chapter 4, written by Manoj Joshi and Mahi Khanna, discusses the role of aircraft carriers in the Indian Navy (IN). In the period 2011-2021, Joshi and Khanna observe, India inducted the carrier INS Vikramaditya, built by Russia, in 2014 and decommissioned the INS Viraat in 2017. Despite the PLAN's forays into the Indian Ocean Region (IOR), its current carrier strength is unlikely to pose a significant threat to the IN. The period between 2021-2031 is likely to witness commissioning of the Indigenous Aircraft Carrier (IAC-I) in 2022, which is built with predominantly indigenous technology at the Cochin Dockyard Limited. However, the acquisition of the second Indigenous Aircraft Carrier-2 (IAC-2) will remain uncertain during the coming decade. The IN has experienced progress with indigenous carrier technology during the last few years and likely to make more gains during the next ten.

Sudarshan Shrikhande, in his overview of the IN's surface fleet covering frigates, destroyers and corvettes, notes that despite budgetary shortfalls between 2011-2021, the IN has done well preparing for the future. In the past decade, India commissioned three Kolkata Class Destroyers, two Shivalik Class Frigates, three Teg Class Frigates, and three Kamorta Class Corvettes. The indigenisation of ship design has gained maturity and will become more pronounced in the coming two decades. To be sure, self-reliance in Indian ship-building is still costly given the low volumes; however, continued dependence on imports will be an equally poor decision. Nevertheless, writes Shrikhande, a concerted effort has to be made to bring costs down over time. In the forthcoming decade between 2021 and 2031, Project 15B indigenously developed Stealth guided-missile destroyers will be commissioned, and Project 18 Stealth guided-missile

destroyers are planned for construction by the IN. Additionally, the Russian-origin upgraded Talwar/Teg class (Project 1135.6) will see induction. Finally, 16 India-built corvettes called the Anti-Submarine Warfare Shallow Water Craft (ASWSWC) are likely to be commissioned, with the first delivery of corvette expected in 2022.

In Chapter 6, Abhijit Singh surveys the current state of India's submarines and what the Navy can acquire in the coming decade. In the period between 2011 and 2021, notes Singh, the IN's principal deficit was in the area of attack submarines, where the shortfall is ten less than the required strength for India's sub-surface fleet. Making matters worse during the last decade under Project 75, the French-origin but Indian-built Scorpene Class submarines have experienced significant delivery delays. Consequently, the IN is unable to decommission its kilo class submarines. On the nuclear submarine front, the IN fared better with the Indian government approving its request for changing its development plan for six conventional submarines with nuclear ones. In the 2021-2031 period, the IN plans to induct six Project-75 I conventional submarines, and a second ballistic missile submarine for deterrence against China. Research and Development (R&D) is also underway for the possible testing of Submarine Launched Ballistic Missiles (SLBMs) with a range of 5000 km and 6000 km.

The third and final section of this report trains the spotlight on the Indian Air Force (IAF). In Chapter 7, Kalianda Appaya Muthana observes that the force structure of the Indian Air Force (IAF) has changed little over the period 2011-2021, where the IAF fighter fleet underwent mostly upgrades to its existing fighter fleet. The single most important acquisition made by the service was the Rafale multi-role fighters, 20 of which have been delivered out of a total 36. For the IAF, the most consequential and serious capability limitation for its fighter fleet is in the area of stealth; the other is lack of a long-range bomber to counter China. Importantly, Muthana concludes, the IAF is unlikely to see changes in its force structure between 2021 and 2031.

In Chapter 8, Angad Singh surveys the IAF's and the IN's airborne Intelligence, Surveillance and Reconnaissance (ISR) capabilities. The IAF controls the majority of India's ISR capabilities. Since the watershed Kargil war of 1999, the IAF has ensured that all tactical aircraft in its inventory have Electronic Intelligence (ELINT) capabilities. The most crucial change in the IAF's ISR structure, Singh observes, has been the induction of Remotely Piloted Aircraft (RPAs) or UAVs between 2011 and 2021, when India acquired UAVs ranging from the Israel Aircraft Industries (IAI) Searcher II to the P8I Poseidon maritime reconnaissance aircraft. Notwithstanding improvements in the IAF's and IN's ISR capabilities, the changes are at best modest. In the decade of 2021-2031, India is likely to shift to short-term solutions and lease UAVs such as the MQ9-B Sea Guardian drones to service its ISR requirements. Singh concludes that there are too many uncertainties hampering the progress of India's ISR capabilities.

This section on the Air Force closes with Manmohan Bahadur's chapter analysing changes in the IAF's transport and helicopter fleets. From 2011 to 2021, both sets of aircraft underwent significant improvements. India made new acquisitions, ranging from C-130J Hercules to CH-47F (I) Chinook multi-mission helicopters. Several Russian-origin transport aircraft such as IL-76 and IL-78 mid-air refuelling aircraft also underwent upgrades during the decade. The next decade could see the IAF inducting multi-role tanker support aircraft A-330, at least as part of a lease arrangement and light multi-mission choppers such as the Ka 226-T. The greatest challenge facing the IAF in the coming decade will be the establishment of a "secure network" for joint operations. All of the IAF's transport and helicopter platforms will need integration as part of a net-centric drive.

Overall, platform modernisation across the three-armed services is not a single-shot event, but rather a dynamic process. Despite a two-front external threat, which should be a ballast for more rapid platform acquisition and upgrades, all three forces will face sub-optimal outcomes over the next decade to service their projected requirements. The Indian state faces both continental as well as a serious emerging maritime threats from the PLAN in the IOR. The IA, for the foreseeable future, is likely to meet with hurdles in the form of limited resources necessary to modernise its platforms. While India's dependence on defence imports will continue for the next decade, the level and pace of indigenisation of military platforms and weapons systems will require close attention and investment. Despite the prospective induction of the LCA MK-1A, the IAF fighter fleet will likely be limited to prolonged, glacial change over the next decade. Notwithstanding budgetary shortfalls, the IN's surface fleet will gain the most, while the woes plaguing the conventional leg of the IN's sub-surface fleet will endure. The expansion of PLAN's naval presence in the IOR will test the IN, but an atrophying conventional submarine fleet bodes ill and will compound the IN's challenges.

All three service branches of the Indian military, short of an extreme crisis, are unlikely to undergo dramatic transformation over the coming ten years. Although not an easy task, the Indian government in the subsequent decade will need to bridge the gap between the projected requirements for new platforms and weapons systems of the Indian armed forces, and the allocation of budgetary resources.

I

Army: Incremental Modernisation with Limited Resources

Main Battle Tanks

Birender Dhanoa

Introduction

The demand for Armoured Fighting Vehicles (AFV) in the Indian Subcontinent is a perennial one. In its edition of 01 July 2021, *Dawn* reported Pakistan's induction of an initial batch of the latest Chinese manufactured VT-4 Main Battle Tanks (MBT). China, too, is now in the mix, having positioned the People's Liberation Army (PLA) in Eastern Ladakh with combined arms battalions of medium and light tanks, such as the Type-99 and Type-96 MBTs and the Type-15, respectively.[1] Indeed, the confrontation with China has reinvigorated a latent desire among armour generals in India to field a suitable light tank in the Himalayas to counter China's numerical strength in AFVs.

In April 2021, the Indian Army (IA) raised a Request For Information (RFI) for approximately 350 light tanks of up to 25 tonnes—air-transportable and preferably amphibious, with a modern gun capable of firing shells and a missile to defeat AFVs, and with a crew of two or three personnel.[2] In June 2021, the IA raised another RFI for a Future-Ready Combat Vehicle (FRCV), seeking a "state of the art technology enabled" MBT (a specific figure of 1,770 tanks was mentioned), to be inducted by 2030.[3]

The Operational Need

The adversarial nature of India's geostrategic relations with Pakistan and China is well-known. Past experiences and current inventories of AFVs in the Pakistan Army and the PLA[a,4] highlight the need for India to maintain strong mechanised forces (a mix of tanks and infantry combat vehicles), irrespective of the ongoing wider debate in militaries about the future of the tank as a predominant fighting platform. While expeditionary forces such as the US Marines and the British Army are considering shedding their main battle tanks completely in the coming years, Indian armour units cannot afford such a drastic move, since the use of mechanised spearheads (from either the West or the North) in conventional conflict is a stated doctrine of both Pakistan and China. Thus, the IA must continue to be well-equipped with capable AFVs, whether for deterring or defeating threats. The challenge lies in maintaining an upgraded and technologically capable platform that has the wherewithal to tackle multi-dimensional threats from smart weapons systems—already fielded or in the pipeline—to specifically defeat or negate the relative superiority that the tank has enjoyed on the battlefield for nearly a century.

Indian Army MBTs: Present and Future

Current Holdings

The backbone of the armour fleet in the IA is the T-90S (the HVF Avadi assembled version is the Bhishma); approximately 1,200 tanks are in service, with another 500 in the pipeline (see Table 1).[5] The other major holding is of the older T-72M1s, with the DRDO/HVF version being the combat improved Ajeya (CI-Ajeya).[6] The bulk of these tanks vary in vintage, from over 40 years to about 20 years, and have been partially upgraded, or are planned to be, to keep them in service over the next decade until a replacement is inducted. Finally, there are the Arjun Mk 1 and Mk 1A tanks; 124 Mk 1s are already in service, and the IA has recently inked a contract with the OFB for 118 Mk 1As, to be inducted over the next five to seven years in a staggered manner.[7] Table 1 provides a basic guide to the holding of frontline tanks in the IA.

a Franz Stephan Gady, an IISS Research Fellow, places the current inventory in the Pakistan Army as 2,400 tanks and with the PLA as 6,240 2nd and 3rd generation tanks..

Table 1:
Frontline Tank Holdings (2011–21)

	Tank (Country of Origin)	Total Nos.	Main Characteristics	Remarks
1.	Arjun Mk 1 and 1A (India)	124, 118[&]	Wt: 58.5 tonnes (68 tons 1A) Armament: 120 mm rifled gun, IFCS with TI sight Engine: 1,400 hp diesel Protection: Composite (Kanchan) Armour, Explosive Reactive Armour (ERA) for Mk 1A only	[&]Mk1A to be inducted in a phased manner by 2025–27.
2.	T-90S/SK[%] (Russia)	1,700*	Wt: 46.5 tonnes Armament: 125 mm smoothbore gun, FCS with TI Sight Engine: 1000 hp turbo diesel Protection: Kontakt-5 ERA	[%]SK is the command variant. *Including 464 tanks under delivery contract with HVF, Avadi.
3.	T-72 (Russia)	2,400[$]	Wt: 41.5 tonnes Armament: 125 mm smoothbore gun, TISAS/ TIFCS (600/1000 tks respectively) Engine: 780 hp diesel Protection: ERA (on CI- Ajeyas)	[$]These are approximate figures collated from different sources for T-72M1 and CI-Ajeya.

Upgrades and Improvements (2011–21)

The focus of changes to the IA tank fleet in the past decade has been on improving its night-fighting capabilities—in response to challenges from the West, upgrades in the tank fleet of the Pakistan Army, and their induction of better anti-tank missiles. These factors have largely dictated the direction of the improvements that the IA has undertaken since 2011.

Table 2 lists the most important upgrades to tank systems that have been implemented or were planned over the last decade (2011–21) to ensure India's MBTs remain an effective deterrent force. These are only a broad indication of the changes that have been dictated mostly by operating experience, but some are due to new threats, mainly with respect to Pakistan.

Table 2:
Key Tank System Upgrades (2021–31)*

Tank	Power Pack	Night Fighting Capability	Protection (Passive and Active)	Auxiliary Systems/Other Improvements	Remarks
T-72	Upgrade to 1,000 hp planned	a. TISAS/TIFCS[&] b. Commander's TI (CTI) sight[$]	ERA Mk 1 for CI-Ajeya	a. Improved Communications b. Integrated fire detection and suppression system (IFDSS)^	[&]$1,600 tanks ^Under progress
T-90	None	Improvements to TI camera and display panel	None	Environmental Control Unit (ECU) and Auxiliary Power Unit (APU)*	*ECU and APU were deemed essential, but plans did not materialise.
Arjun	15 major and 58 minor upgrades to the Arjun Mk 1 have been offered by the DRDO on the Arjun Mk 1A, which is to be inducted in the coming period.				

**Note: Table 2 includes details culled from unlisted sources.*

Future Threats and Options

A debate is currently ongoing within strategic circles regarding the nature and character of warfare in the coming decades. Proponents of technology and futuristic systems believe that the days of total war, involving large-scale ground forces led by armour columns, will give way to a combination of cyber and AI-based autonomous weapons in the air, sea and land, using precision targeting and adaptive-learning techniques. On the other hand, the conservative view is that while the means to wage wars may change, the visceral nature of conflict is such that escalation and all-out war using conventional platforms cannot be ruled out. Defence planners are then tasked with striking a balance between these two views, based on which they must convince finance mandarins to fund the procurement of fighting platforms. The IA's RFI for the FRCV is reflective of this dilemma.

Table 3 lists the possible upgrades planned or suggested until 2030, to keep the current fleet relevant in the next decade. The table also lists the desired capabilities and features, some of which have been extracted from the RFIs of the IA, for fighting platforms that are likely to be inducted into service by 2030.

Table 3:
Prospective Developments (2021–31)

Tank	Mobility	Firepower	Protection	Digitisation and Communications	Remarks
T-72	a. 1000 hp power pack b. APU	Better depth of penetration (DoP) main gun ammunition	ERA Mk I Panels	a. Software defined radio (SDR) b. Anti-drone protection suite ^ c. IFF	These upgrades should be done on approximately 60 percent of the tank fleet, with a life expectancy of 15–20 years.
T-90	a. 1200-1500 hp power pack b. APU	a. Better DoP main gun ammunition b. Next Gen Missile c. ECU d. Third Gen TI Sight e. CTI	a. ERA Mk II Panels b. Active Protection Suite (APS)	a. SDR b. Anti-drone protection suite ^ c. IFF	Tanks in the pipeline should preferably get these upgrades fitted in factory.
Future Tank (Crew 3 or 2)	a. Multipurpose platform b. +-50 tons c. 1500 hp (or more) d. Power: wt ratio not less than 25:1 e. APU	Gun 125 mm smooth bore b. Penetrate at least 800 mm for KE ammunition c. Digital FCS d. ECU	Active Protection Suite	a. SDR b. Battlefield Management System integrated with FCS c. Stealth and Signature Management Technology d. Hybrid Navigation System	These capabilities have been taken from the FRCV RFI, available online.[8]

Note: ^ The requirement has been included by the author.
Source: Author's own, using various sources.

Conclusion

The requirement to maintain a modern fleet of MBTs for the IA will persist for the foreseeable future. While academic debates over the future of warfare are an industry in themselves, and a means to project new technology as a panacea for key challenges in any conflict, ground practitioners must contend with more mundane realities of the present.

A pragmatic approach for the IA will be to upgrade the existing fleet of MBTs to technologically capable and achievable levels in the coming decade, while the quest for the FRCV continues. Furthermore, the acquisition of light tanks remains a chimera; for now, the upgraded BMP-2 platforms, combined with the tanks already inducted in mountainous areas, are sufficient against the extant PLA threat in a joint warfighting environment.

> “Defence planners must consider both cyber and AI-based war, as well as all-out war—based on which they must obtain funding for fighting platforms.”

Infantry Weapons

Javin Aryan and Pulkit Mohan

Introduction

The Indian Armed Forces use a range of weapon systems depending on the situation they are tasked with countering. These include: assault rifles, the mainstay firearm of the Infantry; light, medium, and heavy machine guns, whose high rates of fire provide more muscle to the troops; pistols, carbines, and sub-machine guns, which are more potent in close-quarter battles (CQB); and sniper rifles, which provide an element of surprise and enhance the Infantry's precision-strike capability. Within these categories, the Army can choose from a range of options from various manufacturers. Factors that play a role in deciding the choice of weapon system procured include calibre, cost, range and endurance; the key attribute, however, is reliability. As the Indian Army aims for modernisation, it must adopt a new generation of systems that will not only be dependable in challenging environments and situations, but also give its troops an edge over their adversaries.

Modernisation from 2011 to 2021

Indian military's quest for modernisation has been long and frustratingly slow, indicating the presence of complex challenges as well as inefficiencies in the system. As of October 2020, the Army required approximately 9.5 lakh assault rifles, 4.6 lakh CQB carbines, over 57,000 light machine guns (LMGs), and around 5,000 sniper rifles, for its over 12-lakh-strong force with more than 380 Infantry and 63 Rashtriya Rifles battalions.[1,2]

Despite these massive gaps, the Indian Army's Infantry has not seen any substantial modernisation in the last decade. Its standard issue assault rifles are the INSAS (Indian Small Arms Systems), adopted in the 1990s and known for their lack of reliability; and the indigenously produced Trichy Assault Rifle and Ghatak, variants of the famous AK-47. Of these, even the more favourable AK-47 variants have long become outdated, and the Infantry urgently needs a new generation of assault rifles to transform it into a lean and more efficient fighting force.

In 2019, the AK-203 was selected as an upgrade[3] and the deal is reportedly in its final stage, pending approval from the Ministry of Defence (MoD) and Cabinet Committee on Security (CCS). However, the delay in the acquisition of the AK-203 pushed the government to acquire advanced SIG716 assault rifles from the United States (US) under the Fast-Track Procurement (FTP) procedure, especially in light of the tense situation along the Line of Control (LoC) at the time, China's aggression in Ladakh, and the realisation that Beijing poses an active threat to India's sovereignty and territorial integrity. The SIG716 has been the most substantial upgrade in the Indian armed forces between 2011 and 2021 (see Table 1). The rest have been piecemeal acquisitions, mostly for the special forces (SF) and frontline troops to deal with specific situations.

> "As the Indian Army aims for modernisation, it must adopt a new generation of systems that will be dependable in challenging environments."

Table 1:
Infantry Weapons Acquired by the Indian Military in 2011–21

Date of Acquisition	Weapons System	Manufacturer	Units	Total Cost	Notes
January 2011[4]	TAR-21 assault rifle (5.56 mm)	Israel Weapon Industries (Israel)	5,500		For Indian SF (Air Force: Garud; Army: Para SF; Navy: MARCOS).
	Galil sniper rifle (7.62 mm)		220		
April 2012[5]	MP9-N submachine gun (9x19 mm)	Brügger & Thomet (Switzerland)	1,568	INR 43 crore (US$5.75 million)	For the Ghatak platoons of Infantry battalions.
February 2019[6]	Scorpio TGT bolt-action sniper rifle (.338 calibre)	Victrix Armaments (Italy)	~30		Deployed with troops along the LoC in Kashmir, to counter sustained sniping by the Pakistani Army. Replaced the ageing Russian Dragunov sniper rifle.[7]
	M95 anti-material bolt-action rifle (.50 calibre)	Barrett Firearms Co. (US)			
February 2019[8]	SIG716 assault rifle (7.62 x 51 mm)	Sig Sauer (US)	72,400	INR 700 crore (US$93.56 million)	Divided amongst the tri-services (Army: 66,000; Navy: 2,000; Air Force: 4,000).[9] Within the Army, rifles deployed with troops along the LoC and the LAC.[10] Acquired under FTP.
March 2020[11]	Negev NG7 light machine gun (7.62 x 51 mm)	Israel Weapon Industries (Israel)	16,479	INR 880 crore (US$118 million)	Divided amongst the tri-services, replacing the INSAS LMG. Acquired under FTP.
July 2020[12]	SCAR (L) assault rifle (5.56 x 45 mm)	FN America (US)	1,400		For Indian SF, Acquired through US' Foreign Military Sales
	SCAR (H) battle rifle (7.62 x 51 mm)	FN America (US)	1,050		
	M107A1 sniper rifle (.50 calibre)	Barrett Firearms Co. (US)	100		
	Browning heavy machine gun (.50 calibre)	US	110		
September 2020[13]	SIG716 assault rifle (7.62 x 51 mm)	Sig Sauer (US)	72,000	INR 780 crore (US$04.25 million)	Acquired under FTP. Will equip at least two companies in all of Army's 400+ battalions (with approximately 200 soldiers in each battalion).[14]

Acquisitions Expected in 2021–31

The Indian government plans to use *atmanirbharta* (self-reliance) in defence manufacturing and the 'Make in India' initiative to guide future acquisitions. Once the AK-203 deal is signed, the Indian Army's requirement for new assault rifles will be met; that leaves requirements for carbines, LMGs, and sniper rifles.

In carbines, India has two indigenous options: the Joint Venture Protective Carbine (JVPC), a collaborative effort between the Defence Research and Development Organisation (DRDO) and the Ordnance Factory Board (OFB); and Asmi, a 9 mm submachine gun designed and produced by Lt. Colonel Prasad Bansod of the Army's Mhow-based Infantry School and the DRDO.[15] The procurement of one of these systems will affect the acquisition of Caracal's CAR816 carbine, which was shortlisted in 2018, but the deal is yet to be finalised. However, if the deal for indigenous systems gets delayed, CAR816s may be procured in limited quantities as a stopgap.

For snipers, officers prefer the Dragunov sniper rifle, which has been the Indian Army's main sniper rifle since the 1990s, instead of moving to an entirely new system.[16] Nonetheless, more advanced sniper rifles may continue to be acquired in limited quantities for specialised units and tasks.

Table 2:
Expected Acquisitions and Upgrades of Infantry Weapons, 2021–31

Weapons System	Manufacturer	Expected Date of Acquisition	Notes
AK-203 assault rifle (7.62 x 39 mm)	Indo-Russian Private Limited (India and Russia)	2021	To replace INSAS as the main rifle for the Army. Deal ready to be signed pending approval from the MoD and CCS, with 671,427 units to be manufactured in India after the transfer of technology from Russia. Each unit to cost INR 70,000.
Upgrade of Dragunov sniper rifle	SSS Defence (India) or Kalashnikov (Russia)	SSS Defence upgrades: Trials are underway with various Infantry units of the Indian military and paramilitary forces. Kalashnikov upgrades: Trials to start soon.	Army's main sniper rifle since the 1990s; the system is long due for an upgrade. While the government has included the upgrade programme in its first "positive indigenisation list" and the ban went into effect in December 2020, the rifle's manufacturer, Russia's Kalashnikov, has stated that it reserves the sole right to modify the rifles and has come out with its own upgrade package.[17,18]
CAR816 carbine (5.56 x 45 mm)	Caracal (UAE)	No deal has yet been signed.	An order worth US$110 million for 93,895 units under FTP has been in limbo since the system was shortlisted in October 2018.
Joint Venture Protective Carbine (JVPC) (5.56 x 30 mm)[19]	DRDO and OFB (India)	No orders have yet been placed.	The system became the first indigenously designed and produced weapon to pass the Indian Army's field trials in December 2020s.
Asmi submachine gun (9 mm)[20]	India	No orders have yet been placed.	The weapon is intended for use as a second-line personal weapon for tank and aircraft crews, radio and radar operators, and in close combat situations such as counterterrorist operations, room interventions, and in confined spaces of warships and merchant vessels. The unit cost is likely to be under INR 50,000.

Conclusion

The Indian Army's Infantry is the first to be deployed and the last one out of the battlefield. Thus, the modernisation of its weapons is a pressing requirement, with China's aggressive posturing in Ladakh and the regional instability likely to arise out of a volatile Afghanistan adding to the urgency. It is time for the Indian government to accord top priority to acquiring modern weapons and upgrading existing ones, and ensure the execution of these processes in a time-bound and efficient manner.

The Indian Artillery

Amrita Jash

Introduction

As a critical operational arm of the Indian Army (IA), the Artillery Corps (AC) has evolved into a dynamic combat arm.[1] Comprising ballistic missiles, multi-barrel rocket launchers, high mobility guns, precision-guided mortar munitions, unmanned aerial vehicles (UAVs) and other systems, the AC is tasked with carrying out surveillance, intelligence, engagement of targets, and post-strike damage assessment (PSDA). Based on intelligence and surveillance, the weaponry is used to destroy, neutralise, and suppress the enemy through the synergised application of all fire assets at selected points of decision—to physically and psychologically degrade the enemy's cohesion, and ultimately break their will to fight.[2] Over time, the use of artillery has diversified from major conventional operations involving large formations, and it is now a significant component of Integrated Battle Groups (IBGs).

In the Kargil War, the Bofors guns (inducted in 1987) served as a game-changer with their "shoot-and-scoot technology." Further acquisitions were stalled for two decades. The breakthrough came with the 1999 Field Artillery Rationalisation Plan (FARP), which aimed at 1,580 towed gun systems, 814 mounted gun systems (MGS), 100 self-propelled (SP) howitzers, and 145 M777 155mm/39 calibre lightweight howitzers[3]—through direct imports, licensed manufacturing and indigenous systems. The push towards the FARP came from the need for India to import 50,000 rounds of 155 mm artillery ammunition from South Africa, during the Kargil War.[4] Despite this, the artillery modernisation plan did not pick up pace until 2011, when the Indian Army issued a Request for Proposal (RFP) for a hundred 155mm/52-calibre SP guns,[5] to bridge the three-decade gap in India's artillery capabilities since the induction of Bofors FH77B02.

In modernising the Indian artillery, key aspects have included the mediumisation of artillery; balancing between indigenisation and foreign procurement; proper ammunition development (towed, precision, bunker building, and fuel in explosives and air bursts); and ensuring artillery reach. This is evident from the profile of the weapons and weapon systems that have been added to the Indian artillery since 2011 (see Table 1).

Table 1:
Weapons and Weapon Systems in the Artillery (2011–21)

Category	Name of the System	Status	Production
Towed Artillery	Dhanush (155 mm/45 calibre)	Inducted	Indigenous
	Advanced Towed Artillery Gun System (ATAGS) (155 mm/52 calibre)	On Trial (To be inducted by end 2021 or early 2022)	Indigenous
	ATHOS	On Trial	Israel
Guns	SOLTAM (155 mm/45 calibre)	Inducted	Israel
	Sharang Gun (155 mm/45 calibre)	To be Inducted	Indigenous
	Mounted Gun (155 mm/52 calibre)	Progress not known	-
SP Gun System	K9 Vajra (155 mm/52 calibre)	Inducted	Customised Indian version of South Korean K9 Thunder
Ultra-Lightweight Howitzer (ULH)	M7777 (155 mm)	Inducted	United States
Multi Barrel Rocket Launchers (MBRL)	BM-21 Grad	Inducted	Russia
	Pinaka (Mark I, Mark II)	Inducted	Indigenous
	SMERCH	Inducted	Russia
Missiles	BrahMos	Inducted	India and Russia
	Agni I, II, III, IV, V	Inducted	Indigenous
	Prithvi I, II, III	Inducted	Indigenous
Surveillance and Target Acquisition (SATA) Artillery	Searcher Mk1 and Mk 2	Inducted	Israel
	Heron-Medium Altitude Long Endurance (MALE) UAV	Inducted	Israel

Source: Author's own, using various sources.

Artillery Modernisation Post-2011

Of the procurement targets under the FARP, the AC has already acquired 100 K9 Vajras and 145 M777-ULH. This new inventory highlights three key aspects: first, an end to the long gap in India's artillery acquisition since Bofors, with the induction of the K9 Vajra, Dhanush and M777-ULH. Second, a shift towards greater precision by adopting 155 mm as the standard calibre for all guns, with the 155 mm towed replacing the 122 mm and 105 mm. Third, a shift towards indigenisation under Atmanirbhar Bharat, with the inclusion of weapons systems such as Dhanush and ATAGs, reducing the dependence on imports.

What triggered the long overdue modernisation of the Artillery?

The primary driving factor was India's security concerns over the intensifying territorial disputes with Pakistan and China—neighbours that are both nuclear-armed. In particular, the increasing episodes of border stand-offs with China—Daulat Beg Oldi and Chumar (2013), Demchok (2014), Doklam (2017), and Eastern Ladakh (2020)—as well as Chinese transgressions into the Indian side of the Line of Actual Control (LAC) fuelled the new modern artillery inductions. In 2019, there was a 75-percent surge in Chinese transgressions in Ladakh (497, compared to 284 in 2018); in the first four months of 2020 alone, there were 170.[6] Moreover, the Galwan Valley clash of June 2020, which led to casualties at the border for the first time in 45 years, has further intensified the looming threat of a military confrontation with China, making the artillery a necessity in the age of information warfare.

At the same time, the frequent exchange of small arms and artillery fire between India and Pakistan along the Line of Control (LoC) has been a longstanding security issue. Besides, the "all-weather friendship" between China and Pakistan has created a "two-front threat" scenario for India, resulting in a heightened threat perception. In this regard, the land component attached to the territorial disputes with both China and Pakistan makes artillery crucial. Therefore, the acquisition of towed, self-propelled guns, and howitzers for the plains and the mountains is essential to ensuring India's capabilities to deter and defeat current and future threats. For instance, against the Eastern Ladakh stand-off, India deployed three K9 Vajra guns for trials in a high-altitude mountainous area.[7] Based on the performance, orders for two to three additional regiments of the self-propelled howitzers will be placed.[8]

To be sure, there are also new dangers to contend with, such as the use of drones in modern warfare. Considering the training and cost issues, wisdom lies in building capabilities by adopting a balanced mix of towed and SP guns. The ULHs are pivotal along the high-altitude areas, while the MBRLs are crucial for the preponderance of firepower in quick time over a large area, to provide a "shock effect."

Table 2: Developments (2021–31)

Name of the System	Category/ Type	Origin	Specifications	Procurement/Upgrade Status
Autonomous Towed Howitzer Ordnance System (ATHOS)	Towed Artillery Gun	Israel	155 mm/52 calibre Range: > 40 km	According to several RFP issued over the years, the IA plans to induct 1,580 towed guns, for which Israel's Elbit Systems is the preferred supplier. The deal for the same is yet to be signed.
155 mm and 52 calibre MGS	Mounted Gun System (MGS)	-	155 mm/52 calibre	On 1 April 2021, IA issued a Request for Information (RFI) to procure an unspecified number of 155 mm/52 calibre MGS.
Pinaka Mk-II	Guided MBRL	India	122 mm calibre	On several occasions in May 2018, December 2019, November 2020, and June 2021, DRDO has successfully tested the enhanced version of the Pinaka-guided rocket system.

Source: Author's own, using various sources.

Conclusion

Rapid technological advancement and an increasing shift towards information warfare capabilities require the modern Indian artillery to be technology-intensive. The artillery for the 21st century will be dominated by non-linearity, speed, homogenisation, continuity, connectivity, synchronisation, perception management, and deception.[9] The future will involve directing firepower using precision-guided systems that include loitering munitions, radars, and unmanned combat aerial vehicles (UAVs) as well as drones, missiles and rockets. Thus, in the modernisation of the IA's artillery, the pivotal capabilities are ammunition and precision. While developments in the range of ammunition have already increased the artillery's reach, surveillance remains restricted, which limits precision. The Indian Army must prioritise to address these capability gaps in its artillery modernisation drive.

II

Navy: Promise of Indigenisation, but Portents of Stagnation

Aircraft Carriers

Manoj Joshi and Mahi Khanna

Introduction

India has considerable experience in operating aircraft carriers, having acquired the *INS Vikrant* (R-11), a former Royal Navy vessel, in 1957 and commissioning it into service in March 1961. The carrier, 210 metres in length, used aircraft with catapult-assisted take-off which was later modified to a ski-jump that could use Sea Harrier fighters and Sea King helicopters for anti-submarine protection. The ship was formally decommissioned in January 1997.

The Indian Navy has always included aircraft carriers in the planning of its fleet mix. A Naval Plan Paper 11/1963 in 1963 reviewed the Navy's needs and estimated that they needed two independent fleets based on either flank of the country, and that the fleets should each comprise an aircraft carrier and an escort group.[1] Indeed, given the need for periodic maintenance, the ideal number of carriers would be three.

Although the Vikrant was decommissioned in 1997, the Navy had considered its replacement. *INS Viraat* was another former British ship. It was inducted into the Indian Navy in May 1987 with Sea Harriers and the Sea Kings helicopters. Following the decommissioning of ex-Soviet aircraft carrier *Admiral Gorshkov* in 1996, India negotiated for its acquisition for many years. In 2004, the Indian Navy finally purchased it for $2.35 billion and renamed it *INS Vikramaditya*.

Officially inducted into service in June 2014, its transition into Indian hands required large-scale refurbishment and upgrades. An array of additional modifications entailed great costs at almost every level. The former missile cruiser's weaponry and front decks were substituted for aircraft elevators and a ski-jump capable of undertaking STOBAR (Short Take-Off but Arrested Recovery) operations.

Even after its induction, INS Vikramaditya was subject to more modifications and upgrades at three different points. In 2015, it was refitted with Barak 8 long-range surface-to-air missiles (LRSAMs) and a Russian-built AK-630 close-in weapon system for operational purposes. The AK-630 close-in weapon system was taken from the decommissioned Godavari-class ship. The upgrades were deemed necessary as the warship lacked self-protection systems. Barak 8 SAMs were a collaborative effort between the DRDO and several Israeli entities.

In 2018, INS Vikramaditya was further upgraded with the addition of a marine hydraulic system built by Russia's Rostec subsidiary, Technodinamika. They were used for refuelling and pressurising the hydraulic systems of the 30 MiG 29K fighter jets and six Kamov helicopters that constituted the air wing of the carrier. The most recent maintenance and upgrades were made to INS Vikramaditya in 2020.

Vikrant Reborn

The idea of an indigenously built carrier was first mooted in the Naval Development Plan of 1979-84.[2] The concept of the ship changed over time: it began as a Sea Control Ship, was later modified to an Air Defence Ship, and finally, in 2004, was made into a regular carrier renamed as the Indigenous Aircraft Carrier (IAC-1) Vikrant. Around this time, Russia's offer of a navalised MiG-29K persuaded the designers to take up a STOBAR option where the launch would be through ski jumps, but recovery by arresting gear. This meant a larger ship with a 263-metre length (and 200-metre runway), and so the carrier evolved to a 37,500-tonne design capable of operating the MiG-29K type of aircraft, defended by LRSAMs, AK-360 CIWS, Selex RAN 40-L 3D long-range search radar, and an Elta MF-Star multifunction radar.

The work order for the IAC-1 was issued to the Cochin Shipyard Ltd (CSL) in 2004. Steel cutting happened in 2005, and the keel-laying, in 2009; the expected year of delivery was 2014. Suffering a series of procurement and cost-related delays, and later in 2020, with the outbreak of the COVID-19 pandemic, the Navy failed.[3] The basin trials for the aircraft carrier were completed only in November 2020,[4] while the sea trials have been scheduled to take place towards the end of 2021.[5] Based on the successful basin trials, the Ministry of Defence (MoD) has called for the commissioning of Vikrant by mid-2022. In the period between 2011 and 2021, the navy decommissioned the INS Viraat— purchased from the United Kingdom (UK) in the late 1980s—in 2017. This leaves the IN's current carrier strength to a single vessel.

Table 1: Aircraft Carrier Acquisitions (2011-21)

Class/ Project	Type	Boats	Origin	Displacement in tonnes	Commissioning/ Status
Centaur class	Short Take-off and Vertical Landing (STOVL) carrier	INS Viraat	United Kingdom	28,700	First commissioned into the Royal Navy as HMS Hermes in 1959, was refurbished and recommissioned into the Indian Navy (IN) on 12 May 1987. After serving the Indian Navy for 30 years, it was decommissioned on 6 March 2017.
Kiev class/ Project 11430	Short Take-Off but Arrested Recovery (STOBAR) carrier	INS Vikramaditya	Soviet Union/ Russia	44,500	Conceived from a Kiev class missile cruiser carrier named Baku, first commissioned into the Soviet Navy in 1987. Later rechristened after Admiral Sergey Gorshkov. India signed a deal with Russia in January 2004 to procure a refurbished carrier for $974 million. Project 11430 was completed at an escalated cost of $2.35 billion in 2010. INS Vikramaditya was commissioned into the Indian Navy on 16 November 2013.

Source: Authors' own, using various sources.

The China Challenge

Historically, India's naval planning is largely conducted in an abstract manner, containing rhetoric about "sea control" or "power projection" but without a clearly defined adversary. Indeed, Pakistan has a geography that did not require India to have a significant naval capacity. However, things changed in the 2010s as China's People's Liberation Army Navy (PLAN) began to make forays into the Indian Ocean Region (IOR) ostensibly on anti-piracy missions. Subsequently, PLAN began to more frequently display their strength in the Indian Ocean. Chinese state-owned firms operate commercial ports in eight countries of the IOR, but have access to a military facility only in Djibouti. Analysts say this is because the IOR countries, with the possible exception of Pakistan, do not want to get dragged in as China's co-belligerent.[6]

China's flexing of naval power has raised alarm in New Delhi. While there are no direct signs yet that China aims to set up an IOR fleet complete with bases, logistical points, and other elements, there is little doubt that Beijing considers the IOR a pivotal region, perhaps second only to the western Pacific. After all, 80 percent of China's oil imports, and a massive 95 percent of its trade with West and South Asia, Africa, and Europe, go through these waters. It is also in this region where China confronts both the US and India.

To be sure, China still has a way to go in its fleet of aircraft carriers. At present it has two carriers—the Liaoning and the Shandong, which appear largely for training purposes and neither of which has been deployed in the IOR. The first Chinese carrier Liaoning entered service in 2012; the second, and fully home-built one, Shandong, in December 2017. China's third carrier Type 003 is under construction and is expected to enter service in 2024; it has a capacity of close to 100,000 tonnes in displacement—the size of American vessels of the same kind. There are reports of a fourth carrier, which could be similar to the Type 003 and will use nuclear power.

Furthermore, China has commissioned a 30,000–40,000-tonne Type 075 amphibious assault ship which will be soon followed by two more of the same class. These can carry as many as 30 attack helicopters. There are also reports of a follow-on Type 76 class that would be equipped with electromagnetic catapults and have the capability to launch fixed-wing aircraft.[7]

As David Brewster, research fellow at the National Security College, Australian National University, has pointed out, although China's capabilities could evolve to include "limited contingency and sea denial capabilities, particularly in the northwest Indian Ocean," it would take many more years of sustained naval growth for China to attain a dominance comparable to that of the US. In his view, while there could be occasional visits of Chinese carriers in the IOR, they will primarily be flag-waving exercises.[8] Unlike the western Pacific, PLAN would find that whether it is the Hormuz, or the Maldives and the Straits of Malacca, it would be under the range of Indian land-based air power.

The Future

In 2015, as part of the Defence Technology and Trade Initiative (DTTI), India and the US created a Joint Working Group on Aircraft Carrier Technology Cooperation which had its inaugural meeting in the US. There were expectations that this could yield key technology like the electromagnetic catapult system being developed by the US. However, with little progress taking place in terms of government approval for the project, the Working Group might just remain a talking shop.

Until at least 2019, the IAC-2, more known as the INS Vishal, was very much in the mind of the Indian Navy. The ship would be a qualitative leap from the IAC-1 in terms of size. It would be a 65,000-tonne carrier, powered by integrated electrical propulsion, and carry a complement of 55 aircraft, 35 fixed-wing, and 20 helicopters. It would do away with ski-jumps and launch through the Catapult Assisted Take-Off but Arrested Recovery (CATOBAR), or even an electromagnetic catapult.

At a press briefing on the eve of Navy Day in December 2019, the Navy Chief Admiral Karambir Singh said that funding gaps had forced the Navy to rework its Maritime Capability Perspective Plan for the 2012-2027 period: the Navy would now look at a force level of 175 warships at the end of the plan period, instead of 200 as envisaged earlier (see Table 2).[9] He reiterated the need for a third carrier, but pointed out that the Navy's annual budget allocation had come down from 18 percent of the annual defence budget in 2012, to 13 percent in 2019.

Under the UPA-II government, capital expenditure on defence averaged between 30-32 percent of the overall defence expenditure. Since 2014, it started dipping, reaching a low of 23 percent in 2018-19. It has risen again slightly to 27 percent in 2021-22. This was indicative of the overall resource crunch facing the country, which has had consequences for services like the Navy and the Air Force that require massive capital investment.[10]

Table 2:
Capital Budget of the Indian Navy (in Rs crore)

Year	Projection by Navy	Allocation	% Shortfall	Actual Expenditure
2014-15	22,903	18,507	19	22,270
2015-16	25,152	19,740	21	19,874
2016-17	22,530	19,596	13	19,997
2017-18	27,717	19,348	30	20,118
2018-19	30,736	20,891	32	21,510
2019-20	40,123	26,156	34	27,447
2020-21	51,769	37,543	27	25,385 up to Dec 20
2021-22 (Budget Estimate)	70,920	33,253	53	

Source: Standing Committee on Defence Report No. 20 of March 2021 p. 26 and Report No. 3 of December 2019

Another authoritative view emerged in February 2020, when General Bipin Rawat, in his first interview after taking charge as CDS and Secretary Department of Military Affairs in the Ministry of Defence, appeared tentative when asked about the Indian Navy's requirement for a third aircraft carrier.[11] A few months later, as the Ladakh confrontation occurred, The Hindu quoted "sources" as saying that the immediate need was "a strong Army duly supported by a capable Air Force."[12] The tasks of the Navy may not require "a large number of carriers" and could be accomplished by a combination of smaller ships, submarine, good information."[13]

Table 3: Developments in Aircraft Carrier Programme (2021-31)

Class/ Project	Type	Boats	Origin	Displacement in tonnes	Commissioning/ Status
IAC- I/ Project 71	STOBAR carrier	Vikrant	India	40,000	Indigenously designed by the Indian Navy's Directorate of Naval Design (DND) and manufactured by the Cochin Shipyard Limited (CSL) respectively, Air Defense Ship, later renamed as Indigenous Aircraft Carrier (IAC), was approved by the Cabinet Committee on Security (CCS) in October 2002. Ministry of Defence (MOD) signed the contract with CSL in three phases: The first phase of the contract was signed in May 2007, the second in December 2014, and the third and final phase in November 2019. According to government reports, IAC-I would be commissioned as INS Vikrant by mid-2022.
IAC-II	Catapult Assisted Take-Off but Arrested Recovery (CATOBAR) carrier	Vishal	India	50,000- 65000	IAC-II was originally conceived by the IN as a 65,000-tonne aircraft carrier; however, due to budget constraints, the IN downsized the proposal to a 50,000-tonne carrier. Awaiting clearance from the MOD, the IAC-II remains in the proposal stage.

Source: Author's own, using various sources.

In December 2020, Admiral Karambir Singh reiterated the need for a third aircraft carrier at his Navy Day eve press conference. In the end, however, the question of budget played a hand. The cost of a carrier will be steep, at around $ 16-17 billion with its aircraft component. There are other issues to consider as well. Already, A2/AD ballistic missile systems have emerged as threats to aircraft carriers. New technologies of faster and more agile ships, submarines, and autonomous aerial and undersea vessels—along with Artificial Intelligence-enabled concepts like swarming—could overtake the importance the Navy attaches to a third carrier

In mid-2021, the Navy informed the government that the induction of six nuclear-powered submarines would take priority over the third aircraft carrier in view of the rapid expansion of the PLA Navy in the IOR. The proposal for their construction is pending with the Cabinet Committee on Security.[14] In the meantime, in early June 2021, the government approved another long-standing project for six new-generation conventional submarines.

The bottomline for the development of additional carriers became evident in a report of the Parliament's Standing Committee on Defence issued in March 2021. Even while acknowledging the need for three carriers, an unnamed MoD official posited this alongside the idea of island territories with operational runways and "are ideally suited to block the three ingress routes (Malacca, Sunda, and Lombok Straits) through which Chinese ships and aircraft will be coming in."

Blocking Malacca Straits adjacent to the Andaman and Nicobar Islands is one thing, but it is a stretch to do the same with the Sunda and Lombok Straits which are 2,000 and 3,000 km away from the southernmost runway on the Nicobar Islands, and that too, if flying over Indonesian territory. The short point the official made, however, was that "a call will be taken (later) as to at what stage should go for the third aircraft carrier."[15]

The bigger problem may be that in the absence of a National Security Strategy (NSS), no one is sure as to the exact missions of the military beyond the defence of India and its island territories. While there is no dearth of opinions from senior officials of the military, what is lacking in those statements is authority. What are the threats that are being envisaged? What is the priority that the government assigns to the maritime challenges and, consequently, what kind of resources is it willing to provide to cope with these obstacles? Unless these issues are made clear, it would be simply unconscionable for the government to invest in an aircraft carrier group.

Surface Navy

Sudarshan Shrikhande

Introduction

In multi-dimensional force-structures of any middle- to large-sized navy, every medium has its place in the overall architecture. This article examines some issues of India's surface fleet (focusing on destroyers, frigates, and corvettes) for the period 2011-2021, and the current decade.

2011-2021

The "silent Service" had a particularly tough decade over 2011-2021: significant pressures on its share of the defence budget;[1] growing threats from Chinese and Pakistani sea power; and rising responsibilities within the Indian Ocean Region (IOR) for constabulary and humanitarian assistance roles. Yet, the Navy deserves recognition for what could be called a "coping-plus" approach to counter the difficulties of having less resources while trying to be future-ready. This may have been possible owing to three interrelated measures:

1. Reduction of fiscal, material, operational and personnel pressures by decommissioning older ships, including those which might have been marginally useful. In other words, a "notional" fleet is of little help as a national fleet.

2. The push for future-ready ships. Naval construction is a long-term process. While its course can be altered slightly, if a ship-class has to be drastically curtailed or abandoned altogether, it often is due to poor type and technical choices. (The US Navy's Littoral Combat Ship could be one example.)

3. The modernisation of existing ships with better weapons, sensors, command and control, auxiliary machinery and other capabilities. Planning for this is complex but the IN has become more methodical about it.

A word here about ship types may help. Since the 1970s, destroyers, frigates and even corvettes, as a rule, have increased in displacement. The IN's current destroyers are larger than the old cruisers and magnitudes better in terms of destructive as well as "cruising" attributes. Some modern corvettes may displace more than older frigates and destroyers. However, these classifications do remain valuable for different mission requirements across the spectrum of warfare.

Table 1:
Surface Ships Commissioned (2010-21)

Class/ Project	Type	Boats	Origin	Displacement in tonnes	Commissioning/ Status
Destroyers					
Kolkata class	Guided-missile destroyer	INS Kolkata INS Kochi INS Chennai	India	7,400-7,500	Follow-on to the Project 15 'Delhi' class destroyers, Kolkata class destroyers (INS Kolkata, INS Kochi, and INS Chennai) were commissioned in August 2014, September 2015, and November 2016, respectively.
Frigates					
Shivalik class	Stealth guided-missile frigate	INS Shivalik INS Satpura INS Sahyadri	India	6,200	INS Shivalik, INS Satpura, and INS Sahyadri were commissioned in April 2010, August 2011, and July 2012, respectively.
Teg class	Stealth guided-missile frigate	INS Teg INS Tarkash INS Trikand	Russia	4,000	INS Teg, INS Tarkash, and INS Trikand were commissioned in April 2012, November 2012 and July 2013, respectively.
Corvettes					
Kamorta class	Stealth Anti-Submarine Warfare (ASW) corvette	INS Kamorta INS Kadmatt INS Kiltan INS Kavaratti	India	3,500	Indigenously built by Garden Reach Shipbuilders & Engineers (GRSE), INS Kamorta, INS Kadmatt, INS Kiltan, and INS Kavaratti were commissioned in August 2014, January 2016, October 2017, and October 2020, respectively.

Table 2:
Ships Decommissioned Since 2010[2]

Type	Names	Year
Frigates	Dunagiri, Vindhyagiri, Taragiri	2010-13
Frigate	Krishna (training frigate; ex- UK)	2012
Frigates	Godavari, Ganga	2015/18
Corvettes	Veer, Nipat, Nirghat, Nirbhik	2016-18
Destroyers	Ranjit, Rajput	2019/21

Three important points may be made:

1. A focus on primarily indigenous designs and shipbuilding has yielded results. The acquired maturity will fructify in the coming 20 years.

2. There is greater stress on evolved designs with steady improvements on the "keel" of the fundamental "DNA". Incremental modifications include improved stealth, machinery controls, greater indigenous equipment all around, and weapon and sensor upgrades. This can be seen in the Project 15 (Delhi, 1997) to the three-ship 15A (Kolkata) and the four-ship 15B (Visakhapatnam, 2021 onwards) classes spanning three decades.

3. It is difficult to accurately and rigorously gauge the actual cost of warship-construction in India. There is complex and long-term involvement of design bureau staffs; a few foreign consultancies; DRDO inputs; Defence PSU costs in sensors, weapons, among others (the components and spares of which may be imported). Build-costs seem to be surprisingly greater than in China.[3] Even in good times, costs have to be competitive along the "float-move-fight" framework and a more "corporate" approach to accounting may bring billed-costs down. In the same breath, self-reliance, even with low volumes and sometimes at a higher cost, are better than continued imports; but acceptance of higher indigenous costs should not be a permanent burden.[4]

Modernisation Matters

The Indian Navy began its platform modernisation some decades ago, with the turret (i.e. the one near the bows) of the old Talwar-class frigates, for example being removed and replaced with anti-ship missiles removed from missile boats.[5] Eponymous "Mid life updates"(MLU) have technical, operational and financial angles to balance. They need budget outlays for replacement hardware; matching refit loading of yards; and finally, maintenance of a minimum operational force level. Therefore, not all ships of a class can be upgraded. In the last decade nonetheless, several weapon and sensor upgrades were authorised or completed. Notable among these are the following:

1. Some ships of the new Talwar and Delhi classes were fitted with the indigenous Brahmos anti-ship missiles (ASM) either in vertical or inclined launchers. The benefit of this missile, apart from its speed and lethality are the potential for enhancements in range, targeting and even speed. It is also used by the Army and IAF as well as by the Navy in the next generation of coastal mobile batteries.[6] When upgrades are developed and tested, it is possible for most missile-capable ships to have the latest versions of Brahmos.

2. Sensors (sonars and radars), self-defence systems (torpedo countermeasures, anti-missile), main guns, torpedoes, and fire-control systems were upgraded with far better indigenous or a few imported upgrades.[7] Among other benefits, logistics and maintenance costs should come down.

Table 3:
Likely Surface Ship Inductions (2021-2031)

Class/ Project	Type	Boats	Origin	Displacement in tonnes	Commissioning/ Status
Destroyers					
Project 15B	Stealth guided-missile destroyer	IN Ships Vishakhapatnam, Mormugao, and Imphal. Fourth destroyer in class is yet to be named.	India	7300	INS Vishakhapatnam, Mormugao, and Imphal were launched in 2015, 2016, and 2019, respectively. According to media reports, INS Vishakhapatnam is likely to be commissioned into the Indian Navy in 2021-2022.
Project 18	Stealth guided-missile destroyer	06 in class are planned	India	10,000-13,000	According to some media reports, the Indian Navy is planning to manufacture 13,000-tonne stealth-guided missile destroyers.
Frigates					
Upgraded Talwar/Teg class (Project 1135.6)	Stealth guided-missile frigate	04	Russia	4035	In October 2016, India signed an inter-governmental agreement with Russia to procure four Krivak/Talwar class stealth frigates. In October 2018, India signed a deal with Russia to purchase two stealth warships for $950 million. Later, in November 2018, India's Goa Shipyard Limited (GSL) inked a deal with Russia's Rosoboronexport to manufacture two frigates of the same class in Goa with technology transfer from Russia for $500 million.
Corvettes					
Anti-Submarine Warfare Shallow Water Craft (ASWSWC)	Anti-Submarine Warfare corvette	16 in class have been ordered	India	750	On 29 April 2019, the Ministry of Defence (MOD) signed a contract with Garden Reach Shipbuilders & Engineers Limited (GRSE) to procure eight ASWSWCs for INR 6,311.32 crores. According to the contract, the first ship is to be delivered in October 2022 and, subsequently, two ships will be handed over every year. On 30 April 2019, MOD awarded a related contract to Cochin Shipyard Limited (CSL) to procure eight more ASWSWCs for the exact amount and a similar delivery schedule.

The Next Decade, 2021-31

Reports suggest that Visakhapatnam (Project 15B) shall be delivered in 2021 and three more soon thereafter.[8] There are other media reports of a so-called six-ship Project 18 (New Generation) destroyers greater than 10-12,000 tonnage on the scale of the Chinese Type 055-class.[9] Four more modified Talwar/Teg class frigates would be inducted in the next few years; two from Russia and another two built in Goa. The keel of the first was laid on 18 June 2021. It is difficult to ascertain the reasons for this step instead of constructing four more Type 17s , and then building the superior, possibly seven-ships of Type 17A.[10]

Likewise, there appear to be plans to build six New Generation Missile corvettes[11] (probably by CSL, Kochi) and 16 shallow-water ASW corvettes—eight in GRSE, Kolkata and eight by CSL, Kochi.[12] These ASW corvettes may be an over-investment since ships have limited ASW effectiveness compared to ASW helicopters, aircraft and unmanned underwater vehicles that might be better for future needs.

Conclusion

The Indian Navy is coping with serious budget constraints, rising two-front threats, difficulties in prioritisation, challenges in both shipbuilding efficiencies, and an over-dependence on imports especially in the "fight and move" factors of the surface fleet. Viewed through a narrow lens, the cliché of "cautious optimism" seems fitting. However, when seen through the prism of China's fleet expansion and the dragon's "jaws, claws and lashing tail," the IN's budgets need bolstering and force-planning could benefit with sharper thinking for future-readiness.[13] If anything, the silent Service needs to make some noise about how shrinking budgets would impact on building the navy India needs for future-readiness.

Submarines

Abhijit Singh

Introduction

India is expanding efforts to modernise its submarine fleet, amidst concerns over China's growing naval presence in the Indian Ocean. In June 2021, the defence ministry approved a deal for the construction of six conventional submarines under Project-75 (I) at an estimated cost of INR 43,000 crores.[1] To be processed under the strategic partnership model, the project is slated to become the largest under 'Make in India', potentially creating the foundation of an industrial ecosystem for submarine construction in the country.

Conceived as a follow-on project to the Scorpene class diesel-electric submarines programme underway at Mazagon Dock Ltd, the P-75(I) is aimed at indigenously constructing submarines with modern weapons and sensors, and an air-independent propulsion system (AIP). The proposal, however, lay dormant untilFebruary 2019, when the government approved an 'Acceptance of Necessity'. The strategic partnership model—under which the new submarines are proposed to be constructed—underwent numerous alterations, as officials sought to fine-tune the terms of engagement with foreign firms.[2] The recent go-ahead by the defence ministry may well be the stimulus the project so direly needs.

Developments (2011-21)

Over the past decade, the navy's key operational deficit has been the lack of attack submarines. With a mere 14 conventional subs and one nuclear attack submarine (SSN), the *INS Chakra* (an Akula-II class on lease from Russia), the navy's submarine arm, has been under considerable strain. Not only are current force levels at least 10 short of the ideal figure of 24, Kilo-class (Sindhughosh) subs—the workhorses of the submarine fleet—are fast nearing the end of their service life.[3] Observers say the decommissioning of the *INS Sindhudhvaj* later this year will begin the process of retiring all the boats in the class by the end of the decade.[4]

Table 1:
India's Current Submarine Assets

Class	Type	Boats	Origin	Displacement in Tonnes	Commissioning / Status
Nuclear Submarines					
Chakra	SSN	INS Chakra	Russia	8,140	Under a 10-year lease from Russia; to be completed in 2021.
Arihant	SSBN	INS Arihant		6,000	
Conventional Submarines					
Shishumar class	SSK (Type 209S)	Shishumar Shankush Shalki Shankul	Germany India	1,850	INS Shishumar and Shankush are undergoing a mid-life upgrade to be completed in 2021.
Kalveri class	SSK	Kalveri Khanderi Karanj	France India	1,870	Kalveri, Khanderi and Karanj were commissioned in December 2017, September 2019 and March 2021, respectively.
Sindhughosh class		Sindughosh Sindhydhvaj Sindhuratha Sindhukesari Sinduvijay Sindhuratna	Soviet Union Russia	3,000	Sindhukesari, Sindhuraj, Sindhuratna, Sindhughosh are undergoing a major refit and life certification programme.

Source: Author's own, from various open sources.

Ruefully, Project-75, the replacement programme for the Kilo class, has been moving slowly. Signed in 2005, the contract for six Scorpene class submarines was supposed to have been delivered between 2012 and 2016. But INS Kalveri, the first boat was commissioned only in 2017, five years later than originally scheduled. By 2020, two more submarines—the INS Khanderi and INS Karanj—had been inducted, all without a full complement of their primary weapon, the torpedo. A plan to procure 100 Black Shark Torpedoes from WASS fell through, after its parent firm, Finmeccanica, was blacklisted by the Defence Ministry in the wake of the Augusta Westland VVIP chopper scam.[5]

With the Scopene project struggling to keep pace, the navy has been under pressure to delay the decommissioning of the Kilos. The latter have so far shouldered the burden of undersea defence, but are fast ageing. The loss of the INS Sindhurakshak to an accident in 2003, and the transfer of the Sindhuvir to the Myanmar navy in 2020, has added to the navy's woes. Consequently, many Kilo class subs are being given life-extension refits to maintain capability at least until replacements arrive.[6]

The dip in submarine force levels has also prompted the navy and Mazagon Dock Shipbuilders' Ltd (MDL) to expedite delivery of the Kalveri class. INS Vagir, the fifth boat in the class was launched in November 2020. Four months later, in March 2021, the navy commissioned the third boat in the class, the INS Karanj.[7] With the Vela and Vagir undergoing sea trials, and Vagsheer planned to be launched next year, naval planners are hopeful that impetus will carry forth to the P-75(I) project. Already, the defence ministry has shortlisted MDL and private shipbuilder Larsen & Toubro (L&T) to construct six new stealth submarines with foreign collaboration.[8]

Meanwhile, there is better news on the nuclear submarine (SSN) front. In May this year, the Indian navy approached the government for approval to make changes in the 30-year submarine building plan approved in 1999.[9] The navy intends to replace six conventional attack vessels with nuclear-powered platforms in the context of changing strategic scenario in Indo-Pacific. In the face of growing Chinese deployments in the Indian Ocean, and efforts by other Indo Pacific powers to build submarine capability, there is near consensus among senior officers, both serving and retired, that an Indian SSN construction programme—as lengthy and complex as it is likely to be—is both essential and inevitable.

It is relevant that the Akula class SSN Chakra, on a decade long lease from Russia has recently been returned.[10] India has already signed a deal for the lease of another such submarine, which is expected to be delivered in 2025, New Delhi is also considering leasing one more Akula class SSN, though discussions are reportedly still in a preliminary stage.[11]

Future Developments (2021-31)

Over the next decade, the IN will look to induct at least 6 submarines in the P-75 (I) class, and 6 SSNs. Australia's recent announcement to acquire nuclear-powered submarines under a new tripartite arrangement with the U.K. and the U.S. (AUKUS) will spur New Delhi to redouble efforts to manufacture SSNs for the Indian navy.[12] The navy will also look to induct the INS Arighat—the second ballistic missile nuclear submarine (SSBN) after the INS Arihant—and the S4, an advanced boat in the class, to create formidable deterrence against China.[13] Efforts are on to develop the K5 (5,000 kilometers) and K6 (6,000 kilometers) submarine-launched ballistic missiles for the new class of SSBNs. Researchers have been working on the K-8, a larger missile with a range of 8,000 kilometers.

Table 2:
Planned Inductions Over the Next Decade

Class	Type	Boats	Origin	Displacement in Tonnes	Commissioning / Status
Nuclear Submarines					
Arihant class	SSBN	Arighat S4 S4*	India	Arighat 6,000 S4 and S4* 7,000	Arighat is presently under trails S4, S4* are under construction
S-5	SSBN	03 boats in S-5 class	India	13,500	Project has been approved with a budget of INR 10,000 crores
Akula III class	SSN	01 boat on lease from Russia returned in June 2021	Russia	12,700	In March 2019, India and Russia signed an agreement for the transfer of another Akula III class.
Nuclear attack submarines	SSNs	06 boats	India		
Kalveri class		INS Vela, Vagir, Vagsheer	India	1,870	Vela and Vagir (launched in 2019, and 2020) are in sea trials. Vagsheer is under construction.
Project 75 I	SSK	06 in class are planned	India		On 4 June 2021, India's Defence Acquisition Council (DAC) approved a deal for the construction of six conventional submarines under Project-75I at an estimated cost of INR 43,000 crores.

Source: Author's own, from various open sources.

For now, the focus is on the Kalveri class and the P-75(I) submarines. It remains to be seen how promptly and efficiently plans are going to fructify. If India manages to abide by stated deadlines, the country's submarine modernisation programme stands a good chance of success.

III

Air Force: Improved Capabilities; Major Transformation a Distant Dream

Fighter Fleet

K.A. Muthana

Structure of the IAF

The force structure of the Indian Air Force (IAF) has not changed in the last decade and is likely to stay the same in the coming one. Even with the expected formation of theatre commands, it will be imprudent to divide the fighter aircraft force between theatre commands since such a step would challenge the very nature of air power—the more important characteristics being concentration of force, flexibility, and reach. Thus, assuming that the structure of the IAF will remain the same, this chapter discusses the possibilities for development in the next decade, with respect to upgrades, new procurements, and indigenous development programmes.

Existing Platforms

An overview of the existing fighter fleet of the IAF, its growth trajectory over the last decade, and the plans for the next decade are highlighted below:

1. The last major overhaul of the MiG-21 Bison aircraft has been completed at Hindustan Aeronautics Limited (HAL), Nasik. This fleet is expected to wind down within the current decade.

2. The upgrade of the Mig-29 fleet will continue, including that of the 21 aircraft, which may also be procured.[1] In addition to replacements, procurement is likely to increase the MiG-29 squadron strength by one.

3. The last of the presently contracted Su-30MKI aircraft have been manufactured at HAL Nasik.[2] The replacement of lost aircraft will roll out in a few years; meanwhile, ad hoc upgrades to the fleet/parts of the fleet will continue. A comprehensive avionics suite and weapon suite upgrade is long overdue and is likely to be undertaken. The Design & Development (D&D) of the upgrade may be conducted in Russia, followed by a fleet upgrade in India.

4. The Final Operational Clearance (FOC) Mirage-2000 upgrade has been accorded, and fleet modification is underway.[3]

5. The DARIN II Jaguar fleet will be sustained, and the upgrade of specified aircraft to the DARIN III standard is ongoing.[4]

6. The last of the presently contracted Hawk aircraft have been manufactured. While they are primarily used for advanced pilot training, upgrades to mission systems and the enhancement of the weapon suite are possible.

7. The FOC was accorded to Tejas aircraft, and deliveries are underway. Tejas Mk 1A aircraft[5] deliveries should commence in 2024 and are planned for completion by the end of the decade.[6]

India's existing and contracted fighter platforms remain insufficient to sustain concurrent and full-fledged air campaigns against Pakistan and China—the country's two key adversaries—across the stretch of contested frontiers, international boundaries, and peninsular/island frontiers. Moreover, in the present ecosystem, where the conversion of Tejas from Initial Operational Clearance (IOC) to FOC took six years, no further indigenous programmes are likely to succeed in equipping the fighter fleet by 2031. Additional procurements or robust military partnerships/alliances may be essential to plug operational gaps. In the first half of the next decade, the LCA Mk II may serve to fill the numbers gap. Key events in the last decade are summarised at Table 1 below.

Table 1:
Developments from 2011 to 2020

Fighter Aircraft	Type	Origin	Specifications	No. of Squadrons	Procurement/Upgrade Status
MiG-21 Bison	Multirole fighter/ ground attack aircraft	Soviet Union/ Russia	Single engine Single seater Max. speed: Mach 2.1	4	End-life upgrade completed. HAL delivered the last MiG-21 to undergo a major overhaul in November 2020.
MiG-29	Air superiority fighter aircraft	Soviet Union/ Russia	Twin engine Single seater Max. speed: Mach 2.3	3	MiG-29s are undergoing an avionics and weapon upgrade under a 2009 modernisation programme.
Jaguar	Multirole fighter/ ground attack aircraft	Britain–France	Twin engine Single seater Max. speed: Mach 1.3	6	56 Jaguars are undergoing a navigational-attack system upgrade from DARIN I to DARIN III standard.
Mirage-2000	Air-defence and multirole combat fighter	France	Single engine Single seater Max. speed: Mach 2.3	3	Mirage-2000 fleet is undergoing its third overhaul and avionics, navigational, and weapon upgrade under a 2011 project.
Su-30 MKI	Multirole air-superiority fighter aircraft	Russia	Twin engine Twin seater Max. speed: Mach 2.3	12	In January 2021, HAL Nasik, completed the delivery of 222 Su-30 MKIs. A fleet of 40 Sukhoi fighter jets is undergoing modification to carry air-launched Brahmos supersonic cruise missile, and a Brahmos-armed Su-30 MK I squadron (222) was raised at Thanjavur in January 2021.
LCA Tejas Mk 1	Multirole lightweight fighter	India	Single engine Single seater Max. speed: Mach 1.6	2	(i) On 31 March 2006, the Indian Air Force (IAF) signed an agreement with HAL to procure 16 IOC fighters and four IOC trainers. (ii) Another agreement was signed between the IAF and HAL on 23 December 2010, to procure 16 FOC standard fighters and 4 FOC trainers. To date, the IAF has received 16 IOC standard and one FOC standard fighter aircraft.
Rafale	Omni-role Twinjet fighter aircraft	France	Twin engine 28 single seaters and 8 twin seaters Max. speed: Mach 1.8	2	In September 2016, India signed an inter-governmental agreement with France to purchase 36 aircraft at INR 58,000 crores. As of May 2021, India has received 20 of them. Complete delivery is expected by 2022.

Source: Author's own, using various open sources.

Air Campaigns of the 21st Century

While the IAF is a highly proficient and well-trained force, it is lagging behind China, its principal adversary, in its ability to harness the war-fighting capabilities enabled by the exponential growth in the levels of technology. Sensors and shooters of the three services largely operating in silos are suboptimal, to say the least. A robust combat cloud (a self-contained data and voice network for combat purposes) must be created, wherein all sensors and shooters, both on the surface and above, should be included in the "internet of military things." The MoD has added Software Defined Radios (SDR) to the negative list of defence imports, indicating that India has the indigenous technological capability.

The challenge now will be to make available the resources and efforts required to package the technology as necessary, as well as network all sensor–shooters on and above the surface. At the same time, all future sensor–shooters, including fighter aircraft, must be enabled or designed ab initio, to operate in the cloud. It is important to view weapon systems as organic components of aircraft and enable them as well to operate in the combat cloud. Several Western air forces have already deployed such technology.

Current Capability Gaps

A glaring capability gap in the IAF fighter fleet is the lack of stealth aircraft. While debate is still ongoing across air forces on the cost–benefit analysis of stealth, it is clear that attempting the penetration of modern air defence systems, especially that of India's northern adversary, with non-stealth aircraft is a hazardous endeavour. Stealth aircraft are necessary for weakening enemy air defences, which then paves the way for non-stealth aircraft to penetrate further. The IAF has rightly made the Advanced Medium Combat Aircraft (AMCA) programme its top priority. If early signs are any reflection of future trends, the ideation and processes involved in the D&D of the AMCA may not yield the best results and could mirror the problems, such as delays, that had affected the Tejas programme. Given the pace at which technology is advancing, such issues can be catastrophic on most parameters.

An ideal path for the AMCA programme would have been to run a Research and Development (R&D), competition between the government/public sector and the Indian private sector with a foreign partner, similar to what the Innovation for Defence Excellence (IDEX) organisation does for small-ticket items. However, the Defence Acquisition Procedure, 2020 does not provide for such R&D competitions in fighter aircraft programmes. An alternative to this is to bring in a competent partner with a financial stake in the programme. The partnership can be aimed at inducting technology, including Model-Based Systems Engineering (MBSE), to optimise D&D, manufacturing, and sustainment methods; adopting agile software development techniques to facilitate ease of hardware and software upgrades; and bringing in open mission system architecture to enable application software upgrades even on the fly. MBSE is a key element of Industry 4.0, and has been acknowledged by Indian Prime Minister Narendra Modi.

At present, India's aircraft manufacturing facilities are far from being Industry 4.0 compliant. With significant future-generation technologies and innovation, the AMCA could also have an optionally manned variant, configured either as a weapons carrier or as a sensor platform—to operate unmanned wingmen with different capabilities or to operate as an airborne command-and-control post. The ability to employ hypersonic weapons and directed energy weapons can also be built into the concept.

The second capability gap is the lack of stealthy long-range bombers and the deterrence value it could offer. The efficacy of surface-to-surface missiles with conventional warheads is limited, and their use can be prohibitively expensive. In contrast, long-range stealth bombers offer multiple advantages—in terms of weight of attack, greater accuracy, and reusability—at a fraction of the cost. For India to reach what can be called the "centre of gravity targets" in mainland China, it must first cross the massive Tibet Autonomous Region (TAR). While most such targets are 1,500–2,500 km away, none of India's present aircraft offers an adequate radius of action. Even Air-Launched Cruise Missiles (ALCM) need to have a range of more than 1,000 km, and such weapons can only be carried by the bomber class of aircraft. India does not yet have the capability to conduct meaningful conventional strategic air campaigns against China, and offensive counter-air operations are restricted to airfields in Tibet, along with their resident platforms, storage areas, and infrastructure available at these airfields.

> While the IAF is a highly proficient and well-trained force, it is lagging behind China, its principal adversary.

The third gap is related to Counter Surface Force Operations (CSFO). In the event of an active conflict with China, the IAF would be in a position to contribute significantly to the maritime air operations campaign. However, intense battles are likely to unfold along the northern borders, which are located almost completely in mountainous terrain. Moreover, China is likely to be sensitive to attrition in human resources due to its current demographic profile. The agile Hawk is one aircraft that is ideally suited for counter-surface force (air-land) operations, especially in such terrain.

Therefore, the IAF must upgrade the Hawk aircraft with suitable mission systems and permitted anti-personnel weapons. Production lines must be reopened, and some squadrons inducted specifically for this purpose. Merely redeploying training aircraft when required for this role will not serve the purpose. Intense training and constant practice are essential for them to operate, in close coordination with land forces, in such inhospitable terrain. Use of existing multi-role fighters for this role would either be sub-optimal or an overkill. Contracted and possible future inductions into the IAF are summarised in Table 2.

Table 2:
Developments from 2021 to 2031

Fighter Aircraft	Type	Origin	Specifications	No. of Squadrons	Procurement/Upgrade Status
MiG-29	Air superiority fighter aircraft	Soviet Union/ Russia	Twin engine Single seater Max. speed: Mach 2.3	4*	On 2 July 2020, the Defence Acquisition Council (DAC) approved the proposal for the procurement of 21 MiG-29s and the upgradation of the existing 59 MiG-29s at an estimated cost of INR 7,418 crore.
Su-30 MKI	Multirole air-superiority fighter aircraft	Russia	Twin engine Twin seater Max. speed: Mach 2.3	12	In July 2020, the DAC approved the procurement of 12 Su-30 MKIs from HAL at an estimated cost of INR 10,730 crore.
LCA Tejas Mk-1A	Multirole lightweight fighter	India	Single engine Single seater Supersonic	4*	On 3 February 2021, the Indian government signed a contract with HAL to procure 73 LCA Tejas Mk-1A fighters and 10 LCA Mk-1 trainer aircraft for INR 46,898 crore.
Multirole Fighter Aircraft (MMRCA 2.0)	Medium multirole combat aircraft		75 percent single seater 25 percent twin seater	6*	On 6 April 2018, the Ministry of Defence (MoD) issued a Request for Information (RFI) to acquire 110 fighter aircraft.
Hindustan Turbo Trainer-40 (HTT-40)	Basic trainer aircraft	India	Tandem-seater aircraft Max. speed: Mach 0.36		On 4 February 2021, HAL received a Request for Proposal (RFP) from the IAF for 70 HTT-40 basic trainer aircraft with a provision for 38 more. MoD sources indicate that the follow-on 38 aircraft could be weaponised as light-attack aircraft.

Table 3:
Projects Underway

Fighter Aircraft	Type	Origin	Specifications	No. of Squadrons	Procurement/Upgrade Status
LCA Tejas Mk-2	Multirole medium-weight fighter	India	Single engine Single-seater aircraft		According to the ambitious plan of HAL, the Tejas Mk-2 prototype is likely to roll out in 2022. The first flight is expected in 2023 and production is to start in 2025.
DRDO-HAL AMCA	Advanced Medium Combat Aircraft (AMCA)	India	Twin engine Single seater supercruise stealth aircraft		The Aeronautical Developmental Agency (ADA) is designing and developing the AMCA. The prototype of the aircraft is likely to be ready by 2026, and production to start in 2029-2030.
Hawk Mk-132	Ground attack advanced jet trainer (AJT)	Britain	Single engine Tandem-seater aircraft Max. speed: Mach 0.84–0.85		The IAF and HAL are upgrading mission systems and adding weapons to the existing Hawks. In January 2021, in a first, Hawk successfully fired Smart Anti-Airfield Weapons (SAAW).
Mirage-2000	Multi-role combat aircraft	France	Single Engine Single Seat Max Speed M2.3	4*	Hindustan Times reported on 17 September 21 that IAF would acquire 24 second-hand Mirage-2000 fighters from France at a cost of 27 million Euros.

Source: Various open sources.
*Note: *indicates prospective squadron strength after the complete acquisition of the procurement currently underway.*

Airborne Intelligence, Surveillance, and Reconnaissance

Angad Singh

Introduction

The Indian military has the fourth-largest fleet of aircraft in the world, with approximately 2,100 air assets between the Indian Air Force (IAF), Indian Navy (IN), and Indian Army (IA).[a] The IAF is the largest of these and has the bulk of India's airborne surveillance capability.[1] This chapter uses the umbrella phrase Airborne Intelligence, Surveillance and Reconnaissance (Airborne ISR) to refer to dedicated airborne sensor capabilities, with the caveat that certain platforms bring expanded capabilities to bear, including airborne command, control, communications, computing, targeting, or some combination of these. While several surveillance aircraft bearing military markings are operated by civilian intelligence agencies such as the Aviation Research Centre (ARC) of the Research and Analysis Wing (RAW), these organisations and their structures are beyond the scope of military modernisation, and do not factor in this chapter.

Airborne ISR and command and control (C2) are not new concepts in the subcontinent. Photo reconnaissance and signals intelligence (SIGINT), under which the sub-categories of communications and electronics (COMINT and ELINT) fall, have been around in various forms since Independence. Over the years, they have evolved and expanded to account for evolving threats and technology, with varying degrees of success and efficacy. Following the 1999 Kargil Conflict and 2001–02 military standoff with Pakistan, India's Airborne ISR capabilities began to receive increased attention. Virtually all tactical aircraft currently in use are capable of some degree of ELINT, using onboard or podded receivers, and most are equipped with specialised reconnaissance pods for visual, infra-red or radar imaging.

a The IN does operate its own specialised maritime platforms, and the IA maintains a sizeable fleet of drones.

Present-day ISR

The induction of remotely piloted aircraft (RPAs) and Airborne Early Warning and Control (AEW&C) aircraft in the early 2000s marked the biggest change in airborne ISR in the modern era.

There is considerable overlap between the RPA capabilities deployed by the three services. The initial procurement of the Israeli-built IAI Searcher-I tactical RPAs for the IA was contracted in the late 1990s, and these entered service in 2000. A combined tri-service approach followed in 2002, with additional Searcher-IIs and new medium-altitude, long-endurance (MALE) IAI Herons being inducted from 2002 onward.[2]

Following the retirement of the IAF's MiG-25RB in 2006 and photo-reconnaissance Canberra PR.57s in 2007, Israeli RPAs have formed the backbone of India's airborne ISR capability—a formidable upgrade. These aircraft conduct visual, infra-red and radar surveillance, as well as COMINT and ELINT missions, for durations over 16 hours. In the case of the larger Heron, all surveillance payloads listed can be fitted for simultaneous operation, albeit at the cost of endurance, which drops to around 12 hours. Raw sensor data can be downlinked via a line-of-sight (LOS) datalink in real time or stored for later analysis by dedicated personnel on the ground. These RPAs have also received upgrades over the years, reducing operator workload through autonomous take-off and landing, as well as satellite communication (SATCOM), which frees them from line-of-sight restrictions.

Naval ISR includes specialised maritime reconnaissance and anti-submarine warfare (ASW) aircraft and helicopters, which can also be deployed over land. Since the Alizé in 1965, Naval aircraft have been utilised to conduct surveillance during crises situations and hostilities. During the Kargil conflict, for instance, the "Information Warfare" (IW) Dornier 228 aircraft of the IN were tasked with locating Pakistani radars along the land border.[3] More recently, the Boeing P-8I—the IN's newest patrol aircraft inducted in 2013—was deployed during the 2017 Doklam crisis[4] and the 2020 Ladakh standoff.[5] In addition to being equipped with a versatile ISR fleet, the IN has AEW&C capabilities in the subcontinent, the first service to induct such a system.

In 2003, the IN inducted Russian Kamov Ka-31 helicopters to protect the fleet from enemy air action and control its own carrier-based fighters.[6] The IAF's more capable Israeli-Russia A-50/ Phalcon Airborne Early Warning and Control System (AWACS) were contracted in early 2004,[7] and deliveries of the three aircraft took place between 2009 and 2011.[8] These aircraft combine the airframe and engines (PS-90) of a modernised Russian Il-76 airlifter with an Israeli IAI EL/W-2090 "Phalcon" active electronically scanned array (AESA) radar, providing 360-degree awareness.

Table 1:
Acquisitions (2011–21)

Name	Role	Country of Origin	Quantity	Description
IAI Searcher I/II	ISR RPA	Israel	>110	First contracted in the late 1990s, with several (unspecified) additional orders since. Operated by all three services.
IAI Heron	ISR RPA	Israel	>90	First inducted in 2002, with several (unspecified) additional orders since. Operated by all three services.
IAI-Beriev A-50EI (Phalcon)	AEW&C, SIGINT	Israel/Russia	3	Contracted in 2004, delivered between 2009 and 2011.
Netra EMB-145 AEW&C	AEW&C, SIGINT	India/Brazil	3	Two in service since 2017, one retained by DRDO for further development.
Kamov Ka-31	AEW&C	Russia	14	Naval AEW helicopter. Delivered between 2004 and 2012.
Boeing P-8I	MPA	USA	10	10 aircraft delivered between 2013 and 2021; two more on order.
Boeing 737	SIGINT	USA/India	2	Equipped with the DRDO SIGINT suite.
HAL-Dornier 228	MPA	India	12	Upgraded with new avionics and improved Elta radar and Elbit ESM; 12 on order.
GA-ASI MQ-9B	ISR RPA	USA	2	On lease by the IN.
IAI Heron-TP	ISR RPA	Israel	4	On lease by the IA.

Source: Author's own, using various sources.

Expansion and Modernisation

Despite plans calling for increased and more robust C2 and ISR capabilities across the three services, particularly in the IAF and the IN, the past decade has not seen a significant force accretion, and only modest improvements to capability. As noted above, the IN began inducting Boeing P-8Is in 2013, but the first batch of eight replaced the outgoing eight Soviet-era Tupolev Tu-142 in the same role. The second batch of four aircraft, currently under delivery,[9] will serve alongside the IN's older Il-38s but will eventually have to take over from those aircraft as well. The New Sikorsky MH-60R helicopters, to replace the Sea Kings Mk.42Bs that were inducted in 1988, were delivered only in July 2021.[10] Moreover, plans to induct more Phalcon AWACS for the IAF have been repeatedly mooted, including relatively recently in 2016[11] and 2020,[12] but these have yet to be executed, ostensibly due to their high costs. Similarly, plans to upgrade and arm the existing fleet of Heron UAVs are periodically floated and discarded.[13]

On the indigenous front, capacities appear modest, and the progress has been slow. The DRDO-Embraer "Netra" AEW&C, heralded as a domestic success story, was approved by the government in 2004 for delivery in 2011. The project delivered its first aircraft six years late,[14] with reduced capabilities and a host of procedural irregularities flagged by the Comptroller and Auditor General (CAG) of India.[15] A DRDO-developed SIGINT system was fielded by the IAF, but only two Boeing 737 VIP aircraft were modified.[16] Subsequent SIGINT inductions,[17] or plans to acquire additional aircraft,[18] have all centred on foreign aircraft with foreign sensor suites, suggesting a lack of confidence in the capability or the delivery of domestic equivalents. By late 2020 things came to a head, with additional Phalcon AWACS in limbo, the indigenous AEW&C too limited to merit further procurement, and the ambitious DRDO programme to develop a domestic AWACS-equivalent on the Airbus A330 deemed expensive and risky. As a compromise, the government sanctioned a hybrid AEW Project, which proposed to reuse the bulk of the Netra's systems, including the 240-degree AESA radar, but integrated with surplus Air India A320-family airliners[19]—reducing development time and solving the Embraer platform's main shortcomings of limited range and endurance. However, while the initial plans were for six of the larger A321 airliner to be the host aircraft, Air India declined to part with this profitable variant; in July 2021, the first A319 was delivered to the DRDO in Bengaluru, indicating that this variant has been selected for the AEW Project.

The modernisation of Indian drones has been equally tortuous. Despite multiple prototypes of varying configurations flown over the past decade, India has yet to field a single credible RPA fit for military service. The Rustom-2 (also known as TAPAS-BH) is the principal MALE ISR drone programme currently in development. Reported specifications have varied over the years, but the Rustom-2 is expected to offer an endurance of 24 hours at 30,000 feet. However, the programme has been dogged by delays and, as of October 2020, only demonstrated an endurance of eight hours at 16,000 feet.[20] Perhaps most baffling is the DRDO's choice of propulsion for the indigenous RPA—a pair of piston engines. The early prototypes used two Rotax 914 engines, producing 115 hp each, and more recent ones use a pair of Austro AE330 diesel engines, producing 180 hp.[21] It is worth noting that the Israeli IAI Heron already in service with the Indian armed forces manages similar endurance and altitude figures with a single Rotax 914 engine. The larger and more capable US-made General Atomics MQ-9 Reaper, one of the most prolific and versatile operational drones in existence, uses a Honeywell TPE-331 turboprop engine, the same engine as produced in India by Hindustan Aeronautics Limited (HAL) for the Dornier 228 light transport and HTT-40 trainer.[22] Despite the general design, layout and propulsion characteristics of the MALE RPAs being globally well established, the DRDO has inexplicably opted to pursue all-new configurations and ignore an indigenously built engine that is a proven RPA powerplant. To further complicate the issue, China's Wangfeng Aviation acquired Austro Engine GmbH, along with its parent company Diamond Aircraft, in 2018,[23] which makes India's indigenous MALE RPA reliant on a Chinese-owned powerplant, at least in the near term.

Consequently, the Indian military has turned to easier short-term solutions. With the new Defence Acquisition Procedure, 2020 allowing military hardware to be leased instead of procured outright,[24] the IN has moved quickly to augment its capabilities with a pair of MQ-9B SeaGuardian drones.[25] The IA followed suit, with four turboprop-powered Heron-TPs leased from Israel.[26]

Table 2:
Planned Acquisitions (2021–31)

Name	Role	Country of Origin	Quantity	Description
GA-ASI MQ-9B	ISR RPA	USA	30	Under consideration for procurement for several years.
DRDO Rustom-2	ISR RPA	India	TBD	The Rustom-2 will likely be procured in large numbers if development concludes successfully.
IAI-Beriev A-50EI (Phalcon)	AEW&C, SIGINT	Israel/Russia	2	The MOD periodically approves and re-approves procurement of additional A-50s, but no contract has been signed.
DRDO-Airbus A319 AEW&C	AEW&C, SIGINT	India/Europe	6	Development has started as of mid-2021, but the planned service entry date is unknown.
Boeing P-8I	MPA	USA	8	Two aircraft are to be delivered from under an existing contract, and procurement of another six has been cleared by the MOD.
HAL-Dornier 228	MPA	India	12	Upgraded with new avionics and improved Elta radar and Elbit ESM; 12 on order.
Boeing 737	SIGINT	USA/India	2	Equipped with the DRDO SIGINT suite.
HAL-Dornier 228	MPA	India	12	Upgraded with new avionics and improved Elta radar and Elbit ESM; 12 on order.
GA-ASI MQ-9B	ISR RPA	USA	2	On lease by the IN.
IAI Heron-TP	ISR RPA	Israel	4	On lease by the IA.

Source: Author's own, using various sources.

The Future is Autonomous

Even as India struggles to consolidate its manned and remotely crewed Airborne ISR capabilities, the future will see autonomous platforms take over both ISR and combat operations, blurring the distinctions that separate the chapters of this report. Individual independent drones, autonomous swarms, and Manned-Unmanned Teaming (MUM-T) are being seriously pursued across the world. India, too, has initiated development projects in each of these areas. However, they are largely tentative steps with uncertain goals, timelines or outcomes. In February 2021, state-owned HAL unveiled an ambitious, albeit un-funded, Combat Air Teaming System (CATS), envisioning a range of autonomous air vehicles and effectors operating in conjunction with, or at the direction of, crewed combat aircraft of the Indian military.[27] However, there is no formal IAF requirement or any set of specifications to work towards. The DRDO has a much older programme for an autonomous strike aircraft called "Ghatak," which began in the late 2000s,[28] but as of November 2020, only a sub-scale prototype has flown.[29] Despite the IAF being the first service to work towards adopting autonomous swarms, the novel public competition launched in 2018[30] has yet to result in a winner or a production contract.[31]

With the challenges currently facing India, particularly along its land borders, attention and resources will likely and understandably be poured into solving immediate requirements for persistent and accurate surveillance. It is vital to not lose sight of the future while addressing short-term goals. Going forward, India must work towards ensuring awareness of the adversary's intent to prevent situations such as the ongoing Ladakh standoff with China, as the next lapse in surveillance could just prove far costlier.

Transport Aircraft and Rotary Wing Fleet

Manmohan Bahadur

Introduction

The modernisation of an aircraft fleet can be categorised under three heads: first, the accretion of earlier models, which augments numbers with 'fresh' airframes; second, the upgrade of an existing inventory with modifications to its avionics and/or hardware, which augments its performance characteristics; and third, the acquisition of a newer, more modern type of an aviation asset. During the period 2011–21, there was a significant accretion of modern assets in both the transport aircraft and helicopter fleets of the Indian Air Force (IAF). This chapter examines the previous decade's upgrades and acquisitions, and explores the requirements of the coming decade.

Airborne ISR and command and control (C2) are not new concepts in the subcontinent. Photo reconnaissance and signals intelligence (SIGINT), under which the sub-categories of communications and electronics (COMINT and ELINT) fall, have been around in various forms since Independence. Over the years, they have evolved and expanded to account for evolving threats and technology, with varying degrees of success and efficacy. Following the 1999 Kargil Conflict and 2001–02 military standoff with Pakistan, India's Airborne ISR capabilities began to receive increased attention. Virtually all tactical aircraft currently in use are capable of some degree of ELINT, using onboard or podded receivers, and most are equipped with specialised reconnaissance pods for visual, infra-red or radar imaging.

Table 1:
Developments from 2011 to 2020

Aircraft	Type	Origin	Specifications	No. of Squadrons	Procurement/Upgrade Status
Transport Aircraft					
HS-748 Avro	Short/ medium-range utility transport aircraft	United Kingdom	Twin engine Payload capacity: 6 tonnes Cruise speed: 451 km/hr	04	The plan proposed by Hindustan Aeronautics Limited (HAL) to upgrade the Avro fleet was not accepted by the IAF, and it is instead replacing the Avro fleet with Casa C-295.
IL-76	Heavy-transport aircraft	Soviet Union/ Russia	Four engines Payload capacity: 40 tonnes Cruise speed: 850 km/hr	1.5	The Defence Acquisition Council (DAC) approved the avionics and engine upgradation of IL-76 and IL-78, respectively, in October 2015. However, the project is yet to be accorded financial sanction.
An-32	Medium-transport aircraft	Soviet Union/ Ukraine	Twin engine Payload capacity: 6.7 tonnes Cruise speed: 530 km/hr	07	The An-32 fleet is undergoing technical life extension, avionics upgrade, and overhaul under a US$400 million contract, signed with a Ukrainian state enterprise in June 2009.
Do-228	Light-transport aircraft	Germany	Twin engine Payload capacity: 2 tonnes Cruise speed: 428 km/hr	2.5	In February 2015, the IAF signed a contract with HAL to purchase 14 additional Dornier aircraft.
C-130J Super Hercules	Heavy-transport aircraft	United States of America	Four engines Payload capacity: 21.18 tonnes Cruise speed: 675 km/ hr	02	India signed a contract with the US under the Foreign Military Sales (FMS) programme to purchase six C-130J aircraft in February 2008. On 20 December 2013, India signed a US$1.01 billion deal with the US to procure six additional C-130J Super Hercules.
C-17 Globemaster	Heavy-transport aircraft	United States of America	Four engines Payload capacity: 70 tonnes Cruise speed: 906 km/hr	01	In June 2011, India procured 10 C-17 Globemaster aircraft from the US under the FMS programme for US$4.1 billion. The IAF purchased an additional Globemaster in December 2017.
Flight Refuellers					
IL-78 MKI	Flight-refueller aircraft	Soviet Union/ Russia	Four engines Fuel capacity: 110 tonnes Cruise speed: 750 km/hr	01	The DAC approved the engine upgrade of IL-78 in October 2015. Financial sanction yet to be accorded.

Aircraft	Type	Origin	Specifications	No. of Squadrons	Procurement/Upgrade Status
AWACS/AEW&C Aircraft					
Embraer-145	Airborne Early Warning and Control (AEW&C) aircraft	Brazil	Twin engine Payload capacity: 5.786 tonnes Cruise speed: 963 km/hr	01	In July 2008, India signed a US$208 million deal to purchase three AEW&C Embraer aircraft.
Rotary Wing Aircraft					
Mi-17	Medium-lift helicopter	Soviet Union/ Russia	Twin Engine Payload capacity: 4 tonnes Cruise speed: 225 km/hr	06	In January 2017, 15 years after the IAF first suggested the upgrade of the Mi-17 fleet, the Ministry of Defence (MoD) signed a contract with Elbit Systems of Israel to upgrade 90 Mi 17 helicopters (56 Mi-17 and 34 Mi-171V).
Mi-17V5	Medium-lift helicopter	Soviet Union/ Russia	Twin engine Payload capacity: 4 tonnes Cruise speed: 225 km/hr	06	The IAF ordered 59 Mi-17V5s in December 2012, augmenting its existing fleet of 80 Mi-17V5s, first ordered in 2008. The final batch of Mi-17V5 was received in February 2016.
Mi-26	Heavy-lift helicopter	Soviet Union/ Russia	Twin engine Payload capacity: 20 tonnes Cruise speed: 255 km/hr	01*	The small IAF fleet of three Mi-26s is slated for an extensive overhaul in Russia.
Chinook CH-53F(I)	Multirole heavy-lift helicopter	USA	Twin engine Payload capacity: 11 tonnes Cruise speed: 291 km/hr	01	The MoD inked a deal with Boeing in September 2015 to purchase 15 Chinook helicopters at the cost of US$1.1 billion. The IAF received the last five of the Chinooks in March 2020.
AH-64E Apache	Multirole combat helicopter	USA	Twin engine Twin-seat tandem cockpit Cruise speed: 260 km/hr	01	In September 2015, the MoD signed a deal with Boeing to procure 22 Apache attack helicopters at the cost of US$1.6 billion. Boeing delivered the last Apache helicopters in July 2020.
ALH Dhruv	Multirole Advanced Light Helicopter (ALH)	India	Twin engine Payload capacity: 1.5 tonnes Cruise speed: 245 km/hr	02	IAF inducted the first batch of ALH Dhruv MK III in February 2012.
Cheetal	Light-utility helicopter	France	Single engine Payload capacity: 0.1 tonnes Cruise speed: 192 Km/hr	01	After the initial induction of 10 re-engined Cheetah helicopters (Cheetal), IAF issued a Request for Proposal (RFP) for 12 additional Cheetal helicopters.

Transport Aircraft

By the start of the second decade of the 21st century, the IAF was largely dependent on its old fleet of around17 IL-76s and 95 odd short-haul An-32s; in the light-transport category, there was the six-decade-old HS-748 Avro and the relatively new Do-228 aircraft. These assets offered no specialist role capability, except for logistics support through equipment and personnel movement. To be sure, the IL-76 and An-32 were tasked with paradrop tasks, but missions such as special operations and real short-field and hot and high operations (with acceptable operational load) were beyond their capability. However, considering the fast-changing security environment, India was in dire need of such capabilities, which prompted the IAF planners to focus on the acquisition of special ops C-130J Super Hercules and C-17 Globemaster very heavy transport aircraft (VHETAC).

C-130J Super Hercules

The contract for the latest J model of the legendary C-130 was signed in 2008[1] as a government to government agreement under the US government's Foreign Military Sales (FMS) programme. Six aircraft were contracted to equip the newly formed No. 77 Squadron, which was christened the "Veiled Vipers," reflecting the role envisaged for it—to strike surreptitiously, with speed. The C-130J came with dark night and all-weather operations capability, enabled by electro-optic and thermal imaging equipment and the latest generation Night Vision Goggles for pilots. However, the US did not supply high-quality Digital Terrain Elevation Data for low-level navigation, since India had not signed the foundational Communication and Information on Security Memorandum of Agreement (CISMOA); this restricted the C-130J from flying at ultralow levels as the navigation equipment used commercial unclassified data. The encrypted data was supplied once India signed the Communication Compatibility and Security Agreement (COMCASA) in September 2018—the India specific-version of CISMOA.[2] No. 77 Sqn formed at the Air Force Station Hindan and a contract[3] for another six C-130J aircraft resulted in additional special-ops capability for the North Eastern sector, as the second squadron was formed at Panagarh. The C-130Js provide state-of-the-art special-ops capability, allowing the Indian Army and the IAF to conduct such missions efficiently.

C-17 Globemaster

In 2011, the Government of India entered into a contract[4] with the US government for 10 C 17 Globemasters, which would augment the heavy airlift capability of the IAF. The Il-76 aircraft had aged, resulting in sub-par performance, especially when operating from high altitude airfields such as Leh and Thoise. With superb short-field landing ability[a,5] and exceptional radar and night vision capabilities, the C-17 has revolutionised air logistics in India. During the summer months, when the temperatures reach around 30 degrees Celsius at Leh (10,500 feet above sea level), a C-17 can take off with 30 tonnes of load as against the negligible load that the IL-76 can carry. India had planned to buy three additional C-17s, but could only procure one more due to delayed decision-making.[6] The IAF now has 11 C-17s, which allow India a truly global reach, as evident in the country's outreach to far-flung nations for Humanitarian Assistance and Disaster Relief (HADR) and COVID-19 associated missions.

An-32

The An-32 was inducted into the IAF service in the early 1980s and went in for an upgrade under a contract signed in 2009. The contract[7] aimed for 105 aircraft to be re-equipped—therefore the name An 32RE—with an avionics upgrade, changes in the cockpit for increased crew comfort through noise and vibration abatement measures, and increased reliability and maintainability. The programme ran into a contractual dispute,[8] resulting in delayed upgradation; as per reports, the dispute is still ongoing—a delay of almost eight years and counting.[9] Currently, there is no clarity on this matter as most of the information is classified.

IL-76, Avro and Do-228

There have been no programmes for any upgrade of these platforms considering their limited residual life and the lack of any growth potential. The Do-228 was used extensively for short-haul missions and the IL-76 for strategic logistics operations. The Avro was meant to be phased out during the decade under consideration and replaced with the Casa C 295W,[10] but it did not happen for almost a decade due to administrative dithering and, later, lack of financial support. However, the project was finally cleared by the Cabinet Committee on Security in September 2021,[11] implying that the project can now start with contract signing and subsequent deliveries as per schedule in the next decade. This is a big step forward as it is the first time that a private Indian industry would be manufacturing a transport aircraft, albeit with foreign collaboration.

a During flight trials held in India in 2010, the C-17 landed at the 4620 ft long Gaggal airfield in Himachal Pradesh.

Flight Refuellers

The IAF procured six IL-78 Flight Refuelling Aircraft (FRA) in 2003, which have since been operating with the same basic configuration. A project to upgrade it by replacing the fuel-inefficient D-30 aeroengines with the better PS-90 powerplants was accepted by the government in 2018.[12] However, there has been little progress on it, despite such an upgrade being an urgent requirement. Plans for acquiring six additional A-330 Multirole Tanker Transport (MRTT) have fallen through twice due to the costs involved; a third attempt commenced in 2018.[13] There have been media reports about the IAF considering the leasing of flight refuellers under a new option that has been incorporated in the Defence Acquisition Procedure (DAC), 2021. However, no firm proposals seem to have been moved to the government, making the reports no more than media conjecture.[14]

AWACS and AEW Aircraft

The IAF has only a few of these vital combat enablers, with three IL-76 based Phalcon AWACS aircraft entering the inventory in 2009 and two Embraer-145-based AEW aircraft inducted in 2017.[15] The IAF has been pressing the government for more, since they have added substantially to India's air defence capability.

Rotary Wing Aircraft

The Rotary Wing (RW) fleet underwent substantial modernisation during 2011–21.

Mi-17 Variants

The Mi-17 and Mi-171V fleets provided the major part of heli-lift capability of the IAF for a long time. However, as they aged, some airframes of the two types were replaced with the Mi-17V5. The V5 also replaced the legendary Mi-8, which had outlived its useful life by many years. The Mi-17V5 has uprated engines; an air-conditioned glass cockpit; and modern nav-aids such as digital map display, VOR, and DME; the helicopter comes with NVG-compatible lighting and Gen3 NVGs of Russian origin. As part of the role equipment, in addition to the standard air-to-ground rockets, cargo sling and winching equipment, bambi-bucket fire-fighting capability was acquired. The induction of the V5s added true night-ops capability to the RW fleet and it will continue to be the mainstay of the medium-lift segment in the coming decade.

Chinook and Mi-26 Heavy-Lift Helicopters

The contract for the acquisition of 15 Chinook CH-53F(I) heavy-lift helicopters was signed in September 2015,[16] and all machines were inducted by March 2020.[17] The Chinook, with its ramp-loading facility, was to replace the legendary Mi-26 that was on its way out; however, due to the unique payload that the Mi-26 can carry (20 tonnes in fuselage or underslung), a review was perhaps done, and the three aircraft on the inventory were slated for an overhaul in Russia as per the media in 2019.[b,18] The helicopters are still in India due to issues about the contract.[19]

The Chinook, while not in the same weight class as the Mi-26, has brought in the capability to induct certain categories of heavy equipment in the narrow valleys of the North East, which the Mi-26 cannot navigate. With its high reliability, easy maintenance, exceptional manoeuvrability, and good night-op capability, the addition of the Chinook has added substantially to the heavy heli-lift capability of the IAF. Additionally, since one Chinook can be carried in the cargo hold of a C-17, the IAF can launch HADR operations at great distances, including internationally, in quick time.

Apache Attack Helicopters

The acquisition of 22 H-64E Apache attack helicopters has been a quantum accretion in the potency of the IAF's strike firepower against enemy armoured vehicles. With its mast-mounted milli-metric wave radar, Hellfire air-to-ground missiles, 70 mm rockets coupled with exceptional night-op capability, and network-centric operations compatibility, the Apache has truly improved the IAF's battlefield dominance capability.

ALH Dhruv

The IAF has inducted[20] the ALH Dhruv[21] Mk III and Mk IV versions,[c,22] which bring with them mid-level tactical heli-lift and armed-strike capability. This (relatively) low-cost option will be useful in battle areas where the threat is comparatively benign.

Chetak/Cheetah

The old Chetak/Cheetah fleet soldiers on. However, the availability of the Cheetal—an improvement on the Cheetah, with a more powerful and modern Turbomeca TM333 TB engine that powers the Dhruv—is a welcome addition for ultrahigh-altitude ops on the Siachen Glacier and the hills of Sikkim.

b Anecdotal data points to the reason for the change of decision to the unique heli-lifting of outsized loads, including bulldozers and fuel bowsers, done during the earthquake relief in Uttarakhand in 2015 – a task that the Chinooks cannot undertake.

c It is possible that the induction of the Mk IV has been without the Helina (Dhruvastra) anti-tank guided missile, since its proving trials happened only on 19 February 2021.

Table 2:
Developments from 2021 to 2031

Aircraft	Type	Origin	Specifications	No. of Squadrons	Procurement/Upgrade Status
Transport Aircraft					
Casa C-295	Multirole medium-transport aircraft	Europe	Twin engine Payload capacity: 9.25 tonnes Cruise speed: 482 km/hr		Procurement of 56 Casa C-295 from Airbus was approved in September 2021
An-32	Medium-transport aircraft	Soviet Union/ Ukraine	Twin engine Payload capacity: 6.7 tonnesCruise speed: 530 km/hr	07	The upgrade of the remaining fleet of An-32 is likely to be completed by 2025 at the Base Repair Depot (BRD) no. 1, Kanpur.
Do-228	Light-transport aircraft	Germany	Twin engine Payload capacity: 2 tonnes Cruise speed: 428 km/hr	2.5	The numbers of Flight Inspection aircraft would be 14 228 Dornier as part of the 41 Squadron which has been operating this type of light transport aircraft for many years.[23]
Flight Refuellers					
A-330	Multirole Tanker Transport (MRTT) aircraft	Europe	Twin engine Payload capacity: 43 tonnes Fuel capacity: 111 tonnes		In June 2018, the IAF issued a Request for Information (RFI) to procure six FRAs. To overcome the immediate shortage, the IAF is planning to lease three A-330 multirole tanker aircraft.
AWACS/AEW&C					
AEW&C	Airborne Early Warning and Control (AEW&C) aircraft				On 17 December 2020, the DAC granted an Acceptance of Necessity (AON) for the procurement of six AEW&C Mk-2 aircraft.
Rotary Wing Aircraft					
Mi-17V5	Medium-lift helicopter	Soviet Union/ Russia	Twin engine Payload capacity: 4 tonnes Cruise speed: 225 km/hr	06	Since 2019, Mi-17V5s are undergoing their first major overhaul at 3rd BRD, Chandigarh.
HAL LUH	Light-utility helicopter (LUH)	India	Single engine Payload capacity: 0.5 tonnes with fuel for range of 350 km Cruise speed: 235 km/hr		The Centre for Military Airworthiness and Certification (CEMILAC) accorded Initial Operational Clearance (IOC) to the IAF variant of LUH on 7 February 2020. HAL has an in-principle order of 61 LUH from the IAF.
Ka 226-T	Light multi-mission helicopter	Russia	Twin engine Payload capacity: 1 tonne Cruise speed: 220 km/hr		In 2015, India signed an inter-governmental agreement with Russia to procure 200 Ka-220T utility helicopters (IAF is slated to get 65 helicopters). Once the impasse over the indigenous content is resolved, the first helicopter will be delivered within 36 months from the signing of the contract.

*Note: *Three Mi-26 choppers are with the IAF Squadron No. 126 HU (Featherweights), which also houses Chinook helicopters.*

The Next Decade

Over the last decade, the transport and helicopter fleet of the IAF has already undergone substantial modernisation in terms of new assets. The challenge now is to identify how the fleets can be further modernised from 2021 to 2031.

The next decade is expected to be focused on joint operations in a secure network. Thus, it will be crucial to ensure the inclusion of transport and helicopter assets in the "net centricity drive" of the IAF. This involves equipping the fleets with software-defined radios and software architecture to integrate these fleets in the Integrated Air Command and Control System (IACCS) of the IAF to utilise the full capabilities of the Apache, Chinook, C-17, and C-130J. Information dominance will be key to future combat; hence, Intelligence Surveillance and Reconnaissance (ISR) must be prioritised. This involves not only additional AWACS/AEW&C aircraft and UAVs but also interlinked space assets, since space will be a key domain in any future conflict.

Furthermore, realistic training for war is vital, and simulators for all fleets (in adequate numbers) must be acquired. The IAF should graduate to synthetic and virtual-reality devices. Night vision, too, should be a mandatory qualitative requirement in all future acquisitions.

At present, India has a sufficient basic fleet of transport aircraft and helicopters. While future acquisitions are important for both fleets, these will be expensive, and the IAF will have to take into account the COVID-19-induced financial crunch in their plans. Many modernisation plans in the next decade may have to be limited to upgrades for key requirements, with an emphasis on the better utilisation of available assets and the tailoring of war plans.

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I. Army: Incremental Modernisation with Limited Resources

Main Battle Tanks

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II. Navy: Promise of Indigenisation, but Portents of Stagnation

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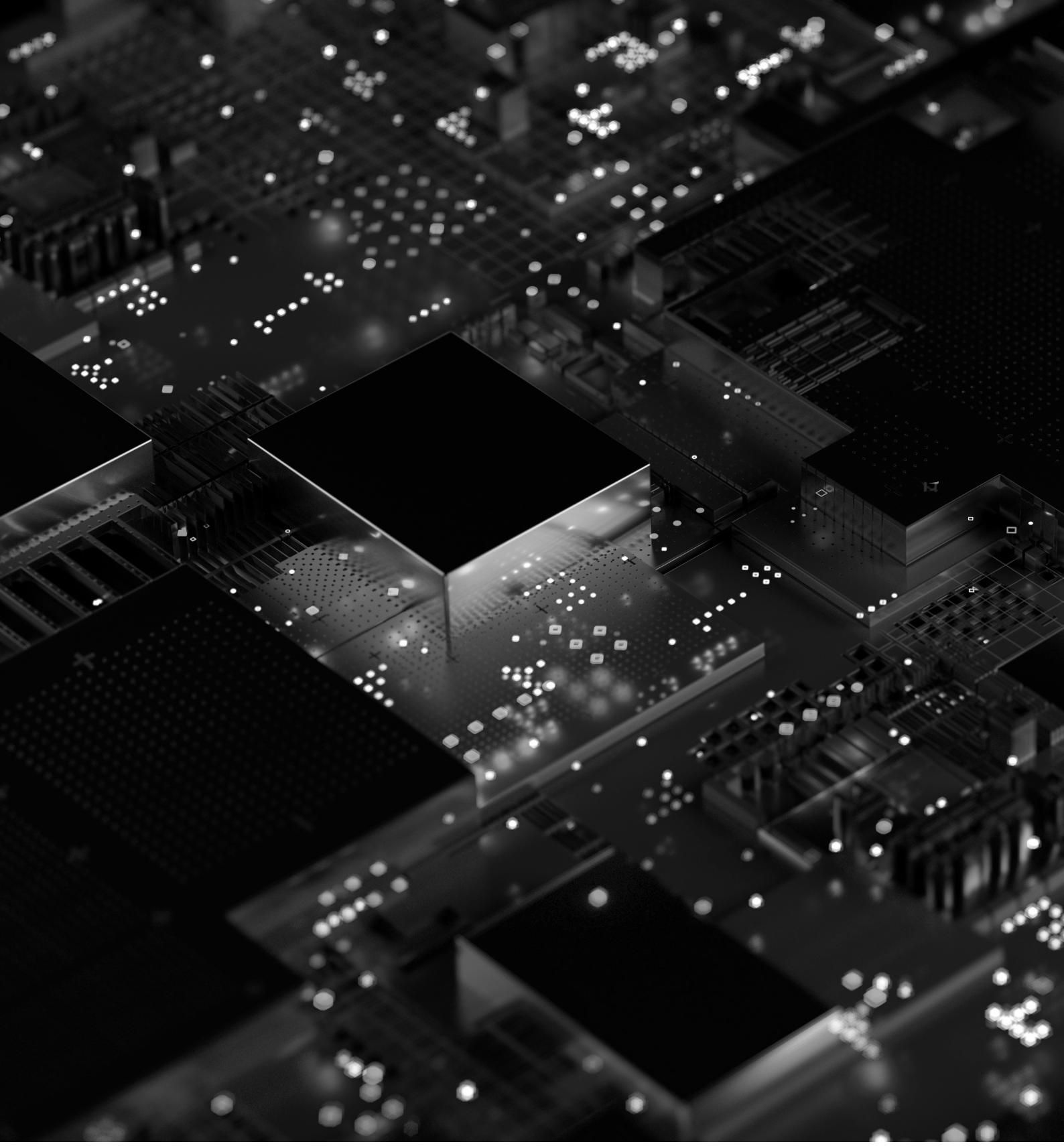

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