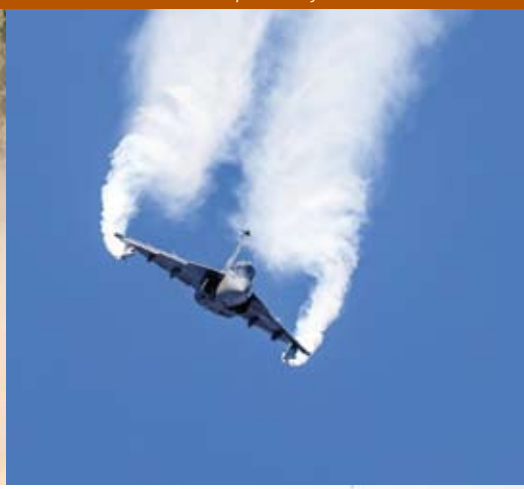

Defence Primer 2017

Today's Capabilities, Tomorrow's Conflicts

Edited by
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Today's Capabilities, Tomorrow's Conflicts

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As India actively aspires to shape its security environment in South Asia and beyond, the future set of demands on the Indian military will be heavily influenced by its evolving global and regional environment. India is situated in a difficult neighbourhood where security threats are expected and predictable but can also be unexpected and unforeseen. Combined with the increasing need to project power in the extended neighbourhood, this extended threat spectrum posits a new challenge.

Future threats and conflicts cannot be won by copying past responses and older means of warfare. India's current defence spending priorities are, however, heavily weighted towards traditional means of war-fighting and conventional modes of deterrence. Current postures favour large-scale conflict in the form of a "two-front war"— an almost negligible forward presence, limited lower-end and versatile assets, and a lack of strategically mobile forces — which leaves India with limited options in responding to contemporary limited-intensity operations, like missions such as non-combatant evacuation, disaster relief, small-scale raids, and combat search and rescue.

Budgetary constraints also mean that the armed forces will not be able to invest in technological solutions wholly to leapfrog their war-fighting capabilities. Adapting legacy platforms to the changing requirements and bringing innovations in war-fighting doctrines and strategies will be the key in dramatically increasing the range and precision of the Indian armed forces to observe, nominate, and prosecute targets.

The government and the armed forces need to prepare themselves for this challenge. The *Defence Primer* will lead off from the principal challenges to India — long, disputed, and militarised borders with Pakistan and China — and further explore visible technological and capability gaps vis-à-vis the ever-widening threat spectrum. It will also address India's ambitions as net security provider in the Indian Ocean and the technological/ doctrinal innovations required for those capabilities.

Strategic Flexibility & Presence

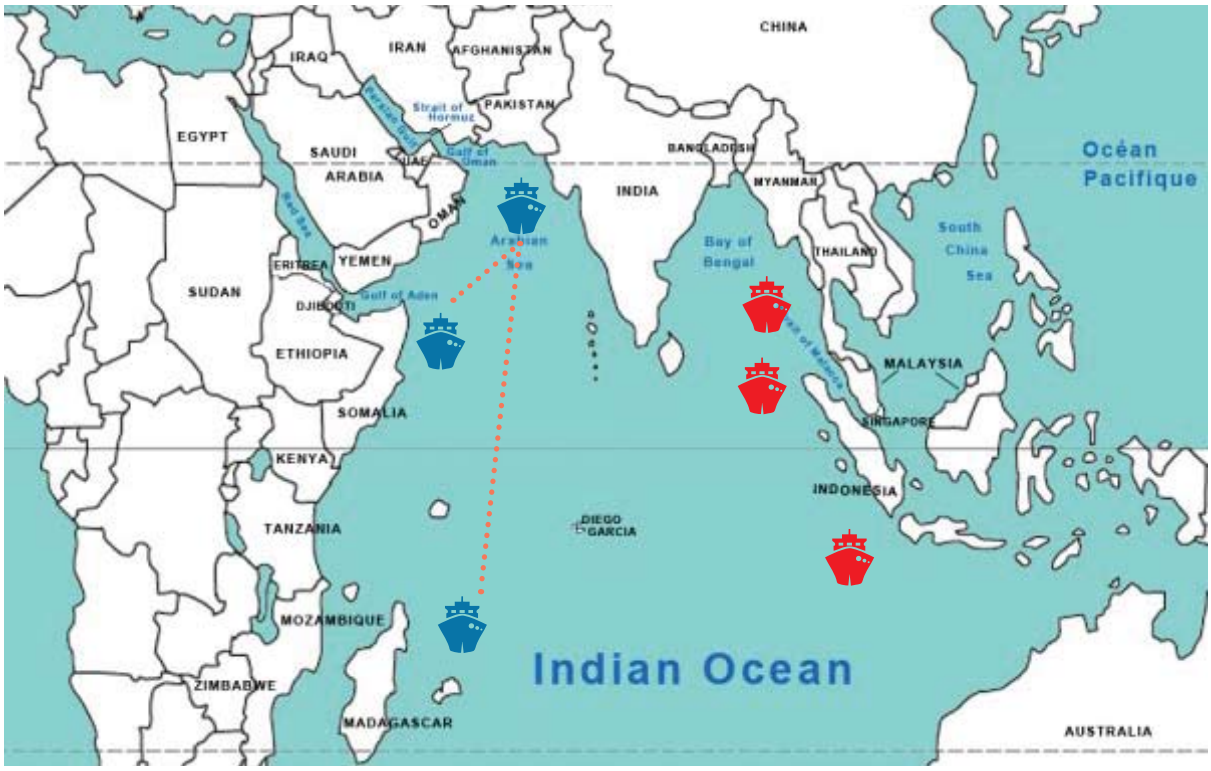
India's military capabilities will have to keep pace with its diplomatic outreach and geopolitical ambitions. In a fast-changing global scenario, the military deployments of the future will be dictated by challenges that may not be limited by traditional boundaries of a nation-state. These challenges, when coupled with conventional challenges, are likely to create deployment scenarios which need wide-ranging military tactics and platforms. They may at times seem redundant, but military capabilities cannot be created in a short period of time. Moreover, the best way to prevent a future conflict is to be prepared for it.

The Indian military thus needs to better invest in a diverse range of dynamic forces and assets to effectively counter adversary challenges along the full spectrum of conflict, particularly in those contests that may occur below its conventional strategic thresholds. Effective deployment, both in terms of speed and distance, is probably the greatest contemporary challenge facing the Indian military. As such, it may be useful to consider how the rapidity of a force deployment serves the policy objectives for which armed force is needed. Rapid deployment capability is expensive and weighing the costs involved in obtaining this capability against the benefits it accrues is therefore crucial.

Key in building on the potential to deploy and operate out of area will be Indian access to certain military bases in the region — like Diego Gracia, Djibouti, Bahrain and the Australian Coco (Keeling) and Christmas Islands — to extend out-of-area humanitarian assistance and disaster relief as well as anti-submarine warfare operations. Agreements like the Logistics Exchange Memorandum of Agreement with the United States, hold the potential to enable and extend these operations deep into the Indian Ocean. While mutual consent is a tenet of the agreement, Indian access to certain foreign bases would be mutually reinforcing, and is worth exploring given the potential to reduce the demands for logistical ships and tanker aircraft when combat assets need to be deployed.

If India intends to protect maritime approaches into the Indian Ocean at the Malacca Straits, Sundra Straits and the Gulf of Aden developing partnerships in the region needs to be central in its ambitions of sea control and maritime denial.

To do this in the short term (10-15 years), the Indian Navy will need to build up the ability to consistently maintain a deployed presence at key approaches in the Indian Ocean Region and the capability to monitor and prosecute targets in wide swathes across this space. Maintaining an approximate 3.0 presence (i.e., three platforms on station 12 months out of the year) in ships/ submarines and anti-submarine/anti-surface warfare aircraft in the Bay of Bengal and the



Platforms	Bay of Bengal	Arabian Gulf
Submarine	3 (9)	3 (9)
Surface Combatant	3 (9)	3 (9)
Maritime Patrol Aircraft	4 (12)	2 (6)

**Deploying one platform requires one more in maintenance and one in training.*

Arabian Gulf hence remains critical to Indian foreign policy and defence posturing.

Aviation assets and platforms supporting and complimenting them will remain key in giving New Delhi the reach it wishes to acquire. There is a corresponding need for acquiring force-multipliers and developing tactics to maximise the potential of such expensive platforms. Current disjointed procurement plans of aviation assets between all three services (Indian Air Force, Navy and Army) and the complete disregard for fleet standardisation by reducing the number of aircraft types have resulted in logistics-heavy platforms and little interoperability. These are important considerations because fleet standardisation reduces maintenance, training costs and improves interoperability/combined arms operations and platform availability for deployments.

The current organisational structure of the Indian armed forces, where each defence service operates in its own silo, is not conductive to joint military action. Jointness in command at theatre level is an eventuality that needs to be imbibed by the three services at the earliest. A future challenge cannot be met without a unified military head — not merely an advisor or coordinator — providing direct support to the top political leadership. The current government has repeatedly spoken about creating such a post, and clearly joined the debate on this subject.

This debate is especially urgent as jointness is linked to the funding issue which will drive New Delhi's cooperative sourcing of capabilities. India's defense preparedness and capability-development efforts will ultimately depend on building an efficient system of defense procurement, indigenous

production capability, and acquisition reform in order to sustain this modernisation.

The fundamental issue relates to the quantum of funds allocated for national security, and the share of those funds for defence modernisation. While the defence budget has fallen to about 1.7% of India's GDP, a larger share of funds is now being allocated towards salaries, pensions and other operating expenses. The shrinking amount for capital expenditure is leaving the military short of its desired state of modernisation. Reforms have been initiated to streamline the procurement and acquisition process, and create indigenous defence development and production capacities, but these will do little to ameliorate the current state of military equipping in the immediate future. The capabilities for the future, even if thought through and accepted by the government, can only be acquired if adequate resources are made available for them. This needs a change in mindset and approach, which can be expected from this government, which is showing greater signs of acting on India's geopolitical ambitions.

The challenge to achieve the blue sky capabilities that are required under various circumstances and in different aspects as discussed in this primer, will be predicated on a stark assessment of the current state of play and an honest appraisal of the means available with the country. The Primer hopes to act as a catalyst for ideas and options for India's security community as the Indian military goes through a number of structural and technological changes.

Filling the Capability Deficit

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Poised to be the third largest economy by 2030 after US and China, India's force structures and military capabilities are far below expectations.[1] Not just in comparison with the two world powers, vis-à-vis whom the gap is too wide to fill anytime soon, but also when assessed against New Delhi's regional threat perception. For example, the inability of India's "surgical strikes"[2] and diplomatic activism to quell cross-border terrorism from Pakistan and a costly purchase of 36 Rafale multirole fighter aircraft from France to fill the shrinking operational strength of the Indian Air Force underline the twin failures facing India's defence planning.[3]

Firstly, despite growing economic and military capacities in absolute terms, India's defence "capability" (or enablers) remains underdeveloped. This is as much an issue of lacking the required technology (both hardware and software) to deal with a widening threat-spectrum, as much it is about outdated military doctrines and strategies. Secondly, though a long-term issue of wider scope, India needs to start developing its defence industrial base at a much faster a rate than it has demonstrated the will for. Instead of proposing

a force outlay for India in 2030, this article concentrates on the various issues India faces today. Resolving some of these issues and addressing others, the article argues, will put India in a much better position to contain threats by 2030 instead of bogging down by "bean counting" exercises.

The first section offers an overview of India's evolving regional security environment, with emphasis on China and Pakistan. The reason for this is the endurance and potency of threats from these countries as opposed to instability in Afghanistan or Bangladesh, insecurity in the Indian Ocean, and cyber activism of the Islamic State elements. The second section highlights India's existing doctrines and equipping the state to meet these threats. The third section analyses the state of India's defence enablers such as Special Forces, interoperability and jointness, and C4ISR (command, control, communications, computers, intelligence, surveillance, and reconnaissance).[4] It advocates sharpening these enablers on one hand, and developing India's defence industrial base with emphasis on R&D on the other.

India's Strategic Adversaries

China and Pakistan have dominated India's security and foreign policy thinking since Independence. Despite moments of conciliation, relations with Pakistan continue to remain tormented—and the trend is unlikely to reverse anytime soon. For instance, in December 2015, after a gap of over a decade, Indian Prime Minister Narendra Modi paid a surprise visit to Lahore in Pakistan. Coming in context of heavy firing along the Line of Control (LoC), the move was cautiously celebrated and viewed as a step in the direction of peace. Another surprise breakthrough in Bangkok (Thailand), where the National Security Advisors of the two countries held talks, led to the institution of a Comprehensive Bilateral Dialogue.

Prone to accidents, however, the dialogue broke down when four heavily armed militants attacked the Pathankot Air Force Station on January 2, 2016.[5] While Indian policymakers scurried for a response, militants associated with the Jaish-e-Mohammad (JeM) executed the "deadliest attack on the security forces in Kashmir in two decades" in Uri in September 2016,[6] killing 19 Indian soldiers. This time, New Delhi openly responded by undertaking the aforementioned 'surgical strikes', wherein teams of Special Forces allegedly destroyed 'launch pads' along the LoC used by militants to infiltrate into Kashmir. Though not new, this was the first time India publicly announced an operation, signalling a shift in intent on how it plans to deal with cross-border attacks.[7]

The surgical strikes, followed by escalation of violence along the LoC and India's diplomacy to isolate Pakistan seems to be failing. As was visible in the 2016 BRICS Summit in Goa, neither Russia nor China were interested in entertaining Indian concerns. If anything, Indian armed forces lost nearly 89 soldiers in 2016 alone due to cross-border attacks,[8] prompting sections of the media to term it *annus horribilis* for soldiers posted in Jammu and Kashmir (J&K). The total number of casualties in the state for the period 2005-2016 stood at 6,012 (including civilians and militants)[9]—a sizeable figure when viewed in the backdrop of an existing ceasefire agreement since 2003 (the casualties were higher in the 1990s).[10] Pakistan's strategy of keeping India off-balance and strategically frustrated, from this perspective, has been effective.

Supported by Pakistan's military establishment, which firmly controls the country's foreign and security policy, a variety of militant actors are active in J&K (and in Afghanistan against the Kabul government as well as India). While the Lashkar-e-Taiba (LeT) is most powerful of these, others such as the JeM and the Haqqani Network

(an Afghanistan-oriented group that helps LeT execute attacks against Indian installation in Afghanistan) form panoply of militant outfits threatening India. Deeply entrenched in Pakistan's domestic sociopolitical landscape, clamping down on these groups can be exorbitantly costly for the Pakistani army. Therefore, even in the best-case scenario, where their capabilities are systematically degraded, these groups are likely to thrive till 2030.

A terrorist attack similar to 26/11—with or without clearance from the Pakistani security establishment—would most likely lead to war between the two countries, even if under the nuclear umbrella. The violent status quo along the LoC ever since the "surgical strike", in this context, plays into the hands of the Pakistani army without inflicting serious operational costs on them. Not only does it keep the Kashmir Valley on the boil, it also undermines India's plan of using sustained military and diplomatic coercion as punishment, and shifts India's focus away from its developmental goals.

As the former Pakistani COAS General Raheel Sharif said before stepping down from office, "India should know that mistaking our policy of patience for weakness would be dangerous".[11] Though India views it as rhetoric, coming from one of the most powerful and celebrated army chief in the history of Pakistan, the statement was loaded with intent, especially in light of the irrelevance of India's conventional superiority over Pakistan. Islamabad's expanding nuclear arsenal, a strategic weapons system that Islamabad wants to deploy even for tactical purposes, affords cover for asymmetric warfare, severely limiting New Delhi's policy options (short of full-scale war).

Even in the conventional domain, despite outmatching Pakistan by a ratio of 3.5:1 in per soldier expenditure, and fielding 1,346,000 active soldiers against Pakistan's 644,000, India may not be able to overwhelm Pakistan.[12] Factors ranging from terrain and favourable deployment of Pakistani forces to a complete lack of surprise in most conflict scenarios, mitigate the few technological advantages India has over Pakistan. Thus, as noted by scholar Walter C. Ladwig III, "Indian policymakers cannot be confident that even a limited resort to military force would achieve a rapid result, which is an essential pre-condition for deterrence failure".[13]

Pakistan's relationship with China offers strategic cover for its activities against India. Though longstanding, the strategic value of this relationship has increased (at least for Pakistan) in the wake of US tilt towards India, worsening relations with Islamabad, rivalry with China, and strained Sino-Indian relations. While there is good reason for skepticism about the extent to which Beijing would support overt aggression from Pakistan, there are equally valid concerns that China's increasing economic footprint in Pakistan—in the form of the China-Pakistan Economic Corridor (CPEC) that comes under the umbrella of the One-Belt-One-Road (OBOR) development strategy—would make Beijing a stakeholder in a future India-Pakistan conflict. Though the viability of CPEC, given Pakistan's precarious domestic security situation, is under doubt, China is unlikely to reduce its developmental footprint in Pakistan by 2030.

In the military sphere, Pakistan accounts for 35 per cent of China's defence exports, making it the largest recipient of Chinese equipment.[14] The two countries recently signed a USD 5 billion deal for transfer of eight conventional attack submarines (Chinese Navy's Type 039 and Type 041 Yuan-Class), half of which would be supplied by 2023 and the rest by 2028.[15] In 2015, China promised to deliver 110 JF-17 Thunder jets, a lightweight single-engine multi-role combat aircraft, of which nearly 50 would be supplied by early 2019.[16] When viewed in context of India's ageing fighter aircraft

and submarine fleet—India shelved the Scorpene submarine deal with France after a serious data leak[17]—such Chinese support to Pakistan helps reduce (if not overhaul) the conventional military gap between India and Pakistan by 2030.

Fluctuations in India's own relationship with China exacerbates these concerns. Beijing's muted response to Pakistan's sponsoring of cross-border terrorism and proactive stalling of Indian attempts for membership of the Nuclear Suppliers Group (NSG) have been two critical issues. Similar to Pakistani Prime Minister Nawaz Sharif's celebrated 2014 visit, Chinese President Xi Jinping visited New Delhi and met Modi in September 2014. However, instead of becoming a historical breakpoint, the visit was sabotaged as a 1,000-strong contingent of the People's Liberation Army (PLA) crossed into southern Ladakh.[18] India responded by dispatching a 1,500-strong counterforce of its own, and called off talks unless status quo was restored. Not only did China refuse to clarify the Line-of-Actual Control as asked by Modi, but little emerged from the visit.

Beijing's proactive courting of India's neighbours and moves in the Indian Ocean Region (IOR) increases India's strategic anxieties. In addition to seeking development of the Gwadar port (Pakistan), the Hambantota port (Sri Lanka), the Kyaukphyu port (Myanmar), and strengthening trade and political relations with both Bangladesh and Nepal, China recently invested in its first-ever IOR port in Djibouti.[19] Despite India's access to Sittwe (Myanmar), Seychelles and Mauritius among other ports, the rate of Chinese expansion in the IOR puts stress on India's "port diplomacy". India's capacity crunch is somewhat visible in Japan's intervention to jointly develop the Chabahar port in Iran, which New Delhi views as strategically critical for access to Iranian, Afghan, and Central Asian markets.[20]

In background briefings to journalists and analysts, Indian officials confess that the Sino-Indian relationship is undergoing its most difficult phase since 1962. Though the special envoys of the two countries have met frequently, and so have the National Security Advisors, there is little visible progress. Beijing's support for Pakistan's bid for NSG membership adds insult to injury. While intelligent and effective diplomacy from both sides can arrest this trend, the structural disparities between the two countries are increasing. In the economic sector, for instance, of the robust bilateral trade figure of USD 70.73 billion, India's trade deficit stood at USD 52.68 in 2015-16.[21] Militarily, China's defence budget stood at nearly USD 215 billion in 2015, more than four times that of India's USD 51.3 billion.[22] With the number of active soldiers at 2,285,000, China's manpower is also much higher—and so are its technological capabilities.

India's Response and Challenges

India's strategic force structures (nuclear triad) and doctrines (no-first-use policy combined with credible minimum deterrence) are well developed. New Delhi has also begun investing in building transport and communications infrastructure along the China border, inducting Mountain Strike Corps, expanding its naval capabilities, and upgrading the Indian Air Force (IAF) in response. However, there is still a wide gap between aspiration and reality. To bridge this, more recently, India emphasised on rapid military modernisation and redrafted the Defence Procurement Procedure (DPP).[23] Intent on upgrading the lethality and mobility of its armed forces, India has been diversifying its arms import. This not only implies a shift away from its stockpile of outdated Soviet and Russian weaponry, but also suggests it becoming the biggest arms importer in the world (accounting for 14 per cent of global arms imports).

In order to rectify import-centric procurement, DPP-2016 emphasises on 'Make in India' within the defence sector, and speeding up defence imports. Nonetheless, the Ministry of Defence remains divided over the issue of strategic partnerships (SPs) i.e. whether to allow one company in one segment or allowing foreign players to ally with Indian companies in multiple segments such as ammunitions, aircraft, warship, target acquisition and other critical material.[24] Herein lies the dilemma. Indian companies require time to become internationally competitive—an investment the government can't afford given the shortfall in India's defence platforms. Heavy reliance on foreign players further hinders development of an indigenously-focused defence industrial base. While there is no end-date to reconcile such structural dilemmas, a clear vision with a workable plan should be articulated by the Ministry of Defence.

One of the biggest and controversial decisions, for instance, was the purchase of Dassault Rafale multirole fighter jets from France in 2016 to fill an operation void in the IAF. After years of deliberations and failed negotiations over pricing with France, India decided on buying 36 ready-to-fly planes instead of its previous hope of procuring 126 fighter jets with a technology transfer clause built in. India is also inducting 3,000 indigenously produced 155mm/52calibre artillery guns and has signed a USD 737 million contract with US to buy 145 M777 Ultralight Howitzers. Aiming to ensure flexibility in mountainous terrain, these guns would replace the infamous but effective Bofors gun.

Defence deals worth INR 43,000 crore were also signed with Russia to purchase air defence systems, jointly produce stealth frigates and Kamov helicopters.[25] Israel is keen on supplying cutting-edge technology, including 'Litening-4' targeting pods for IAF's Sukhoi-30MMKI fleet, 'Spice 250' precision-guided munitions with a standoff range of 100 km as well as 'Spike' anti-tank guided missile systems, and missiles.[26] The Navy, too, despite various accidents in recent years, is inducting multi-mission platforms such as INS Chennai that are capable of shore bombardment, anti-submarine and anti-ship warfare, air defence, and defending strike groups.[27]

Ostensibly promising, India's military modernisation process (at the heart of India's force structures) is wrought with systemic challenges. Firstly, most of these measures are stopgap i.e. India's combat readiness and defence standards vis-à-vis China (but also Pakistan), till recently, have been despicably low. True, India is much better equipped to counter a Pakistani challenge similar to the 1999 Kargil intrusion or a Chinese aggression like in 1962. But it is not equipped to overwhelm Pakistan without crossing the nuclear threshold in case of a terrorist attack, thus reverting to old-style LoC battles. The infantry, for example, is still seeking a more effective rifle than the indigenous INSAS rifles, and there still is a dearth of tactical air mobility in the form of helicopters and night vision equipment (though drones have filled the gap to an extent, they are unavailable at brigade or battalion levels). This ongoing equipment acquisition then becomes an exercise in "catching-up" rather than being "competitive".

Secondly, despite the ambitious modernisation process, India's military doctrines are woefully underdeveloped. Evolving from the Sundarji Doctrine, developed in the 1980s for "defensive" purposes, the Indian Army articulated "Cold Start" in 2004 after the failed Operation Parakram. Aimed at undertaking swift offensive strikes within Pakistan under the nuclear umbrella, "Cold Start" came under criticism for being operationally unviable.[28] Still, that did not stop Pakistan from developing battlefield tactical nuclear weapons to annihilate advancing Indian corps in the event of war.[29] While India has not responded by altering

its own nuclear force structures, it evolved its doctrines from "dissuasive" to "active" deterrence, and begun to emphasise upon the use of offensive covert action (against Pakistan).[30]

Thirdly, despite being aware about the need for high-quality indigenous defence production, there is little visible progress. This is despite the aggressive PR in favour of the domestically produced HAL Tejas and jointly produced (with Russia) BrahMos cruise missile. This is most indicative in the budgetary allocation towards 'revenue' and 'capital' expenditures by the government. In 2016, for instance, of the USD 52.2 billion defence budget (2.26 per cent of the GDP), nearly 52 per cent was allocated to the Army, 16 per cent to the Navy, and 22 per cent to the Air Force.[31] Of this total, more than 60 per cent is 'revenue' expenditure meant to cover operating costs, about 28 per cent is 'capital' expenditure on permanent assets, and the rest is for 'capital acquisitions'.[32] Unless measures are taken to reverse this trend, without compromising on the welfare of soldiers, the dream of 'Make in India' will remain exactly that—a dream.

A combination of strain in civil-military relations, questionable quality of tactical level military leadership, and inter-service rivalry form the fourth challenge. Lack of dialogue between military professionals, civilian bureaucrats and politicians has been a longstanding problem, often leading to mutual mistrust. Recent agitation over the one-rank-one-pension scheme and reports of alleged irregular movement of troops towards Delhi in 2012 highlighted the delicacy of India's civil-military relations. Centralisation of security decision-making further erodes civil-military trust (NSA Ajit Doval was blamed for micromanaging counter-terror operations during the Pathankot attack).[33] Compounding this challenge is missing conversation between the three services itself. Undermining interoperability, competition between the three services has hindered development and implementation of joint doctrines.

Enabling Indian Forces

In the light of India's widening threat spectrum, ongoing military modernisation, and the panoply of challenges it faces, how best can it secure itself by 2030? There are two broad issues that need to be worked upon with urgency. Firstly, India needs to sharpen enablers such as interoperability, Special Force capabilities, and C4ISR coupled with development of asymmetric capabilities. As scholar Shashank Joshi argues, more than the different land and air capabilities, such enablers are "crucial to India's military power in both local and broader contexts".[34] Secondly, India needs to take serious steps towards developing its defence industrial base with emphasis on R&D.

Indian planners are acutely aware of the need for effective joint operations and C4ISR. Creation of the Integrated Defence Staff, the Andaman and Nicobar Theatre Command in 2001, the Strategic Forces Command in 2003, and the Defence Intelligence Agency after 26/11 were belated steps in this direction. However, without access to military assets and a limited resource set, these agencies remain toothless in comparison with the three services. Allocating more resources towards these agencies, which can then be tasked to overhaul India's existing doctrinal state with emphasis on joinery, would be a start.

To ensure further cohesion, establishing the position of a Chief of Defence Staff (CDS) would go a long way. Appointing a CDS has been a sensitive issue that brings out the insecurity of India's civilian politicians vis-à-vis an all-powerful military position. In this context, the government's recent decision to appoint a CDS, then, is a welcome move. A CDS can help bridge the operational gap between strategic and tactical

level of warfare, which is often either taken over by politicians (Jawaharlal Nehru in 1962) or National Security Advisors. If instituted properly, a CDS can reduce civil-military mistrust and decrease inter-service rivalry.

A separate Special Force Command for offensive clandestine operations should be created (akin to the US Joint Special Operations Command or JSOC).[35] The Indian Army's Parachute Regiment can contribute towards this endeavour with active involvement from the Navy and the Air Force. Operating with limited technology, lack of centralised command, and poor skill sets, India's Parachute Regiment does not currently fulfil the role of elite Special Forces. Directly under the CDS, such a Special Force Command can provide credible policy options to the government to undertake limited offensive action deep across enemy lines without majorly escalating conflict levels. It could, in fact, be a first step towards expediting India's stated plan of developing integrated theatre commands that require effective jointness as a prerequisite.[36]

Further, sharpening India's intelligence gathering and analysis machinery is of critical importance. India's aerial and satellite surveillance capabilities, for instance, have improved over the years. As Rajeswari Rajagopalan shows, a combination of IAI Searcher II reconnaissance drones, airborne early warning and control (AEWC) systems, and Israeli Phalcon radars have increased the IAF's visibility considerably. India's successful space programme has afforded a rich mix of military and dual-purpose satellites (RISAT-1 and 2, CARTOSAT-2A and 2B, GSAT-7, OCEANSAT-2, TES, and the INRSS).[37]

HUMINT under the Research and Analysis Wing (R&AW), and TECHINT under the National Technical Research Organisation (NTRO), however, remain shrouded in secrecy—making assessment difficult. Functioning from the Cabinet Secretariat, there is no oversight of R&AW and NTRO's activities. This has often led to both over and underestimation of these agencies' potential. More worryingly, it is argued that R&AW's capabilities have been undermined due to rivalry with other agencies such as the Intelligence Bureau, and the Military Intelligence. Intelligence observers remain sceptical about R&AW's covert offensive architecture in the neighbourhood as well.[38] These agencies could be brought under parliamentary oversight, both to ensure reduced inter and intra-agency rivalries and also to develop efficient intelligence cycles and accountability.

Finally, in addition to the above-mentioned aspects, India needs to allocate more funds towards developing a strong defence industrial base. This would be difficult in the light of 7 percent GDP growth rate. India could allow private companies to enter the industry (and not just support big businesses like Reliance), cut red tape within India's premier defence research organisation (DRDO), and emphasise on higher resources allocation towards R&D. China's sophisticated defence industrial base that allows indigenous production of conventional as well as asymmetric weapons such as Anti-Satellite (ASAT) systems (that could be transferred to Pakistan in future) is a challenge to India's security and aspirations. Working towards narrowing this gap by 2030, in addition to plugging the "capability" gap, should be on top of India's defence agenda.

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Future Challenges for the Army 2030

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The last decade has been a disorienting period for the Indian Army. While land borders with Pakistan and China remain unsettled, the Army's core competency—conventional land warfare—has been increasingly constrained by the maturation of Pakistani nuclear capabilities and Indian leaders' prioritisation of stability. While much-publicised ground raids into Myanmar and Pakistan have put the Army at the heart of conventional deterrence, supplanting the Air Force as the presumptive instrument of first resort, these operations have employed a small and atypical subset of the organisation, and cannot yet be said to have had strategic effects. Modernisation in the combat arms has been slow and halting, with growing competition for resources from the capital-hungry Navy and Air Force. Despite unquestioned civilian supremacy, civil-military relations have grown more acrimonious, tensions between veterans and the government have grown, and intra-Army disputes over promotions and appointments have spilt over into the courts.[1] What does the future hold for the Army, what are its challenges, and how can it best address them?

Priority Missions

Barring a breakthrough in diplomacy with Pakistan or a fundamental change in Beijing's view of New Delhi, primary threats will remain insurgency and terrorist activity, Kargil-like efforts to revise borders or control of territory, and conventional military attacks arising from other scenarios such as a Pakistani ground response to Indian air strikes. The Army's priorities will therefore remain territorial defence, conventional deterrence, and counterinsurgency. The most significant changes to the Army's doctrine and structure—the evolution of a "proactive" strategy colloquially known as Cold Start, and the raising of a mountain strike corps—have been driven by the second of these. However, the recent decision to have an infantry general supersede two mechanised forces' officers in the appointment of army chief indicates the continued importance of counterinsurgency to political leaders, not least during what could be a long phase of unrest in Kashmir.[2] It is likely that these will remain the priority missions for the foreseeable future.

Secondary Missions

In addition to these three central missions, the Army increasingly faces a wider set of secondary tasks. In December 2015, Prime Minister Narendra Modi told the Combined Commanders Conference that "our responsibilities are no longer confined to our borders and coastlines. They extend to our interests and citizens, spread across a world of widespread and unpredictable risks".[3] The Army lags behind the other services in its embrace of out-of-area operations, but a growing Chinese presence in the Indian Ocean littoral, particularly Pakistan and Djibouti, may increase the salience of amphibious and other expeditionary forces. Other secondary tasks include humanitarian and disaster relief (HADR), which has acquired an overt element of regional competition and international prestige, and which includes large-scale evacuation of Indian nationals from unstable areas. Again, these secondary missions will likely remain stable over the next decade.

India's Way of War

India, informed by history, has shunned formal military alliances and is likely to continue doing so. India is highly likely to fight alone in its border wars. However, India's growing defence partnership with US, its deepening interest in the security order in the Western Pacific, and its self-identity as a "net security provider" mean that the Indian Army is called upon to play a role in a future military coalition. India's heavy involvement with UN peacekeeping operations provides some experience in this regard.[4]

Priority	Threats/interests	Example
Higher priority		
Territorial defence	Revision of borders	Kargil
Conventional deterrence	Terrorism, conventional war	Post-Uri strikes
Counterinsurgency	Insurgency, terrorism	J&K, Assam
Lower priority		
HADR	Regional influence	Op. Maitri (Nepal)
Out-of-area operations	Regional influence, peacekeeping	MONUSCO (Congo)

Force Structure

What is the Army's current force structure, and what might that force look like in the coming years?

Core skills

Both modern warfare and its political context are changing. Military technology is rendering the battlefield more transparent, units and platforms are better networked (but also more vulnerable), and norms against large-scale conventional warfare are driving the use of hybrid, less overt methods of coercion and compellence. At the same time, the fundamentals of land warfare have not changed.

Stephen Biddle has shown that military capability depends ultimately on proficiency with cover, concealment, dispersion, suppression, small-unit independent manoeuvre, and combined arms.[5] Caitlin Talmadge argues that these skills require merit-based promotion, rigorous and frequent training, and decentralised, unified, and clear command.[6] The Indian Army enjoys considerable autonomy in these areas, with the exception of mid-level and senior promotions.[7] However, a shortage of over 9,000 officers is likely to impact the quality of junior leadership.[8] Recent reductions of officers' status relative to civilian counterparts, along with rising private sector salaries, may compound this problem.[9] Building out an augmented quality force structure, however, takes significant time and it is likely that the current structure of the Indian Army will persist for the next decade.

In addition to these core skills, the Indian Army also requires sufficient numbers and quality of arms in core combat branches: infantry, artillery, and armour. Each of these areas is undergoing a belated, gradual, and uneven process of modernisation. This has significant implications for the Army's future operational capacity.

Infantry

Infantry modernisation began over a decade ago with the 'Future Infantry Soldiers As a System' (F-INSAS) scheme for lighter and better-equipped forces, has since broken up into separate parts for equipment and communication.[10] Progress has been extremely slow. Bulletproof jackets approved in 2009 arrived only seven years later, in late 2016, leaving the Army to operate with half the required quantity in the interim.[11] The Defence Research and Development Organisation's (DRDO) $7-8 billion replacement carbine and assault rifle programme has been beset with problems such as delayed trials, slow negotiations, and cost overruns.[12] DRDO's latest effort, the Excalibur, is being "provisionally" inducted[13] but has been widely criticised[14] and, according to a senior Indian Army official, "does not have any future".[15] In 2014, senior Army officers described infantry modernisation as "delayed by six to seven years", almost exclusively because of the Army's inability to formulate qualitative requirements (QR).[16] If these institutional failings at the Army, ministry, and governmental levels go unaddressed, infantry capabilities are likely to remain an issue of concern into the 2020s. This is especially concerning because the rate of Pakistan and, particularly, Chinese infantry modernisation is quite significant.

Artillery

India has only a tenth of self-propelled artillery it requires, a shortfall of 1,600 guns across all types, and widespread obsolescence in existing inventory.[17] India's towed, wheeled, and self-propelled guns have subject of drawn-out procurement and manufacturing efforts.[18] These are now yielding fruit, with 80 per cent of the Army's capital budget dedicated to artillery in 2016.[19]

Six Indian-built 35km-range Dhanush howitzers have been inducted and deployed in Siachen and Rajasthan—the first new artillery guns in three decades, since the 1980s vintage Bofors-with 114 more approved for manufacture in June 2016.[20] In November, India finalised a $700 million deal with US to buy seven regiments of the M777 ultra-right howitzer, with 20 guns delivered within two years and the remaining 120 to be assembled in India over the next four to five years.[21] Their weight, permitting carriage by Chinook, makes them particularly suited for the new 17 Corps, India's fourth strike corps and the first intended for mountain terrain. Finally, India is likely to induct around 100 self-propelled 155mm K9 Vajra-T, a modified Samsung K9 with about 50 per cent indigenous content, over the next three years.[22] This would rectify a perceived imbalance created by the US sale of self-propelled artillery to Pakistan in 2009.[23] The 45km-range Advanced Towed Artillery Gun System (ATAGS) is an earlier stage, with firing trials in December 2016.

These efforts should also be considered alongside progress in building and acquiring both indigenous Multiple Launch Rocket System (MLRS) and multiple regiments of the short-range BrahMos cruise missile. Some of these systems should be available to the Indian Army in the coming years, but the challenges of equipping and procuring a modern force will remain.

Armour

The future of Indian armour is similarly in flux, with tension between indigenous and imported systems, and deeper questions around the optimal balance between protection and mobility in India's likely theatres of conflict. While the T-72 remains in service, deployed in greater numbers to Ladakh over the past few years, the pillar of armour modernisation is the indigenous Arjun Main Battle Tank (MBT) and license-built Russian T-90S MBTs. As of 2016, India had produced less than a quarter of the 945 T-90s ordered by the Army.[24] Over 400 further T-90s were ordered in November.[25]

The Arjun Mark 1 has not been cleared for combat because of its weight, and three-quarters of the fleet was grounded as of mid-2015 because of technical problems with the transmission system, targeting, and thermal sights, as well as a shortage of imported parts.[26] As many as 118 lighter and more advanced Mark 2 variants have been cleared, but the Army has requested international proposals for a Future Ready Combat Vehicle (FRCV) to be inducted in 2025-27. This could circumvent DRDO and undermine the future utility of the Arjun tank.[27] Arjun's defenders point out that it has out-performed the flagship T-90S in trials while critics in the Army criticise its inability to fire anti-tank guided missiles (ATGMs) through its main gun[28] as well as its inability to cross some bridges owing to weight.[29] The future of Arjun is likely to be a bellwether for indigenous modernisation.

Platform	Old	New
Assault rifle	INSAS (1990s-2000s)	TBD
Ultra-light artillery	?	MH77
Towed artillery	FH-77B (1980s)	Dhanush, ATAGS
Self-propelled artillery	M-46 (1980s)	K-9 Vajra
MBT	T-72 (1980s)	T-90, Arjun, FRCV

But even if it is a success, India is not procuring tanks in sufficient numbers to open up a militarily meaningful gap over Pakistan—if such a gap could be exploited under nuclear conditions at all.

Doctrinal Developments—Where India is and Where it can Go

These are India's capabilities and force structure, but what are the challenges in how it might be employed? That is, what is India's current Army doctrine, how did it get here, and where can it go in the next decade or so? The fundamental political issue driving the security competition between India and Pakistan is that the latter continues to have a revisionist political agenda towards the former. Pakistan has used both its covert, and then overt, nuclear weapons capabilities to more aggressively pursue that agenda.[30] While India desperately tries to escape entanglement between conventional and nuclear doctrine, Pakistan races to more deeply intertwine the two as a deterrent to Indian conventional action. This is the fundamental doctrinal challenge facing the Indian Army, and has been for decades, with variation on the same theme.

Indeed, India and Pakistan are presently in their third cycle of conventional nuclear dynamics. Even prior to testing nuclear weapons in 1998, Pakistan used its recessed nuclear capabilities to more aggressively support insurgent and secessionist movements in India's Punjab and Kashmir.[31] This was the first cycle in the India-Pakistan security competition under the shadow of nuclear weapons. The second cycle began after India openly tested nuclear weapons in May 1998, and Pakistan followed suit three weeks later. In that iteration of security competition, elements within the Pakistan Army attempted to directly revise the status quo by infiltrating across the Line of Control (LoC) in the Kargil sector, on the theory that Pakistan's nascent nuclear capabilities would enable it to achieve a fait accompli and deter Indian conventional retaliation, particularly across the International Border (IB).[32] A delayed, but ultimately effective, Indian conventional response limited to the LoC highlighted the risks of potential further escalation across the IB and underscored just how risky an overt Pakistani revisionist strategy could be. Force on force engagements in open terrain between nuclear powers would generate extreme and unwelcome risks.

That birthed the third cycle where the Pakistani state shifted away from the failed strategy of overt infiltration in Jammu and Kashmir to sponsoring mass-casualty terrorism in Indian cities—such as the 2001 Parliament attack and the 2008 Mumbai siege—using quasi-firewalled proxies such as the Jaish-e-Mohammed (JeM) and Lashkar-e-Taiba (LeT), on the theory that India's nuclear weapons cannot deter terrorist attacks and that Pakistan's growing nuclear inventory would deter ground-based conventional retaliation.[33]

For India, the dilemma of this third cycle has been how to generate credible conventional retaliatory options—primarily Army-driven—that would punish particularly the Pakistan Army for sponsoring mass-casualty terrorist attacks against its cities, and thereby deter future support for such outrages, without approaching Pakistan's nuclear thresholds? The fundamental paradox of this condition is that any retaliation punitive enough to serve as a potential deterrent for state-sponsored terrorism would almost by definition require India to cross Pakistan's presumed nuclear redlines, especially the so-called military attrition threshold.[34] Through the Parliament attacks, India's mainstay conventional response centreed around what is colloquially known as the Sundarji Doctrine, which envisioned massive armoured manoeuvre warfare through the plains and desert sectors of Pakistan and which would certainly, if

ever employed, risk threatening the survival of the Pakistani state. This response, which would require weeks to mobilise, proved futile as a coercive tool in the 2002 Operation Parakram.

But the lesson the Indian Army drew from its experience in Operation Parakram was not that the fundamental retaliatory concept was flawed, but that the long mobilisation time (of 21 days) for the main strike corps elements (I, II, and XXI Corps) to deploy from their peacetime locations in the interior narrowed India's perceived window for a retaliatory ground war. The Indian Army's subsequent changes to doctrine and posture became popularly known as 'Cold Start', although there is little evidence this was formally adopted by the Army, agreed with other services, or approved by civilians.[35] Public accounts of Cold Start suggested that it entailed breaking up the Strike Corps into eight to 10 so-called 'integrated battle groups' (IBGs, which ended up never being integrated, nor battle ready) and locating them closer to the border so that India could begin offensive retaliatory operations from a 'Cold Start' in 48-72 hours from an order to do so. The operational problem with this concept is that those IBGs, being deployed so close to the border, would be ripe targets for preemption. The logistical challenge was the grave difficulty of acquiring land for new bases. As a result, though 'Cold Start' received a lot of media hype, the Army was never keen to move away from its main operational concept of employing the existing strike corps, with I and II Corps engaging their counterparts in the Jammu and Punjab sectors, and XXI Corps conducting deeper penetration in the desert sector.[36]

What the Indian Army instead adopted is what is internally known as 'Proactive Strategy Options', which maintains the erstwhile strike corps' concept but focuses on more streamlined mobilisation—on both the Pakistani and Chinese fronts. On the Pakistani front, this first involved reorganising the four defensive holding corps which have always been deployed closer to the IB (IX-XII Corps). By attaching an armoured brigade to each of the holding corps, the Army converted IX-XII Corps into 'Pivot Corps', which can quickly 'pivot' from defensive to offensive operations while the three strike corps mobilise behind them. This has allowed the Indian Army to claim to the political leadership that it would be ready to initiate offensive operations roughly seven to 10 days after an order to do so. But critically, the *operational concept* of Proactive Strategy Options is no different than India's longstanding conventional strategy.[37]

For all the talk of waging conventional war below Pakistan's nuclear thresholds, the concept still calls for I and II Corps to engage and destroy their counterparts in the northern plains sector and for XXI Corps to execute a deep strike in the desert sector. However, the Army's assumed war aims—in particular, the balance between attrition of the Pakistan Army (punishment) and seizure of territory (bargaining)—remain unclear. Indeed, the latter may inadvertently but inescapably overlap with the former, as the level of attrition of the Pakistan Army that would be required to hold sizeable pieces of Pakistani territory, particularly population centres, would certainly cross any nation's nuclear redlines, and certainly Pakistan's. A similar concept of territorial seizure and bargaining may also have informed the Indian Army's currently largest unfunded mandate: the so-called Mountain Strike Corps (XVII Corps headquartered in Panagarh), which would similarly attempt to seize territory in Tibet to use as either a deterrent to Chinese aggression, or as a bargaining chip if deterrence has failed. The Indian Army doctrine towards Pakistan and China is converging on the same concept, even though the two fronts are radically different and pose different conventional and nuclear challenges.

At the broader political level, Indian leaders' key problem, likely considered during the Cabinet Committee on Security deliberations following

the Mumbai attacks, is that the distinction between 'limited' ground retaliation and 'total war' is extremely difficult to maintain once a large-scale war commences.[38] This is especially so in the case of Pakistan, given its small size and the vulnerability of its population centres and lines of communication. And on the Chinese front, without the ability to surge reinforcements to a Mountain Strike Corps, Chinese forces might be in a position to significantly attrite the Indian position rather than attempt to bargain for peace. Therefore India finds itself, in this third cycle, with only marginal improvements in finding a credible punitive/deterrent conventional option.

However, the media hype around Cold Start, particularly its description as a national war strategy rather than an operational concept, has been a strategic blunder for India, as it facilitated Pakistan's efforts to justify the expansion of its nuclear arsenal and the development of a wider array of delivery capabilities to further to entangle conventional operations with the risk of nuclear use. This was captured in Pakistan's shift in nuclear doctrine from "credible minimum deterrence" to "full spectrum deterrence", the latter requiring Pakistan to 'close the gaps' in deterring both Indian conventional and nuclear forces. At the lower end, that means developing battlefield nuclear systems like Nasr and cruise missiles such as Babur and Ra'ad to deter Indian conventional power by operationalising them as usable war-fighting instruments should the Pakistan Army be attrited by an Indian offensive.[39] At the higher end, that means developing a survivable 'third strike' of strategic nuclear forces to deter India's (increasingly incredible) threat of 'massive retaliation' to Pakistani limited first use. In this way, Pakistan is betting that India would not retaliate against Pakistani cities for a tactical nuclear use on Indian forces—most likely in the Pakistani desert against, for instance, XXI Corps elements[40]—not only because it would be disproportionate, but also because Pakistan would be able to hold at risk multiple Indian cities should India retaliate. India's inability to develop a credible–here, meaning plausibly limited–conventional retaliatory option, coupled with Pakistan's closing of the gaps in deterring India's conventional and nuclear forces, has essentially resulted in Indian paralysis should it suffer another mass-casualty terrorist attack on its soil. While Pakistan further entangles its nuclear and conventional operations, the Indian Army must stop deluding itself into believing that these domains are completely firewalled and that Army doctrine can be developed and implemented in isolation from India's nuclear doctrine.

Indian leaders therefore have four options. First, they can shun overt military force, opting for diplomatic, covert, and other means of retaliation. This was the course chosen in 2008.[41] Such an approach makes some sense, given the risks of escalation outlined here, and the potential impact of escalation on India's broader economic, political, and diplomatic objectives, in relation to the comparatively modest cost imposed by terrorism. However, domestic political pressures mean that overt restraint is not a viable long-term approach. This is where future Army doctrine and posture becomes salient.

Second, Indian leaders can opt for ultra-limited ground incursions, constrained in size (sub-company level) and penetration (sub-4km). Such raids have been regular occurrences on the LoC in the 1990s and 2000s, but reached their zenith in the publicly announced "surgical strikes" of September 2016.[42] The use of Para (Special Forces) units gives the Army an outsize role in conventional deterrence, but reduces its scope to effectively escalate to the strategic level–a far cry from Cold Start. Building up this capability so that it can perform more complicated raids and operations is a task that will take years. This might be the most plausible role for the Army but it relegates it to operations that are relative strategic pinpricks.

Third, Indian leaders may consider stand-off capabilities that do not require large-scale ground penetration.[43] Airstrikes are the most potent and precise of such capabilities, although a longer-term reliance on these would challenge the Army's domination of Indian military strategy. However, the Army could still play a role through the use of artillery (the mainstay of tactical deterrence on the LoC today), rockets, or its expanding tactical cruise and ballistic missile forces. [44]The use of stand-off force can of course expand into a conventional ground war, but this would have the advantage of placing the onus of escalation onto Pakistan, putting India on a credibly defensive footing, and so precluding credible Pakistani threat of even limited nuclear use. There would, however, be a risk of Pakistani stand-off retaliation against Indian military facilities and population centres. It should not be assumed that the escalation dynamics of a war confined to stand-off capabilities will necessarily favour India.

These options have implications for the Indian Army's doctrine in the years upto 2030. Should airstrikes take a more dominant role in India's repertoire of retaliatory options, the evolution of the Army's doctrine should consider how best the institution could provide support to a stand-off strategy. This would be institutionally and ideologically difficult, given the Army's historically central and paramount role in Indian wars. Furthermore, ultra-limited ground engagements are likely to grow in importance, particularly after the political–if not necessarily *deterrent*–success of the September 2016 raids. Indian leaders may also demand better options for targeting, killing, or capturing high value targets within Pakistani territory. As with support for airstrikes, this will require close cooperation between the Army and intelligence agencies, as well as enhanced investments in airlift and other specialised equipment.

While this discussion has focused on Pakistan—India's most likely and arguably complicated adversary—India's approach to China has somewhat different constraints. While nationalist sentiments on both sides might drive escalation once a militarised dispute has begun, the risk of conventional or nuclear escalation is generally less severe than in the case of Pakistan. One reason for this is that India's probable military targets do not present a plausible existential threat to Beijing. Another is that China does not view nuclear weapons as war-fighting instruments. But if a strategy of seizure and bargaining is less risky against China, it is also militarily more difficult, given the correlation of forces and the difficult terrain. The demands on fixed-wing and rotary airlift in particular are likely to be exceptional, surpassing even the rapid pace of India's present buildup. Even if India were to develop a viable Mountain Strike Corps, the question of what piece of territory to seize, how deep, and how it could hold it against Chinese PLA reinforcements are all questions to which the answers remain unclear.

Civil-military relations

India's civil-military relations have been summarised by Anit Mukherjee in the previous iteration of this volume.[45] How do these affect the Indian Army?

First, military strategies based on manoeuvre warfare demand rapid, responsive, and therefore decentralised decision-making. While special forces raids allow for a high degree of political oversight given the limited scope of such operations, this is not so in conventional ground wars. Political leaders would have to entrust commanders with greater autonomy if strike units were to maximise opportunities for penetration and advance.

India's recent military history, notably the restrictions imposed on airpower in Kargil, and the risks of conventional and nuclear escalation,

indicate that this will not come easily. It will require political leaders' familiarity with the details and risks of war plans, an understanding of political and diplomatic sensitivities by commanders, and resilient wartime communications, especially for out-of-area operations. If war aims are unclear—whether strikes are to punish, to seize territory or bargain—mutual civil-military understanding becomes all the more crucial. Even with improvements in these areas, India's civilian dominance is likely to prove a further constraint on the types of strategies that the Army can realistically employ.

Second, while the Rafale is likely to continue a nuclear-delivery role for the Air Force, India's nuclear forces will are re-balancing away from the air-breathing leg of the triad towards the Navy-operated sea-based and Army-operated land-based legs. India's intermediate-range missiles are increasingly deployed in canisters.[46] This shortens launch times and enhances survivability; however, it also lessens the dispersal of nuclear weapon components that prevailed in previous decades and, therefore, dilutes a powerful physical means of negative civilian control.[47] But this gives the Army a major role in nuclear operations, and in the Strategic Forces Command. It presents the Army with an opportunity to better integrate conventional and nuclear doctrine—not to operationalise nuclear weapons as war-fighting instruments but to better consider how to deter lower order Pakistani nuclear use by making the threat of limited, rather than massive, retaliation more credible.

Conclusion

This chapter has provided a brief overview of the challenges facing the Indian Army's force structure, doctrine, and civil-military relations. Armies do not turn on a dime and they are big institutions, so many of the challenges that have plagued the Army thus far—shortage of equipment and innovative doctrinal thinking—will likely continue for the foreseeable future. The question is whether the Army's leadership in the coming years will be nimble and creative enough to seize opportunities to develop more credible conventional offensive options and roles against both Pakistan and China, and potentially reshape the Army to implement them. Historically, the nature of civil-military relations in India has resisted radical shifts in Army thinking—Sundarji may be the only example, but the belief that he may have almost dragged India into war during the Brasstacks crisis has led to a string of Army leaders that have more restrained ambitions for the institution. For that to change, there has to be will among the Indian political leaders to re-craft the Army for modern challenges. Even with the latest supersession of the Army Chief, it is unclear whether that will exist for a long term. Without it, the Army will likely continue on a straight-line path, strong enough to protect the country's fate, but too weak to change it.

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Modernising of the Indian Army

Future Challenges

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The Indian Army is the third largest army in the world in terms of the sheer number of personnel. However, this description obfuscates the fact that it is not as powerful as one of the world's largest armies. Its capacity to undertake military operations optimally in the multi-domain, technology-dominated battlefield of the future is questionable. The Indian Army essentially remains a force largely organised, equipped and trained to fight wars of the past. Having said that, it is not as if the Army cannot carry out its role and tasks successfully if it is provided the requisite means to do so. And so, it seems almost imperative that the Army be modernised expeditiously if it has to be prepared to take on the security challenges of the future.

As India rises in stature, economically and technologically, towards a more eminent position in the region and the world, it has to concurrently build on its military power, in the modern context, to thwart the threats and challenges that it is likely to face along the way from our potential adversaries. However, for India, building military power is not easy, given the budgetary constraints, especially when the country needs to meet the

requirements of economic development to provide human security and a better quality of life to its people.

The inadequacy of funds is compounded by bureaucratic prevarication, risk averseness, frequent changes in qualitative requirements by the Army, and occasional corruption charges, which result in blacklisting of vendors in an unplanned manner. Hence, not only is there a need to efficiently identify the future orientation and equipment needs of the Army—in its role as the largest and most powerful component of the Indian military—but it is also important to find a way forward to build capacity and speed up the procurement process while addressing the problems that may prove to be a barrier for the force.

Future Security Scenarios

India's threats and challenges in the military realm primarily emanate from the historically inherited territorial disputes involving its two nuclear armed neighbours, over which five wars have already been fought. The growing nexus on military and nuclear matters between our potential adversaries suggests that, unlike in the past, India may face a 'two-front threat' the next time round. Meanwhile, the fact that the existing territorial disputes are 'land-centric' highlights the pre-dominant role of the Army in the Indian security context.

Further, Pakistan has been running a sub-conventional campaign against India since the early 1990s, which essentially involves stoking militancy in Muslim-majority areas of Jammu & Kashmir (J&K), where it has been pushing terror modules across the border under cover of nuclear coercion to cause casualties among civilians and security personnel in an effort to keep the Kashmir issue alive. Nuclear 'sabre-rattling' is used in conjunction with the cross-border terror strikes to prevent India from "raising the ante" and retaliating with a punitive conventional response. The last war fought in this backdrop was the Kargil War in 1999, limited in scope and duration, which was launched by the Indian Army with support from the Air Force to evict an 'hybrid' intrusion by the Pakistan Army across the Line of Control in the Ladakh sector of J&K.

Changing Nature of Conflicts

In the aftermath of the Afghanistan and Iraq wars of the first decade of this century, the world has witnessed a reduction in full fledged 'State vs State' wars. *Hybrid wars* appear to be the new norm, involving a combination of two or more of the following:

- ***Conventional/Regular warfare:*** State vs State wars, primarily waged by conventional forces or regular troops on both/all sides. In case of India, all such wars will be fought under a nuclear overhang, implying that escalation to the level of nuclear exchanges is possible, and must be planned for.

- ***Irregular warfare:*** Conflict against a State by employing trained combatants who are not regular military soldiers. Pakistan has launched such 'irregulars' in all its wars against India.

- ***Asymmetric warfare:*** War between sides whose military power differs greatly, waged by the weaker side using non-traditional means like terrorism. Wars waged by insurgents/ terrorists against nation states, its government or people fall in this category. For example, 9/11 by al-Qaeda and the Afghanistan war by the Taliban, among others.

- ***Unconventional warfare:*** War waged by a

country using means other than established forms of armed conflict to make the adversary capitulate even without a classical war. Economic wars, water wars and legal wars are some examples.

- ***Technological/Informational warfare:*** Wars fought in the areas of cyber, space, electronic, propaganda, psychological, media or social media.

The Indian Army, as the largest component of the military, should be prepared to deal with asymmetric, informational and/or conventional threats in the backdrop of a nuclear coercion from across our Western border in the short to middle term, and additionally, from the Northern border in the long term. The Indian Army must therefore aim to achieve cross-spectrum (nuclear, conventional, counter sub-conventional) war-fighting capability to achieve a favourable outcome even in a 'wo-front war scenario, which would concurrently achieve credible or punitive deterrence, as required, against our potential adversaries.

Capability Building in the Indian Army

India is not a member of any traditional military alliance and thus has to maintain an independent military capability as a critical need to retain its strategic autonomy while protecting its unity and integrity against possible threats.

The primary role of the Indian Army is to ensure the territorial integrity of the nation by deterrence or by waging a war. The secondary role of the Army is to provide assistance to civil authorities, when requisitioned. In keeping with its mandated roles, the Army has to ensure multi-dimensional capability to deal with external threats from our potential adversaries and also be prepared to assist in dealing with internal security threats of a heightened nature, especially those involving secessionist uprisings against the state or disaster management.

Accordingly, as most of our current threats pertain to conventional conflicts over disputed land borders and sub-conventional challenges like insurgencies and cross-border terrorism, the Indian Army has been structured as a 'two-and-a-half front' force, whereby, not only has the Army built conventional capabilities to deal with threats along the Western and Northern Fronts, but it has also built the capacity to deal with the lesser 'sub-conventional front'—by employment of the Rashtriya Rifles independently or in combination with regular, paramilitary or police forces.

Capability building of the Army is a continuous process, where budget, especially capital funds, are requested annually based on the projected needs for implementing a 15-year long-term perspective plan. However, it has been the experience for many years now that adequate capital funds for modernisation are not allotted, and consequently, there are major shortfalls in acquiring new equipment and other war-fighting capability in a time bound manner.

Modernisation Needs of the Army

The Army of the future will have to be technologically oriented, with many more specialists on its rolls as compared to generalists. It will have to be equipped progressively with modern weapons and weapon systems, supported by technology-based processes and automation to meet the needs and challenges of the future battlefields. Accordingly, the Army will need to replace or upgrade its ageing inventory of weapons and equipment while also restructuring in a transformational way. However, considering that

the modernisation plans of the Army are lagging far behind already, budgetary constraints will play an important part in formulating and executing plans for the future.

As far as weapons and equipment are concerned, the Army needs the following on priority to replace or rejuvenate vintage equipment as part of the capability development programme:

- ***Infantry:*** The infantry, which is continuously being employed in counter-terrorist or counter-insurgency operations, needs to be empowered immediately by provisioning of new generation lightweight assault rifles, bulletproof jackets and helmets, hand-held thermal imagers (HHTIs) as well as a host of other modern weapons like carbines, machine guns, rocket launchers, anti-tank guided missiles (ATGMs), mortars, night-vision devices, radio sets and better back packs to replace outdated weapons and equipment. Further, the infantry needs to reduce the number of general duty (GD) soldiers and replace them with specialists. To that extent, it is worth serious consideration that many more infantry battalions be converted into Special Forces battalions. Further, the fourth company of each infantry battalion needs to be converted into a Special Operations company.

- ***Artillery:*** Adequate quantities of new 155 mm artillery guns, including indigenously manufactured Dhanush systems, as well as more lethal precision artillery systems like BrahMos cruise missiles, Smerch and Pinaka rocket systems need to be inducted immediately to replace its earlier vintage 105 mm and 130 mm guns and vintage rocket systems. Also, the procurement of M-777 light howitzers must be expedited for early deployment along the mountainous terrain of the northern borders.

- ***UAVs:*** More quantities of Unmanned Aerial Vehicles (UAVs) of latest technology must be inducted in adequate numbers for surveillance and precision attack operations in both peace and war.

- ***Mechanised Forces:*** Additional quantities of contemporary technology such as night-enabled T-90 tanks and ICVs, equipped with long-range ATGMs, need to be inducted on priority. Older generation T-72 tanks and ICVs must be refurbished and technologically upgraded at the earliest. Future Ready Combat Vehicle (FRCV) and Future Infantry Combat Vehicle (FICV) projects must be pursued with vigour so that the next generation of state-of-the-art replacements are inducted within the next 10 years.

- ***Army Aviation:*** Acquisition of three squadrons worth of new generation Apache attack helicopters into the Army Aviation has been reportedly sanctioned, as a follow up of the Air Force order. Further, the Kamov replacement helicopters, indigenous Light Utility Helicopter (LUH) and Light Combat Helicopter (LCH) projects must be pursued aggresively so that reliable helicopters are delivered to the Army at the earliest.

- ***Air Defence (AD):*** The Army AD equipment is undergoing a total revamp. The various Army AD weapon acquisition projects—for all types of surface to air missile systems—as well as the process of upgrading old generation systems must be provided fresh impetus so that these materialise at the earliest.

- ***Engineers:*** Combat engineers need to be provided new generation bridging equipment, mine-laying equipment as well as mine clearance equipment. Where possible, old equipment must be upgraded indigenously.

- ***Night Vision Devices:*** All arms of the Army have to be night enabled by fulfilling the remaining requirement of light-weight, long-range and easily usable night vision devices.

Challenges in Capability Building

There are huge ongoing challenges in the process of capacity building of the Indian Army. The more important of these are discussed as follows:

- At present, military planning is hamstrung by lack of a clearly articulated and integrated military strategy. In such a situation, the three wings of the military are left to devise their own strategies and military philosophies, which could end up being at cross purposes with each other. The reasons that can be ascribed to this state of affairs is the absence of military expertise at the apex level of national security and defence matters, exacerbated by non-institution of the appointment of Chief of Defence Staff to coordinate defence policy and strategy more meaningfully.

- Lack of modernisation and an alarmingly large percentage of old equipment are still in use because several proposals for acquisition of new equipment and upgradation of existing equipment having been inordinately delayed.

- There seems to be an expanding hollowness in arms and ammunition over the years due to quality issues related to indigenous production of modern ammunition, compounded by inadequate budgetary support.

- Lack of capital budget for new procurement schemes, especially 'big ticket' items, is another challenge. This is due to the fact that there has been inadequate allocation of defence budget for several years now. Though at least 2.5 percent of GDP should be allotted for defence expenditure (other than pension), only 1.5 to 1.7 percent is actually allotted, resulting in reduction of budget allocation in real terms after taking into account the annual inflation component. The Army's inter-service share within the defence budget has taken a dip—from 60 percent in 1990-91 to about 52 percent in the current budget. The problem is exacerbated by the burgeoning revenue expenditure, especially on pay and allowances, and the alacrity displayed by the finance ministry in withdrawing defence capital funds year on year, apparently for balancing shortfalls and deficits under other heads of budget expenditure, cleverly projecting these as 'surrenders'. Though 40 percent of the Army budget should be spent on capital procurement, including committed liabilities, a meagre 15 percent has been spent in the last two years.

- Over the decades, the Indian Army has continued to expand, in terms of human resource,, in its quest to build its capability to deal with potential threats and challenges. However, there have been some faulty human resource policies in the Army in recent years, which have incentivised holding more manpower by linking it to calculation of senior rank positions in the Army. The total strength of the Army stands at more than 1.3 million. The 'manpower problem' has been exacerbated by lack of serious control over the ever-expanding size of civilians under the defence ministry who suck up a large percentage of the revenue budget of the Armed Forces without proportionate returns in 'capability' terms. All this has adversely affected the Army's efforts at optimisation and modernisation in an era of overwhelming budgetary constraints. In fact, matters have reached a serious point, where, within the next two to three years, there may not be any money left in the Army budget for

new 'capital' purchases after expending budget under the revenue head, combined with the committed liabilities of the capital budget.

- There is not enough expertise within the Army in the field of weapon design and technology, resulting in lack of meaningful inputs for the indigenous defence industry. An Army Design Bureau (ADB) has been inaugurated recently to address this shortfall. As of now, it is still too early to determine whether the ADB will be able to produce the desired results towards providing guidance to the indigenous defence industry for producing new weapons and equipment for the Army. The Army must continue to study the experiences of the Navy Design Bureau to draw lessons for developing the ADB on similar lines, or better.

- There is a lack of sustained efforts within the Army to develop expertise on defence procurement and financial issues. The Army remains rooted to the outdated policies of employing 'generalists' rather than 'specialists' to man the weapon procurement functions at Army headquarters. Unless serious efforts are made to create a cadre of specialists to man critical functions related to procurement of Army weapons and equipment, starting with the Apex level, the situation is not likely to improve. Formulation of General Staff Qualitative Requirements (GSQR) and conduct of trials are two specific areas of weaknesses within the Army, and needs constant efforts at improvement.

- Then there is inefficiency and apparent lack of accountability of various organs of the defence ministry responsible for indigenous design and manufacture of weapons, equipment and ammunition for the Army, namely the Defence Research and Development Organisation (DRDO), Ordnance Factory Board (OFB) and Defence Public Sector Units (DPSUs). It is obvious that the vibrant private industry of the country is not yet being provided a level playing field to compete fairly with the public sector. Consequently, the indigenous defence industry, mostly based on the public sector, is unable to provide items of desired quality in a timely manner. Most procurement through this route are affected by huge cost overruns.

As a consequence of the mentioned problems, especially lack of capital budget, the Army's modernisation plans are running far behind schedule. The only saving grace has been the continued acquisition of the relatively modern and robust T-90 tanks for the Armoured Corps and the continuing production of BMP-II infantry combat vehicles, which are the mainstay of the mechanised infantry, which taken together, continue to provide a combat edge on the Western front.

Concluding Observations and Road Map for the Future

India needs to progressively build capability of hard military power, soft power and demonstrated power in its quest to be recognised as a regional power with global influence, which can deter threats to its stability and integrity. The Army, as the largest component of the Indian military, has to be prepared to play its mandated role in the interests of defence and security of the country. However, budgetary constraints, combined with disproportionate stress on sub-conventional warfare, has led to adverse effects on capability building for conventional deterrence and war fighting.

Some of the measures that need to be put in place are discussed below:

- The Indian military of the future, backed by

nuclear capability, is essentially meant for conventional deterrence and war fighting to the extent of even taking on the worst case scenario of a 'two-and-a-half front threat'. The Indian Army's deterrence posture must be based on flexible capability-based structures to deal with various forms and levels of conflict. It requires technology pre-dominant capabilities for prosecuting hybrid conventional and informational wars under the nuclear shadow. We need to prepare for the same with an immediate (three years), medium (seven years) and long-term (15 years) perspective. We must develop appropriate retaliatory counter sub-conventional threat capability within existing resources by raising the Special Forces Command.

- The Indian Army needs to undergo transformation and right-sizing towards becoming an optimised modern force, with a more efficient teeth-to-tail ratio. Though it provides 'comfort' from the military commanders' point of view to have an independent capability for each front, it would make more pragmatic and economic sense to have only a minimum essential capability on either front while maintaining a suitably large dual-front capable central reserve, possibly under the aegis of a Strategic Reserve Command to reinforce the front where the actual threat develops. Thus, our logistics need to be integrated and optimised on priority.

- Enhanced jointness with the Air Force and the Navy, appointment of a Chief of Defence Staff (CDS) and formation of 'theatre commands' would definitely contribute to optimisation of resources. However, for such a system to succeed, the structure of each theatre command' and service background of the commander must reflect operational necessity and not 'political' or 'mathematical' correctness. In the latter case, the repercussions would be disastrous.

- The Indian Army must fully operationalise the concept of the Reorganised Army's Multi-role Quick Reaction Force (RAMFOR) by creating a highly mobile assault division as a strategic reserve, consisting of modular brigades capable of being transported swiftly by air, land or sea. This must be done within its existing resources.

- The Army must review its 'big ticket' needs and prioritise them periodically, as has been done for the past three years, and ensure sustained push with the government and bureaucracy to ensure timely procurement of items listed as 'most critical'. Modernisation of equipment must involve not only replacement of vintage equipment but also upgradation of selected quantities of old serviceable equipment in a phased manner. Maximum priority must be accorded to acquisition of 155 mm towed artillery guns, air defence weapons for mechanised formations, assault rifles and ATGMs for the infantry, and replacement helicopters for the Army Aviation, as well as for technological upgradation of T-72 tanks and ICVs. Fresh review of quantities of each 'big ticket' item must be carried out, keeping in view the enhanced effectiveness of newly procured systems.

- The government must closely monitor capability building of the services, especially the Army, and vigorously support plans to address 'hollowness' of weapons, equipment and ammunition. Where necessary, the government must not hesitate to sanction 'one-time import' of ammunition against critical deficiencies.

- The government must increase allocation for defence (excluding pensions) to 2.5

percent of GDP initially, and further raise it gradually to 3 percent until modernisation of the Armed Forces is complete. Concurrently, the government must introduce a system of 'roll-on' budget, whereby funds once allotted to defence cannot be re-appropriated for any other purpose. It should even consider re-allotting previously withdrawn or surrendered budget to the Armed Forces to help catch up with their modernisation needs. Further, the proposed defence expenditure must be aligned with NITI Aayog's three, seven and 15-year vision and budget allocation perspective.

- The Indian Army must cap its overall numbers at the current level of 1.3 million but continue making fresh efforts at making up for the shortfall of officers. New structures for expanding the Army Aviation, enhancing informational warfare capability and for raising geadquarters for the proposed Special Operations, Cyber and Space Commands must be provided manpower from within the existing establishment.

- The government must stop protecting the defence public sector and create a genuine level playing field for entry of the private sector into indigenous defence manufacturing. The private industry must be provided all possible incentives and encouragement to not only manufacture components and sub-systems for the defence PSUs and Ordnance Factories—or just take over their assembly lines—but to manufacture full systems independently as well.

- ADB must be fully operationalised on priority under the guidance and support from the Ministry of Defence. It must be empowered to contribute effectively towards creating futuristic designs of all types of weapons and equipment for the Army. A separate cadre of officers must be deputed to this organisation and specialisation, once created among them, must be retained. Care must be taken, however, to protect their promotional prospects and career interests.

- All functions within the procurement set-up at Army headquarters must be manned by specialists rather than by generalists, thus making drastic improvements in the existing system. Specialists can be created by focussed selection, followed by extended and repeated tenures in ADB and procurement-related postings at Army headquarters.

- The Indian Army must introduce measures to restructure as well as cut down revenue expenditure with a view to generate more funds for capital procurement. The first step in this direction would be to integrate and, where possible, outsource its logistic functions. A good beginning was made in this area in 2011-12 as part of an initial implementation of the Army's Transformation Study ordered at that time. However, the process was stalled and reversed due to vested interests and lack of sustained resolve. Further, concurrent to induction of new big ticket items and automated processes as part of the Army's modernisation, the Army must restructure its units and cut down manpower where warranted. Plans for the same must be approved well in advance. However, efforts to reduce manpower must follow (and not precede) the equipment modernisation process.

- Last but not the least, the government must provide guidance to the military through issuance of national security strategy, defence policy and military strategy so that the three services, including the Army, can align their respective policies and doctrines to these formulations in a coordinated manner.

There can be no doubt that the Indian Army needs to be modernised on priority. To achieve this objective, the government and the Army will have to take a look at the entire issue afresh and come up with innovative solutions to address the various obstacles standing in the way. Unless the identified challenges are addressed imaginatively, the modernisation plan will continue to flounder, as has been the experience over the past few years. Nonetheless, if the government of the day is seriously interested in modernising its Army, it must start off by allocating additional budget and starting a system of 'roll-on' budget so that money once allotted for modernisation cannot be re-appropriated for any other purpose whatsoever.

India's Air Force at a Pivotal Crossroads

Challenges and Choices Looking to 2032

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The Indian Air Force (IAF) was first established in 1932 as an auxiliary of the Indian Empire during the height of the British Raj. Today, that much-expanded and greatly modernised institution has since become the world's fourth largest air arm, with more than 1,300 aircraft and 170,000 personnel operating out of more than 60 far-flung bases nationwide. It is now looking forward as an able fighting force to its impending centennial in less than two decades.

Despite its impressive advances in capability in recent years, however, the IAF now faces a growing force structure predicament as a result of its declining number of fighter squadrons for accommodating the growing air threats posed by China and Pakistan. For years, the IAF had an authorised end strength of 39.5 fighter squadrons to deter and, if need be, defend India against these growing threats. More recently, that number of authorisized squadrons was increased to 42. Yet, against that overall fighter force size approved in principle, the IAF maintains only 35 fighter squadrons in active service today. According to a recent assessment by the Indian government's

Parliamentary Standing Committee on Defence, that number of squadrons is at risk of declining even further to as low as 25 by 2022 as the service's ageing and obsolescent MiG-21s and MiG-27s are progressively retired before they can be replaced by India's indigenously developed new Tejas Light Combat Aircraft (LCA).[1]

In light of this ever-deepening IAF fighter force-size predicament, it would be an overreach to suggest that it "has brought Indian air power to its knees," as one Indian appraisal recently concluded hyperbolically.[2] Yet, more than a few informed observers would readily concur with the more measured judgment of the respected American analyst Ashley Tellis that the IAF is now "in crisis" as a result of its steadily declining fighter inventory.[3] Indeed, the situation was assessed as having become a matter of sufficient concern that the IAF's Vice Chief of the Air Staff, Air Marshal Birender Singh Dhanoa, declared frankly before the start of the service's latest *Iron Fist* firepower demonstration in March 2015: "Our numbers [of active fighter squadrons] are not adequate to fully execute an air campaign in a two-front scenario."[4]

That assessed predicament points to a growing need for both the IAF and the broader Indian defence community to begin bending every effort to halt and reverse this continuing decline in India's fighter strength. That, in turn, will require some hard choices on the part of both before long to draw and duly honour an unsentimental line in the sand between what is absolutely essential for the IAF and what would merely be ideal for it to have in a perfect world. Towards that end, the discussion that follows will review the most urgent decisions now facing India's leaders with respect to the IAF's three fighter acquisition programmes that have long been in various stages of still-unfinished evolution—the just-mentioned LCA, the Medium Multirole Combat Aircraft (MMRCA), and the Fifth-Generation Fighter Aircraft (FGFA), the last of these an advanced stealth fighter intended to keep the IAF in the major league of aerial combat capability.

Completing the Tejas Acquisition

The IAF's LCA that is now, at long last, in its initial phase of being operationally fielded is the Hindustan Aeronautics Limited (HAL) Tejas delta-winged light fighter intended eventually to recapitalise at least a portion of what remains of the service's long-serving MiG-21s, now slated for final retirement by 2020. The Tejas (which means 'brilliance' or 'radiance' in Sanskrit) recently completed a long-in-progress multi-year technical evaluation aimed at ensuring that the aircraft's performance attributes would meet the IAF's declared operational needs.

This indigenous product, which first flew in January 2001, has its programmatic roots running as far back as 1983, when the IAF first formally recognised its eventual need to replace its inventory of MiG-21 fighters that had been the service's combat mainstay since the 1970s. In early 2006, the IAF signed a contract with HAL for the delivery of 20 Tejas Mk I fighters to be ready for squadron service by 2011 once the aircraft passed its initial operational clearance. That milestone was not met, however, owing to multiple recurring development problems and resultant schedule slippages that have repeatedly hindered the programme's progress ever since.

Ever since the aircraft's maiden flight in January 2001, the preproduction versions that have been in flight trials ever since have been powered by General Electric's F404 engine (which also powers the earlier versions of US Navy's F/A-18 Hornet) as HAL and the IAF continued to await—ultimately in vain—the maturation of a planned more powerful domestically-designed engine called the

Kaveri. As a result, in its current configuration, the LCA is underpowered for its intended mission needs. For its part, the indigenous Kaveri engine programme ultimately proved to have been so afflicted by both design problems and rampant inefficiency that the IAF finally gave up on it.

To make a long story short here, after 32 years of continuously plagued and halting development, the first production Tejas Mk I aircraft was finally delivered to the IAF Chief of the Air Staff, Air Chief Marshal Arup Raha, in a formal handover ceremony at the HAL plant in Bengaluru on January 17, 2015. A retired IAF air marshal wrote soon thereafter, however, of "the low level of confidence the IAF has in this platform," as attested by the fact that the aircraft had still so far received only its initial operational clearance and that the IAF to date has ordered only 40 Mk I versions to equip two squadrons, the delivery of which is now expected to be completed by 2020.[5] In this regard, India's Comptroller and Auditor General later reported that the LCA Mark I "still has significant shortfalls... in meeting Air Staff requirements" that will cause it to have "reduced operational capabilities and reduced survivability, thus reducing its employability when inducted into IAF squadrons."[6]

On the positive side of the long-protracted LCA saga, Air Chief Marshal Raha, an experienced fighter pilot, flew the Tejas two-seat trainer version in May 2016 and subsequently declared it "a good aircraft and fit to be inducted into the IAF."[7] However, in light of the LCA's relentless developmental problems throughout its three-decade-long history, the IAF's current plan to acquire no more than six squadrons of that aircraft seems all the more wise, particularly considering that the IAF chief's stated hope as recently as April 2016 that one Tejas squadron would be fully operational by year end has since proved overly optimistic.[8]

It might make even further sense for the IAF to abandon entirely its long-promised eventual Mk II version of the Tejas and to proceed instead with all deliberate dispatch towards filling out its remaining 12 MiG-21 and MiG-27 squadrons. Squadrons, that will have been vacated by their current aircraft retirements within four years with whatever domestically-built foreign fighter that the IAF and the Indian government may eventually settle on to be produced under the aegis of the 'Make in India' programme recently initiated by Prime Minister Narendra Modi (see immediately below for further discussion of this just-arisen new IAF fighter acquisition option). On this potentially liberating new count, an experienced former IAF test pilot who was closely involved in the Tejas's development programme during his time in active service wrote in early 2015 that because of its "serious deficiencies in performance, the LCA cannot become the IAF's frontline fighter at the low end of the mix," nor can the IAF afford to "look for a one-to-one replacement of its rapidly ageing MiG-21 fleet."[9]

Picking an Acceptable MMRCA Beyond the Rafale

In marked contrast to HAL's long-troubled LCA programme, a more substantial and potentially rewarding undertaking that has been in train for more than a decade has been the IAF's effort to acquire a new Medium Multirole Combat Aircraft (MMRCA) to supplement and eventually supplant its ageing inventory of MiG-29s and Mirage 2000s. That programme initially entailed a $10 billion bid by the service to induct 126 new fourth-generation foreign-designed fighters, with all but the first 18 to be manufactured in India by HAL and with an option for a follow-on acquisition that might ultimately yield a total of 200 new MMRCAs for the IAF in due course. This competition initially pitted six contenders against one another for the intended winner-take-

all prize—Lockheed Martin's F-16 (essentially a latest-model Block 70 F-16E/F missionised to specific IAF needs), Boeing's F/A-18E/F (likewise missionised to IAF requirements), the Eurofighter Typhoon, the Dassault Rafale, SAAB's JAS-39 Gripen, and the still-developmental MiG-35 derivative of the MiG-29.

After protracted internal deliberations, the Ministry of Defence finally issued a formal request for proposals in August 2007 from the five foreign contenders that had opted to enter into the MMRCA competition. After having received formal bids from those contenders, the IAF then completed its technical evaluation phase and subsequent flight trials of the candidate aircraft in 2010, after which it chose the Rafale in January 2012 as its preferred follow-on MMRCA.

The ensuing government-to-government negotiations for the IAF's pending Rafale acquisition, however, soon became mired in various contractual disagreements, the most notable being Dassault's understandable unwillingness to accept final responsibility for the quality of one of its products to be manufactured by HAL in India over which it would have no direct control. A seeming break of sorts in this protracted impasse was finally achieved in April 2015 when Modi, during an official Indian state visit to Paris, unexpectedly offered a direct government-to-government buy of 36 Rafales for the IAF in flyaway condition straight off Dassault's production line. At that point, with all on the French side having finally agreed to that proposed transaction, the remainder of the long-festering initial Indian tender for 126 to 200 co-produced Rafales that had hitherto failed to reach fruition was summarily cancelled, thus ending with the seeming stroke of a pen the IAF's arduous decade-long quest for a follow-on MMRCA—yet still with nothing to show for it but the promise of a scant fraction of the number of new fighters it had initially sought.

In that important respect, the most significant downside of the arrangement achieved by Modi was its preclusion of any option for a follow-on procurement of any additional Rafales by India at the same price agreed to in principle, since the contract the two countries signed on 23 September, 2015, included no provision for any purchases beyond the 36 aircraft already agreed to—meaning that any desired subsequent buy would have to be renegotiated at a new price.[10]

All of that said, the IAF's original declared requirement for 126 to 200 new fighters to fill out its desired follow-on MMRCA inventory remains the same now as it was at the competition's start. On that count, Air Chief Marshal Raha recently reiterated that "it is important [that] we have an MMRCA." It may not need to be more Rafales than the 36 now negotiated for, he hastened to add, but "we need to have [something in that category] in the quickest possible time."[11]

As for what such an alternative in the same fighter category might ideally be, the Modi government recently expressed its readiness, under the rubric of its newly-declared 'Make in India' initiative, to support the IAF's eventual acquisition of one of the fighters evaluated during its initial MMRCA flyoff, albeit this time to be made in India by the chosen foreign producer, and with India's private industry rather than with HAL now envisaged as partnering in any such domestic manufacture. Towards that proposed end, Lockheed Martin, Boeing, and Saab have all expressed their readiness to move their entire production lines for their respective F-16s, F/A-18s, and Gripens to India to continue producing the most advanced versions of those aircraft not just for the IAF, but also for prospective additional buyers worldwide, and with a substantial supporting involvement of the Indian domestic labour force under the auspices of Indian private industry participation with whichever of those foreign companies may ultimately be picked to meet whatever may remain

of the IAF's unfulfilled MMRCA requirement. Whatever course of action the IAF and the Indian government may ultimately choose to take in this regard, the stakes have become unprecedentedly high at a time when the IAF sorely needs such a continued recapitalisation effort to get its fighter squadron strength back up to a more reassuring level.

Achieving Final Closure with the FGFA Requirement

The last of India's three ongoing fighter acquisition initiatives entails its long-determined pursuit of a stealthy Fifth-Generation Fighter Aircraft (FGFA), to begin entering service with the IAF once its MMRCA induction nears completion. Towards that ambitious end, the Indian government in late 2007 signed an agreement with its Russian counterpart to co-develop a suitable variant of the Sukhoi Design Bureau's long-awaited T-50, a prospective Russian stealth fighter that was and continues to be promoted as being comparable in its essential design features and performance capabilities to the US Air Force F-22 Raptor air dominance fighter.

The T-50 finally made its long-awaited maiden flight at Sukhoi's manufacturing facility at Novosibirsk in January 2010, and it has undergone continuing developmental trials at the Zhukovsky flight test centre near Moscow, Russia, ever since. Sukhoi describes the aircraft as one that will eventually incorporate very low observability to enemy radar and sustained supersonic speed without the need for using engine afterburners that consume the aircraft's precious internal fuel so voraciously.

In addition to promising to provide the IAF with a stealthy multirole fighter for the 21st century, a major aim of the proposed endeavour from the Indian government's perspective was to enlist HAL's involvement in a cooperative arrangement with Sukhoi to modify the aircraft to meet specific IAF mission needs. At the programme's start, Russia and India each promised to contribute more than $4 billion to the FGFA development enterprise. However, throughout the nearly 10 years that have since elapsed, HAL has played no role whatsoever in the PAK-FA's development, and a serious question has arisen regarding HAL's likely opportunity for playing *any* significant role in the aircraft's co-development, since its most basic design features have already long since been set.

Further compounding the mounting uncertainties that now cast a dark shadow over the IAF's initial hopes for its FGFA venture with Russia, throughout the seven years that have elapsed since the T-50's maiden flight in early 2010, Sukhoi has flown only six prototypes of the aircraft to date, and its flight test programme continues to show halting progress at best. With respect to its all-important promised engine development, the T-50 test airframes now flying are still powered by merely improved versions of the engines that power the IAF's existing Su-30MKIs. The aircraft's projected definitive engines that will be needed for it to be able to supercruise at supersonic speeds without the use of afterburners—an essential precondition for a fifth-generation fighter—have not yet even been developed, let alone flight-tested.

For its part, India's state-owned aeronautics establishment from the very outset has counted on its promised co-development of the PAK-FA to provide it needed access to Russian stealth technology and design know-how that will eventually be applicable to its planned indigenously-produced Advanced Manned Combat Aircraft (AMCA) that remains solely in initial concept development thus far, with an engineering and manufacturing development phase expected to begin in 2017. Yet the Russians to date have steadfastly refused to allow India any close exposure to that technology or even

any willingness in principle to share it, and IAF pilots—now seven years into Sukhoi's T-50 test programme—have still not been permitted to fly the aircraft.

Apparently in light of the T-50's continuing developmental problems summarised earlier, the IAF in October 2012 reduced its planned acquisition of the aircraft from its original expected buy of 214 to just 144. Yet a further curve ball with regard to the seriousness of the T-50 programme was thrown India's way when the Russian Ministry of Defence announced its decision in July 2015 to reduce its own planned buy of the aircraft to just a dozen for the Russian Air Force, less than even a single squadron's worth, and to opt instead for the less expensive and more reliable fall-back alternative of the Su-35, a much-improved upgrade of the now-venerable Su-27.[12] That may have been at least one factor behind a report the following month that the IAF had further reduced its planned acquisition of T-50s to just three squadrons totalling 63 aircraft—a 70 percent decline in numbers from what had originally been envisaged as the IAF's prospective fifth-generation fighter force.[13]

In this regard, the IAF's leaders argued before India's Ministry of Defence towards the end of 2014 that the prospective Russian-developed FGFA—that had long been in their force-modernisation plans—had since shown clear "shortfalls ... in terms of performance and other technical features." The service's vice-chief later declared that the aircraft's existing interim engine was unsatisfactory, its radar was inadequate, its stealth features appeared poorly engineered, India's permitted work share was too low, and the aircraft's unit cost would be prohibitive by the time the T-50 is eventually ready for series production.[14] These problems led one former IAF officer in mid-2016 to conclude finally that the Indo-Russian venture was showing "all symptoms of being still-borne."[15]

All of this raises the inescapable next question as to whether the IAF and its civilian superiors might now conceivably have a growing incentive to begin giving close consideration instead to the American F-35 as a more promising FGFA candidate, since it offers the only realistic alternative available for the IAF's eventually acquiring an effective stealth fighter by the time of the service's centennial in 2032. At the outset of the IAF's proposed joint FGFA venture with Russia in 2007, India's defence minister at the time was so confident of its prospects that he rejected any thought of India's signing up to the F-35 programme. That alternative has still not yet been openly explored in Indian force development discussions throughout the years since, even though the US government has expressed its willingness to entertain any such indication of Indian interest. Today, nearly a decade later, perhaps the time for such consideration by the IAF and by its civilian superiors in the Indian government may now finally be at hand.

The IAF's Enduring Strengths

Despite its gradually declining number of active fighter squadrons, the IAF has nonetheless evolved over the past decade and a half into an air arm of world-class respectability in every other significant respect. That abiding fact of life needs to be kept prominently in mind by any who would fret about the service's force-structure tribulations in simple terms of numbers of fielded combat aircraft. Any Indian fighter pilot today from the Chief of the Air Staff to down would declare confidently that he and his service remain more than up to the demands of taking on any plausible combat challenge that might come their way any time soon.

The IAF's most notable maturation milestones in recent years have been its emergence as India's main means of nuclear deterrence, its growing role as

India's leading provider of *conventional* deterrence, its shift from being a geographically-limited force to one with growing transcontinental reach, and its ability to achieve not only prompt tactical but also strategic effects as the country's first responder in case of a sudden military challenge to India's core security interests. As just one indicator of the IAF's continuing transformation in combat capability, the service now operates one of the world's finest fighters in the Soviet-designed and Indian-built Su-30MKI multirole combat aircraft. This platform, with a total of 272 on order and possibly more yet to follow, is not just a stock Russian product like India's earlier MiGs, but a true hybrid aircraft built expressly to IAF requirements and incorporating both indigenous and Western technology, including the Israeli-developed Litening targeting pod that enables the precision delivery of conventional munitions from safe stand-off altitudes beyond the effective reach of enemy short-range surface-to-air missiles.

With regard to its doctrine and concepts of operations, the IAF stands today at the cutting edge of modern air power thinking, with its leaders well mindful that any future conflict will be air-led and that the conflict's outcome will turn heavily on what the IAF can contribute to the joint fight.[16] That continuing evolution in the service's operational outlook was perhaps best reflected most recently through the release in 2012 of a new and updated version of the IAF's earlier 1995 doctrine document aimed at capturing the latest in applied approaches toward air warfare.[17]

As for the mindset that governs day-to-day IAF sortie generation at the squadron level, the service's latest doctrine manual expressly acknowledges the abiding rule of western air forces stressing "the need to validate [force employment concepts] through realistic exercises."[18] Towards that end, IAF fighter pilots in their routine peacetime training now log 180-200 flight hours a year in a variety of air-to-air and surface-attack sortie profiles. This intensity of training is easily at par with the average number of flight hours flown annually by their US Air Force and Navy counterparts. Recent years have also seen an increased trend towards the periodic conduct of squadron-level large-force employment exercises involving multiple tanker hookups and the supporting involvement of airlifters, helicopters, and teams of Special Operations Forces.

High-profile bilateral international training exchanges have also become a new and welcome focus of IAF activity over the past decade and a half, offering both useful learning opportunities for IAF pilots and also invaluable occasions for showcasing the IAF's increasingly refined air combat prowess. The service first opened itself up to the outside world of military aviation in February 2003 when it invited a detachment of French Air Force Mirage 2000 fighters to Gwalior, in the Indian state of Madhya Pradesh, to take part in the Garuda I air-to-air training exercise. It was only after that eye-opening experience that the IAF fighter community began to appreciate the importance of acquiring proficiency at beyond visual-range air-to-air combat, as well as the value of cross-training with western air forces rather than simply accepting as gospel what their Russian suppliers had long said with respect to the combat capabilities of Russian aircraft.

That cutting-edge operating capability was more recently showcased when an IAF contingent in 2008 participated for the first time ever in the US Air Force's renowned two-week-long Red Flag large-force training exercise conducted four times a year out of Nellis Air Force Base, Nevada. That IAF deployment of eight Su-30MKI strike fighters, two Il-78 tankers, and two Il-76 airlifters was by far the service's most elaborate involvement in such international training events since the practice first began for it on a regular basis in 2003. The IAF included a mix of seasoned and novice pilots in its deployment package, and they rode a steep

learning curve throughout the two-week exercise. Although its Su-30MKIs were not configured to tap into the American Link 16 communications network, they flowed seamlessly into the Blue Force's daily game plan in every other respect.[19]

Another IAF force contingent, this time consisting of four Su-30MKIs, four Jaguars and two Il-78s, took part in Red Flag Alaska 16-1 conducted out of Eilson Air Force Base, Alaska, during a similar two-week period from April 28 to May 14, 2016. In that latest reprise of the IAF's earlier Red Flag experience, IAF pilots planned, briefed, and led three coalition strike missions, with their Su-30MKIs taking part in both Blue and Red Force roles. Afterwards, the exercise's chief operations officer, US Air Force Lieutenant Colonel Brian Toth, recalled of the experience, "The IAF's participation has been very good.... For most nations, it takes an exercise or two to step up to meet the requirements of a mission commander. The IAF has been mission commander three times and also performed the package commander's roles."[20] One could scarcely ask for a more authoritative and credible foreign validation of the IAF's operating prowess.

Understanding the IAF's Declining Fighter Force Size

For all its many organisational strengths summed up here, the IAF continues to suffer from a growing shortage of combat aircraft owing to the progressive retirement of its older fighters in the absence of a concurrent dedicated effort by the Indian government to maintain and sustain the service's authorised squadron strength. The still-unaddressed question here concerns the extent to which the permanent Indian civilian government bureaucracy, with its ingrained corporate drag and impacted decision processes, and the country's ruling political elites who oversee and approve all defence resource apportionment, will ultimately be able to muster the capacity for collective action that will be required for them to act most expeditiously toward providing a measure of enduring relief to this single most persistent IAF liability.

At bottom, when it comes to pursuing its legitimate force modernisation needs in the policy arena, the IAF has repeatedly faced a hard sell. Like India's other two uniformed services, it wields little organisational clout in high-level defence decision making. By all accounts, political leaders and senior civilian bureaucrats in the Ministry of Defence and the Ministry of Finance make all major strategy and weapons procurement decisions, with inputs emanating from the service chiefs only when expressly requested. This arrangement has been the outgrowth of an early determination by newly independent India's first leaders in 1947 to ensure firm civilian control over the armed forces. Within its framework, there is an agreed and routinely exercised channel through which the service chiefs can let their programmatic needs be known. However, as two respected scholars of Indian security policy have pointed out, the services are "entirely at the mercy of the civilian bureaucracy, both in the Ministries of Defence and Finance," when it comes to resource apportionment and policy matters.[21]

Yet another obstacle to rational IAF force development has long been what one Indian observer called the government's "Victorian-era bureaucracy" and what a former Indian Navy chief described as that bureaucracy's "archaic system of higher defence management."[22] A former mid-level US defence official, who served in New Delhi, recalls from first-hand observation in 2009, "the government of India has a very hierarchical decision-making process whereby even minor decisions need to be approved at very high levels of the bureaucracy. This creates a major chokepoint for getting things done."[23]

A final impediment to effective IAF force-

development planning is the fact that there is no military representation in the formal structure of India's government, since the service chiefs are excluded from a permanent role in the Cabinet Committee on Security. This arrangement, unique among the world's major democracies, militates against the most senior political leadership's interacting with the Chiefs of Staff Committee and with the service chiefs individually in a policy-useful way. It also has, in the words of one knowledgeable observer, "insulated the armed forces' leadership from security and defence decision making and eroded the role of service chiefs as professional military advisers to the government."[24]

Desiderata for Reaching the IAF's Centennial on a High Note

The above-noted political and bureaucratic facts of life in India lie at the heart of the IAF's steadily declining number of fielded fighter squadrons and—arguably—are largely responsible for it. At its core, the problem here ultimately does not lie within the corporate confines of the IAF, which is as sophisticated and professional as any air force anywhere when it comes to its ability to conduct rational long-range force planning. Rather, the principal source of the IAF's current force-structure malaise is what one Indian scholar recently described as "India's lackadaisical military acquisition processes and a habitually obstructive and ... lethargic [civilian] bureaucracy" that shows "little evidence of adequate understanding and will to prepare for the projected ... challenges of the future."[25] Thanks to that ingrained failing on the larger Indian government's part, the IAF continues to be burdened with a mounting crisis in fighter-force end strength, with its authorised goal of 42 squadrons now down to 39 on paper, but with only 31 squadrons currently in actual service and with an expected further decline to 28 or fewer squadrons as still more obsolescent MiG-21s and MiG-27s go to pasture before the promise of any recovery can be realised.

Given this ever-deepening predicament, the IAF's pronounced edge over its most likely opponents in pilot proficiency and tactical acumen may well be its most valuable ace in the hole for offsetting its otherwise disturbing decline in numbers of fielded fighter squadrons. For more than a decade now, the IAF and its civilian superiors have endlessly agitated over three vital fighter acquisition initiatives that, to date, have delivered to the service the grand total of just two Tejas Mk I indigenously-made fighters, both of which have been deemed still not ready for unrestricted operational use. To reverse this self-inflicted adverse situation, India's civilian defence bureaucracies will need to bend every effort to get beyond their past equivocations to both make and systematically honour three hard decisions to get the IAF's three most important still-continuing fighter force modernisation efforts off dead centre and moving in a productive direction at long last.

First, the government of India must make a firm and final determination as to how many Tejas LCAs it will expect the IAF to acquire and then must support every needed effort to make that aircraft operationally acceptable to the IAF's leadership. Second, it must soon choose a preferred MMRCA candidate from among the three foreign-designed alternatives now back in contention and support the earliest establishment of a domestic production line for that aircraft under Prime Minister Modi's 'Make in India' aegis. This effort should be made not only to satisfy the IAF's MMRCA requirement beyond the 36 Rafales already negotiated for, but also to help replenish at least some of the service's MiG-21 and MiG-27 squadrons that will soon be losing their existing aircraft to long-overdue retirements.

Third and last, India must finally face up squarely to the question of whether it is still willing to

continue gambling, at great likely cost for dubious gain at best, on Russia's now manifestly flawed and faltering FGFA candidate. If it is not, and if the IAF is indeed determined to have a fifth-generation stealth fighter in its inventory by the time of its centennial celebration in 2032, the Indian government will need to take a searching look at the F-35 as its only realistic alternative for making good on that requirement. Either way, if it and the IAF can come to a definitive meeting of the minds on these most pivotal force-development issues once and for all, India's air service will have every chance of reaching its 100th anniversary standing both proudly and with confidence as one of the world's most able and respected air arms.

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Future Challenges for the Indian Air Force

Innovations & Capability Enhancements

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The India Air Force (IAF) is one of the best funded in the world, however, paradoxically it is one of the most underfunded for its allocated task. In order to defend the country against potential hostile actions and provide deterrence against both Pakistan and China, the IAF is increasingly ill equipped. One of its largest drawbacks in terms of operational efficiency—that it operates more types of fast jet simultaneously than almost any other air force—is also paradoxically an indication of how well funded it is compared to many air forces, which think of themselves as "reference air forces". A victim of political interference in procurement efforts, the IAF has been relatively unsuccessful in convincing politicians to move towards an air power-centric approach taken by most global powers, and it still competes for funding with a huge Army and an increasingly strident Navy with blue water power projection ambitions. Despite a target strength of 44 squadrons of fast jets, the IAF is at present well below its authorised minimum safe figure of 39.5 squadrons.[1] In fact, almost a quarter of its intended numerical strength has been lost to obsolescence in a little over a decade, even without considering normal attrition, which remains high

in its older fleets.

In terms of fast jets, India currently flies the Hawk, Mig-21, Mig-27, Mig-29, Jaguar, Mirage 2000, Su-30MKI and Tejas; and will soon fly the Rafale. In addition, the current ambition is to procure another lightweight fighter, most likely the Saab Gripen E/F or Lockheed Martin F-16 'Block 70/72', as well as a fifth generation derivative of Russia's troubled PAK FA/T-50 stealth fighter. With such a staggering diversity, ranging from extremely old and on their way to retirement to cutting edge and expensive multi-role aircraft, the IAF faces daunting logistics, training standardisation and force design challenges. Moreover, partly due to the expense of supporting and operating so many different aircraft fleet, the IAF is seriously under strength with only 32 squadrons as of early 2016.[2] The fast jet components of the IAF will be examined here in terms of its air defence and strike capabilities as against Pakistani and Chinese airpower trends.

At present, the IAF is undergoing a phase out its ageing and accident-prone Mig-21, which was a fine interceptor in the 1960s and 1970s but is now laughably outclassed by every hostile aircraft it might encounter in the region.[3] This leaves the bulk of Indian air defence duties to the large and growing Su-30MKI multirole fighter fleet, alongside the exclusively air-to-air Mig 29s and the small but capable multirole Mirage 2000-5 fleet. The indigenously produced Tejas Mark 1 has so far proven inadequate for IAF's needs; and so development of an improved Mark 1A is a matter of priority in order to minimise the numerical shortfall created by the final retirement of the remaining Mig-21s by 2017. The 36 Rafale swing-role fighters being procured directly from France will certainly help meet India's air defence requirements, given the potent air superiority capabilities of the type, but it is too small a number to provide much of an answer to India's requirements for defending its vast airspace from intruders and potential hostile strikes. Further, the Rafale will be the only remotely credible type operated by the IAF for an airborne nuclear delivery mission against Chinese and even eventually Pakistani air defences in the years to come. So it is likely that the majority of the Rafale fleet will concentrate on the nuclear deterrence mission unless the order number expands in future to the detriment of its capability to maintain pilot proficiency in the conventional multirole and air defence domains.

The Su-30MKI needs to be discussed in some depth since its numerical dominance in the makeup of the IAF into the 2020s means that the latter has staked a huge gamble on the type, remaining viable and competitive against rival air forces for some time to come. India has ordered 272 Su-30MKIs and has, so far, received over 240 of the heavy fighters. This large fleet size contrasts with an envisaged strength of around 55 Mirage 2000s, 70 Mig-29s and 36 Rafales, as well as somewhere in the region of 200 light fighters—most likely a mix of Tejas Mark 1A/2 and Gripen/F-16s.

The Su-30MKI shares almost all standard strengths and weaknesses of late-model 'Flanker' family. It is extremely manoeuvrable in a close-range turning fight, although it bleeds energy fast in high-alpha manoeuvres and does not have the thrust-to-weight ratio of the latest Western or Russian fighters. It has a large and powerful radar, can carry a wide variety of missiles and ground attack munitions, and has an impressive range on internal fuel. On the downside, it has a huge radar cross-section (RCS) and is thus liable to be detected long before it can detect opposing fighters—whether operating under active or passive search methods. The thrust-vectoring engines significantly increase manoeuvrability at high angles of attack, low airspeeds and very high altitudes. However, at the same time, it increases maintenance complexity and decreases reliability. With a mix of long and short-range missiles and different seeker heads,

the Su-30MKI is a dangerous opponent for non-stealth fighters of the fourth and 4.5 generations. However, against fifth generation fighters such as the F-22 Raptor and F-35, as well as China's developing J-20A, the aircraft has few answers. Stealth aircraft will always detect the Su-30MKI from very long range, and can take position to either avoid it or engage under the best possible launch parameters.[4]

For the task of carrying the main weight of policing India's airspace and conducting multirole air superiority and strike missions against Pakistan in a future conflict, the Su-30MKI is likely to give the IAF a capable and potent core fleet for the next 10-15 years. However, against Chinese Su-35, J-10B and J-11 fighters, it is at least equalled in most scenarios; but the J-20A and future Chinese stealth aircraft will significantly outclass it. Further, the Su-30MKI is not credible against modern air defence networks, due to very high RCS, heat signature and, at best, average electronic warfare and jamming capabilities. This means that, for deterrence purposes, it is not credible against China and will slowly lose its capability to conduct deep strike missions in Pakistan as the latter improves its defences. With the air-launched Brahmos supersonic cruise missile integrated, however, the type does give the IAF a formidable anti-ship capability, especially with the long range inherent in the 'Flanker' design.

The IAF's other air defence types do not offer much that the Su-30MKI cannot either. The Mirage 2000-5, currently being upgraded and modernised at the Indian Mark 2 standard, remains a capable and efficient lightweight fighter but cannot offer any BVR improvements over the Su-30MKI. It is a rough analogy in capability terms at medium and short ranges with China's J-10A, Pakistan's F-16 Block 52+ and FC-20 (J-10 derivative), and only provides a marginal superiority over the Sino-Chinese JF-17. Meanwhile, the Mig-29 is an ageing design, which remains formidably manoeuvrable within visual range but shares Su-30MKI's drawbacks of huge RCS and lack of supercruise, besides being desperately short legged on internal fuel. It remains a limited capability interceptor for the IAF with little technology-growth potential. The Rafale could certainly be a highly capable air combat capability for the IAF but, as previously mentioned, 36 is a very small fleet to defend such a large airspace; and the IAF's nuclear deterrence mission will most likely take priority for the type. Essentially, the IAF is equipping itself with air defence types that are at least adequate to face the current threat types, which it is likely to encounter. However, it remains numerically in a state of understrength; and consecutive delays in modernisation efforts mean that by the time the new force composition is fully in place, China will most likely to operating fifth generation J-20s in relatively large numbers, for which the IAF will have no adequate answer. Pakistan has also expressed interest in both the Su-35 (a more capable 'Flanker' in the air superiority role than the Su-30MKI) and the Chinese FC-31 stealth fighters. However, the FC-31 is still very much an unknown quantity and the J-31 on which it would be based has not found favour with the People's Liberation Army Air Force (PLAAF) in China so far. It would be unwise, therefore, to suggest Pakistan is on the verge of operating fighters which could seriously threaten the IAF over Indian territory.

In the medium term, the IAF needs to decide whether it is aiming to offer a serious challenge to the growing might of the Chinese PLAAF or not. If the main effort is to remain focused on Pakistan, then the current acquisition programme for Indian combat airpower is probably technologically adequate but remains short on mass. If offering a serious aerial challenge to Chinese freedom of action in India's backyard is the intention however, the IAF is on course to fall seriously short in both the quality and quantity of its fighter force by the mid-2020s. Indigenous fighter development

efforts are unlikely to solve this problem. The Tejas saga has exposed some uncomfortable realities for India's defence aviation industry. While it has proven to be capable of upgrading existing airframes with a variety of avionics, weapons and engines—for example, the Jaguar and Mirage 2000 upgrade programmes—HAL has taken 30 years, huge resources and a great deal of political backing to produce a lightweight fighter with modest conventional capabilities and serious quality control issues. The inability to reach a satisfactory set of arrangements to manufacture the 4.5 generation Rafale in India was not simply a matter of price, but also a result of HAL's unsuitability in its current form to ensure sufficient quality control for manufacturing modern high performance fighter aircraft. The task of producing a fifthgeneration fighter—or sixth—will be a far more formidable undertaking.

India has placed its hopes in the fifth generation sphere on the Russian PAK FA/T-50 programme, and has been a longstanding partner and funder of the aircraft's development. However, this is beginning to look like a poor investment decision since Russia is discovering what China and US also discovered with the J-20 and the F-35 programmes, respectively. The fact is that while it is comparatively simple to develop flying prototypes that look like fifth generation fighters, it is exceedingly difficult to transition to produce something in quantity that performs like a fifth generation fighter, both in low-observability and sensor fusion-enabled situational awareness. There are many reasons to criticise the manner in which US and Lockheed Martin (an American global aerospace, defence, security and advanced technologies company) have managed the F-35 programme, but the core reason why the aircraft's delivery is so delayed and expensive—compared to initial assumptions—is because of the featuresUS wants in the aircraft and its extremely difficult systems engineering.

Russia's plans for purchasing the T-50 for its own air force have now been cut back to a laughable single squadron for the VVS, which is a very strong indicator that all is not well inside the secretive programme.[5] Difficulties remain with the aircraft's engines, wing strength and stealth properties, as well as sensor integration for the pilot. While a usable combat-capable T-50 might emerge towards the mid-2020s, developing an Indian Sukhoi/HAL Fifth Generation Fighter Aircraft (FGFA) derivative will take longer still; and be expensive and slow to deliver in quantity. The upshot of all this is that India has a serious fifth generation fighter problem if it plans to confront China in air. It is unlikely to get combat-worthy platforms from Russia in the short term, and US has not yet indicated any willingness to sell F-35s to the IAF. Meanwhile, the J-20A low-rate production aircraft being displayed by the PLAAF represent a fast-emerging capability for low-observable strikes inside Indian airspace by China in a crisis. One solution might be to seek purchase of new generation AWACS aircraft, which might at least give current generation IAF fighters an idea of where to look for stealthy intruders. Saab's latest Erieye ER—which uses a very high-energy AESA array to reportedly track stealthy fighter-sized targets at significant range—has been bought by the United Arab Emirates; and represents a potentially disruptive technology which India could benefit from.[6] Another path might be to purchase Russian long-wavelength frequency agile ground radars such as the Nebo-series in order to provide a credible anti-stealth capability for the five regiments of long range S-400 air defence systems, which India agreed to purchase from Russia in October 2016 for deliver by 2020.[7] This combination, far more than any aircraft which the IAF has in the procurement or development pipeline at present, is likely to remain a serious threat to any low-observable would-be intruders into Indian airspace.

In terms of offensive conventional striking power,

the IAF will have to rely increasingly on the same multirole fighters as it does for air defence—the Su-30MKI and Rafale. This is because India's two dedicated strike and interdiction fast jets, the Jaguar and Mig-27, are both long past their prime against peer-competitors in spite of several engine, avionics and weaponry upgrade programmes during their long service lives. Following a spate of crashes due to technical failures, the IAF is aiming to retire its entire Mig-27 fleet by 2024, and has already started decommissioning individual airframes.[8] In contrast, the Jaguar has recently been upgraded again and, particularly in the case of these newest *DARIN III* standard aircraft, possesses a respectable payload capacity, excellent range on internal fuel at low level, and the ability to deliver a range of precision munitions. However, the essential limitation for both the Jaguar and Mig-27 in terms of current and future combat effectiveness is that generational improvements in fighter and air defence radars have rendered their core concept of operations—flying very low in ground clutter to avoid detection on deep-penetration strike operations—at extremely high-risk in the face of modern opposition. Pakistan's F-16 fleet, as well as China's Flanker derivatives and J-10 family are all equipped with radars capable of good detection and tracking performance in look-down, shoot-down mode against ground-hugging intruders. Both the Mig-27 and upgraded Indian Jaguar *DARIN III* have very limited self-defence capabilities, so would have to be closely escorted by dedicated fighter types during medium-level sorties into hostile airspace, thereby further reducing the number of Indian fighters available for air defence/superiority missions. The ill-fated MMRCA programme was supposed to provide a powerful supplementary and, eventually, replacement capability for IAF strike squadrons. However, as with air defence tasks, the 36 Rafales will be extremely capable in the strike role, but are being bought in completely insufficient numbers to replace the 125 Jaguars and around 85 Mig-27MLs still in IAF service. A purchase of either F-16 'Block 70/72' Vipers or Gripen E/Fs to complement the Tejas in the light-fighter niche and fill some of the void left by the failure of MMRCA would certainly go a long way towards addressing the obsolescence of India's strike fighter fleets.

None of the types at present operational in the IAF can hope to survive long inside a Chinese HQ-9 missile engagement zone (MEZ). Therefore, it seems logical for the IAF to accept that maintaining conventional deterrence capabilities against the might of a rising Chinese superpower is unlikely to remain possible in the next 20 years, based on current trends. However, it should be well within the capabilities of the IAF to adequately defend Indian airspace and provide a powerful deterrent against Pakistan, given its level of technical competence and funding, provided it accepts that its fighter aircraft will not be able to detect and destroy stealth threats, and continues to invest in modern air defence missile and radar systems optimised for these difficult targets.

The IAF as a highly proficient service which, unlike many of its Western counterparts, operates in the vicinity of, and trains to fight against, two peer competitors in high-end operations. Pakistani and Chinese aerial capabilities present very different levels of threat to India's ability to defend its own airspace, and likewise, their respective air defence capabilities present greatly differing levels of threat to India's own offensive power-projection capabilities. India stands to benefit from an effects-based measurement of capability requirements, rather than the older practice of 'counting airframes'. Instead of chasing an unrealistic target of 40-44 squadrons of modern combat aircraft, or even the current minimum target of 39.5 squadrons, the IAF should try to eliminate much of the costly duplication of platforms for various missions and focus on defending its airspace from potential Chinese intrusions in future, and maintain credible offensive strike

capabilities to ensure stable deterrence at the sub-nuclear level against Pakistan. These two tasks might be effectively attained by developing a modern and potent ground-based integrated air defence system (IADS) focused on counter-stealth capabilities for defence against China, paired with a smaller number of fourth and 4.5 generation multirole fighters to provide flexible air defence and strike capabilities to counter Pakistan. This sort of approach, however, would mean accepting a loss in airframe numbers and a cull of older, less effective types to allow rapid acquisition of modern multirole types in sufficient, but not equivalent numbers. An example of this approach is that against modern opponents such as the Chinese and Pakistani Air Forces, replacing the 14 squadrons of Mig-21s and Mig-27s with three or four squadrons of modern F-16 'Block 70/72s' or Gripen E/Fs would certainly represent a significant growth in capability, despite a large numerical decrease in airframes available.

Given the lack of credible fifth generation fighter options for the IAF in the foreseeable future, India's most profitable avenues for capability enhancement of its existing fourth and 4.5 generation types in the face of Pakistani and Chinese threat technologies are likely to be found in long-ranged, high-speed standoff weaponry and electronic warfare. These approaches both hinge around reducing the vulnerability of non-stealthy air assets—by allowing engagements at longer ranges in comparison to threat system engagement envelopes—and offer the potential to significantly prolong the operational usefulness of the fourth generation types against high-end threats for all air forces. It is, therefore, encouraging to see the progress being made in the IAF's Su-30MKI fleet, for example, in terms of integrating the capable Israeli Elta EL/M-8222 jamming pod and Brahmos cruise missile. The eventual incorporation of the Zhuk-AESA radar on the fleet should also enhance situational awareness, survivability and electronic warfare capabilities.[9] Equally, the Rafale will bring the formidable and impressive SPECTRA electronic warfare suite, SCALP EG cruise missiles and the Gripen NG (should India opt to purchase it). Electronic warfare-based approaches to aircraft survivability require a sustained tempo of investment in software development to remain viable but, due to this higher refresh time, are inherently more flexible than a reliance on airframe-shaping for stealth properties.

Luckily, part of the IAF's core strength, partly as a result of its practice of operating so many different types of aircraft in so many different roles simultaneously, is its institutional capacity for flexible and novel ways of approaching problems. The IAF also stands at a fascinating crossroads between Eastern and Western approaches to airpower, a position which brings great logistical challenges but also great opportunities to harvest from technology and concepts of operations. A mix of Russian-style modern IADS development, with Western models of airpower for power projection, offers huge promises for India's defence and deterrence needs. However, before embracing a radical modernisation and restructuring programme, the IAF must overcome entrenched political interference in military procurement decisions, as well as the fixation on solutions which have been 'made in India', otherwise it risks continuing along its current path of trying to catch up with outdated acquisition plans to fight yesterday's wars.

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Doctrinal and Technological Innovations in the Indian Armed Forces

Countering Future Terrorism and Asymmetric Threats

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The principle asymmetric threat that India faces and will continue to face well into the policy-relevant future pertains to Pakistan's reliance upon terrorist proxies under its nuclear umbrella. Pakistan relies upon terrorist proxies for several reasons. First, they are relatively inexpensive. Analysts believe that the annual operating budget of Lashkar-e-Taiba (LeT) is about $50 million of which about $5.2 million is dedicated to military operations.[1] Compared to Pakistan's defence budget of $7.4, this amount is meagre.[2] Second, no matter how robust India's counter-intelligence, counter-terrorism and counter-infiltration efforts are, it is impossible to detect and pre-empt every terrorist attack planned and supported by Pakistan. Third, these attacks achieve Pakistan's minimalist objectives. While they cannot and will not change the territorial dispensation of Kashmir, they do effectively focus international attention on the so-called 'Kashmir dispute,' which in turn prompts international calls for dialogue. Pakistan uses these calls at home and abroad to legitimise its claims to Kashmir. Finally, the use of proxies confers some degree of plausible deniability which hinders India's ability to argue persuasively for punitive actions bilaterally or by

the United Nations. Complicating this scenario is Pakistan's explicit reliance upon its ever-expanding nuclear arsenal to raise the cost of Indian action and to draw in international actors to shield Pakistan from the consequences of its actions.

This creates a series of dilemmas for the Indian state and, in turn, for its application of power. To date, India has generally opted to use "strategic restraint," which has generally involved not responding to Pakistan-sponsored terrorism militarily. Proponents of this approach argue that avoiding a major conflict with Pakistan will permit India to continue its economic growth, and thus its ability to continue to invest in military modernisation. Moreover, Pakistan's behaviour is self-marginalising and undermines the integrity of the Pakistani state. However, many observers fear that India is making a virtue out of a necessity to obfuscate the fact that India lacks the ability to punish Pakistan militarily while retaining control of the escalation ladder.[3] Whether India is making a strategic decision or simply making a virtue out of inability to act otherwise, India is essentially accepting that dozens, if not hundreds, of Indians will continue to die as a transaction cost of India's economic growth. While such a trade-off seems distasteful once articulated, it is not an irrational one to argue the national benefits to such an approach. On the other hand, if India were to undertake the reforms in defence, it would need to better manage the threat—the financial and political costs will likely be great and unlikely to fructify over the policy relevant future. And, despite these investments, success cannot be assured.

Here I argue that in the near term, India should consider military others than war for a variety of reasons. Most importantly, it is far from obvious that India can achieve its objective of compelling Pakistan to abandon terrorism under its terrorist umbrella through war. Thus what India may be able to do is raise the cost of this strategy to Pakistan while seeking to deny some the benefits that it enjoys. In this essay, I make three assumptions. First, I assume that India has chosen to cease making a virtue out of a necessity. Second, I assume that Pakistan will not resort to the use of nuclear weapons unless the very existence of the state is imperilled. The reason for this is straightforward: presently, the conditions of "mutually assured destruction" do not hold. While Pakistan can inflict grievous damage to India, India will ultimately survive. Pakistan, on the other hand, will not survive a nuclear retaliation. Most of its military, industry and population is concentrated in the Punjab region and the country lacks strategic depth as is well known. Third, I assume that China will remain as uninvolved as it has in the past and will not undertake military action against India in defence of its client's continued ability to use terrorism as a tool of policy.

The Challenge

India's central challenge is to compel Pakistan—particularly its army and Inter-services Intelligence Directorate (ISI)—to cease using groups like LeT to terrorise India into making some concession to Pakistan's equities in Kashmir. This challenge is daunting as Perkovich and Dalton note, despite their reckless misformulation of India's principle challenge.[4] As they note, for a compellent strategy to be effective, the chain of action and reaction must ultimately inflict more harm on the object of the compellence strategy (Pakistan) than on the compeller (India). Put differently, how can India inflict such costs upon the Pakistan army and the ISI that they will cease and desist from attacking India using terrorist proxies that does not ultimately impose more cost upon India?

Does it make sense for India to initiate war over a terrorist strike? If India were to launch a limited aims war with the intent of seizing valuable territory before the international community intervenes and use that territory as a bargaining chip to

force Pakistan to concede to a comprehensive peace, would that peace hold? How can India ensure that the war remains limited? When the dust settles, with countless dead on both sides, has the status quo changed? Is there anything that India can do to impose such costs that is short of a comprehensive defeat of Pakistan and the ISI? Under the conditions of such a defeat, would India be more or less secure? These are incredibly difficult questions to answer and, in my view, have not been asked and answered effectively in the open source domain.

To achieve a comprehensive defeat of Pakistan, as Dalton and Perkovich have argued, India must make massive overhauls in virtually all aspects of its civilian-military relations, higher defence organisation, defence procurements, defence modernisation and service-specific visions of the future battlefield, among others. The military is not integrated into civilian decision-making, the services resist jointness; the Defence Research and Development Organization in India has a monopoly on defence development but often fails to deliver; the Ministry of Defence often fails to make important acquisition deals in part because it lacks a specialised cadre of defence professionals, and there is little political will to redress these sundry hindrances. Most exigently, India requires "[p]olicies and capabilities to decisively punish Pakistan in the event of another major terrorist attack against India," yet has not rigorously analysed much less articulated such a strategy, nor debated the resources and methods that could be reasonably acquired and deployed to "move Pakistani leaders to curtail the terrorist threat."[5]

For these reasons, I argue that India should pursue military operations other than war in the near term while the above-noted issues are debated and hopefully resolved. (Despite a crippling mis-framing of the puzzle which exculpates Pakistan from direct responsibility of using these groups as tools of policy, Dalton and Perkovich exhaustively examine the range of military requirements needed to compel Pakistan and the myriad political and financial investments that would ensue.) These options, detailed below, include sub-conventional actions in Pakistan, limited actions along the Line of Control (LoC), and continued fortification of the LoC and border with better integration with police organisations.

Sub-conventional Operations

One of the puzzling aspects of Indian behaviour is that it has generally demurred from engaging in sub-conventional operations in Pakistan in the recent past. Presumably India's own nuclear deterrent should provide India the same umbrella of impunity for such operations as Pakistan's umbrella affords it. In the 1980s, then Prime Minister Rajiv Gandhi ordered the Research and Evaluation Wing (RAW) to establish two covert groups: one to target Pakistan generally and another to target Khalistan groups in Pakistan.

The two groups were responsible for carrying out insurgency inside Pakistan. A low-grade but steady campaign of bombings in major Pakistani cities, notably Karachi and Lahore, were carried out. This forced the head of the ISI to meet his counterpart in RAW and agree on the rules of engagement as far as Punjab was concerned. The negotiation was brokered by then-Jordanian Crown Prince Hassan bin-Talal, whose wife, Princess Sarvath, is of Pakistani origin. It was agreed that Pakistan would not carry out activities in Indian Punjab as long as RAW refrained from creating mayhem and violence inside Pakistan.[6]

The reason for this seems to be a policy decision undertaken by former Prime Minister I. K. Gujral to demobilise assets that Indian intelligence cultivated for sub-conventional operations.[7] It takes years to cultivate such assets and they cannot

simply re-activated. India should reverse this policy of sub-conventional restraint immediately. It will likely take years to re-establish the kinds of assets inside Pakistan needed for effective sub-conventional deterrence. India would be wise to commence this immediately.

India must also tread carefully in the kinds of sub-conventional operations it would pursue. In recent years, India has flirted with giving a fillip to the Baloch insurgency. This is appealing at first blush. However, I believe it may not be wise for several reasons. First, the Baloch militant groups are not disciplined, prone to competition among each other and killing civilians. Supporting such groups run the risk of undermining India's pristine reputation of not engaging in such activities in Pakistan. Second, the Pakistani state has no compunction about massacring Baloch. Any Indian interference will be used as further justification at home and abroad for ever more brutality. Similarly, providing funding to the Pakistani Taliban would likely be unwise even though it has a demonstrable record in undermining the Pakistani state. Because the Pakistani Taliban are Deobandi, they have strong ties with Deobandi groups that target India and Afghans. The potential for blowback is quite high for this option.

Instead, India should focus its efforts on degrading groups like the LeT, Jaish-e-Mohammad (JeM) as well as their enablers in and out of uniform. India would not likely attract international opprobrium if it focused its covert operations to non-state combatants and their enablers in the state. Dalton and Perkovich recommend against this, citing Israel's history of leadership decapitation and the ever-more sanguinary violence that the targeted groups perpetrate. It is true that leadership decapitation strategies are not suitable for groups with whom one wants to negotiate because such strategies remove from power the persons who can control the production of violence.[8] This is not the case with LeT, JeM or its enabling support network. In fact, LeT has a very hierarchical structure and tends to move the same leaders about these various positions. LeT has not developed a deep bench of replacements. Thus India should consider seriously how it can degrade key leaders. LeT seems particularly ripe for such options given its hierarchical structure.

Given that these leaders tend to roam about in cities, with Pakistani protection, this will not be an easy feat. However, it should not be impossible. JeM is similar. While the organisation had a serious leadership split in late 2001 with most of its members turning against the state, Massood Azhar remained loyal. The ISI has invested considerable resources to relaunch JeM in recent years as a part of its strategy to manage the Pakistan Taliban problem. Given the hierarchical nature of these groups' organisational structure and given the dependence of the groups upon key personalities, their elimination could be an effective means of degrading their lethality.

India should also focus upon those in and out of uniform who are providing assistance to these groups. These individuals link the terrorist group, the army and the ISI; and are important conduits for money, training, mission planning and personnel selection. Pakistan is riven with criminal and competing terrorists who could potentially be cultivated for these tasks. Additionally, India's historic ties to Afghan intelligence may also be a propitious partnership to undertake operations in Pakistan.

Actions Along the Line of Control and International Border

The Uri raid of September 2016 drew high praise from Indians. However, Indian armed forces had been conducting these raids for years: they simply were not made public.[9] Clearly these kinds of

raids are not adequate to degrade the terrorist organisations' ability to conduct strikes even if they are an important kind of operation that must be performed routinely. When India went public with the raid, Pakistan denied it. This was likely a wise move on Pakistan's part: had it conceded the raid took place, there would have been domestic pressure to respond demonstrably. As it was, Pakistan undertook reprisals. Only Indian security professionals know whether India inflicted or suffered more costs. What is clear is that while these kinds of operations are important, they are not game changers.

The task for India is to develop a capability to conduct strikes against terrorist infrastructure as well as those military formations that enable them to operate in territories that would not justify Pakistan launching a larger punitive offensive. Arguably, the Indians should work with supportive international partners to ensure that the Pakistan response is muted. The most likely terrain for these operations is Pakistan-administered Kashmir. However, there may be need to do so along parts of the International Border as well on occasion.

To conduct these operations effectively, India needs to invest much more heavily in special operations units that are specifically designed for infiltration operations to conduct high-risk missions on enemy soil. This suggestion is not intended to denigrate India's current capabilities or numerous special operations groups; rather to emphasise the need for specific elite that conduct these kinds of operations in this terrain. India should also consider inducting armed drones. However, drones are frequently misunderstood. Drones are simply a means of delivering ordinance without putting a pilot at risk. Drones are only effective if used in conjunction with a sophisticated human intelligence network inside Pakistan, operating in concert with signals and other forms of intelligence as well as requisite command and control capabilities.

The United States has been widely criticised for its use of drones in Pakistan. Opponents of the policy have argued that the strategic effects of drones outweigh their tactical benefits. Others claim that drones create more terrorists than they kill. However, there is scant evidence for the maximalist versions of these claims while there is evidence that drone strikes in Pakistan have helped curb violence, particularly high value targets. As these hard targets became increasingly off limits, Pakistani terrorist groups reverted to their older habit of targeting civilians.[10] If India pursues the use of armed drone strikes, it should consider and learn from US experiences with signature strikes (in which individuals are killed based upon their behaviour even if their identity is unknown) versus personality strikes (in which specific persons are targeted based upon a robust intelligence package). The former strikes were very controversial and often had high civilian casualties whereas the former tended to be more precise with fewer collateral deaths and injuries.

Hardening the Borders and Integrating with Improved Law Enforcement

India continues to make efforts to frustrate ability of Pakistan's security forces to facilitate the infiltration of their terrorist proxies into India. India should consider continued investing in ever newer technologies to harden the LoC and parts of the International Border from which infiltration takes place. However, even the most robust of efforts will be inadequate to pre-empt every terrorist cell or every agent provocateur. Once the perpetrators are on Indian soil, it is the task of domestic law enforcement and intelligence agencies to catch the person. There has been adequate ink spilled about the seams that exist across and among these different agencies by Indian analysts. The question remains: why have these previously identified reforms been slow to transpire or not at

all? This is an Indian domestic political question that is beyond the remit of this author. However, it is a well known fact that terrorists exploit these seems. (In Europe, the analogue is Belgium which is riven with competing, dysfunctional and non-cooperating security agencies as well as a thriving arms market.)

Another related problem is the failure to robust reform India's police. This is a well known problem. The police are poorly trained, poorly compensated, poorly armed and lack basic personal protective equipment. Acquisitions are riven with corruption and often result in India's police using defective gear. This is not the fault of the police. It is the failure of state legislatures to prioritise modernised policing. The reasons for this are lamentable and tragic: politicians in India would prefer to have police forces under their control rather than acting as professional forces to serve and protect the polity. India's policing still derives from the Indian Police Act of 1860, which created forces to subdue rather than protect the citizens. Unfortunately, failures in policing can have enormously strategic impacts.

One example of this is afforded by the Kashmir crisis of the summer of 2016. After the killing of a known Kashmiri militant, Pakistan was able to orchestrate stone throwing by women and children in Kashmir with the intent of provoking a disproportionate response from police. This ruse worked when Indian security forces shot and killed protestors with so-called non-lethal munitions when they were surrounded. This created a situation that became ever-more ripe for Pakistani interferences which in turn brought to the two nations to loggerheads. This could have been avoided had the police in Kashmir had a different concept of policing. Instead of seeking out the chimeric non-lethal munition, policing should focus upon crowd control. This requires the police to have the appropriate gear for crowd maintenance, which Indian police force generally lacks. (The United States is NOT an example of effective policing in crowds. Instead, India should look to Japanese or western European models.) The British, German and Japanese police, among others, are adept at managing crowds of thousands of people without a single fatality.

Unfortunately India's domestic political imperatives make such changes very unlikely. There is very little pressure from the public for police reforms and legislators have their own incentives to not engage in the revolutions in policing that are needed to effectively protect India. Moreover, private industries have not developed lobbying efforts to pressure police reforms because they seem to prefer using private security. This is rational: lobbying will require them to spend resources with dubious outcomes while investing in private security has obvious and immediate gains. While policing is not traditionally seen as an issue for the armed forces, in environments afflicted by insurgencies and terrorism, police forces are a necessary if over-looked part of the overall security puzzle.[11]

Conclusions

While Indian capabilities to deliver a decisive defeat to Pakistan may take decades to develop, in the near term India should consider military operations other than war to contend with this continuing security threat from terrorist groups like LeT and their masterminds in the Pakistani army and ISI. The task will be calibrating these responses to deprive Pakistan of an opportunity to launch a larger conflict. This will require working with partners like the United States and Britain to force Pakistan to acquiesce. This is not akin to asking for permission; rather a notification of Indian intentions immediately before undertaking the planned operation. These efforts will fall short of the overall goal of coercing Pakistan to cease and desist from using terrorism as a tool of policy; however, they may provide an important interim step in degrading their lethality.

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Preparing for the Future Indian Ocean Security Environment

Challenges and Opportunities for the Indian Navy

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During the next 15 years, the Indian Navy (IN) will have to grapple with a complex and unpredictable security environment as the Indian Ocean/Asia-Pacific region undergoes a major power transition resulting from the rise of China, deals with regional instability, and faces the proliferation of disruptive military technologies. These developments will shape the capabilities needed to achieve Indian national security objectives, as well as the operational employment of those capabilities. To succeed, the IN will need to acquire and maintain three overlapping foundational capabilities: Sea control in the Indian Ocean, power projection within the Indian Ocean, and power projection beyond the Indian Ocean. With these foundations in place, the Navy can then scale, modify, or augment its operations to meet emergent challenges. This paper discusses each of these foundational capabilities in turn, explaining their importance, identifying impediments to acquiring them, and suggesting means of overcoming impediments. Developing these foundational capabilities will be costly, requiring India to acquire a considerable amount of additional naval capacity. By doing so, however, it can help ensure that the IN has the

building blocks needed to meet the challenges of the coming decades.

Sea Control

The most foundational capability that the IN will need to develop in the next 15 years is the ability to maintain sea control in the Indian Ocean Region (IOR). On its face, the term might seem to suggest exclusionary or coercive use of the oceans. And in the event of conflict, navies must have the ability to deny an adversary use of the sea at particular times and places. However, sea control also seeks to ensure that the maritime domain remains an open common, in which shipping passes freely and one's navy is able to manoeuver at will. Without it, a country's adversary could prevent its naval forces from exercising their most basic functions of protecting sea lines of communication (SLOCs), facilitating commerce, and generating security.

The primary impediments to Indian sea control in the IOR come from evolving Chinese naval and air capabilities and, to a lesser extent, from Pakistani Navy developments. China's submarine and surface forces are growing both qualitatively and quantitatively, and these forces are expanding operations beyond their traditional areas. China also is in the process of operationalising its first aircraft carrier, setting the stage for carrier strike group operations. Further, Chinese long-range air and ballistic missile capabilities, supported by a robust command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) architecture provide an asymmetric capability to project power into the IOR from China.

With regard to Pakistan, the establishment of a Naval Strategic Force Command in 2012 could portend a future in which Pakistan employs nuclear weapons at sea. Pakistan's move to acquire at least eight diesel submarines fitted with air-independent propulsion systems from China in the 2023-2028 timeframe adds more uncertainty to this subsurface mix. Pakistan also possesses a variety of surface assets, including frigates and fast-attack craft. And, in the aerial domain, Pakistan employs the US-made P-3 Orion anti-submarine and maritime surveillance aircraft carrying the Harpoon missile. Together, these burgeoning capabilities will challenge India's traditionally preeminent position in the Indian Ocean, and could significantly erode its freedom of manoeuver.

Indian leaders will need to pay close attention to these challenges and devise effective responses. These will likely include enhanced maritime-domain awareness (MDA); improved anti-submarine warfare (ASW); development of more mobile, dispersed and resilient forces to mitigate air and missile threats; and better electronic warfare capabilities.

As sea control is foundational to maritime operations, maritime domain awareness is foundational to sea control. In future, the traditional view of MDA must expand to multi-domain awareness that includes the surface, subsurface, air, and cyber realms, since operations across these domains are synergistic and mutually supporting. Effective MDA depends on networks of fixed and mobile sensors that provide surveillance of areas of interest, and also requires the ability to fuse, integrate, and distribute the resulting operational information. The application of information technology and data analytics to development of a multi-domain common operational picture (COP) is an area of ongoing innovation.

ASW will be a mission area of particular importance as India tries to cope with the challenges posed by Chinese and Pakistani submarines. The traditional threat to disrupt sea lanes of communication posed by an adversary's submarine forces is expanding to include the

threat of submarine-launched cruise missile attack on maritime and land targets. Improved quieting will make submarines increasingly difficult to detect in future while nuclear or air-independent propulsion will increase their range and endurance. China is now deploying both conventional and nuclear-powered submarines in the Indian Ocean, which have resupplied at ports in Pakistan and Sri Lanka.

To counter this, the IN will need a robust subsurface COP as well as the ability to hold hostile submarines at risk when required. This is potentially an area of increased cooperation between India and US., which could leverage the US Navy's six decades of experience with strategic anti-submarine warfare. These efforts could include other partners as well.

India's acquisition of the capable P-8 Maritime Patrol Aircraft (MPA) will increase its ASW surveillance and engagement capabilities. The geography of the IOR, which enables choke-point ASW sensor employment, facilitates submarine detection. However, maintaining track on and re-acquiring submarines remain a significant challenge, and airborne ASW and geography alone may be insufficient to provide truly robust anti-submarine surveillance. An enhanced IN ASW architecture might employ fixed sensor arrays located at choke-points, augmented by mobile, potentially unmanned, sensors for initial detections. These detections would be handed-off to fixed or rotary-wing air or surface platforms to maintain track. The ASW COP could be enhanced by integrating non-acoustic information from Electronic Intelligence (ELINT) and Communications Intelligence (COMINT) sensors, and partner information. Effective integration of these data will pose technical and operational challenges but can provide major benefits. Careful requirements analysis will be necessary to determine what mix of air, surface and submarine ASW capabilities will be optimal. US systems analysis capabilities could be helpful in this effort, helping India to identify a logical path forward in a resource-scarce environment.

Enhancing Surface Warfare (SuW) capabilities in the IOR poses challenges similar to ASW, with some important differences. Maintaining an SuW COP is easier in some respects, since most or all of the sensors that support ASW can also support SuW. Additional sensors, including conventional and over-the-horizon radars (OTH-R), unmanned air or surface systems, and potential future space assets, can provide persistent wide-area surveillance. Engagement of adversary surface ships is complicated, however, by increasingly capable offensive and defensive systems. This is particularly true of Chinese surface combatants, which possess layered hard and soft-kill air-defence systems, as well as long-range anti-ship missiles. To counter this, IN may want to enhance both its offensive and defensive capabilities. On the offensive side, IN could expand fielding of the proven BrahMos missile, and further improve its range and survivability. BrahMos fielding options could include expeditionary coastal defence cruise missile (CDCM) batteries, which could be deployed rapidly to locations such as the Andaman and Nicobar Islands to control access to the Indian Ocean. India might also leverage its mature ballistic missile programme to develop an anti-ship ballistic missile capability. Defensively, IN could improve the survivability of its naval forces by investing in improved air and missile defence capabilities. Because hard-kill defence against modern anti-ship cruise and ballistic missiles is technically challenging and expensive, IN might want to emphasise soft-kill options to include on and off-board electronic attack and decoy capabilities. These capabilities should be employed as part of an operational construct that includes emission control, mobility, and dispersed operations to complicate adversary targeting. These concepts are also applicable to land-based forces such as the CDCM discussed earlier.

Whatever mix of capabilities India ultimately adopts, technical and operational integration of data from multiple sensors, potentially including those belonging to partner states, will be essential, thus enabling the creation of a maritime common operating picture for the IOR. India has already made significant progress in this direction with the inauguration of the Informational Management and Analysis Centre (IMAC) for the centralIOR, as well as Prime Minister Narendra Modi's initiatives in the Seychelles, Mauritius and Maldives to expand India's maritime domain awareness network with coastal surveillance radars. Due to the prowess of India's civilian technology sector, and the depth of its manpower resources, India may well have a comparative advantage in this area.

Power Projection Within the Indian Ocean Region

The second set of capabilities that IN will need to acquire is power projection within the IOR. While sea control refers to the general ability to ensure open access and freedom of manoeuver, power projection entails the ability to bring naval capabilities to bear rapidly in a particular location, often in support of land or air operations. These capabilities could include a range of kinetic and non-kinetic fires, as well as amphibious assault and expeditionary sealift. Of particular importance will be India's ability to reach core areas of interest, including its coastal areas, maritime zones, Exclusive Economic Zone (EEZ), continental shelf, the Arabian Sea, the Bay of Bengal, and the Andaman Sea, including the Malacca Strait.

Possible impediments to India's ability to project power within the IOR include China's expanding footprint in the Indian Ocean, and growing Pakistani capabilities, as discussed earlier. India will also have to contend with non-state actors, such as those who carried out the 2008 Mumbai attacks; and an arc of instability on the IOR periphery, which is the locus of such problems as Somali piracy, Makram coast drug trafficking and the ongoing conflict in Yemen, where India conducted a well-executed noncombatant evacuation operation (NEO), Operation Rahat, in April 2015 when it rescued over 5,000 people.

To respond to these challenges, India will need to develop sufficient maritime strike capabilities to hold at risk Pakistani and Chinese naval forces and bases in the IOR. This could involve a range of force-employment options up and down the escalation ladder, including cruise missiles, special operations forces and air assets. Improvements in Intelligence, Surveillance, and Reconnaissance (ISR), targeting, and command and control (C2) architecture will also be useful. These capabilities can facilitate decision making and battle management in increasingly complex maritime environments. Unmanned aircraft systems (UAS) such as the MQ-1 Predator, networked with $4^{th}/5^{th}$ generation land or sea-based fighter aircraft, could be helpful in this regard.

The acquisition of additional amphibious ships and the adoption of amphibious warfare doctrines and operating concepts will also be important. Amphibious ships have enormous capacity and extended sea legs, enabling them to support ongoing power-projection efforts. They also are ideal for providing regional security force assistance, engagement, and maritime diplomacy, which can help India to shape the IOR security environment. India could consider collaborating in the amphibious space with Japan and Australia, which are also in the initial phases of developing amphibious capabilities.

In addition, amphibious capabilities are required to support Humanitarian Assistance and Disaster Relief (HADR), Non-combatant Evacuation Operations (NEO) and expeditionary operations. They could also support Indian peacekeeping

missions in Africa, most notably in the Congo, where India provides the largest contingent in the UN peacekeeping force. IN recognises the need for amphibious capability and plans to build four Landing Platform Docks (LPDs).

U. and India have a history of amphibious and HADR collaborations. In 2007, US sold the Amphibious Transport Dock-class ship USS TRENTON, now the INS JALASHWA, to India. And from 2008 to 2010, US and India held an annual bilateral tabletop exercise known as Habu Nag, focused on developing the skills necessary to conduct HADR operations. It is time to revive and enhance this important training to feature an actual landing exercise, and include other interested countries such as Sri Lanka or Bangladesh. Such preparation may be especially important in coming years because of climate change, which could trigger extreme weather events and increase the demand signal for HADR missions. The 1991 response to Cyclone Marian, which devastated Bangladesh, illustrates this need. Over two million people were affected and approximately 140,000 people lost their lives in this tragic storm. Operation SEA ANGEL, led from a US amphibious task force, which included helicopters and landing ships distributing aid and medical care to millions of people, proved the value of a sea-based response to humanitarian disasters.

Power Projection Beyond the Indian Ocean Region

The third foundational capability that India will need to develop is power projection beyond the IOR. Although India's primary interest lies in the Indian Ocean itself, the ability to establish an operational presence and protect equities, contribute to collective efforts, and influence outcomes in greater maritime Asia is important as well. This is particularly true given the strategic interconnectedness of the two regions, ongoing challenges to fundamental norms such as freedom of navigation in the Asia-Pacific, and India's Act East policy.

Impediments to Indian power projection beyond the IOR would come predominantly from China's robust anti-access/area denial (A2/AD) architecture. While similar to some of the challenges presented above, the A2/AD problem here will be much greater as it was designed to counter the powerful offensive capabilities associated with US aircraft carrier strike groups (CSG). This type of capability will pose significant problems for Indian naval assets seeking to enter and remain in the region.

India can take a number of steps in an effort to overcome these impediments. First, it could increase the size and reach of its submarine force. Given their stealth and survivability, submarines can operate effectively in non-permissive A2/AD environments that would repulse surface ships. India currently has 14 operational submarines, and a long-range plan to expand the force to a total of 24. Defence Minister Manohar Parrikar has called for expansion of the submarine fleet beyond even this number. Although a detailed operational and campaign analysis will be necessary to determine precise quantities, the mix should include nuclear attack submarines, which will have better range and on-station time than conventionally powered subs.

Second, India could increase the size and reach of its surface fleet, though its ships would still face difficulties penetrating a complex A2/AD environment. Surface ships armed with longer-range missiles, and operating from a greater standoff range, could mitigate this problem, using the developmental subsonic Nirbhay missile, or an extended-range version of the supersonic BrahMos. Campaign analysis-based modelling would help determine the most effective mix of

weapons and platforms.

Third, IN could improve its logistical capabilities. Helpful measures would include acquiring additional logistic support ships, and improving combatant ship design to increase fuel and ammunition capacity and provide longer-range and on-station endurance. India could also consider establishing more forward-deployed units, with associated shore-based support infrastructure.

Fourth, India could develop its ability to execute network-centric operations. This would require the acquisition of global C4ISR capabilities, including space-based assets. Network-centric operations would provide Indian Naval Forces, ranging from aircraft to carrier battle groups to submarines, the necessary battle-space awareness and command and control to operate with greater precision, and thus enhance survivability, in a difficult A2/AD environment. Networked C4ISR is also a key enabler for effective maritime strike operations.

Finally, for many future missions and scenarios, including the provision of general maritime security—such as counter piracy, counter terrorism, HADR, NEO—as well as responses to potential crises with China, Indian interests will likely align with US and other regional states like Japan, Australia and Vietnam. India could make more effective contributions to joint security operations, and enjoy greater success penetrating robust A2/AD architectures, as part of a coalition of these states than it could by attempting to operate independently. IN may therefore wish to develop varying degrees of interoperability with other navies. Although some might worry that this could erode India's strategic independence, such interoperability would not require formal alliances, and could be scaled to suit India's relationships with a range of partners. Thus, if properly managed, interoperability could significantly enhance India's security without unduly impinging on its autonomy.

Conclusion

The development of the three foundational capabilities discussed above will require India to balance strategic priorities with available resources as part of an ongoing commitment towards building naval capacity. Doing so will not be easy, from either a political or a fiscal standpoint. To make the task more manageable, India could decide to focus its near-term efforts on its highest priority, foundational goals, such as Indian Ocean sea control, and pursue other capabilities over the longer term. Whatever specific approach it chooses, developing these capabilities will help ensure that India is able not only to maintain its traditional sphere of influence in a rapidly changing maritime Asia, but also emerge as a major regional power, playing a more important strategic role than ever before.

Future Technologies for the Indian Navy

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India's emergence as a strategic actor in Asia has drawn attention to its Navy's role as a security provider in the Indian Ocean. With growing maritime reach, and an admirable record of service in the Indian Ocean Region (IOR), the Indian Navy (IN) is widely seen as an important security player in the Asian commons. Beyond securing the critical Indian Ocean sea lanes, however, the Navy has also had to deal with a sharp uptick in irregular threats in India's near-seas. Ever so often, the mission has involved combating extra-regional influence in India's maritime neighbourhood through subtle power projection.

The strategic nature of threats has underscored the importance of technology in expanding naval offensive and defensive capabilities. Despite expanding its combat prowess, the Indian Navy has grappled with systemic deficiencies and delays in shipbuilding projects. As a corollary, there has been a growing clamour for the infusion of superior knowhow in naval systems to preserve IN's combat edge. India's maritime analysts have been worried about the deployment of Chinese warships and nuclear submarines in India's near-seas. The anxiety has been heightened by South Asia's

emergence as a theatre of geopolitical contestation, leading to urgent calls within the Indian strategic community to speed up IN's modernisation. Asia's murky power politics has highlighted the strategic imperative of robust maritime presence operations in the near-littorals.

Maritime observers are convinced that a high-stakes technological contest is unfolding in the Asian littorals. It involves growing attempts by rival powers to acquire modern capability for effective posturing at sea. These include precision-guided missiles, advanced intelligence, surveillance equipment and autonomous systems. The push towards advanced munitions, unmanned combat vehicles, quantum computing technology and hypersonic, has led many to contemplate new kinds of warfare scenarios involving cyber, space and energy weapons.

The Push for Naval Modernisation

Studies of the future maritime environment have acknowledged the increasing predisposition of navies to employ modern weaponry for posturing and deterrence. These include the use of precision-guided missiles, unmanned vehicles and networked systems to achieve theatre dominance. There are indications that the use of long-range sensors and precision-strike capabilities in the future will rise exponentially, even as the maritime battle-space undergoes a veritable compression, imposing sharp restrictions on the freedom of manoeuvre of surface naval forces.

Analysts aver maritime operations in the post-modern era are likely to involve operational concepts that would require remote sensing and stand-off capability. By popular reckoning, in many of these areas—viz. scouting campaigns, network centric warfare, special operations and littoral war-fighting—unmanned and autonomous systems will play an important role in influencing events, both during peace and conflict.

Despite an early foray into indigenisation over five decades ago, IN hasn't yet succeeded in constructing an efficient maritime industrial complex. While India's warship construction programme has proceeded apace (with at least 48 ships and submarines under construction in Indian shipyards), most projects remain dependant on foreign technology. To add, larger institutional lacunae such as insufficient capital, dated technology and deficient planning, continue to plague the system.[1]

Even so, maritime managers remain optimistic about IN's technological developments. Last year, the Navy announced the release of a guideline document, the 'Indian Naval Indigenisation Plan (INIP) 2015-2030', to enunciate the need for developing various advanced systems for its platforms.[2] An ungraded version of a previous plan for the period 2008-2022, the new document sought to outline projects for a new phase of self-reliance, involving local manufacturing of advanced equipment under the 'Make in India' initiative.[3]

In particular, naval engineers are said to have identified critical cutting-edge technologies to build into the warship building plan. The Navy plans to induct high-definition radars, infra-red seeker, sonars and electronic warfare suites to minimise foreign dependence for sensors and weapons. This appears consistent with the Ministry of Defence's Technology Perspective and Capability Roadmap (TPCR-2103) that calls for the acquisition of modern subsonic, supersonic and ballistic missiles, equipment and sensors, propulsion and power generation, and surveillance and detection systems.[4] More significant is the advocated shift from an ammunition-based, theatre-centric model to a directed energy weapons-based network-centric model.

Further, more instructive is a wishlist of 100 new technologies announced by IN in May 2016, to be acquired by 2031.[5] These can broadly be classified into five major types of sensors and weapons.

Precision Guided Missiles (PGM)

The first category of keenly sought after technology is precision munitions, particularly drone-launched guided missiles and loitering missiles. There is a growing realisation in Indian military circles that smart ammunitions have a distinct set of advantages over conventional munitions. For their versatile and flexibility of usage, the sheer range of potential targets, and the ability to limit collateral damage, the former are a clearly superior choice. The fact that smart ammo can be deployed onboard unmanned aerial vehicles, a platform of choice during littoral operations, makes it an attractive option.

Unfortunately, India's precision ammunition manufacturing technology remains underdeveloped. Efforts to establish joint ventures for precision-guided munitions (PGM) manufacturing haven't found much success, owing principally to the lack of capital investments necessary for such ventures. The precision attack and targeting capabilities of Indian Armed Forces are currently limited to laser-guided bomb (LGB) kits attached to dumb bombs on Air Force jets.[6] The increasing usage of precision bombs and missiles in Indian naval and air weapon systems hasn't done much to expand India's indigenous manufacturing capabilities. Despite considerable efforts, New Delhi remains dependant on import of smart munitions.

With "loitering" missiles too, the story hasn't been much different. Nirbhay, the Defence Research and Development Organisation's (DRDO) subsonic cruise missile, is yet to clear its field tests.[7] With an ability to lurk undetected over a target area and a capacity for higher loads of ordinance, subsonic missiles are considered indispensable by modern maritime forces.[8] Unfortunately, with subsonic missiles, success has been fairly limited.

In April 2016, reports that OIS Advanced Technology (OIS-AT) is partnering with Sagem of France to manufacture the munitions locally for the Indian Air Force caused some cheer in defence circles.[9] DRDO says its negotiations with Sagem will lead to the development of the New General Guidance Munition (NGPGM), a 1000-kilogramme class bomb compatible with the Indian Air Force's Mirage-2000H/TH.[10] The successful miniaturisation of ammunition for aircraft operations could lead to the development of missiles for naval drones in the future.

Net Centric Operations

Since the early 2000s, IN had been on the lookout for a satellite which could shorten the 'sensor-to-shooter loop' to swiftly detect and tackle tactical threats. While the DRDO has developed the means to build such a platform, it didn't have an indigenous GSLV rocket to carry the satellite.

After several years of trial and error, India finally launched its first dedicated military satellite GSAT-7 or 'Rukmini' in 2013.[11] A geo-stationary communication satellite, the GSAT-7 enables real-time networking of all Indian warships, submarines and aircraft with operational centres ashore, providing IN with an almost 2,000-nautical-mile-footprint over the critical IOR. With UHF, S, Ku and C-band transponders, the Rukmini's 'over-the-sea' usage will soon be complemented by the GSAT-7A, a satellite dedicated for IAF and Indian Army operations.[12]

Expectedly, the GSAT series is superior to the 'dual use' Cartosat satellites or the Technology

Experimental Satellite that the Indian Armed Forces previously used for surveillance, navigation and communication purposes. Rukmini's ability to keep an eye on the IOR by providing real-time inputs was demonstrated at a theatre-level readiness exercise earlier in 2016, when near complete integration and synergy was achieved between two widely dispersed but networked fleets in the Indian Ocean.

Meanwhile, the Navy has also placed navigation satellites in orbit. In September 2016, the Indian Space Research Organisation (ISRO) placed the seventh satellite of the Regional Navigation Satellite System (IRNSS) in orbit.[13] NAVIC, as the IRNSS is popularly called, will be used to provide accurate real-time positioning and timing services over India and the region, extending upto 1,500 km around India. The constellation consists of three satellites in Geostationary Orbit (GEO) and four in Geosynchronous Orbit (GSO), about 36,000 kms above the Earth's surface.

The challenge now is to place low Earth orbit (LEO) satellites in space since IRNSS does not provide good photographic intelligence about enemy forces and assets in a dynamic war situation. ISRO engineers say the IRNSS is not equipped with cameras and sensors and, therefore, is not capable of providing high-quality photographic intelligence in real-time.

Anti-Satellite Weapons

In principle, India has always opposed the weaponisation of space. The Ministry of Defence's TPCR-2013, however, dwelt on the need to develop ASAT weapons "for electronic or physical destruction of satellites in both LEO (2,000km altitude above earth's surface) and Geosynchronous orbits".[14] Despite their deletion in subsequent roadmaps, the need to exploit space for military purposes has been clearly established.

A year earlier, V.K. Saraswat, the then chief of DRDO had announced that India was moving to integrate an anti-satellite weapon to neutralise hostile satellites in low earth and polar orbits. In an interview, Saraswat suggested that India's anti-ballistic missile (ABM) defence programme could be utilised as an ASAT weapon, along with its Agni series of missiles.[15]

Even today, DRDO contends that it can develop ASAT weapons if required by marrying the propulsion system of the over 5,000-km Agni-V missile with the 'kill vehicle' of its two-tier BMD (ballistic missile defence) system.[16] According to defence engineers, work has begun on a futuristic programme for launching 'mini-satellites on demand' for use in the battlefield as well as 'EMP (electromagnetic pulse) hardening' of satellites and sensors to protect them against ASAT weapons.[17]

Many Indian analysts, however, say ASAT capabilities require a number of technologies that India does not presently possess. These include modern space-based sensors, synthetic aperture radars, electronics, sound navigation system, guidance and control, and global positioning systems. There are also questions about India's ability to produce infrared sensors, optical devices, electronic-optical sensors, and magnetic sensors vital for detecting and monitoring events in space.[18]

Artificial Intelligence

It is 'artificial intelligence' (AI)—the ability for combat platforms to self-control, self-regulate and self-actuate, using inherent computing and decision-making capabilities—that constitutes the most radical and contested of all new technologies.

Advanced computing technologies today enable autonomous systems to identify and strike hostile

targets, a phenomenon that has led to a growing interest in 'intelligent' naval combat systems. The advent of data-driven decision making in naval systems is fuelling efforts to combine AI with analytics and cloud computing. More crucially, maritime forces are charting a move away from the diagnostic to the predictive space—shifting from the management of data to actual decision-making, powering decision-cycles of combat systems.

Even so, there are complex questions that require firm answers. Many of them have to do with the ethics of AI. While drones avoid subjective decisions based on incomplete information and tensions, they sometimes find it hard to avoid risky manoeuvres, leading to untoward incidents or collateral damage in combat situations. Autonomous weapons also pose many legal and moral dilemmas. Consensus, for instance, is yet to evolve on whether the use of AI-prosecuted targets in battle—without due authorisation from a human source—constitutes a legitimate act. Indeed, many naval commanders express reservations about divesting human executive control over weapons systems.[19]

And yet, there is little denying the need for modern-day operators to be actively assisted by sensors and systems. AI provides the technology to augment human analysis and decision-making by capturing knowledge that can be re-applied in critical situations. It seeks to alter human intervention from 'in-the-loop' controller to 'on-the-loop' thinker who can focus on a more reflective assessment of problems and strategies, guiding rather than being buried in execution detail.

AI, however, really implies an inherent ability for a combat system to take targeting decisions. It's worth emphasising that maritime forces, including many in the Navy, remain skeptical of autonomous weapon systems with independent targeting capability. Operational commanders still regard the decision to execute a missile launch as the exclusive preserve of the command team, which must act independently. Notwithstanding its utility in remotely operated weapons like drones, broader questions about AI's utilisation in combat remain unanswered.

Directed Energy Weapons

Around the world, a top priority with navies is to get their ships off gunpowder—a high vulnerability for naval ships, whose explosive laden magazines represent the nautical equivalent of a ticking time-bomb. As a result, a growing number of maritime forces around the world have made a push for energy weapons. Russia, US and China have all made major strides in high-energy laser and microwave technologies, which have shown the potential for altering the dynamics of maritime battle.

Many of these navies have focused on perfecting state-of-the-art energy weapons, which incorporate precision tracking/pointing and laser beam combination. India's DRDO, too, is prioritising Direct Energy Weapons (DEW) development in the technology perspective and capability roadmap.[20] The agency claims it has already built a number of smaller DEW systems. These include devices designed to disarm mines and other IEDs, vehicle-mounted crowd control units, and hand-held devices capable of overpowering armed individuals

The question of how viable laser weapons are going to be in the long term, however, continues to vex the naval scientific community. There is talk of chemical oxygen iodine lasers, high-power fibre lasers and a 25-kilowatt laser that can knock out a ballistic missile during its 'terminal phase' from up to four miles away.[21] These are ambitious plans that do not look achievable in near future.

Besides, mounting energy weapons aboard aircraft and naval ships is a challenging proposition, owing in no small part to the difficulty engineers face in directing a focused energy beam from a moving platform.

Yet, the difficulties are well worth the payoff. DEWs offer a number of advantages, including cost-effectiveness and an ammunition supply limited only by the weapon's power source. Energy weapons also fire at the speed of light, is virtually silent, and can limit collateral damage.

This is one reason why supported weapons programmes, like Laser Weapon System (LaWS) and the electromagnetic rail gun, are being tested by many top-ranking navies—including the US Navy. These new weapons have a virtually unlimited magazine, only constrained by power and cooling capabilities onboard the vessel carrying them. Not only do these provide safety for sailors and marines, they also reduce dependency on gunpowder-based munitions. Many Indian scientists now believe the potential cost savings offered by laser weapons and low-cost electromagnetic railgun projectiles (as against expensive missiles) make energy weapons a worthwhile investment for the DRDO.

Unmanned Aerial Systems and 'Smart' Missiles

For IN, unmanned systems constitute the holy grail of futuristic warfare. Unmanned Aerial Vehicles (UAVs) are a source of enduring interest because of their ability to remain on station for extended periods and provide crucial data in real time.

The Navy's three UAV squadrons in Kochi (Kerala), Porbandar (Gujarat) and Ramanathapuram (Tamil Nadu) operate Heron and the Searcher MK II vehicles for coastal surveillance. Each squadron has eight Searchers II and six Heron UAVs, with each unmanned platform possessing a capability to operate at an altitude ceiling of 15,000 ft to 30,000 ft. Reportedly, plans are in place to induct at least two more squadrons of UAVs to be controlled from ships to increase the range of surveillance. These units would be specifically employed in reconnaissance, surveillance and intelligence gathering missions in the far littorals.

IN also plans to induct strategic unmanned systems, including a fleet of high-altitude long-endurance (HALE) maritime UAVs as well as rotary-wing tactical UAS. Since 2010, Indian naval officials have been in discussions with their US counterparts for the possible transfer of a fleet of high-altitude long-endurance (HALE) maritime UAVs—the modified Global Hawk developed under the Broad Area Maritime Surveillance (BAMS) programme.[22]

In March 2015, IN invited bids for ship-borne UAVs that can augment various patrolling and search-related tactics on its vessels.[23] In order to enhance ISR capabilities and monitoring of Sea Lines of Communication (SLOC), as also to improve EEZ safety, anti-piracy and anti-terrorism patrols, naval managers have expressed the need for ship-launched UAVs that can enable communication between sea-borne platforms and other friendly vessels, aircraft and satellites, especially IN's dedicated naval satellite.

In some ways, the growing propensity of navies for autonomous operations is a reflection of the growing tensions in Asia-Pacific. The unprecedented rise in surveillance platforms deployed in the South China Sea, particularly China's deployment of high-tech drones, such as the Harbin BZK-005, has reinforced a perception in New Delhi that Chinese future military operations will focus on dominating Asia's littorals.[24]

Fearing an expansion of PLAN presence in the Indian Ocean, New Delhi has sought to improve

its surveillance capabilities in the IOR by inducting long-range maritime aircraft (P 8-Is) and seeking the transfer of the multi-mission 'Predator' platforms from US.[25] In addition, Israel will supply 10 Heron TP armed drones for the Indian Air Force, capable of carrying 2,000 kg of weapons payload and air-to-ground precision missiles.[26] India already operates unarmed Heron-1 aircraft for surveillance and reconnaissance missions and a fleet of Harpy drones—a self-destruct aircraft carrying a high-explosive warhead and primarily used for taking out enemy radar stations.

Unmanned Underwater Vehicles

For the past few years, the DRDO has been designing and developing multiple autonomous underwater vehicle (AUVs) to meet broader operational requirements for futuristic scenarios.[27] In April 2016, DRDO scientists successfully developed an autonomous underwater prototype for multiple maritime missions in India's waters.[28] A feasibility study undertaken for the development of different types of AUV platforms showed that the Indian R&D was capable of designing various kinds of unmanned underwater vehicles (UUVs)—from hand-held slow-speed ones to military-class platforms—with the capability to assist in the entire gamut of maritime security.[29]

DRDO's prototype is a flat fish-shaped vehicle capable of speeds upto 7 kmph at depths of up to 300 metres below sea level.[30] Fully pre-programmed in terms of algorithms and mission requirements, the robotic vehicle is piloted by an on-board computer developed by the Visakhapatnam-based Naval Science and Technology Laboratory (NSTL). The design, apparently, is being reworked upon to provide the prototype with passive sonar and electro-optical sensors for anti-mining missions.

Meanwhile, NSTL is working on an ambitious programme called 'Autonomous Sea Vehicle' (ASV), modelled on the US Navy's 'Manta Unmanned Underwater Vehicle' programme. A 'submadrone', a submarine-launched swimming spy plane contained within an underwater drone with folded wings housed in a torpedo canister, and the Indian ASV will be launched from submarine tubes and deployed in reconnaissance mode for a fixed time period.[31] For deep-sea exploration, India has the Samudra, a low-cost AUV that operates underwater with pre-programmed inputs.[32] Fitted with an on-board image processing unit, it can undertake path detection, obstacle avoidance and target identification under the sea.

The development of unmanned and autonomous underwater vehicles (U/AUV) is likely to depend on the future effectiveness of such platforms in carrying out conventional submarine missions. Analysts point out that modern submarines' need for secrecy limits their utility in the far-littorals. If underwater vehicles could replace submarines, then a navy's appetite for greater adventurism in enemy waters could rise significantly.

The more important implication of U/AUV operations is the shift in anti-submarine warfare operations from defensive to offensive missions. Since their inception, ASW techniques have been used primarily to protect specific assets in critical littoral spaces. The thrust of the naval effort has involved protection of the core of the fleet from prowling submarines. U/AUVs challenge the existing paradigm by targeting submarines on open patrol. In order to negate the advantages of modern submarines in terms of high endurance, speed and an inherent stealth, unmanned platforms are being designed to operate in packs, making it harder for submarines to escape detection in constrained spaces.[33]

The Way Forward

For India, the main technological challenge is to reduce the imported content of indigenously produced naval sensors and weapons. While there are plans to build future naval technologies under the 'Make in India' initiative, it is unclear if an outright indigenisation approach to technology will be effective. The problem for New Delhi is that even though foreign defence companies are willing to collaborate with Indian manufacturers, they are reluctant to transfer cutting-edge technologies. Equally worrisome, however, is the suboptimal capacity of Indian firms to acquire and absorb foreign technology.

Outwardly, the maritime technology mission seems well defined. Through the INIP, the Navy has announced its ship-building ambitions, which it believes will enable India to be a net provider of security in the maritime neighbourhood, thus building capability and enhancing capacity of regional partners. Yet, the shortfalls in terms of both Indian R&D and Indian manufacturing remain serious. For maritime managers, the mission involves five urgent tasks (a) R&D in military sciences and technologies; (b) amalgamation of R&D and the manufacturing sector; (c) bringing about an integration of users, designers and manufacturers; (d) making projects commercially viable, achieving economies of scale; and (e) tiding over technology-denial regimes.[34]

It is the infusion of foreign technology and capital that is likely to present the biggest challenge, especially in the manufacturing of modern sensors and weapons. In the case of high-range hypersonic missiles, laser and directed energy weapons, for instance, Indian scientists haven't managed much external support. Outer space too hasn't attracted too much foreign collaboration. Since 2007, when Beijing tested its ASAT (anti-satellite) weapons against low Earth orbit satellites, New Delhi has been on the lookout for counter-space capabilities.[35] After China's space agency tested 'direct-ascent kinetic kill' capabilities, the space project acquired urgency. A growing number of senior Indian military officials point to the inevitability of a military race with China to protect space assets and a contest in space. Yet, Indian scientists acknowledge the lack of technology and investment in inducting kinetic and directed-energy laser weapons.

With network-centricity, the basic building blocks seem to be in place. Key data links are being produced indigenously, and more networked military communication satellites will soon be orbit. The critical part will be the integration of modern weapon systems into the wider architecture for which more investment and R&D will be needed.

Going forward, autonomous platforms are likely to be an area of focus. DRDO's project to indigenise Rustom-I, a Medium Altitude Long Endurance (MALE) UAV, by integrating HELINA, a locally developed anti-tank missile, is slowly progressing.[36] Even though the avionics of Rustom have posed some problems, Rustom-2, an upgraded platform, completed its first flight in November 2016 from Challakere near Bengaluru.[37]

A key enabler for armed UAV flights in India would be the new domestically developed satellite-based augmentation system (SBAS) called GAGAN, useful for navigation and precision vertical guidance for commercial airplanes.[38] Designed essentially to assist civil aviation in India through the enhancement of satellite navigation (SATNAV) signals, GAGAN will be available to Indian military users as well. Local industry has been trying to develop a light-weight GAGAN receiver module that can be fitted aboard UAVs and is capable of receiving 'refined' signals from the American GPS, Russian GLONASS, and Indian Regional Navigation Satellite System

(IRNSS) which will become fully operational in the near future.[39]

The more complicated task will be the development of UUVs, where Indian engineers will need to fully comprehend demands that future operations are likely to place on underwater autonomous platforms' ISR sensors, and command and control systems. The bottom line objective for India's R&D community will be to extend operational awareness within the battle space without assistance from manned systems and human decision makers. At the same time, UUVs will need to accurately assess the operational environment and undertake calibrated action in foreign waters without escalating an existing situation. The critical requirement is to ensure that the quality of command decisions closely matches those taken by naval commanders.[40]

For the moment, it appears, the institutional focus is likely to be in areas where there is a base level of expertise—mainly maritime sensors such as electronic warfare suites and sonars. Many of the DRDO-developed EW systems, such as Ajanta, Ellora and Porpoise, installed on the latest frontline surface, airborne and subsurface combatants, will likely be substantially upgraded. Likewise, IN's family of advanced underwater-sensors, including Advanced Panoramic Sonar Hull mounted (APSOH), Hull-mounted Sonar Advanced (HUMSA) and USHUS, will be developed further.

To build future war-fighting capabilities, the key for IN will be to acquire disruptive technologies, including electromagnetic rail guns and kinetic energy projectiles; laser-directed weapons, weapon-control systems and communication suites. New naval aviation assets—such as carrier-borne fixed-wing aircraft, ship-borne multirole rotary-wing aircraft, ship/carrier-launched-and-recovered UAVs and UCAVs—will also need to be built in under the Make in India programme.

IN has ambitions to acquire and develop technologies in many crucial areas. Going forward, military scientists will need to show progress with high-definition radars, infrared seekers, precision munitions and energy weapons. It will be important to build these weapons under license, for which both government and private industry will need to spend more on research and development. The critical task will be to expand research and development to a level where India maritime technological initiatives become self-sustaining.

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The Poverty of Expectations

Likely but Unfamiliar Challenges

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In his foreword to Roberta Wohlstetter's 'Pearl Harbor: Warning and Decision'[1], Nobel Laureate Thomas Schelling wrote, "There is a tendency in our planning to confuse the unfamiliar with the improbable. The contingency we have not considered looks strange; what looks strange is thought improbable; what is improbable need not be considered seriously." He goes on to warn that the "danger is not that we shall read the signals and indicators with too little skill; the danger is in a poverty of expectations – a routine obsession with a few dangers that may be familiar than likely."

This essay looks at three strategic scenarios that may sound unfamiliar today but cannot be dismissed from the realm of reality. With a time horizon of 2030, it is possible that some or all of them may be seen as more likely going into the future, and a few perhaps completely dismissed as the situation evolved. None of the scenarios, however, is a ridiculous fantasy; all of them are grounded in reality as it exists today.

There are a few common characteristics kept in mind while framing these scenarios. One,

they must threaten India substantially, whether geographically, economically, politically or socially. Two, the threat must have a security component, which necessitates the involvement of the military. Three, the scenarios have to be broad-based in nature where the details of the specific threat may vary but still fit in the larger picture. And four, they should fall within the danger of 'poverty of expectations' of the government.

Scenario 1: A tactical nuclear weapon attack by terrorists on Indian mainland

Pakistan has developed the Hatf-9 (Nasr) short-range ballistic missile (SRBM) as part of its full-spectrum deterrence against India. Pakistan claims the Hatf-9 is equipped with a tactical nuclear warhead (TNW) which can stop the advance of Indian mechanised forces into Pakistan. A TNW is a low-yield (8-10 KT) short-range nuclear warhead which is extremely costly and complex to manufacture and difficult to transport, store and maintain under field conditions. Because TNW-fitted missiles have to be fired at a very short notice, unlike bigger strategic weapons, these nuclear warheads have to be kept in a fully assembled state. Moreover, the authority to fire a TNW has to be delegated to lower-level military commanders at an early stage in the battle. All this creates a proclivity among the military commanders to 'use them or lose them'.

Pakistan army's control over nuclear decision making and the risk of nuclear weapons falling into the hands of the jihadis have been the potential threats that India has been worried about. As far as the use of TNWs by Pakistan army is concerned, Indian policy is crystal clear. Former National Security Advisor (NSA) Shiv Shankar Menon has put it thus, "If Pakistan were to use tactical nuclear weapons against India, even against Indian forces in Pakistan, it would effectively be opening the door to a massive Indian first strike, having crossed India's declared red lines. There would be little incentive, once Pakistan had taken hostilities to the nuclear level, for India to limit its response, since that would only invite further escalation by Pakistan."[2]

A similar degree of clarity exists, courtesy the No-First-Use policy, on India's non-usage of nuclear weapons to respond to a terrorist attack from Pakistan. But confusion would prevail if terrorists, from groups seen to be closely aligned to the Pakistan army or the Inter-Services Intelligence (ISI), or operating from Pakistani soil, get their hands on a tactical nuclear weapon. As Menon has explained, the one situation that India really worries about is the radicalisation of the Pakistan army.[3] Even a section of radicalised officer cadre could get easy and full access to a TNW during deployment, unlike a strategic nuclear weapon which needs multiple levels of control before being fired. The radicalised officer could then fire a TNW on an Indian civilian township or a military target. Or it could hand over the device to a terrorist group, which could try and smuggle it into India to use it on a major Indian city in the glare of television cameras.

A 10 KT nuclear weapon would damage all buildings within a radius of one kilometre, and debris would cause injuries within six kilometres of ground zero.[4] All electronic devices within five kilometres would stop functioning and a mushroom cloud would be visible in the sky. Population up to 30 kilometres of the blast will suffer from acute radiation and all public services in the area would be rendered non-functional. The number of dead would depend on the density of population, nature of blast and the weather conditions but in a densely populated Indian megacity, it could well be in thousands. All this would be happening in the full glare of media, making the situation even more untenable for

the authorities. This is a scenario India's nuclear doctrine does not provide a clear answer to.

The situation is further complicated by the precedent set by cross-LoC surgical strikes following the terror attack on Uri army camp in September 2016. To satisfy popular anger and achieve emotional closure for the wider public following a nuclear strike, the Indian government will be forced to respond. The nature of response would be a political call but a nuclear strike gives India full authority to retaliate using a nuclear weapon, which the international community will have to accept. It would then have to be a massive Indian first strike to prevent any further escalation by Pakistan. If Pakistan does not want India to respond with a nuclear strike, it will have to make huge public concessions on terrorists to New Delhi. Even then, depending on the political climate and the state of bilateral relations, India may have to unleash a demonstrable military response.

There is little that India can do to prevent this scenario from developing except using international diplomatic pressure to stop Pakistan from developing TNWs, and force it to act on terror groups which are aligned with the Pakistani army and the ISI. Moreover, Pakistan should double-check the security of its fissile material, and take forward a process of strict vetting its one-star and above military ranks for jihadi proclivities. If US authorities covertly monitor the development and movement of nuclear weapons in Pakistan, New Delhi should try and be a part of such a monitoring mechanism without making it public. Finally, notwithstanding the state of bilateral relations, India and Pakistan must keep lines of communication between its top political, military and diplomatic leadership at all times to prevent any miscommunication and misleading step from either side. It will not be easy but the fallout can then be contained to a great degree, if not fully prevented.

Scenario 2: Evacuating Indian diaspora if Saudi Arabia collapses

The Indian diaspora population in West Asia is currently estimated at 7.3 million, out of which three million alone are in Saudi Arabia.[5] The largest evacuation done by India was in 1991, when more than 0.17 million people were evacuated by Air India in 67 days.[6] Even though India has undertaken many other diaspora evacuations since, they have all been much smaller in nature. Mass evacuations of this nature from a foreign land present several challenges and risks which vary from political, diplomatic, military to media and perception management. The situation is further complicated because such situations arise in a conflict scenario where a humanitarian crisis in simultaneously unfolding.

Saudi Arabia remains ostensibly politically stable at the moment with the ruling house of Saud at its helm in Riyadh. There are however underlying problems which can cause upheaval in the oil-rich country any time. The sectarian divide in the country between the Sunni majority and the Shia minority, plus within various Sunni tribes, remains a major cause of concern. It is also threatened by extremist Islamist forces which remain opposed to the house of Saud, and have been responsible for many terror incidents in the country. Saudi Arabia remains a close American ally but its constant tussle with the Shia republic of Iran or the Jewish state of Israel can trigger major instability in the kingdom. The region has also seen a demand for democracy in recent years, and those protests could erupt against the monarchy too. These could be triggered by the state of economy, which is dependent only on crude oil prices. It needs a barrel of oil to be in the range of $80 to balance its budgets, and if the price of crude oil remains low for a sustained period of time, even a minor incident could bring about a major change.

An analysis of available naval and air assets shows that the total current evacuation capacity of the government in a single trip is 67,458 persons.[7] This number is woefully inadequate in case of a rapid mass evacuation. A better understanding of the evacuation capacity comes from the concept of 'Figure of Merit', which is defined as the number of people that can be transported across a certain distance in kilometres. It is derived by multiplying the carrying capacity of each asset with its maximum operating range in a single trip. The total sea lift capacity (Figure of Merit) per day is 30,993,600 persons-km and the total air lift capacity (Figure of Merit) per day is 556,171,176 persons-km, if all the military and civilian aviation and sea-based assets of the government are included.[8]

With Riyadh being 2,780 km from Mumbai, the desired evacuation capacity for three million-strong Indian diaspora in Saudi Arabia comes to 8,340,000,000 persons-km. If 100 per cent of the 556,169,376 persons-km Figure of Merit are available, the evacuation from Riyadh can be completed in 15 days. If a more realistic estimate of only 30 per cent of the resources being made available is done, the evacuation from Riyadh will take 50 days.[9] The Indian diaspora works in the kingdom largely in the unskilled and the semi-skilled sector; and is spread all over the country. This assumes that the Indian missions in Saudi Arabia will be able to bring the Indian diaspora from various locations in the kingdom to Riyadh as air and naval assets are made available by New Delhi.

These assumptions—of 50 days taken for evacuation from Riyadh with the airport being functional there and the Indian diaspora being moved easily from across the country—are only valid if the crisis does not alter the governance structure of the kingdom. In the case of a scenario where the kingdom is overthrown by either Islamists, a democratic protest or due to an external conflict, the situation would be more desperate for New Delhi. Having set a precedent of rescuing Indians in trouble from the region over the last 26 years, the Indian government will still have to move quickly to evacuate the Indian diaspora from Saudi Arabia.

If the Riyadh airport is unavailable, India will have work out alternate plans to move the populace to neighbouring countries, provided a safe route is available. India must have access to operational sea and air bases for uninterrupted operations in neutral countries, wherever there is a major concentration of the Indian diaspora.

Alternatively, India will have secure the ports and use only its naval assets to evacuate the Indian citizens. This can be done with the help of the local forces or along with one of the foreign forces, which may have secured the naval bases for the evacuation of its own nationals. If no foreign force is available, India will have to send its force to secure the naval base and the airport as well as create a secure enclave for the Indian diaspora for those 50 days. Although this activity can be undertaken by the Navy's Marine Commandos as the vanguard, it needs logistics support, scenario planning and rehearsals to be successfully executed at a short notice. The Indian Air Force and the Army will also have to be involved to provide support and additional resources for the enormous task. Besides the military component, New Delhi will have to put its diplomatic energies to ensure that the evacuation of the Indian diaspora takes place in an unfamiliar and non-conducive environment.

Scenario 3: China strangulates India

In 2005, American consulting firm Booz Allen Hamilton came up with the 'String of Pearls' theory. The theory, which has been debated vigorously, argued that China will try to expand its naval presence by building civilian maritime

infrastructure along the Indian Ocean periphery. It has been partly discredited as Chinese efforts to control the South China Sea have left most Asian countries wary of Beijing, which has been further supplanted by the American pivot towards Asia. The global focus, however, has not been directed at India and its neighbourhood—a clear and present danger for India.

The Indian Ocean is a nerve centre as half of the world's container traffic and one-third of its bulk cargo plies through that route. More than 80 percent of the world's sea-borne oil transit—over one lakh ships annually—takes place in the Indian Ocean with the Strait of Malacca in the East accounting for 40 per cent of it. For the planners in New Delhi, there is strategic importance in controlling the sea lanes in the Indian Ocean. But the scenario goes beyond the sea lanes of the Indian Ocean, as it involves encircling the Indian landmass by creating various pressure points in the neighbourhood and restraining New Delhi from assuming its natural leadership role in the region.

Some of the elements of this strategy are already in place. Pakistan remains a staunch military ally of Beijing; and the Gwadar Port, developed by China, has the potential to become a full-fledged regional hub and a transshipment port in future. Beijing provided the majority share of funding for the $1.2 billion construction, which is connected to the Karakoram Highway, linking the Arabian Sea to Western China through the China Pakistan Economic Corridor.[10] This has the potential to not only develop into a sea-based threat but also a strategic military challenge for India.

Similarly, in Sri Lanka, the recently added Colombo International South Container Terminal was built with the collaboration of China Merchant Holdings Company. The same Chinese company is set to take over an 80 percent share of the Hambantota deep sea port in exchange for taking over $1.1 billion of Sri Lanka's debt to China.[11] As part of similar proceedings, an as yet unnamed Chinese company will also take over the debt-riddled, revenue-draining Mattala International Airport in Southern Sri Lanka in an attempt to turn it around financially. Sri Lanka had offered China debt-for-equity swaps that included the Hambantota port and Mattala airport, but these were rejected on the grounds that China preferred to enact such deals via commercial entities rather than through government-to-government exchanges. However, there seems to be a change in thinking in Beijing, which has the potential to convert Sri Lanka into a full-fledged Chinese enclave at a very strategic position in India's neighbourhood.

China has also financed a container shipping facility in Chittagong, Bangladesh, which has a potential military role for the Chinese. Even though the current Bangladesh government insists that the port is of an entirely commercial nature and is off limits to military vessels, the situation could change rapidly with a change in government in Dhaka. Reports about Chinese presence in Maldives and Myanmar have also been seen from time to time. While no concrete developments have been announced here, China could move on rather quickly to build a military base in these two countries. New Delhi should also be equally concerned about a Chinese military presence in Nepal, sometime in the future.

The worst-case scenario, in such a case, would mean Chinese military bases—or civilian facilities which could easily double up as military bases—in Nepal, Bangladesh, Myanmar, Sri Lanka, Maldives and Pakistan. That would encircle India dramatically, constraining Delhi's strategic freedom in its own neighbourhood and putting it under pressure in bilateral negotiations. Imagine China making a grab for the Andaman and Nicobar Islands—something Indonesia had threatened to do in 1965 after having laid a claim for them. The military situation did not materialise then but India was concerned enough to approach US even then.[12]

The answer to such a scenario is similar even now. Indian response has to be premised on preventing such a scenario from developing, even if it doesn't have the economic muscle to match those of Beijing. But by using deft diplomacy, and exploiting historical and cultural connections with the countries in the neighbourhood, India can still achieve a lot. Further, New Delhi will have to be more open to the idea of allying with other countries in the region which are concerned about China's hegemonic designs. Even under the current Bharatiya Janata Party government, there has been political resistance to the idea of doing joint sea combat patrols with the US Navy in the Indian Ocean. That resistance may have to be overcome if the Chinese ambitions in India's neighbourhood have to be thwarted. Finally, there is no alternative to building India's military strength to create the correct balance of power, which will provide both an incentive to prospective allies and a deterrence to China.

Conclusion

These scenarios are neither exhaustive nor exclusive in nature. But they provide a window into the diverse and unlikely nature of military challenges that could be thrown up in future. As India's influence increases and it starts playing a greater global role, the complexity of such challenges will increase manifold. The military and the government cannot afford to be surprised by these challenges. They must learn to anticipate what is likely but appears unfamiliar. "The failure to anticipate effectively," as Schelling warned, can often lead to a catastrophic disaster.[13]

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Possible Indian Nuclear Options in 2030

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Fifteen years from now, in 2030, what changes will India have made to its nuclear doctrine and posture? Fifteen years is a long period of time, and it is difficult to know what India's strategic landscape will look like at the end of it. Nonetheless, it is possible to make some reasonable assumptions about India's future strategic environment and to explore possible implications for Indian nuclear policy.

Today, China and Pakistan are the main sources of India's strategic challenges. Pakistan continues to support a proxy war against India, using Islamist militants to attack targets in Indian Kashmir and India mainland. In doing so, it hopes to attrite Indian resources and remake territorial boundaries, wresting Jammu and Kashmir from Indian control. China has been enjoying rapid economic growth, and assembling a military that is increasingly able to assert coercive pressure against states in the Indian Ocean/Asia Pacific region. Enduring Sino-Indian border disputes make these problems even more worrisome for India. Both sets of problems are longstanding; they have been at the forefront of Indian security concerns for well over the past 15 years, and it seems safe to assume that they will

remain there in 2030.

Even as they have endured, these challenges have also changed in important ways, and they will continue to do so. India will have to adjust to the new realities that they pose. Below, I discuss these changes and possible Indian nuclear responses. I argue that, given Pakistan's move to full-spectrum deterrence, including battlefield nuclear weapons; and China's combination of increasing military power, authoritarian preferences, and coercive behaviour, India in 2030 may wish to consider changes to its nuclear posture, including the development of more flexible nuclear capabilities to ensure that it has options across a broader spectrum of the escalation ladder; and reconsideration of its commitment to no-nuclear-first use. It will also have to consider the tradeoffs involved in pursuing a robust sea-based deterrent and missile defences. In both cases, despite the attractions of robust capabilities, strong arguments exist in favour of more limited approaches, and they will be deserving of serious consideration. The purpose of this discussion is not to offer policy prescriptions. Rather, I suggest possible directions in which Indian nuclear posture could move in coming years, and explore some of the costs and benefits of various approaches, as India seeks to generate security for itself in an increasingly challenging strategic environment.

Pakistan

The main challenge on the Pakistan front will be its move towards full-spectrum nuclear deterrence, which includes, most importantly, battlefield nuclear weapons. The Pakistanis have found that nuclear weapons provide an excellent complement to their longstanding strategy of using Islamist militants to challenge India's control of Kashmir, enabling them to behave more boldly than they otherwise could, knowing that any Indian retaliation would necessarily be limited. This approach, however, is premised on Pakistan's threat to use nuclear weapons first in the event of a large-scale Indian conventional attack. And this threat may lack credibility. For, by using nuclear weapons first and inviting an Indian nuclear response, the Pakistanis are threatening to turn danger into catastrophe. Would the Pakistan really do this? If their nuclear weapons are successfully to deter an Indian conventional attack, the Indians will have to believe that the answer is yes. The need to ensure credibility of this threat has become especially acute as Indian economic growth has outpaced Pakistan's, India has undertaken major conventional military improvements, and the United States and India have become close strategic partners.[2]

In order to address this problem, Pakistani is devising a tactical nuclear capability. It will employ short-range, low-yield weapons integrated with troops close to the Indo-Pakistan border, with launch authority probably pre-delegated to officers in the field at some point during a crisis. This promises to make Pakistani first-use threats more credible in two ways. First, battlefield nuclear weapons are relatively small and will be employed against military targets; they will not require Pakistan to launch large-scale attacks against Indian cities. The choice to escalate a conventional conflict to the nuclear level may thus be less momentous, and therefore easier for Pakistan to make, than it was before. Second, during a crisis, the decision to employ battlefield weapons may not be fully in the hands of Pakistani national leaders. Rather, the decision may be delegated to a field commander embroiled in a conventional fight, who could prove more willingness to choose escalation than senior leadership making decisions in relative calm, far from the front lines.[3] Of course, even as they potentially enhance credibility, such measures also create significant concerns regarding physical custody of the weapons as well as the integrity of command and control.[4]

Pakistan's battlefield nuclear capability is still emerging. Pakistan first test-fired its short-range Nasr missile only in 2011. Although Nasr appears to have entered service after further testing in 2012 and 2013, it is not certain if Pakistan has been able to miniaturise warheads sufficiently to use with the missile.[5] Fifteen years from now, however, Pakistan's battlefield nuclear capacity is likely to be far more sophisticated. This may pose a problem for Indian nuclear doctrine, which threatens only large-scale strikes, designed to inflict overwhelming costs on the enemy.[6] This could leave India with no means of responding proportionately to limited nuclear use. Thus, India may find itself in much the same quandary as US was under the massive-retaliation doctrine during the 1950s, lacking a credible way of responding to, and potentially deterring, low-level provocations.[7]

India could adopt an approach to this problem similar to US efforts to address it during the Cold War—building flexibility into its potential nuclear responses. Specifically, India can make clear that it reserves the right to respond to nuclear attack proportionately, from low levels to the highest rungs of the escalation ladder. Doing so may require India to acquire smaller weapons and shorter range delivery platforms.[8] But India should be able to do so without the custody and command-and-control problems generally associated with forward deployment and pre-delegation of launch authority. The reason is that India would not need to use these smaller nuclear weapons first to deter a Pakistani conventional attack. Rather, it would use the weapons only in response to low-level nuclear use by Pakistan. Thus, in Pakistan's case, India may be able to create flexible options that enhance deterrence without falling prey to some of tactical nuclear weapons' more pernicious effects.

China

Although China has long been a subject of Indian concern, its ability to exert coercive leverage over India and the region is increasing. At root, China's coercive power comes from its economy. Rapid economic growth, averaging just under 10 percent per year since 1978, has facilitated major Chinese conventional military improvements, particularly in the areas of cruise and ballistic missiles; command and control; intelligence, surveillance, and reconnaissance; and cyber networking, all of which will enhance China's conventional precision-strike capabilities.[9] It has also enabled China to modernise its nuclear force, including continued growth of its warhead arsenal; development of road-mobile missiles armed with multiple independently targeted reentry vehicles (MIRVs); and buildup of its sea-based deterrent.[10]

It is difficult to know how the Chinese economy will perform in the coming decade and a half since it has slowed significantly in recent years, declining from just over 14 percent in 2007 to approximately 6.9 percent in 2015.[11] India has enjoyed impressive performance since undertaking market reforms in the early 1990s, and has averaged growth just below 7.5 percent per year over the past decade. Nonetheless, India's economy will remain far smaller than China's in the coming decades, with India's GDP reaching approximately $6.6 trillion by 2030 and China's topping $22 trillion. Japan, the only other Asian country predicted to rank in the top 10 world economies, is expected to produce about $6.4 trillion in 2030.[12] Thus Chinese power is likely to continue to grow relative to India and the larger Asian region in the years ahead. How will China conduct itself?

The answer to this question is not entirely clear. China appears to be moving in an increasingly authoritarian direction, with President Xi Jinping recently receiving the title of "core leader," which will enable to him to exert even stronger control over the country in the years ahead.[13] Such domestic political arrangements do not, of course, translate directly to particular foreign policy behaviour. They

do, however, suggest that Chinese preferences may be more coercive than deliberative. This concern is compounded by numerous examples of aggressive Chinese strategic behaviour, including territorial reclamation projects, refusal to submit territorial disputes to international arbitration, establishment of an air defence identification zone in the East China Sea, and repeated and protracted incursions across the Line of Actual Control separating India from Chinese-controlled territory.[14] In addition, China has been strengthening its relationship with Pakistan, helping it to develop the Gwadar Port in Baluchistan as part of the $46 billion China-Pakistan Economic Corridor, which will link China's Xinjiang Province with Pakistan and the Arabian Sea.[15]

These developments will ensure a robust nuclear-weapons capability, which will become especially important to India in the years ahead. Nuclear weapons will provide assurance that even if China amasses a significant preponderance of power at the conventional level, it will be limited in its ability to coerce or otherwise harm India. This can help India not only to defend itself against outright military aggression, but also to resist pressure to conform to Chinese economic, legal, and territorial preferences.[16]

Will India's current nuclear doctrine be helpful in its efforts to withstand Chinese conventional military pressure and achieve these goals? India has pledged not to employ nuclear weapons first against an adversary; it will do so only in response to a nuclear or chemical/biological weapons attack on its homeland or forces deployed abroad.[17] Such a no-first-use (NFU) policy is well suited to a conventionally stronger party that can deter, and if necessary defeat, its adversary without resort to nuclear weapons. It may, however, be less well suited to a conventionally weaker party that might need nuclear weapons to blunt a stronger opponent's conventional attack.[18] If a weaker state credibly promised not to use nuclear weapons first, it could undermine its ability to deter conventional aggression by its stronger adversary; the adversary could engage and defeat the weaker state at the conventional level, believing that it was unlikely to face nuclear retaliation. If the weaker state's nuclear capacity is to deter conventional aggression, there must be a real risk that it will use nuclear weapons first in a conflict. India is in a strong conventional position relative to Pakistan, and thus an NFU posture makes sense in this context. India is in a weak conventional position, relative to China, however. India may therefore wish to revisit its current posture, perhaps adopting a more ambiguous declaratory policy that, while not embracing first use, would sow more doubt in the mind of a potential adversary than its current, clear NFU stance. Calls to rethink no-first-use already animate debates within Indian strategic circles.[19] They are likely to become even more common as Chinese capabilities grow in the coming years.

In its efforts to deter China, India may also seek more flexible nuclear options, including choices at the lower levels of the escalation ladder. India faces potential challenges from China on two fronts: along its northern borders in Aksai Chin, Sikkim and Arunachal Pradesh where longstanding territorial disputes continue to fester; and in the maritime domain as China extends its reach from the Western Pacific to the Indian Ocean and into the Middle East and Africa. One approach to managing this two-front problem could be for India to attempt to freeze the status quo in one area and focus attention on the other. Nuclear weapons might assist the Indians in doing this, protecting the northern borders where the strategic environment is relatively static, and seeking simply to maintain current boundaries. This could help to enable India to devote resources to the maritime domain, which is more dynamic, and will require a diverse mix of military capabilities to meet emergent challenges. Smaller, battlefield-type weapons could be preferable for the northern-border mission,

enabling India to block mountain passes and repulse attackers without using disproportionate force—though forward deployment and the associated pre-delegation issues would create custody and command-and-control concerns similar to those mentioned regarding Pakistan.[20] Indian leaders would need carefully to weigh these risks against nuclear weapons' defensive benefits when considering this type of approach to the border problem.

Sea-based nuclear weapons will be another potentially attractive option for India as it attempts to generate deterrence against China. With the recent induction into the Indian Navy of the nuclear-powered ballistic missile submarine INS Arihant, and the testing of the K-4 sea-launched ballistic missile, India has taken significant steps towards developing a sea-based deterrent capability.[21] Nonetheless, the programme remains at a relatively early stage, and it is not yet clear how far it will develop, or how much India will come to rely on the sea-based leg of its nuclear capability.

On its face, a sea-based deterrent has much to recommend it. Hidden beneath the oceans from first-strike dangers that threaten ground and air-launched nuclear weapons, it can significantly enhance the survivability of a state's retaliatory force.[22] A sea-based deterrent can also have downsides, however. Sea-based weapons are technically complicated, expensive, and pose significant command-and-control challenges. Their ability to launch nuclear strikes from close abroad, with little warning time, also can be destabilising.[23] A cheaper, less complicated, and potentially less destabilising approach could be to expand India's arsenal of land-based missiles, enhancing survivability through sheer number of weapons. India's submarine force could then focus on tasks such as intelligence, surveillance, reconnaissance; blockades; and SLOC interdiction. Despite a sea-based deterrent's obvious attractions, India will need to carefully consider these tradeoffs as it decides how far to pursue the development of sea-based nuclear capabilities.

Finally, in the years ahead, India may seek to defend itself from nuclear attack by expanding its missile defence capabilities. India already has undertaken significant efforts in this direction, including development of indigenous area-defence capabilities, and the acquisition of ready-made systems from countries such as Russia and Israel. The temptation to seek to develop a more robust shield will be strong. Missile defences are intuitively appealing, and policymakers naturally wish to do everything possible to shield their countries against nuclear attack. It is politically difficult to explain to constituents why they would potentially forego any protective capabilities that such systems could afford them. And missile defence might provide some real protection against small nuclear attacks resulting from accidents or unauthorised use.[24]

Nonetheless, it is worth keeping in mind problems that pursuit of a robust missile defence capability could entail. First, technology is complicated and expensive to develop. Second, adversaries can adjust to missile defence with relative ease; it is technically far simpler to overwhelm a missile defence system with additional warheads or decoys than it is to make the system marginally more effective.[25] Finally, missile defence could be destabilising. A state possessing robust missile defence could launch a counterforce attack on an adversary, and use its BMD to absorb the remainder of the adversary's second-strike capability. This possibility can encourage arms racing, and nuclear-first use in a crisis. Pursuit of a robust missile defence capability thus could undermine India's strategic position rather than improve it, consuming scarce resources and increasing competition with states such as China. As a compromise, India could consider maintaining a modest missile defence capability, designed to absorb small strikes resulting from accidental or unauthorised launch,

rather than seeking to develop a robust missile defence capable of real damage limitation in the event of a large-scale nuclear exchange.[26] This could enable India to capitalise on the strengths of missile defence while avoiding the cost and stability problems that it can entail.

Despite the difficulties inherent in any attempt to predict the future, it is safe to assume that, as they develop nuclear policy over the next 15 years, Indian leaders will have to grapple with the issues raised in this paper. In discussing these issues, I have not sought to make policy prescriptions. My purpose, rather, has been to suggest some directions in which Indian leaders might decide to go, and explore tradeoffs that they may have to consider, given some of the basic principles of nuclear deterrence, as well as the unique characteristics of India's strategic environment. Whatever Indian leaders ultimately decide, the serious consideration of alternatives such as these may stimulate debate that can, in the end, help lead towards better nuclear policy decisions.

Endnotes

1 The opinions expressed in the paper are the author's and do not necessarily reflect those of the Department of Defense.

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India's Cyber Defence and Tackling Tomorrow's Challenges

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Statistically, we live in one of the most peaceful periods in human history. Despite the seeming frequency of conflicts worldwide, the number of wars and the resultant loss of human life is at an all-time low.[1] Statistics, however, can be misleading. While the number of wars (defined as an armed conflict between two States) has decreased, the number of skirmishes between State and non-state actors is higher than ever before. The 21st century has also witnessed a shift from the traditional theatres of conflict of land, air and sea, to newer domains like cyber. Cyber conflicts are different from traditional conflicts in two important ways. First, cyber-attacks often only require dual-use civilian technology, making the proliferation of dangerous tools harder to control. Second, cyber exploitation occurs across borders by both State and non-state actors, making attribution of the attack to a particular entity one of the most complex legal challenges.

The other significant difficulty lies in the ubiquity of information and communication technologies and the scale of damage that vulnerable systems pose. Following the technology boom of the late 20th and early 21st century, information systems

have become an integral part of governance and delivery of services. Unlike traditional warfare, in cyberspace, the distinction between military vs. civilian targets is not as readily applicable. The most frequent targets of cyber attacks are therefore government services and companies that are enabled by the Internet. Any strategy to combat cyberspace threats must then be significantly divergent from traditional strategic thinking. It must be resilient to combat the dynamic nature of threats. It must be flexible to account for rapid advances in technology. Finally, it must be cohesive to encourage greater cooperation between the government, the military and the private sector to help secure systems that are critical to all three stakeholders.

To address this imperative, India's defence establishment needs to integrate cyber defence as well as offence in its day-to-day operations. The defence sector's involvement in cyber operations can increase overall security of India's cyber systems and incentivise innovation in the domestic cyber technologies.

This paper is an attempt to identify the threats to information systems that are most likely to arise in near future. It will also suggest policy prescriptions for developing human as well as technological capacity to deal with these threats.

Threats

To say that the Internet is ubiquitous would be an understatement. We live in a connected world where our machines—from kitchen appliances to defence systems—are constantly communicating with each other. They are reliant on a framework of interdependent networks managed at many different levels by the government and the private sector. While all information is important to protect, some information exchanged over the Internet requires more protection than others. When networks carry information that is necessary to ensure economic security of the country or social stability, they are designated as Critical Information Infrastructure (CII). Due to their importance to a country's economy as a whole, CII is also the most frequent target of cyber attacks, and will continue to be so in future cyber conflicts.[2] The threat that vulnerable CII poses to a country's economy is best illustrated by the attacks on Estonia in 2007 and Georgia in 2008. In both cases, cyber attacks that were allegedly State-sponsored caused massive disruptions in the countries' networks, causing the collapse of essential services for weeks. The Estonian attack that lasted nearly a month brought down the country's top media outlets, banking services and telecommunication companies.

At the time, Estonia was the most wired country in Europe, with many essential services reliant on the Internet. Today, many other countries share the same reliance on the Internet for day-to-day governance. Indian CII, too, has been subjected to cyber attacks in the past. In 2014, computers in the Defence Research and Development Organisation (DRDO) were hacked allegedly causing the leak of sensitive strategic information. More recently, nearly 3.2 million credit and debit cards issued by nine Indian banks were allegedly compromised in a cyber attack that targeted ATM machine systems. In all of these cases, the breaches were detected after significant damage had been done because the country lacks an effective institutionalised system for threat assessment and vulnerability detection.

Post-demonetisation of nearly 86 percent of India's currency, the stakes have only risen, with a substantial percentage of the population having been forced to migrate to digital payments services. The Indian Internet user has also come to rely on the Internet for delivery of government services. However, amid this transition to a digital economy, no significant steps to protect Indian

networks appear to have been taken. Significant breaches in the recent past such as the alleged Russian hacking of the servers of the Democratic National Committee and the 'Legion' hacks of prominent Indian political and media figures' Twitter accounts tell us that cyber attacks can even hijack democratic processes and conversations. These attacks represent a threat to the foundational aspects of a democratic nation and should therefore be treated with the same amount of gravity as other traditional forms of attacks. While no solution can be arrived at overnight, there are many steps that both policymakers and defence organisations can take to improve the state of cyber defence in India. First and foremost, among these steps, must be an exercise to build domestic capacity—both human and technological.

Safeguards

Human capacity

Cyber security in India is largely considered a matter of necessity—something that must be done to protect our networks against outside intrusion. However, in order to be able to compete with the most technologically advanced nations in the world, Indian leaders will need to realign this narrative. Cyber security is not just a necessity, it is an opportunity to create best-in-class intellectual and technological capital. However, to achieve this goal, it is not enough to merely train more professionals, it is equally important to lend cyber operations the administrative and financial support that it requires.

Cyber Security Professionals as a First Line of Defence

Due to the unique nature of cyberspace threats, it is critical for a country like India to develop a specialised workforce to safeguard these systems. The National Cyber Security Policy of 2013 recognises the need for training and skill development of 500,000 cyber security professionals by 2018 to protect India's IT systems. In reality, however, the number of cyber security specialists for civilian as well as military defence in India is abysmal. Countries that have advanced their cyber war-fighting capabilities have done it on the back of tightly coordinated programmes that built expertise to not only understand and address threats but also build both offensive and defensive technology domestically. Israel's Talpiot programme, for instance, was developed in the late 1970s after the nation's leaders realised the importance of creating technologically-adept soldiers to command its future forces and reduce the country's dependence on foreign technology.[3]

The programme has produced personnel who have not only gone on to command important units of the Israeli Defence Forces but also develop some of Israel's most sophisticated military technologies like the Iron Dome and David's Sling. Perhaps, a testament to the effectiveness of the Talpiot programme is the fact that its graduates have also gone on to create some of Israel's most successful technology start-ups after completing their military service.

The Indian Army's Military College of Telecommunications Engineering, similarly, has been a steady source of human capital for the military's cyber operations. The college follows a dynamic curriculum that is reportedly updated frequently according to the Army's needs. However, the specialists graduating from these programmes will be tasked with not only protecting India's military networks but also civilian systems. They would therefore be better served by working closely with the private sector.

Cyber Command for Inter-Agency Cooperation

A critical difference between India's approach to cyber security and those of more 'cyber-ready' countries like the United States (US) is an acknowledgement of the military applications of cyberspace in policy. India's National Security Policy recognises the need to create a secure cyberspace; and has identified eight key agencies to fulfil this mandate. All of these agencies are however civilian bodies. The US Department of Defence, on the other hand, has promulgated a cyber strategy that lists supporting military operations with cyber operations as one of its stated goals. US has also institutionalised its cyber command that coordinates cyber operations between the army, air force and marines. China, too, has established its cyber command, which is housed under the Third Department of the General Staff; and reportedly employs 130,000 personnel.

Cyber commands offer institutional and inter-agency coordination for developing responses to cyber threats. At present, India's forces treat cyber defence with varying levels of priority. The Indian Army, has the most extensive cyber agenda among the three forces. The Corps of Signals is the lead agency that is tasked with developing cyber command and control software as well as training cyber security personnel. The Air Force and Navy both have agencies dedicated to information technology, however, these function with a view towards enhancing military communication technologies and not network warfare. Although, the Air Force Network demonstrated some capability for network warfare, this too is limited in its applicability for the 21st century threat scenario.[4] India needs to create a cyber command that can serve as the nodal agency for coordinating cyber defence activities and developing policy on that front.[5] In time, the command can also take charge for developing programmes for active cyber deterrence. In addition to increasing coordination and data sharing across agencies, the command can serve as a focal point for intelligence analysis and threat mitigation.

Technological capacity

Technology is its own antidote. No amount of administrative modernisation will secure India's digital future if it is unaccompanied by necessary technological safeguards. Going forward, Indian military will need to acquire, as well as indigenously develop, state-of-the-art technology. This acquisition process must be multi-pronged. First and foremost, it must be defensive, focussing on securing Indian networks against intrusion and malicious exploitation. Second, it must be offensive, acquiring systems that are able to infiltrate networks and gather real-time intelligence to protect India's strategic interests. Third, the acquisition must also prepare the armed forces for the inevitable congruence of cyber and kinetic weaponry in future conflicts.

Cyber Ranges for Testing Network Integrity

This paper has earlier discussed the interdependent nature of information networks in today's world and the military imperative of protecting civilian networks. The process of protecting networks, however, is complex and not foolproof. A significant challenge in information security is identifying and correcting vulnerable points in one's network that are susceptible to attack. Penetration testing of both civilian as well as military networks therefore must necessarily be a priority for the Indian government. One way to institutionalise the penetration testing process is by establishing a cyber range in India.

Cyber ranges are information facilities that serve

as test beds for network vulnerability. These ranges can simulate the public Internet as well as other specialised networks. In a secure and compartmentalised environment, these facilities allow controlled testing of the resilience of networks against cyber attacks. This not only helps identify loopholes in networks that are vulnerable but also help assess the damage caused to networks and their potential fallout in case of a large-scale breach. A private sector company launched India's first commercially available cyber range in 2016[6] and it has been reported that Cisco plans to establish another such facility in the near future.[7] It is however imperative that the Indian government invest in the creation of a dedicated, state-of-the-art facility to test the resilience of military networks.

Zero Day Vulnerabilities for Offence and Intelligence Gathering

Vulnerabilities in computer networks make cyber attacks an imminent threat for India's national security and economy. At the same time, the vulnerabilities that exist in software represent an opportunity for India to further its strategic goals. World over, governments as well as software companies are engaging hackers to identify coding flaws in software that can provide unfettered access to computer systems. These flaws, called zero day vulnerabilities, have fuelled an underground market that sells these to the highest bidder. Once obtained, these vulnerabilities can be kept dormant until the need or opportunity to use them arises or until they are discovered. Zero days—named for the fact that once discovered, the developer and the exploiter have zero days to either fix it or exploit it as the case may be—have gained prominence in light of the Stuxnet worm that was developed by the US and Israel to target Iran's nuclear power plants.

US is currently considered the market leader in zero days with an annual budget of $25.1 million dedicated to the acquisition of these vulnerabilities. Its success however is attributable to more than the spending. US is one of the few countries in the world with an institutionalised system for the acquisition and handling of zero days. The Vulnerability Equities Process (VEP) was begun in 2010 to ensure that US intelligence agencies disclose a vulnerability to the developer once the it has been utilised.[8] The VEP also prescribes procedure for disseminating information about a discovered vulnerability to associated agencies in intelligence, law enforcement and the department of energy to assess whether they have any utility for the vulnerability. Although the process is far from perfect, it is a significant step towards assessing what risk a vulnerability poses to a country's cyber systems, and ways in which it can serve the national interest.

For India to actively tackle cyber security threats of 2030, it is imperative that the country develops its own offensive capabilities. That perception that 'cyber defence' is a misnomer is a familiar refrain in the field of cyber security. Indian policymakers and, in particular, its military would be well served to internalise this notion. Lack of technological capacity and insufficient coordination between the various arms of the Indian defence establishment have been a long-standing problem for country's defence posture. A formalised process for acquisition of zero day vulnerabilities and well-coordinated policy for cooperation among various intelligence agencies in their utilisation may just be the determining factor in whether or not India emerges as a cyber power in the future.

Autonomous Technology for Command and Control

As a country in a hostile neighbourhood, India's moves towards cyber defence modernisation will also need to take into account future conflicts of

which information warfare is likely to be an integral part. Even if these conflicts are primarily fought with kinetic weapons, they will likely use cyber and autonomous technologies for deployment. DARPA, for instance, has developed the Persistent Close Air Support (PCAS), which allows better coordination between ground agents and combat air crews to reduce the time taken for calling in an airstrike by nearly a factor of 10.[9] The German army too has deployed the NBS Mantis for forward base protection. The Mantis, consisting of six 35 mm guns, is capable of detecting, tracking and shooting down fast-moving projectiles. These advances have only been made possible due to years of investment in research and development of autonomous technologies. In India, the research in this area has been severely lacking.

India's first level of engagement with autonomous technologies was as at an informal meeting of experts on the subject held under the aegis of the Convention on Conventional Weapons (CCW). At the meeting, India's permanent representative to the Conference on Disarmament called upon nations to ensure that the technology gap between States is not widened by the proliferation of autonomous weapons. His statement indicates that India is willing to sit on the sidelines until such a time that clear international norms are created around the use and deployment of autonomous weapons. Unfortunately, this is an unsustainable policy in the long run. Autonomous weapons that are currently under development are likely to be deployed soon for no other reason than that they will significantly reduce the time taken in an attack-kill chain. They are also likely to cut down the number of human casualties by reducing the number of troops on the ground and through more precise targeting. Even as norms around their use are being debated, Indian policymakers would be prudent to fuel research and development in the area. The most cost effective way to do this would be to leverage the power of India's booming technology sector and incentivise research into military applications of artificial intelligence.

Conclusion

India's deficit in cyber capability is a direct consequence of the inadequate prioritisation of cyber security in domestic policy. India's recent relaxation of two-factor authentication for small value transactions is one such move that is emblematic of a larger disregard for cyber security even as its cyber systems are constantly threatened by both State and non-state actors.[10] On a positive note however, India is, now more than ever, in a position to help address these inequities. India was a member of the UN Group of Governmental Experts in 2016, a body created to assess developments in the field of information and telecommunications in the context of international security. India was also represented at the meeting of experts under the CCW; and will later this year, host the 5th Global Conference on Cyberspace (GCCS), the largest gathering of its kind with over 100 countries participating. The GCCS presents a unique opportunity to build partnerships and help set the agenda for information security in the coming years. These developments are also a recognition of India's emergence as the next big cyber power. Indian policymakers would be well advised to help leverage this position to bolster the nation's cyber defence and not squander these opportunities.

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Creation of a Defence Space Agency

A New Chapter in Exploring India's Space Security

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Outer space exploration has turned into a key part of a modern society's functionality with several services including weather, communication, Internet, banking and navigation, supported by satellites orbiting the Earth. India being one of the major actors in outer space has in many ways led the usage of satellites for the benefit of the society. With the space infrastructure of India powering the economy, is there a case for exploring the defence of these vital systems? Moreover, given that the geopolitics and security scenarios are changing with respect to the utilisation of outer space, should India explore its capabilities and capacities built in the country for the past 50 years for dedicated space defence operations? The present work provides insights on the key question as to are we or are we not at a tipping point where the government needs to draw a vision in securing national interests via creation of a Defence Space Agency as an interim arrangement until a full-fledged Aerospace Command is in place. If so, what are its technological, organisational and policy facets?

The case for India's utilisation of outer space has

traditionally been to "harness space technology for national development, while pursuing space science research and planetary exploration".[1] Today, the global space economy is a key part of modern society infrastructure, providing connectivity, insights of the Earth from space and navigational support. In terms of financials, the space economy grew by 9 percent in 2014, reaching a total of $330 billion worldwide, with commercial space activities making up 76 percent of the global space economy with a growth of 9.7 percent (2014).[2]

India, very much a part of the global space economy, has matured to be one of the key actors in outer space; and is one of those that reap benefits of infrastructure in space with the Indian Space Research Organisation (ISRO) operating one of the biggest fleets of satellites (remote sensing, satellite communications and navigation) in the world. Today, India's space programme is valued at more than $2.3 billion in assets already in orbit; this figure rises to around $37 billion ground-based infrastructure and value-added services are included.[3] These satellites have facilitated governance, harnessing the advantages of space for its citizens.

However, given the changes in the international and regional security and geopolitics of outer space over the past two decades, one might argue that India needs to consider utilising its space capacities for securing its regional and territorial interests and the safety of its space infrastructure. Some steps in this regard have already been taken in an incremental style.

The first such concrete step was taken in 2010 with the creation of an Integrated Space Cell (ISC) under the Integrated Defence Services (IDS) Headquarters of the Ministry of Defence. The ISC has had a coordinating role between armed forces as well as with the Department of Space and Ministry of Defence for greater integration of space technology and assets into military operations.[4] Following such developments, for the first time, ISRO built and launched dedicated military communications satellites, GSAT-7 (2013) for the Navy and GSAT-6 (2015) for armed forces.[5] Further, the Technology Perspective and Capability Roadmap (TPCR) of the IDS details several space-based capabilities envisioned for India's expanding space-based security needs.[6]

With this dedicated infrastructure in outer space, experts within space security have signalled the threat to these assets due to our reliance on them.[7]

From technological, organisational and political perspectives, India needs to take a stand in active utilisation of outer space for meeting its security interests and affirming its position among the global space community in providing a transparent regime to utilise outer space for national security. Therefore, given the evident movement in utilisation of space systems for space-based security interests, formation of a dedicated defence space establishment in India seems a logical step in taking charge of these advances.

Facets of a Defence Space Establishment

Following recent turn of events, there has been a movement towards opening up India's space security by a possible creation of a Defence Space Agency (DSA) as an interim arrangement until a full-fledged dedicated Aerospace Command is in place.[8] This seems a case for the expansion of ISC for a more active role in utilisation of outer space within the armed forces. The case for a defence space establishment is not just of adding a final frontier edge to warfare or adding theatre capability via space assets to the armed forces. It is about developing a multi-dimensional approach to using outer space for strategic purposes.

Establish minimum technology umbrella: While creation of a DARPA-like agency in India may be thought off as a moon-shot, there is tremendous scope to establish certain minimum technology capacity umbrella that is at par with that of advanced militaries and spacefaring nations. This minimum technology umbrella will not only feed into the current requirements but also act as a catalyst to spin-off advanced requirement concepts for the future.

Space security doctrine: Declaring a space security doctrine that encompasses the military space utilities as well as spelling out the conditions under which India will consider the offensive and defensive use of space should be a priority. The doctrine should also factor in India's internal security challenges, including surveillance of the vast coastlines, porous border areas and other insurgency-related issues.

Capacity building in the industry: With the recent opening up of markets with a much more conducive environment via foreign direct investment, there are institutional challenges within the system that need to be addressed. While the private sector is now trying to move ahead with investments, there are still a lot of challenges in building up capacity in the private sector for it to deliver turnkey-level solutions for large/complex systems. One of the big challenges, however, is to strike a balance between the public and the private sector so that they co-exist without any conflict of interest.

Long-term roadmap & foundation for next generation systems: While the TPCR provides some sense of what space-based capabilities are of interest in the realm of defence and security, there is a need to develop a dedicated long-term roadmap for space security in India. One can draw inspiration from ISRO in developing such decade-long roadmaps and meeting technical challenges systematically in an effort to meet long-term goals.

There is a need to develop mechanisms for the promotion of home-grown innovation in defence space systems (both in public and private sector) that will enable India to leapfrog in technologyand to build next generation systemsthat provide an edge in Command, Control, Communications, Computers, Intelligence, Information, Surveillance, and Reconnaissance (C4I2SR).

Technological Capacity Interests

With the seed sown for space exploration right from the first satellite flown in 1957—being driven via defence interests—time and again, space capabilities have proven to bring an additional dimension to traditional defence capabilities that can support C4ISR.

Figure 1 reflects minimum baseline technological capacities that need to be established to have an effective foundation in integration of space capabilities into the various military functions. Completing such an array of technological capacity requirements shall have a multitude of effects on speed, accuracy & precision of information collection, strategic planning & decision making, integration of technology to gain battleground superiority across the different forces and platforms. Each of these identified technological capacity has been detailed further to provide insights into their operational use from a strategic user perspective.

Space Weather

With growing number of space assets, one of the major fields of growing importance to monitor the health and safety of all systems in space and their allied equipment on the ground is tracking space weather. This has emerged as a part and parcel of Space Situational Awareness (SSA), with a broad

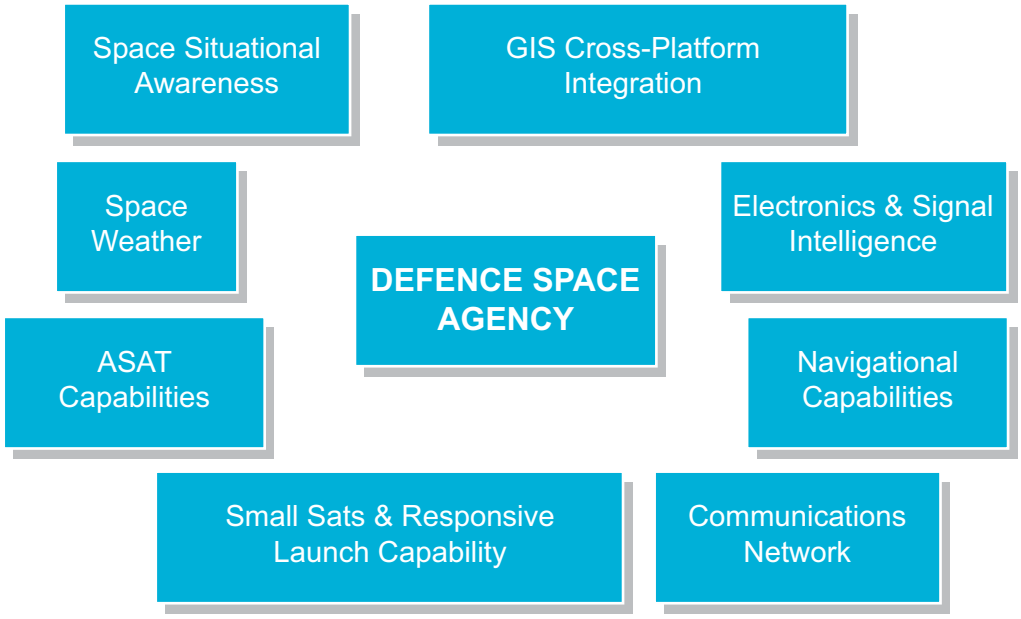

Figure 1. Technological Capacity Interests of Defence Space Agency

scope of monitoring and predicting near-Earth space environment that can degrade and disrupt the performance of technological systems due to adverse conditions caused by activities such as solar storm.

Space weather has gained such prominence that several spacefaring nations have developed preparedness strategies for space weather exigencies. For example, the Unither Kingdom has a National Space Security Policy (NSSP) whose objectives include resilience to the risk of disruption to space services and capabilities; and has developed a Space Weather Preparedness Strategy.[9]

There are several mapped impacts of space weather situational awareness on the ability to use space assets for missions which include communication and navigation, among others. From a space command and control perspective, these include decreased operational payload utility, decreased ability to control satellites, and loss of satellite tracking. From an ISR perspective, it would mean inaccurate position data or loss/degradation of intelligence due to radio frequency interference, range uncertainty, loss of target discrimination, spectral distortions, degraded system performance, reduction in resolution of SAR images due to solar flares, and ionospheric storms. From a SatCom and long-range communications perspective, these would be inability to exercise C2, inability to send evacuation with life of small teams at risk. From a positioning, navigation and timing perspective, these include loss of navigation and manoeuvring accuracy for precision-guided munition, and decreased ability to synchronise ops with precision timing.[10] Given these risks at large from space weather, there is a need to expand the scope of understanding the scientific phenomenon of space weather to turn around the knowledge of these effects (spacecraft charging and ground effects) to design inputs and operational strategies for critical systems,[11] especially communications and positioning.

EO Small Satellites & Responsive Launch Vehicle

One of the major areas of low Earth orbit (LEO) exploitation in the recent times is in building low-cost small satellite (<150 kg) constellations

for fast revisit periods. This trend, unlike other space technology trends, has been led by commercial start-ups. Militaries across the globe are taking note of this trend, since this provides an unprecedented access to space data to users. There is tremendous potential to exploit miniaturisation of electronics and Commercial Off The Shelf (COTS) components to build small satellite platforms that can provide sub-meter resolution imagery at less than USD 5 million (about INR 35 crores, excluding launch). These platforms in constellation can act as complimentary systems to larger satellites such as CARTOSAT, which can be of similar resolution but can provide bigger swath. However, once launched in a constellation of six to 12 satellites on a single plane, small satellites can even compensate for the swath.

Figure 2 provides an overview of a small satellites constellation in orbit. While having very high resolution satellites such as CartoSat 2C in orbit shall provide capabilities of mapping up to 0.65 m resolution on the ground, these satellites are expensive and can only be launched one at a time, and they provide a revisit of about four days. Therefore, there is a strong case to deploy a constellation of small satellites that can support <1 m resolution on <150 kg platforms as gap fillers to this larger satellite capability. Any intelligence picked up by this network can be further enhanced by using the higher resolution capability on the CARTOSAT series.

Moreover, these networks of small satellites can also be launched on demand with retrofitting on

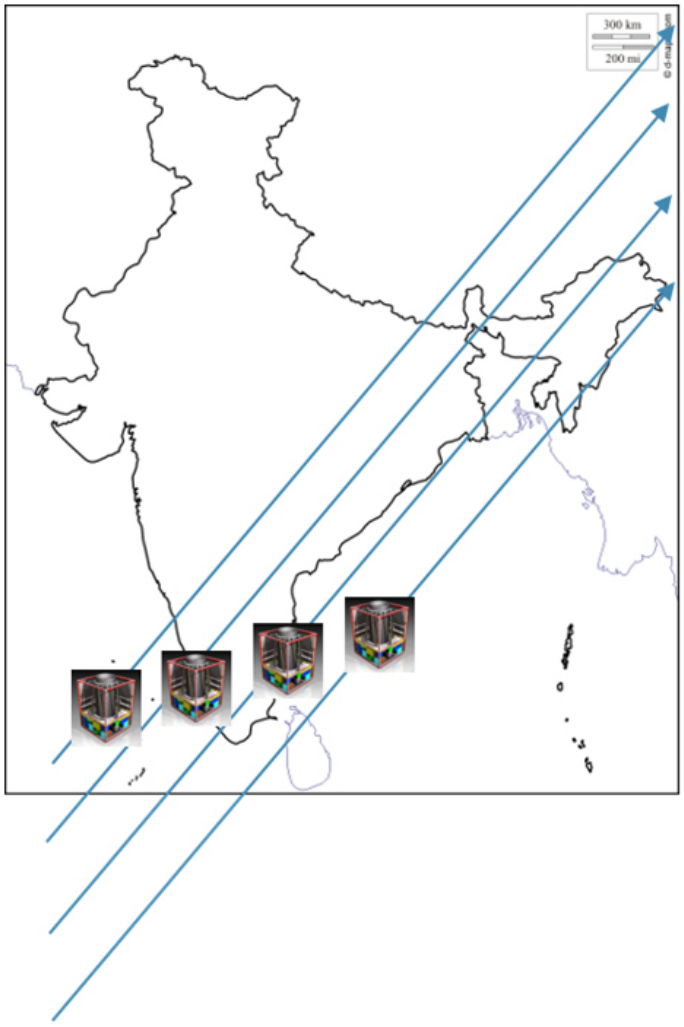

Figure 2. Small Satellites in Constellation

Agni-5 with mobile launching capabilities. This has the potential to be developed as a responsive launch capability programme where a network of six to eight satellites can be launched on one rocket through a single plane to provide excellent coverage in swath. As far as coverage is concerned, a CARTOSAT provides coverage of about 10 km swath in a single satellite. However, having a network of these satellites on a single plane with an adjusted phase angle difference can provide a combined swath of 60-80 km, which has immense potential for exploitation in image intelligence. One has to also note the possible exploration of such a constellation in two or multiple orbits (one in polar sun synchronous and other in a slightly inclined orbit) to exploit security interests around the borders.

ASAT Capabilities

Following the Chinese ASAT missile test destroying an unused weather satellite in January 2007,[12] there has been a debate on India's ability to develop and demonstrate ASAT capabilities, which can act as a deterrent against such adversaries in the final frontier. India recognises such tests as a threat to all space assets as well as being against the spirit of non-weaponisation & peaceful usage of outer space.[13]

While most of the ASAT tests have been performed in LEO, there is speculation of China performing long-range ASAT tests that could threaten Medium Earth Orbit (MEO) and Geostationary Earth Orbit (GEO) satellites.[14] From a 21st century strategic perspective one can argue that in advanced threat scenarios, assets in LEO—which typically are into Earth Observation (EO) and remote sensing missions—are more dispensable against assets providing navigational and communications capabilities from MEO and GEO. Removing the navigation and communications capability from space can have a crippling effect for large-scale military operations.

From an Indian perspective, it is quite clear from several official statements at UN forums, such as the Conference on Disarmament in Geneva, that it is against weaponisation of outer space.[15] However, India's stand on conducting ASAT tests is unclear. There are concerns that if it does not demonstrate such a capability, it will be left behind facing a repeat of what happened in the nuclear domain.[16]

While India does have the fundamental building blocks for a kinetic-kill full-fledged ASAT weapon based on Agni and the ballistic missile interceptor, showcasing this capability has to be done in a responsible manner without creating huge amount of long-lasting debris that could damage existing satellites.[17] A possible template to showcase technological capabilities may lie in following a strategic engagement of a low-flying asset that may not sustain any in-orbit debris but will completely be destroyed in entry and upper atmosphere. US performed such a mission as recently as 2008, launching a single Standard Missile-3 (SM-3) and destroying a 5,000-pound satellite with nearly 100 percent of the debris safely burned-up during re-entry within 48 hours and the remainder safely re-entering within the next few days.[18] One has to note that India does not have any space asset at such a low altitude; and if such a capability has to be demonstrated, one of the dying satellites will have to be lowered to perform such a test.

While the policymakers may choose to make concrete decisions on such matters reactively, technologically the focus should be on having long-range tracking capabilities, on-ground development of technological building blocks to increasing reach to MEO & GEO, and systems of denial of service. Long-term technology focus can definitely pursue the potential of exploiting non-kinetic kill options by exploring cyber or focussed high-energy techniques.

Signal Intelligence

The need for satellite-based signal intelligence due to limitations of ground-based equipment (owing to radio horizon as well as such an equipment being compromised in advanced threat scenarios due to attack) is real. The field of satellite-based Signal Intelligence (SIGINT) encompasses Communications Intelligence (COMINT) with a focus on interception and decryption of military and strategic communications, Electronic Intelligence (ELINT) with a focus on developing technology for radio signals interception and decryption. The scope of SIGINT has also expanded towards capturing of telemetry signals with a special focus on missiles.[19]

At present, India has extremely limited space-based COMINT capabilities with two GEO satellites supporting strategic communications with the multi-band communication satellite GSAT-7and GSAT-6.[20]

However, China not only has full-fledged secure satellite communications networks, but also has expanded its satellite capabilities and may very well be equipped to use its network of LEO and GEO satellites to accurately track and target naval assets in near-real-time as part of its satellite-aided Anti-Ship Ballistic Missile (ASBM). Similarly, from an air-defence perspective, ELINT capabilities may be used to precisely locate air defence systems, making such systems vulnerable.[21] The Yoagan constellation launched by the Chinese is said to have capabilities of providing 16 targeting opportunities with less than 10-km location uncertainty for ballistic missile launch.[22]

Given the modernisation of armed forces and the increased air and maritime interests, India should at least establish a minimum ISR capabilities starting with three dedicated satellites and expanding to six with wide band receivers to be able to monitor activities in the Indian Ocean and South China Sea. Use of an array of space-based sensors, along with other sensors using common standards and communication protocols for transmitting information automatically through machine-to-machine interfaces, are important. These become useful in the context of missile targeting as well as establishing data links in a multiple platform/ command & control scenario.

GIS Cross Platform Integration

Geographic Information System (GIS) is a powerful tool to combine various spatial, spectral and other sources of data to generate key insights for security stakeholders. With the ever-increasing computational power alongside the increase in the number of sensors available, utilisation and integration of GIS into specific scenarios and actual traditional battlefield systems (such as UAVs, tanks, submarines, aircraft, etc.) will provide an edge over adversaries.

Post 9/11, US floated a dedicated National Geospatial-Intelligence Agency (NGA) in 2003 to provide geospatial intelligence putting policymakers, military, intelligence professionals and first responders at a decisive advantage.[23] This dedicated agency claims to have helped track down al Qaeda leader Osama bin Ladin and shared insights with the special operations team that successfully stormed his compound in Abbottabad, Pakistan.[24]

Tracking and visualisation of insurgent attacks based on their use of the geography, terrain, population density, and infrastructure with different mathematical models can be used to combat guerrilla warfare.[25] This has tremendous scope for exploration from an internal security perspective for India.

Dedicated tools in GIS have been explored for coastal security by combining several data sources

such as high-resolution images, Lidar, conduct of fleet/vehicle mobility analysis, continuous sea–land Digital Elevation Model (DEM) and geo-visualisation of changing shorelines with tidal levels in an effort to build a Littoral Warfare Database that enables commanders to take feasible and realistic decisions.[26]

With the exponential dispersion of sensors (both in space, on ground and below) and emergence of technologies such as IoT/M2M, fusing all such data alongside GIS information will hold the key to taking intelligent decisions. There is no doubt that cross-platform integration of GIS technology as well as on-ground decision intelligence support system are the very basic needs of an effective network-centric warfare strategy.

Navigational Capabilities

India has completed the Indian Regional Navigation Satellite System (IRNSS) constellation for providing accurate position information to users in India as well as the region extending up to 1500 km from its boundary.[27] This constellation can be used to aid in navigation for missions on land, in sea and in air; and can very well serve as an invaluable component of network-centric warfare.

While India is undertaking modernisation of its defence equipment, the integration of indigenous navigation systems at the user segment of these equipment will definitely be an important step towards self-reliance in defence technology. Typical examples of such uses shall be in the ballistic missile programmes such as Agni, and cruise missile programme such as BrahMos.[28] The indigenous navigational capabilities have a wide array of other uses also, of course, outside of strategic areas—from most mundane such as location devices for infantry to smart bombs, covert surveillance and armoured warfare.

Space Situational Awareness

Satellites form an important part of network-centric warfare and therefore are prone to a broad range of natural disasters and intentional attacks, including cyber-attacks, space weather, space debris, collisions with other satellites and ASAT attacks. Therefore, it is necessary to have a military space situational awareness capabilities to not only track objects in space but also map the capabilities of various space systems and their implications for national security.

India right now has limited capabilities in the field of space situational awareness, with major asset for tracking objects such as space debris being carried out by ISRO's Multi-Object Tracking Radar (MOTR).[29] While tracking is a major portion of space situational awareness, ground-based radar tracking may provide real-time collision analysis, given the cataloguing of the location and orbital information about all space objects. However, from a military dimension, there is a need to develop space-based systems that can help determine the capabilities of various space systems in-orbit and the intentions of its owner.

Internationally,there have been recommendations made to develop radar-independent tracking methods such as lasers, coherent infrared sensors as well as developing space systems with a sole purpose of tracking the functional capabilities of suspected satellites that may serve the military functions.[30]

A dedicated space situational awareness initiative within the defence space agency can serve for gathering space-based network-centric intelligence capabilities of adversaries and shall help map out evolving ground-based counter-capabilities.

Communications Capabilities

The current satellite communications platforms for defence operations are served by GSAT-7 for Navy[31] and GSAT-6 for the armed forces.[32]

One of the significant areas to explore COMINT from a defence space perspective is its ability to exploit GEO platforms for data relay services for UAVs or other airborne platforms. Such airborne platforms can send their observation to a data relay satellite in GEO via an optical link. Subsequently, the satellite-based data relay services via high-speed laser communication can be used to replace expensive network of ground stations needed to constantly receive LEO satellite data. Moreover, there is also scope to explore inter-satellite links between GEO satellites that can be used to share resources and/or route traffic around a satellite network. In order to effectively exploit space, India also needs to focus on having orbital slots available in GEO, which shall be critical to have the necessary authorisation by International Telecommunications Union (ITU) to place satellites over the Indian-subcontinent.

Logic for A Space Security Doctrine

India's space programme has grown enormously over the past decade but without a broad strategic plan because India has lacked an overall strategic doctrine that lays out its long-term goals and objectives. As India's power and influence rises, there has to be greater clarity on what it wants to achieve as a nation in its overall security as well as within each of the important security domains such as nuclear and outer space.

India has many external security challenges, from cross-border terrorism and internal insurgencies to unresolved border and territorial issues, all of which call for a huge defence-space requirement. Repeated terrorist attacks in India, including on sensitive military installations, point to the need to better integration of space technology for military functions such as reconnaissance, and safe and secure communication channels, which put a premium on India's space capabilities. While space utilisation has picked up in the backdrop of these challenges, these are still being done in a haphazard manner.

India must also outline its red lines in space, that is, under what circumstances offensive use of space will be sanctioned. These must be laid down in clear terms to bring about clarity within the Indian establishment but also clarity in the minds of the adversary as to what is considered permissible behaviour and what might provoke a military response (intentional jamming and blinding, destruction, interference). This should include, for instance, a code of conduct and standard operating procedures for any threat to Indian space assets to avoid ambiguities.

The doctrine must also spell out how space assets will be put to use to deal with the internal security of India. The internal security challenges are very vast and these include surveillance of the cross-border areas, monitoring of the vast coastlines and water spaces, and monitoring naxal-affected areas. The cyber-outer space interface is another set of challenges that need to be factored within the doctrine. The growing linkages between cyber and outer space domains present India with new challenges, and India should develop a set of considered options that would protect against its vulnerabilities in space.

Space Security Strategies and Policy

Having established itself as a major space power, what India lacks is an overarching strategy that guides its space programme. In the absence of such

a strategy, India's space programme and ISRO's attempts to cater to the wide-ranging demands have represented more of a piecemeal approach. India has to factor in the growing requirements of the space assets in social, economic and security arenas. A space security strategy will synchronise these growing requirements, taking into account India's total capacity, including political and economic capital. National space security strategy should also include the command and control structures to implement and respond to situations identified in the doctrine such as offensive uses of space and maintaining space deterrence.

Audit of Technology Integration and Performance

Even as ISRO has done a splendid job with India's space programme, there has to be better accounting and auditing of the technological developments and, more importantly, technology integration and performance. Providing constant insights on the performance of the programmes, the direction of the organisation, insights from an international technology and geopolitical perspective through a parliamentary oversight group or government-funded defence think tanks—such as the Institute for Defence and Strategic Analyses (IDSA), Centre for Air Power Studies (CAPS)—can be done via a dedicated Task Force created within the DSA for this purpose.

Conclusion

While there are significant opportunities to integrate satellite-based technologies into the defence realm, there is a need to carefully plan this technology integration. Given that DRDO does not focus its efforts on development of satellite platforms, there is tremendous opportunity for Indian industry to invest into such platforms.

Moreover, the defence space agency can act as an observer and regulator, which will constantly assess the needs of the armed forces and executes those needs via the industry. This provides a win-win situation for both the armed services and the local industry. This also ensures that there is scope for long-term capacity building in the country that can foster export of turnkey solutions for satellite-based products and services from India. Further, this will serve as a method of fruition of the tremendous efforts put forth by ISRO to develop a local industry ecosystem over the past 40 years.

Additionally, wherever there are gaps in state-of-the-art technologies, there is tremendous scope to explore closing such gaps with models such as international JVs under initiatives such as 'Make in India'.

From an organisational coordination perspective, there is a need to setup a clear protocol for coordination of defence space use between already established institutions—such as Defence Image Processing and Analysis Centre (DIPAC), Aviation Research Centre (ARC), National Technical Research Organisation (NTRO), Defence Intelligence Agency (DIA), Defence Satellite Control Centre (DSSC), and Research and Analysis Wing (R&AW). The critical aspect of the utilisation of the space dimension for intelligence gathering by these institutions can further elevate the quality of inputs to both investigative bodies as well as policymakers for internal and external security.

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