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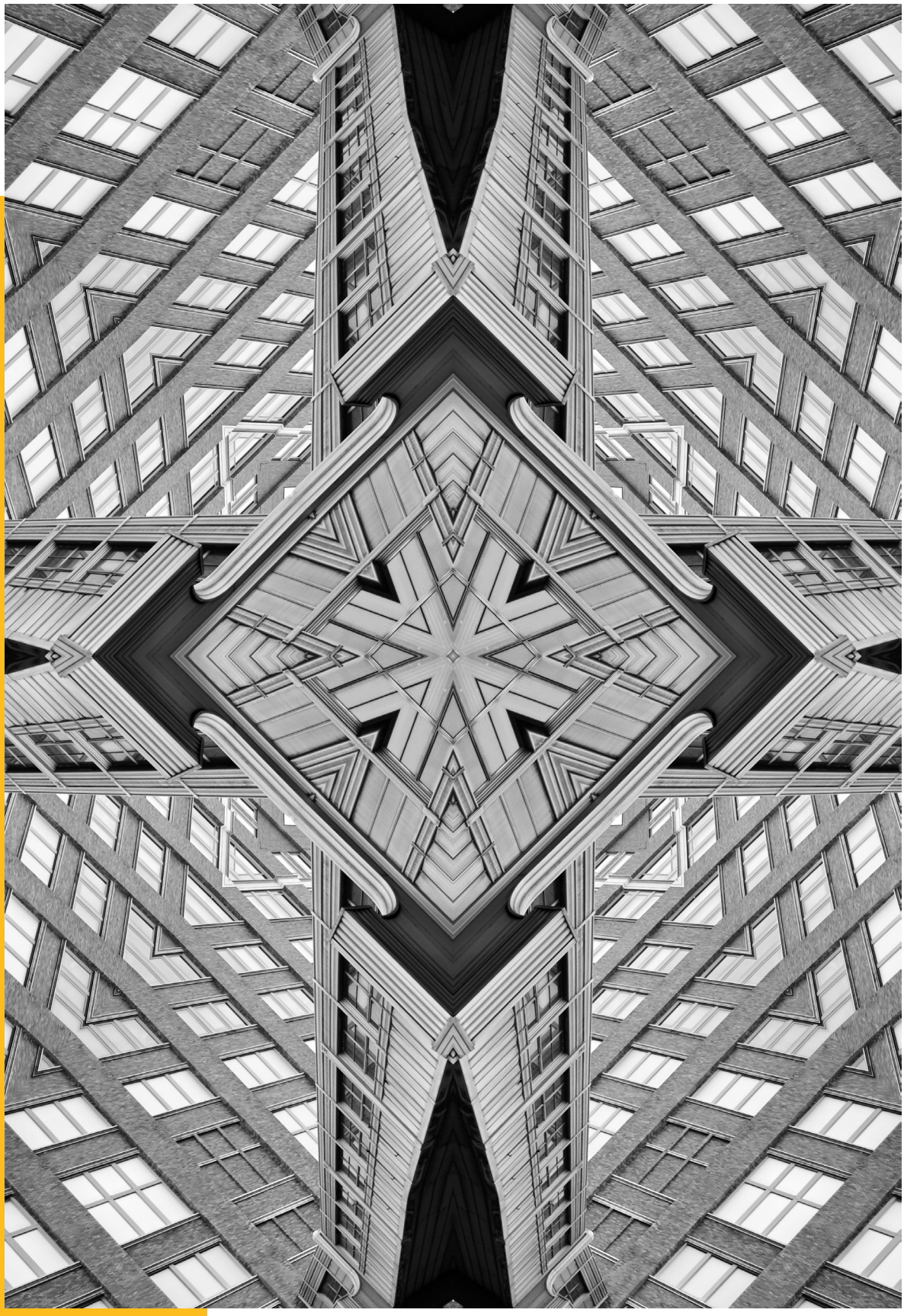

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The Imperative for Technical Reservists in the Indian Army

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Abstract

As the Indian Army (IA) integrates new and emerging technologies, it will also need technical specialists for innovation and their effective application in peacetime and wartime. This analysis makes the case that the IA can create a technical reserve drawn from the Technical Entry Scheme (TES), Territorial Army (TA) and its Reserves, which can be merged to perform the missions and tasks of the IA. Any prospective technical reserve force that emerges must merge some of the functions and conditions of service of the TA and Reserves. Relaxing some of the conditions of service can also allow for combining the expertise of an older and a younger cohort of technologists. Drawing technologists from the commercial and civilian sector for service under the technical reserve force will enhance mission effectiveness and augment innovation during wartime and peacetime. Technical reservists may be part-time soldiers, but they bring value to the IA.

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Introduction

Addressing the question of whether the Indian Army (IA) should create a technical reserve force requires examining how the IA recruits its reservists.[a] The Territorial Army (TA) is utilised in peace time and the reservists in times of war. However, the IA does not recruit technical reservists to the extent it should. Merging some of the conditions of service in the reservists and the TA will enable establishment of a technical reserve force in the IA.

Since the modern battlefield will involve the application of advanced military technology, it also requires technical specialists to manage, adapt, and use highly complex technologies. In this context, the Hooda Committee or panel[b] established in 2018 had recommended appointing a director general for future or emerging technologies such as Artificial Intelligence (AI) and robotics to capture the opportunities generated by these technologies.[1] The Hooda Committee report also recommended ways to reduce the size of the IA or limit manpower costs for greater efficiency.[2] The report recommended improving the efficiency of the IA by trimming its manpower and replacing it with technology.[3] The downsizing of the IA under the Agnipath scheme introduced in 2022 requires the service to become a smarter fighting force. The Hooda report dovetails with the Agnipath scheme.

The late Chief of Defence Staff (CDS) General Bipin Rawat also stated the importance of "improving" the teeth-to-tail ratio.[c,4] Improving the teeth-to-tail ratio would support financial efficiency. Adapting and integrating advanced frontier technologies as well as a technical reserve force made up of volunteers is also necessary. However, advanced militaries across the world have been experiencing a decline in the number of personnel in combat arms, such as infantry, artillery, or armour, compared to the growth

a Reservists are "transmigrants" who move from the civilian sphere to the military sphere, and vice-versa. They belong to plural or fluid social groups, i.e., have interactions with two or more social groups. See: Vincent Connelly and Eyal Ben-Ari, "Introduction: Negotiating Reservists: Transmigrants and Multiple Contracts," In *Contemporary Military Reserves: Between the Civilian and Military Worlds* (Routledge: London, 2023), 3.

b The Hooda Committee Report, submitted to the National Security Advisory Board (NSAB) in December 2018 to propose ways in which the IA could increase efficiency, had three key recommendations: cutting down the size of the Indian Army, establishing a reserve force that included a novel idea covering "standing units and serving soldiers", and establishing a Cyber Command.

c Teeth-to-tail ratio provides a measure of the number of personnel in combat units as opposed to the number of personnel it takes to support and supply them. There is no dearth of recommendations by committees in the past to downsize the IA, such as the Shekatkar Committee Report, which also proposed cuts in manpower and was originally submitted in December 2016. The author in this analysis specifically makes the case that India needs a novel form of elite technical reserve duty, such as in the US and Israel.

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of personnel in headquarters, logistics, and intelligence. As the IA proceeds to establish Integrated Battle Groups (IBGs) with a greater infusion of technology, emulating the Chinese, who have deployed Combined Arms Brigades (CABs) against India, as well other advanced militaries across the world will be necessary.[d,5] Developed and militarily consequential states such as the US have augmented their teeth-to-tail ratios by substituting manpower with technology and firepower.[6]

Although developing countries such as India cannot completely emulate the US and other advanced militaries, they will need to incorporate new and advanced technology and employ technical personnel from the civilian domain, which has a high level of technical expertise compared to within all three service branches of the Indian military. With India likely to become a hub for the development and export of AI[7] and technical expertise in AI and computation becoming vital in contemporary and future warfare, it will be necessary to engage the commercial sector and recruit technical reservists. A technical reserve force must be built, in part, on lateral entry to the IA from the civilian or commercial sector and the expansion of the TA with technical specialists.

Building on the recommendations of the Hooda Committee, this paper explores the opportunities and challenges faced by the IA in creating a technical reserve force. It also examines why and how creating technical reserve forces for the IA can enable greater technical innovations for battlefield applications and help the IA tap into a wider pool of talent.

d The US is a prime example. See Jon R. Lindsay, *Information Technology & Military Power* (Ithaca: Cornell University Press, 2020), pp. 29-30.

The Current State of the TA and Reservists in the IA

The IA is an all-volunteer force with active-duty personnel numbering 1,237,117 and 960,000 reserve troops as of August 2024.[8] A technical reserve will be a combination of technical talent from the commercial sector and an older generation of military officers whose experience can be harnessed to develop adaptive and innovative technological solutions for combat missions and operations.

However, the question remains about the need for a technical reserve unit if the IA can secure technical advice and meet its technical requirements through non-reserve avenues. First, such a unit would allow the IA to have access to advanced engineering capabilities from the Indian commercial sector, which, when utilised with forward deployed forces, can add operational and economic value to the IA.[9] The recruitment of technical reservists who are specialists in their field will generate additional capacity for the IA, which would otherwise not be cost-effective for the regular forces of the IA.[10] Second, a technical reserve force would permit top military commanders to work directly with some of the country's best technological minds from the commercial and civilian industries, who serve not only as external partners but also collaborators in specific military missions.[11] Third, a military reserve force within the IA can help develop a reciprocal engagement with the commercial sector that derives from the best practices and expertise of each.[12]

The TA is primarily involved in peacetime missions, whereas the IA's reserve forces are deployed in wartime.[13] However, the scope of their missions is not clearly delineated, which has led to the prescription that these "auxiliary" forces be merged for economic efficiency.[14]

The TA performs a support function to regular active-duty forces. Its personnel are recruited as "officers" and "enrolled persons" under provisions of the Territorial Army Act, 1948.[15] As these forces are not equipped to meet all the technical requirements of the IA, with the exception of cyber warfare specialists, they are deployed in support roles for active-duty forces and infantry-based operations. The TA also performs tasks related to providing aid to civil authorities.[e] This involves relieving the regular army of "static"

e See Subsection 7(3) of the Territorial Army Act, 1948, https://indiankanoon.org/doc/1151670/.

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duties and assisting the civilian administration when natural disasters occur.[16]

The age limit for personnel in the TA is 18-42 years.[f] The TA comprises civilians, and actual and confirmed employment in the civilian sector is a prerequisite for serving; former officers from the regular army are also permitted to join part time, following screening by the Army Selection Board (ASB), certification, and clearance.[17] It is unclear how many of these officers who return to serve in the TA are engineers, and there is no evidence they can serve in the Corps of Engineers (CoE), Corps of Electronic & Mechanical Engineers (CE&ME), and Corps of Signals (CoS), which primarily consist of technically qualified personnel from the regular army (See Table 1).[18] It is only in very exceptional circumstances that civilians who are technically qualified can be recommended to serve as Junior Commissioned Officers (JCOs) "by Area/Sub/TA Group Headquarters" CoE, CE&ME, and CoS[19] (Table 1). Otherwise, eligibility to serve in the aforementioned engineering domains requires one of the following: (1) prior military experience of at least four years, (2) service in the National Cadet Corps (NCC) with a confirmed Proficiency Certificate to be a JCO, (3) served as JCOs in the IA or in one of the other two service branches, or (4) are technically qualified employees from the Personnel and Training Department, Port of Commissioners or the Railways.[20] These are highly restrictive and demanding conditions to serve in the IA engineering streams under the TA scheme. In addition, it appears that the IA's leadership has not fully updated the terms of service in the CoS, CE&ME, and CoE since 1976.[g] In case these conditions persist, they need to be revised by way of widening the pool of recruits, especially from the commercial domain, to meet the demands of absorbing emerging and frontier technologies.

The TA's engineer regiments are drawn specifically from their parent units, such as the Indian Oil Corporation (IOC), the Indian Railways, and the Oil Natural Gas Corporation of India (ONGC),[21] and not from the CoE, CE&ME, and CoS. The TA does have officers serving in signals units; some of them are likely to be engineers, yet 75 percent of them, according to one analysis, are deployed for counter-insurgency and counter-terrorism operations in Kashmir and the Northeast.[22] Further, this arrangement

f For guidelines, see: https://www.jointerritorialarmy.gov.in/uploads/pdf/Advt-for-Employment-Newspdf-0c2ca3060576f4e7842c8e7ecd01f7f0.pdf. See also https://territorialarmy.in/page/3

g This author has not found an updated edition on regulations governing the TA in all the engineering streams.

imposes limitations on engineering that do not align with the battlefield and operational requirements of the IA because they are only restricted to peacetime missions.

The IA under its TA scheme already recruits technically qualified candidates in the officer branch for specialised fields such as cyber warfare, who are subjected to the same conditions in terms of rank, tenure, pay, and age limits as the other arms of the TA.[23] Confining the engineering talent pool exclusively to an age group of 18-42 years also limits the technical experience that the IA can tap. Although ex-officers of the IA can join the TA, it is unclear how many who do join possess technical or engineering backgrounds. For ex-officers who join the TA, the Chief of Army Staff (COAS) can relax the age limit at his/her discretion.[24] If this discretionary principle or authority bequeathed to the COAS can apply to ex-officers who join the TA, why can it not apply to the TA's recruitment of technically qualified individuals without prior military experience from the civilian and commercial sector specialising in cyber warfare or any other specialised technical field?

Yet, the recruitment of cyber warfare specialists into the TA can be misleading because its focus is narrowly restricted to cyber warfare. Consequently, the IA is deprived of a younger cohort of technical specialists to work with older or experienced specialists in other technical streams. The TA does not cover recruitment into specific areas such as Artificial Intelligence (AI), Electronic Warfare (EW), synthetic biology, additive manufacturing and Quantum Technology (QT).

Cyber warfare specialists recruited through the TA scheme can serve as a template or basis for recruitment to the aforementioned specialised areas. These technically qualified TA recruits can also be embedded for the duration of their mandatory annual service of two months with some of the IA's internal research institutions, such as the MTCE, and the IA can also cross-post them to the other two services, i.e., the Indian Air Force (IAF) and the Indian Navy (IN), especially as the three services move towards greater theaterisation.[h] This will enable an understanding of best practices of each

h This is already happening with joint tasks in the field of repair and recovery, logistics, UAVs, and reconnaissance. See: https://indianexpress.com/article/india/cross-staffing-of-army-officers-to-iaf-navy-soon-8633929/; https://www.deccanherald.com/india/army-officers-to-be-deployed-to-navy-iaf-in-theaterisation-push-report-1222908.html

service, generate dynamic interactions, and help develop solutions to some technical problems and innovations. Therefore, the TA, which already serves as an entry point for technical specialists in cyber warfare from the civilian and commercial sectors, should do the same for technical specialists from the commercial and civilian sectors working in the fields of AI, QT, drones, robotics, synthetic biology and additive manufacturing.

Another glaring weakness is that, at a minimum, there is no clarity about whether cyber warfare specialists recruited under the existing TA scheme will be mandated to report for duty during a military emergency or following the outbreak of a war. Technical specialists will need to align and adapt their expertise and proficiency in wartime. This is why the proposal to merge the reserves and TA[25] needs to extend to the TA's cyber warfare specialists as well as all technical fields recruited under the TA scheme for both wartime and peacetime missions. It also needs to be included in the terms and conditions of service (See Table 2). Further, the terms of service in the TA in other technical fields, such as AI, QT, and robotics, can be the same or similar to that of the TA's cyber warfare specialists. Notably, the vacancies for TA cyber warfare specialists in 2023 and 2024 were only six and four, respectively, which is very limited.[26]

Table 1: Branches of Engineering in the Indian Army

Branch of Engineering in the Indian Army	Functions
Corps of Engineers (CoE)	Provide mobility to IA forces by constructing bridges, tracks, and helipads. The CoE also creates obstacles for the enemy, such as laying mine-fields and demolishing bridges. The CoE is the first to move in and the last to exit the battlefield.

Branch of Engineering in the Indian Army	Functions
Corps of Electronic & Mechanical Engineers (CE&ME)	Recovery and repair of all army vehicles, aircraft, radio, and other electronic equipment through field workshops, zone workshops, advance base workshops, and army base workshops. Design, development, trials, and induction of new equipment through the indigenisation of foreign equipment and technical advice to units.
Corps of Signals (CoS)	Communications between static and mobile forces for voice, data, and fax through digital, automated, and secure networks by using microwave radio, optical fibre cable, and satellite and millimetre wave communication, satellite communications in the mountains, strategic broadband satellite network computer data networks, and static peace communications. The following are parts of the CoS: 1. Electronic Warfare 2. Computer 3. Emergency Response Team 4. Data Centre 5. Network For Spectrum 6. Strategic Alliance between Signals 7. BSNL

Source: DBIT[27]

Table 2: Eligibility, Terms and Conditions for Cyber Warfare Specialists in TA

Conditions of Eligibility	Educational Qualifications	Selection Procedure	Embodiment for Training	Terms and Conditions of Service
(a) Nationality: Only citizen of India. **(b) Age Limits:** 18 to 42 years on the date of application. **(c) Physical Standards:** A candidate must be physically and medically fit in all respects. **(d) Employment:** Gainfully Employed.	**(a) Essential QR.** **(i)** Educational Qualification. Any Graduate (Cyber Security/ Technology Computer Science preferred). **(ii) Experience**. Minimum 03 years' experience in core Penetration Testing / CEH / Cyber Security with reputed organisations or as independent consultant or Founder of organisations dealing with Cyber Security. **(iii) Recognised certification / formal** training in CEH, Penetration Testing, or Cyber Security and Red Team Ops. **OR** **(iii)** Minimum 03 letters of recommendation from industry acclaimed cyber experts or NAAC "A" accredited Institute or recognised information Technology / Cyber Security bodies / Government organisations to testifying the Proof of Concepts and published papers on Cyber Security / CEH / Information Management. **(b) Desirable QRs.** (i) Programming Language expertise. (ii) Functional knowledge of Hacking Forensics.	**(a)** A four-phase selection procedure will be followed: **(i) Phase I: Document Check.** Benchmarking of candidates will be done based on qualification for preparation of merit list & issuing call letter for written test. **(ii) Proficiency Test.** **(aa) Phase II: Written Test (100 Marks).** Only candidates scoring 60 Percentile and above in objective type written test will qualify for Practical Test. **(ab)Phase III: Practical Test (100 Marks).** Candidates qualifying in Practical Test will be called for Interview. **(iii) Phase IV: Interview (300 Marks).** Interview by Board of Offrs at Directorate General of Territorial Army. **(b)** Recommended candidates will undergo Medical Examination at Armed Forces Clinic, New Delhi followed by their Police Verification for final selection.	**(a)** Six months Pre-Commission Training as provided in TA Rule 20A amended vide SRO 65 dt 29 Apr 2023. (Candidates shall be commissioned in TA only on successful completion of the said Pre-Commission Training). **(b)** Two months annual training camp every year if not continuously embodied for six months in a training year (01 April – 31 March).	**(a)** Territorial Army is part time concept with mandatory two months training in a year and does not provide full time career. **(b)** Service in Territorial Army does not guarantee pension and the same is subject to embodied service as per organisational requirement. **(c)** Commission is granted in the rank of Lieutenant. **(d)** Pay and Allowances and privileges will be same as Regular Army Officers when embodied for training and military service. **(e)** Promotions upto Lt Col by time scale subject to fulfilling laid down criteria. Promotion to Colonel and Brigadier by selection.

Source: Army Headquarters Selection Board (ASB) For Specialized (Cyber Warfare), 2024[28]

The Current State of the TA and Reservists in the IA

In contrast to the TA, the army reserves are a supplementary force deployed for wartime missions and operations. These supplemental forces are covered under the Indian Reserve Forces Act, 1888[29] and amendments in 1925 and 1987. The reserve service was created for personnel who wanted to receive a pension and had to undergo periodic training and report to duties during emergencies. Under Section 8 of the 1925 Indian Reserve Force rules, reserve personnel are obliged to receive a pension for their service.[30] The revision in 1987 established the duration of service in the reserves following completion of active duty in the regular army and mandated personnel who joined the reserves to reveal their post-army contact details to the IA, especially if they differed from their home address.[31]

However, the reservist system continues to face challenges. Reservists often retire only after they become eligible for a pension, then move to security occupations in the civilian and commercial sectors. This shift creates multiple challenges for the IA, from tracing the current addresses of reservists to recalling them in the event of war or other emergencies.[32] The IA also faces challenges in training and arming reservists after issuing orders for their return to service during emergencies. Ammunition, weapons, and equipment are stored in ordinance depots and would be difficult to secure[33] owing to limited assistance from the ordinance depots, as many of the personnel manning the depots would have returned to their parent units due to military crisis or emergency.[34] Additionally, as with the TA, there are age limits for reservists, and it is unclear how many, especially from the officer cadre, have technical backgrounds; most reservists are likely to belong to the traditional fighting arms of the IA such as the infantry or artillery. These factors make the conditions for service for reservist officers a limitation for the IA in the technical or engineering streams.

Retired officers, especially with technical backgrounds, should be permitted to voluntarily enter reserve duty, which is currently set at five years and terminated at age 50, to extend their stints voluntarily to at least 60 years.[35] Personnel recruited under the Short Services Commission (SSC) scheme should be permitted to serve voluntarily above the current age of 40 years for men and 37 years for women either before or after their contractual service period ends.[36] Officers from the reserves and SSC can serve

voluntarily as technical reservists which is for two months annually that the TA's cyber warfare specialists serve. Yet, a condition should be that they be "gainfully employed", as is the case with TA officers after they complete their mandatory service.

Despite challenges, the TA and reserves can serve as a template for a technical reserve force. Among the two, the TA could provide a more credible model because it is not just made up of volunteers, as with the reserves; additionally, the TA's service requirements mandate that participating personnel are gainfully employed in the civilian sector.[i] Former army personnel who serve in the TA do so only part time. Additionally, the reserve-force model would increase financial costs for the IA as it comprises pensionable or superannuated recruits or personnel and mandates pension payouts, which will not be financially sustainable. However, before being adapted for a technical reserve force, the TA Act would require amendments to the conditions of service.

i For more on cost effectiveness, see: https://timesofindia.indiatimes.com/blogs/col-nagial/territorial-army-a-citizen-force/

External Assistance for Technical Challenges of the IA

The IA receives external assistance through mechanisms such as the Army Design Bureau (ADB), Innovations for Defence Excellence (iDEX), and the Acing Development of Innovative Technologies with iDEX (ADITI) scheme.

The ADB, launched in 2016, was an early technological initiative by the Modi government that served as an interface between academia, industry, start-ups, and the IA.[37] The ADB aims to strengthen indigenisation by tapping into Defence Public Sector Undertakings (DPSUs), the Defence Research and Development Organisation (DRDO), and private industry. It has undergone subsequent refinements and remains among the key initiatives to leverage the Indian civilian industry's technological capabilities to solve the challenges facing the IA, especially in frontier or emerging technologies. The ADB's "Compendium of Problem, Definition and Statements – 2023" highlights multiple areas where challenges are faced,[38] from cutting-edge technologies such as AI, drones, robotics, and quantum technology (QT), to more traditional areas such as armaments and ammunition. The compendium defines the problems and why existing capabilities are inadequate for resolving them to boost existing capabilities and enhance operational effectiveness. These problem statements highlight the multiple technical challenges that the IA needs to address. While these problem statements are helpful, they are no substitute for a technical reserve force.

The ADB requires the IA to define its problems and seek solutions from academia, start-ups, and industry. Notable successes under the ADB include Vidyut Rakshak, an Internet-of-Things (IoT) based generator monitoring and control system that was completed under the guidance of Indian Institute of Technology-Delhi (IIT-D) faculty through the Army Technology Board (ATB) and is now undergoing mass production by Indian industry.[39]

iDEX was launched in 2018 to overcome the technological challenges of the Indian Armed Forces. iDEX engages with Micro, Small and Medium Enterprises (MS&MEs), start-ups, individual innovators, research and development (R&D) institutes, and academia to encourage innovation and development of technology across the defence and aerospace sectors. iDEX

is primarily financed by the Defence Innovation Organisation (DIO).[j,40] It follows a similar template to the ADB in that the armed services, who are the end users, state their problems, which are attempted to be resolved through available solutions in the start-up ecosystem.[41] Some successes under iDEX include counter Unmanned Aerial Systems (UAS) by the start-up Big Bang Boom Solutions (BBBS) that use long-range sensors, jammers, AI, and computer vision analytics to identify threats from hostile drones;[42] and radio frequency (RF) jammer guns developed by the start-up Gurutvaa System that jam Global Navigation Satellite System communications and data links to limit threats from adversaries.[k,43] In 2022, iDEX Prime was launched, which provides funds between INR 1.5 and 10 crores to emerging start-ups.[44]

Under the ADITI scheme, launched in March 2024,[45] start-ups receive a grant-in-aid of INR 25 crores for research, development, and innovation in defence technology.[46] The scheme is primarily geared towards meeting the innovation and technical challenges faced by the IA by interfacing with academia, industry, and start-ups. As a newly launched scheme, the performance and relative success or failure of ADITI remains undetermined.

All four schemes—ADB, iDEX, iDEX Prime, and ADITI—are aimed at resolving technical challenges for the end user, i.e., the armed services and more specifically the IA. These initiatives allow the Armed Forces to keep pace with the latest technological developments and incorporate frontier technologies. However, they do not address the recruitment of human technical talent as reservists drawn from commercial industry into the ranks of the IA, which is vital for contemporary and future warfare.

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j The DIO was founded by two state-run DPSUs: Bharat Electronics Limited and Hindustan Aeronautics Limited. DIO provides policy guidance, whereas iDEX serves as the executive arm to execute and foster the development of novel technologies that meets the needs of the defence and aerospace sector and encourages collaboration between the services, start-ups, and the defence industry. See: https://idex.gov.in/idex

k The RF jammer guns have already received orders from the Indian Air Force, with the Air Force and IA expressing Acceptance of Necessity for both systems developed by the start-ups. See: https://www.financialexpress.com/business/defence-idex-startups-are-breaking-boundaries-in-high-tech-pseudo-satellite-platform-swarm-alfa-s-and-quantum-crypto-anurag-bajpai-js-mod-2575789/

The Necessity of a Technical Reserve Force for the IA

Human talent is vital across a range of fields relevant to the IA's innovation requirements, including cyber technology, AI, QT, space technology, additive engineering, and synthetic biology. The IA, under its TA scheme already recruits technically qualified candidates into the TA for specialised fields such as cyber warfare.[47] Yet, existing mechanisms in the IA must be incorporated for research and innovations in military applications and warfighting. The ATB is the IA's in-house R&D organisation and develops innovations that meet the IA's operational requirements.[48] It also conducts research with IITs across India. The ATB comprises serving personnel from the IA, who work under the guidance of faculty members from IITs. In late 2023, 80 such innovations were shortlisted, of which 34 were selected for further development.[49]

Irrespective of how the IA's in-house solutions evolve, there is a need to engage external contributors to enhance innovations so that they meet the warfighting requirements of the IA. To this end, the IA needs to set up its own innovation unit drawn from reservists or create an "elite technical reserve force"[l] at least partially derived from the commercial and civilian sector. China has already done this through the Military Civil Fusion (MCF).[50] Israel and the US also use technologists from reserve groups or the private sector. India can replicate the Israeli model,[m] similar to the US. However, India cannot pursue Israel's conscript system, wherein all reservists must have at least two to three years of active-duty experience. Without conscription, it would be impossible to recruit a sufficient number of military personnel into the Israel Defence Forces (IDF) to defend against the acute military and national security threats Israel faces. Unlike militaries in most democratic states, the IDF plays a key role as a socialising agent and deploys narratives emphasising the importance of military service as synonymous with civic duty and national identity.[51] Finally, Israel is too small in terms of population to base its defence on an exclusively all-volunteer fighting force. The United

l The case for this well laid out for the US military. See: https://www.washingtonpost.com/opinions/2024/03/04/tech-reservists-israel-us/

m Following the 7 October 2023 Hamas terrorist attack that killed and led to the capture of Israelis, precipitating the current Israel-Palestine war, Israel mobilised a large number of its reservists. The reservists of the Israeli Defence Forces (IDF), many whom come from Israel's advanced technology industry, have played a key role in the multiple wars that the country is fighting. These reservists belong to different age groups but are mostly older. The US is also trying to emulate the Israeli model. See: https://www.washingtonpost.com/opinions/2024/03/04/tech-reservists-israel-us/

The Necessity of a Technical Reserve Force for the IA

States has an all-volunteer military[52] with a reserve system in the form of the Army National Guard (ARNG), similar to India, but not identical.

The Hooda report called for moving beyond using retired soldiers for reserve duties and do it equally with serving personnel, which would be along the lines of the reserve model that the Americans and Israelis follow. Indeed, instead of the TA, it is the regular army that has undergone expansion.[53] This point only reinforces the imperative to merge the TA and the IA's reserves. Although the Hooda report, which has not been fully released to the public, saw it as a cost-cutting exercise,[54] if modified and extended to at least a portion of technically qualified personnel who have done stints in the IA, it could help the IA in tapping the expertise of personnel with technical experience in both the military and commercial domains.

Although both Israel and the US have been more frequently at war compared to India, the challenges that confront New Delhi are not dissimilar to those of these countries. India is surrounded by two hostile states on its northeastern and western borders, i.e., the People's Republic of China (PRC) and Pakistan, respectively, which pose a collusive threat to India. Further, an active boundary stand-off, which has only eased slightly, between India and China persists. A technical reserve force comprising technologists from the Indian commercial sector could help meet the battlefield requirements of the IA.

There is a need to establish mechanisms for recruiting experienced civilian or commercial technologists into the IA, at least on a selective basis.[n] For instance, the TA Act can be amended to include the recruitment of technical qualified individuals from the commercial sector. It has been argued that standalone legislations or amendments to the TA Act cannot crystallise in the current environment due to the deep political polarisation in the country. However, this constraint does not preclude a debate about the merits of technical reservists for service in the IA. The passage of a law or amendments to the TA Act that permit the establishment of a technical reserve force will

n See, for example, the views of a serving Signals Corps officer: Colonel Suraksh Vir, "Atmanirbhar Bharat: Establishing Credible National Cyber Capability," *U.S.I.* CLIV, no. 686 (April-June 2024): 286.

need consensus, and the incumbent government is obliged to seek broad political agreement by engaging allies and parliamentary opposition.

Software and information management are also critical. The "information system" that was developed by the Royal Air Force (RAF) during the interwar years persists[o] and is even used by the Indian Armed Forces. However, it needs to reduce the obstacles between operational and technical expertise by recruiting reservists who can adapt their experience from the civilian domain to the IA's needs.[55] In military confrontations, especially with an adversary such as the PRC—which is likely to continue to develop and hone non-contact warfare that reduces physical close-quarter combat[p]—the IA will need to place at least as much emphasis on technical expertise as on traditional military power.[q]

The shift in modern warfare has increased computational load and requires a high level of cognitive ability. The Hooda Committee recommendation, reinforced by that of General Bipin Rawat, to improve the teeth-to-tail ratio of the IA was more focused on substituting manpower with technology. While this is necessary for limiting manpower costs, especially in the IA's infantry and other units, an elite reserve technical force or technical specialists from outside the IA recruited as part of the TA from a variety of technical fields, can also contribute to achieving this goal. New and existing technology need to be adapted to specific missions and battlefield conditions.[r] Technically

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o This system was a rationally structured grouping of personnel and machines that processed data. During the Second World War, the intent of senior commanders was implemented through decentralised execution by a lower-echelon officer from among civilian scientists and technologists with military RAF officers making technical adjustments and adaptions for war. See: Jon R. Lindsay, *Information Technology & Military Power* (Ithaca: Cornell University Press, 2020).

p This is recognised even among serving officers of the IA. See: https://www.idsa.in/system/files/jds_4_2_dsharma.pdf. For more on Chinese perspectives on non-contact warfare, see: Jacqueline Newmyer, "The Revolution in Military Affairs with Chinese Characteristics", *The Journal of Strategic Studies* 33, no. 4, August (2021): 495-499.

q Lindsay notes that warfighting today and in the future increasingly "emphasizes brain over brawn." See: Lindsay, *Information Technology & Military Power,* p. 30.

r This is recognised by some former corps commanders of the IA. See, for example: Lt. Gen. PJS Pannu (Retd.), "Role of Niche and Disruptive Technologies in India's Deterrence and War Fighting Capabilities," *38th USI National Security Paper 2021*, United Service Institution of India (USI), 2021, pp. 63-71.

qualified personnel drawn from a reservist technical force, who are not exclusively from an operational military background, can help partially overcome or redress the technical challenges faced by the IA, making adjustments and refinements for technology to work effectively. They will also play a key role in enabling the IA to adapt to evolving battlefield operations. In this regard, reservists can play a role as complements and supplements to the IA's in-house technical personnel.

For instance, the IA already employs and uses combat engineers who build bridges and airstrips under fire in a combat environment or during natural disasters and their constructions are not built perfectly that meet precise municipal or architectural standards, but they are reasonably well built to meet time constraints and the high-tempo mobility requirements during military operations.[s,56] Indeed, there is also a reciprocal relationship or influence between the IA and civilian municipal authorities. For instance, a few years ago, Bombay or Mumbai Municipal Corporation (B/MMC) took inspiration from the IA in rebuilding dilapidated bridges that are reasonably constructed in Mumbai city at a quicker pace under difficult weather conditions.[57] Technical teams deployed in forward positions perform a similar function similar to the US Army's cyber units[t] that the IA can emulate by deploying cyber teams at the brigade level and below with a few drawn from the commercial and civilian sector. As one expert pointed out, Human Machine Teams (HMTs) are necessary for the IA and should have a structure that involves data mining, digital units, and AI alongside cyber and Electronic Warfare (EW).[u] HMT enabled by AI can ease the burden on the IA through the delegation of tasks to machines where feasible.[58] This can help humans focus on high-end processing, acquiring situational awareness, and gaining a better understanding of the adversary's military plans and capabilities.[59] This also requires a dedicated set of skilled personnel, with some being technical reservists, who can resolve and handle challenges as

s For engineering in a combat environment, see: https://dras.in/perspective-on-military-engineering-in-indian-army/

t The US deploys cyber teams as part of an expeditionary Cyberspace and Electromagnetic Activities (CEMA) unit that was recently launched by the United States Army Cyber or Army Cyber (ARCYBER). These units provide localised support at the brigade level rather than depending on distant and remote strategic resources of US Cyber Command, which until recently were only available at the theatre and joint force level. See: https://defensescoop.com/2024/11/26/army-building-a-new-expeditionary-cyber-battalion/

u The point was flagged by an anonymous reviewer of this paper.

they emerge on the battlefield.[v] Although AI will be the foundation of HMT and is recognised by the IA,[w] the financial allocations made by the service of roughly INR 400 crores (US$50 million) is inadequate.[60]

While HMT is necessary, any potential specialised cyber and EW units, or Cyber and Electromagnetic Activities Teams (ECTs), of the IA need to be deployed at the brigade level to impact cyber operations on the ground, predominantly through RF, EW, and information operations.[x] To some extent, this is already underway with the IA's move to establish IBGs, which are terrain specific but have an organic component of signals units consisting of EW and possibly CW elements.[61]

A key area of focus for the IA, with the involvement of the Signals Technology Evaluation and Adaptation Group (STEAG), should be the creation of a "triad" of cyber, space, and Special Operations Forces (SOF), similar to the approach of the US military in synergising these forces.[62] SOF units will serve as vectors of access and positioning in forward areas of close proximity[63] to Chinese and Pakistani targets, which the IA's cyber forces can then attack. Initially, ECT teams could involve active-duty IA personnel who can be forward deployed below the brigade level, whereas some technical-reserve elements can be placed in higher echelons of command, such as at the corps and theatre levels.

The IA has already launched two initiatives for which technical reservists can and in all probability perform tasks for the service. The Command Cyber Operations and Support Wings (CCOSWs) for Network-Centric Operations (NCO), launched in April 2023,[64] aim to ensure robust cybersecurity by preventing hostile cyber penetration and allowing for the smooth operation of networks for all major formations and their command centres.[65] Defensive cybersecurity and operations are critical to ensuring cyber resilience and serves as the foundation for offensive cyber operations.[y] The IA has set up

v The author thanks an anonymous reviewer for this point.

w See, for example, a serving IA officer's view: Lt. Col. Richa Datt, "Fusion and Integration of AI and Data Analytics with Military Intelligence in Indian Armed Forces with an Emphasis on Optimisation of Intelligence Cycle," Center for Joint Warfare Studies, December 2024, p. 31.

x This is what the US Army or ARCYBER is doing. For instance, see: https://defensescoop.com/2023/08/02/modern-triad-initiated-by-army-is-making-its-way-to-joint-combatant-commands/

y From the author's interaction with a cyber expert.

test beds to ensure that all niche technologies, including cyber, are absorbed and distributed at scale across the service.[66] This should not only involve the IA's in-house technical teams but also tap into external experts, which to some extent, already happens through the TA's cyberwarfare specialists, who are technical reservists.

The STEAG, mentioned earlier, was set up in March 2024. STEAG is dedicated to absorbing and innovating in next-generation communications technologies such as AI, 5G, 6G, machine learning, and QT for defence applications.[67] At STEAG, a colonel rank will oversee innovations in a range of wireless systems, including mobile exchanges, electronic communications, and software-defined radios customised to meet the IA's operational requirements.[68] STEAG will increase the demands for applying emerging technologies on the battlefield. The STEAG, highlights that, contrary to perceptions, the IA does have institutional mechanisms in place to manage emerging technologies.

There are other supplementary institutional efforts that predate the STEAG, such as the AI Centre at the Military College of Telecommunications Engineering (MCTE), Mhow, which was established in December 2021 to incubate and innovate in emerging technologies such as AI and frontier technologies.[69] A Quantum Lab was also set up at MTCE in December 2021. State-of-the-art cyber-range and cybersecurity labs have been established for training personnel in cyber warfare.[70] Electromagnetic spectrum operations have also received attention within the service and the cyber range and cyber labs have been established based on internal ideas developed by the IA for operations across the Electromagnetic Spectrum (EMS).[71] The IA's technology institutions are dedicated to innovations in AI, QT, and cyber technology.[72] The IA's internal institutional and research effort is to transition to next generation communications through post quantum cryptography.[73] There is already an agreement between the IA and QuNu —a start-up that, under the iDEX 2.0 scheme, is contracted to develop a single hop 200 kilometre Quantum Key Distribution (QKD) to secure communication system that enables quantum-resistant algorithms and serve as a replacement for conventional encryption.[74] It will augment security, limit manpower requirements and introduce frontier technologies in to the

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IA, which is compatible or consistent with what the Hooda Committee and the late CDS Rawat recommended.[75]

Yet, technical specialists will be required to manage breakdowns in the QKD[z] because its uses have limitations because it is hardware based, making it inflexible to upgrade with security patches, vulnerable to internal threats, connected to the physical layer, thus creating a new attack surface than conventional cryptography, and driving up infrastructure costs as relays have to be trusted at facilities hosting quantum equipment.[76] In some instances, innocuous clutter in the quantum communications channel may be indistinguishable from actual eavesdropping.[77] For these reasons, both in peacetime and wartime, relying exclusively on in-house technical specialists will be insufficient, and drawing on technical reservists specialising in QT and quantum communications will be necessary. More recently, the Centre for Development of Advanced Computing, which falls under the Ministry of Electronics and Information Technology (MeitY), and MCTE signed a Memorandum of Understanding to create a Centre for Excellence (CoE) at the MCTE. The CoE will catalyse the development of cutting-edge technologies for military applications.[78]

Beyond institutional changes to generate better R&D in emerging technologies, the three-armed services launched their joint cyberspace doctrine in June 2024.[79] This doctrine provides some guidance to the IA about cyber-attacks against strategic targets, including critical infrastructure, transportation, banking and financial systems, and command-and-control nodes of the Indian Armed Forces. With increased digitisation across the civilian and military domains, there will be an increase in attack surfaces, which, in turn, will require more cybersecurity experts with AI skills to handle threats.[80]

In the context of AI with military applications, the IA will need to collaborate with the commercial sector and academia to bridge the shortfalls in its compute capacity. In order to achieve this, it will need access to the national

z This point well noted in the context of the maritime domain. It is equally valid for land forces and the army because there will be wear and tear for quantum equipment. See: Lt. M.J.L. Colbeck, "Quantum Encryption in Military Communications," *Conference Proceedings of EAAW,* November 6, 2023.

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AI ecosystem, innovation centres that can develop Large Language Models (LLMs) aligned with the IA's military needs, and data platforms capable of meeting intelligence requirements by identifying and separating relevant and 'clean' data from irrelevant data.[81] These challenges are among several that require immediate attention.

Reservists can tailor their commercial expertise to the IA's technological requirements. In addition, a select group of personnel from the TA recruitment mechanism can form a technical reserve unit for the IA. However, these technical reservists cannot be a cohort of "temporary workers" and must have technical skills that align with the mission requirements of the IA as well as the technical proficiency to adapt and re-adjust technology induced by friction and glitches in peacetime and especially in wartime.[aa]

As the IA inducts new technology and restructures itself to become a more agile fighting force capable of combined arms warfare, the burden to train and integrate personnel proficient in communications, the challenges associated with handling computational, informational, and other technical challenges will also increase. To address this, CCOSWs can also include technical reservists. For instance, the "modern system"[ab] of combined arms warfare, which involves concealment through offensive and defensive tactics, suppressive fire, independent manoeuvre, combined arms cooperation, differential concentration, and defence in-depth,[82] has increased communications requirements for successful and decisive military outcomes.[83] Indeed, when the STEAG was set-up in March 2024, a senior Indian Ministry of Defence (MoD) official noted, "Communications are an important component of military operations. In the fast-evolving technologies for the battlefield, the side with better communication technologies and the ability to connect various constituents for the information sharing will have edge over its adversary."[84] The STEAG mandates innovation in key emerging technologies with military applications, which creates a compelling case for recruiting technical reservists.

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aa This point is made in Lindsay, *Information Technology & Military Power,* p. 225.

ab For an explanation of the "Modern System", see: Stephen Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle* (Princeton: Princeton University Press, 2004).

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This requirement is bound to increase with India moving towards the establishment of theatre commands involving tri-service cooperation. Inter-service cooperation between air and land forces and between naval and air forces will become more demanding, especially in the domains of communications and information processing. Advanced militaries worldwide have grown to meet the computational burden and information-processing capacities by creating a new set of specialised occupations such as cryptology, EW, space operations, meteorology, operations research, computer network operations, psychological operations, and public relations.[85] While AI and QT may offer some solutions to cope with the increased information processing and encryption demands and challenges, they are likely to create demand for new skillsets and roles, alongside giving rise to a set of new technical challenges for the IA. The use of technical reservists from the civilian commercial must align with the military or the IA's missions.

Even the most 'perfectly' crafted information system, such as the RAF's Fighter Command in the Second World War, in which friction was kept to a minimum and there was a maximisation of efficiency, had to contend with minor breakdowns at lower levels.[86] This required civilian technical operators working alongside military practitioners in forward deployed areas, making adjustments for effective performance of Fighter Command because they had a shared understanding of its mission.[87] Fighter Command used radar scientists and a select group of civilian ham radio operators from its "healthy peacetime radio industry" to serve as radar and Direction Finding (DF) operators who experimented with radar and RAF radio equipment to make them work effectively.[88] This stands as a model of emulation and foreshadowed the adaptation of civilian skillset and commercial technologies for innovation by the military in the digital age.[89]

In this context, the question that needs to be addressed is: What would a reserve technical force look like for the IA?

India's domestic conditions serve as a barrier sociologically, institutionally, and legally in conscript military through preventing the creation of an elite technical reserve force. From a sociological standpoint, there needs to be seamless movement between the civilian and military domains. Institutionally, the army will need to show some flexibility, allowing for

greater two-way movement of technical personnel fostering a dynamic and symbiotic interaction between the commercial and military domain. Also, rank agnosticism involves moving away from being excessively hierarchical as long as the civilians recruited as part of a reserve force recognise that their technical work aligns with the mission sets and operational requirements of the IA. Secondly, from a legal standpoint, age barriers will need to be done away with. Currently, the Reserve Forces Act as well as Territorial Army Act place age limits, with the latter pegging it at 42 years and the former 50 years.[90]

Further, the Technical Entry Scheme (TES), which caters to a permanent commission, also bars women from being recruited.[91] It is also possible, in the case of personnel recruited through the TES, that several move to the private sector upon completion of their minimum mandatory service. The latter cohort should have the option of voluntarily reverting to their parent units and the streams (see Table 3).

Despite efforts and initiatives such as iDEX and iDEX Prime, which have aimed to tap into the Indian private sector to meet the technological needs of the IA, the results are not sufficient; there is also a need for technical reservists who can improve mechanical and technical failures or malfunction in peacetime and wartime. Commercial technologies that are dual use can also be refined and improved with the help of technical reservists who can adapt and tailor them to specific battlefield conditions during active military hostilities. Mission critical capabilities, as the Ukrainians have shown in their ongoing war against Russia, are sourced from the private sector or commercial technologies are tailored to their mission requirements.[92] In fact, there is even localised R&D that involves small tech labs deployed on the frontlines of the battlefield with engineers from drone manufacturing firms evaluating and adjusting drone performance through software updates by making rapid modifications.[93] War, to be sure, has served as an impetus to adapt commercial technologies to meet the operational requirements of the Ukrainian military. Nevertheless, the IA need not wait for a war but start the process of integrating and using commercial technical experience to meet its mission and operational requirements.

Table 3: Technical Entry Scheme

Location	CME, Pune	MCTE, Mhow	MCEME, Secunderabad
Parent Arm	Corps of Engineers	Corps of Signals	Corps of Electronics and Mechanical Engineers
Stream	Mechanical and civil engineering	IT & Telecom Engineering	Electronics and mechanical engineering

Source: "Indian Army (Permanent Commission) 10+2 Technical Entry Scheme-53"

The IA cannot completely replicate Israel's model that highlights a symbiotic organic relationship between the military and the tech sector and society.[ac,94] However, the IA can incorporate some elements, such as recruiting people from diverse backgrounds, especially those from an older age group and irrespective of gender.

The service need not wait for a conventional war to break out to invest in technical reservists. Even the grey-zone military challenges facing India require reservists to be selectively involved in the IA's capacity.

Compared to Israel, the US serves as the better model for India in that it has an all-volunteer military as India, and similar to American companies,

ac Many of Israel's technologists have skillsets that are transferable to the hi-tech private sector, and they apply these skills in the case of a military emergency. For instance, senior technical talent seamlessly entered the IDF following the 7 October 2023 Hamas attack. Older software engineers have been critical in the ongoing war effort against Hamas. Additionally, senior volunteers from Israel's financial sector have been able to rapidly establish links on Hamas's financial transactions. A group of older men and women from academia employed high-end algorithms to filter GoPro, phone, and multimedia content used by terrorists. Most of Israel's hi-tech industry is run by and composed of technologists who were IDF personnel themselves, allowing them to convert "skills, networks, and ethics" tailored to the needs of the hi-tech industry when they enter it. See: Swed and Butler, "Military Capital in the Israeli Hi-tech Industry"; https://www.washingtonpost.com/opinions/2024/03/04/tech-reservists-israel-us/

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Indian companies in the private sector have substantial human talent.[ad] The Marine Innovation Unit (MIU)—the United States Marine Corps' elite reserve unit dedicated to innovative solutions for the USMC—can serve as a model for emulation. While several of their recruits have prior experience in the USMC,[95] their experience is not exclusive, and they come from varied backgrounds, such as academia, hi-tech, and "makerspaces".[96] A distinctive feature of the MIU is that it is composed of small units.[97] The MIU also assists active-duty units of the Corps with technological challenges.[98]

ad In the Indian case, this is well captured in Lt. Gen. R.S. Panwar (Retd.), "Artificial Intelligence in Military Operations: A Raging Debate, and Way Forward for the Indian Armed Forces," United Service Institution, 2018.

Recommendations for an Elite Technical Force in the IA

Rank agnostic: People from different age groups should be recruited on a voluntary basis. This requires a shift in the way the IA approaches recruitment. It would need to discard its hierarchical military culture and support lateral entry from India's engineering institutions to create an elite technical reserve force. Excessive secrecy will also adversely impact the IA's capacity to leverage technical inputs from commercial and civilian technologists. There are obvious risks in diluting secrecy. The Edward Snowden example weighs on Indian military planners, yet the payoffs from involving and leveraging the strength of civilians with specialist technical backgrounds belonging to diverse engineering streams is high and recognised.[ae] Indeed, the balance between secrecy and openness in the recruitment of cyber warfare specialists through the TA mechanism could serve as a template for recruitment civilian technical specialists in a range of engineering domains relevant to the IA from the commercial sector.

Deep technical expertise: Civilians with considerable technical expertise that aligns with the mission and operational requirements of the IA should be recruited. There should be explicit opportunities for technologists from the commercial sector to join the technical reserve force. Either a substantial educational and experiential background or a combination of both should be preferred. They must also work in small teams. Further, recruits who are technically qualified under the Agnipath scheme should either be retained or become part of the technical reserve force and allowed to revert to their parent units once every year as part of their reserve duty or during a military crisis or war.

Not just another reserve unit: This technical reserve force cannot be a smaller, part-time version that supports the active force, as is the case with the TA and the IA's reserves. It has to be a unit that can contribute special talent drawn mostly from the civilian and commercial domains. While select personnel with technical backgrounds from existing TA battalions can be recruited and the IA can also upskill some personnel in data science, information technology, and computer science, this would incur some financial costs. The TA's cyber warfare specialist mechanism serves as a better

ae This is recognised by serving CoS officers. See, for example: Col. Suraksh Vir, "Atmanirbhar Bharat: Establishing Credible National Cyber Capability," *U.S.I. Journal* CLIV, no. 636 (April-June 2024): 286.

model of recruitment, because the recruits already have prior qualifications and employment in the civilian and commercial sector. The other approach is to encourage TA personnel to get additional training on their own that the IA can certify and validate. Merging the TA and the Army Reserves, which has been hanging fire for some time, should also be expedited. A merged TA and reserves will should be deployed and used for the IA's peacetime as well as wartime missions.

No age limits: There is a proposal to extend the age limit of technically qualified personnel in the IA to 23 years and retaining up to 75 percent of technically qualified soldiers and specialised personnel, especially in the CoS, engineering, and air defence.[99] In the current context, entry into the technical reservists should have flexible age limits. Imposing age limits would deprive the IA of an older and more experienced set of technologists working alongside younger technologists. Removing age limits can also help the IA tap into greater engineering depth, a lot of which is concentrated in the Indian commercial and civilian sector. There is also talent in the private sector that is above the age of 42 years. Age limits can be extended up to at least 60 years, especially with personnel from technical backgrounds.

Gender neutral: Recruitment should take place across gender and sex. At present, the IA Technical Entry Scheme (TES), which is for a permanent commission, is limited to unmarried men between the ages of 16.5 and 19.5 years.[100] Attracting, harnessing, and retaining talent regardless of gender and sex should be key. The TES should add a provision that allows men and women, as is the case with recruitment under the SSC and TA scheme, following their tenure, to return to the service as reservists in the engineering branch where they served. The TA, which recruits cyber warfare specialists including men and women, should serve as the template for recruitment into multiple technical fields such as AI, robotics, QT, synthetic biology, and additive manufacturing.

Recommendations for an Elite Technical Force in the IA

CoS: The CoS is the key repository of computer engineering, EW, satellite communication across variable terrain, secure or encrypted communications, and fibre optic cable that support the military commander during operations. Officers who left the CoS and the IA to join the commercial sector must be permitted to return to their CoS units as this can allow them to combine their military experience with commercial experience. The CoS will be a key repository alongside internal technical institutions such as the MTCE for integrating emerging technologies into the IA. This can be replicated in other engineering streams of the IA, such as the CoE and the CE&ME.

The TA as a better model: The TA requires the all-volunteer elite reserve force to have prior employment in the commercial sector. Therefore, Indian private-sector technology companies must enable a revolving-door policy, at least for a few hi-tech professionals, allowing them to move back and forth between the military and commercial domains, which will help meet the requirements of the IA. If civilians cannot be recruited as reservists, then serving personnel will need to be trained to undertake multiple operations. This can be achieved under the purview of the Defence Cyber Agency (DCA), which is tasked with training personnel for all three services.

Conclusion

An elite technical reserve force is increasingly emerging as a necessity. The infusion of new technology in the IA, through schemes such as ADB, iDEX, iDEX Prime, and ADITI, require supplemental initiatives such as those proposed in this paper. Technical reserves can have benefits for the IA s mission and operational requirements. They are not just part-time soldiers but are integral to the performance of the IA in peacetime and wartime, contributing through technical innovation, adaptation, and improvisation.

Crafting technical solutions to challenges on the battlefield also requires that the IA draw on technical experience from the commercial and civilian domains. Several technologies that are developed in the commercial sector can also be adapted and tailored for military use. This could apply to a range of legacy and emerging technologies. Further, personnel who combine military and commercial experience are able to convert their skillsets from each domain.

In actual combat, technical reservists called for duty can help overcome, or at least redress, the friction of war that involves mechanical and technical breakdowns and restore the weapons system or platform and communications or software to function effectively. Like all soldiers, technical reservists also have to imbibe the importance of mission command, which involves centralised intent and directives of upper echelon commanders with decentralised execution and initiative by lower-level combat leaders on the battlefield.[101] No single military technology provides a decisive advantage on the battlefield, and understanding its limitations and circumventing those limitations is important,[102] which requires at least the partial involvement of technical reservists. Contemporary and future warfare also demand cognitive abilities, which a technical reserve force can provide.

The IA, like any service, values lethality by absorbing and integrating latest technologies and capabilities, but it also needs technically proficient personnel to effectively apply them as well as adjust and innovate around them. Thus, creating reserve opportunities for technically qualified individuals from commercial and civilian sectors on a voluntary basis is indispensable.ORF

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