CENTRE FOR JOINT WARFARE STUDIES

SPECIAL BRIEF

RECENT CONFLICTS: EARLY MILITARY TECHNOLOGY LESSONS FOR THE INDIAN ARMED FORCES

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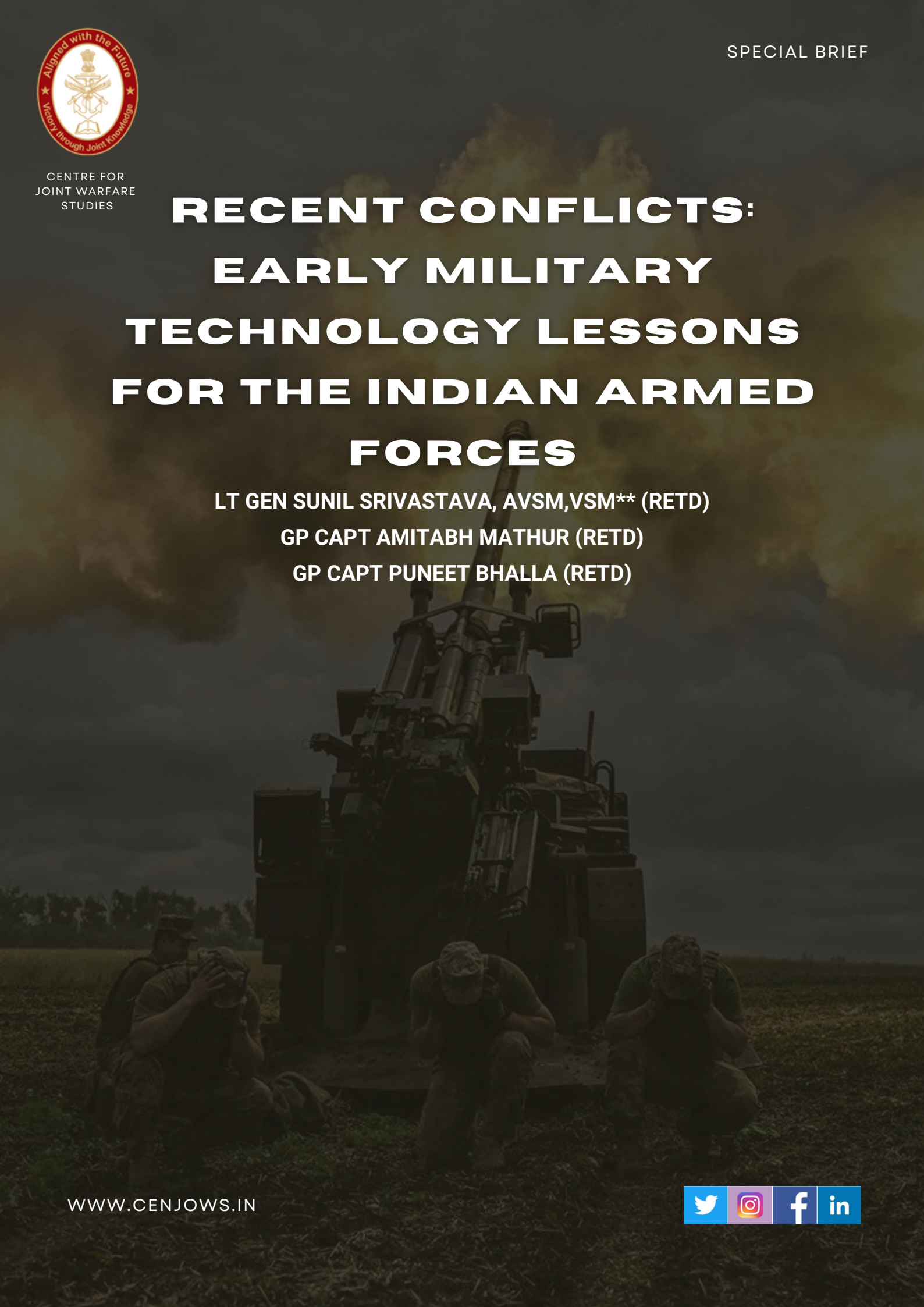

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CENJOWS

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The 1991 Gulf War demonstrated how conventional wars are transformed by technology, perhaps overshadowing the impact of equally salient doctrinal, training and organisational evolutions. The notion that technological prowess can win wars quickly and with little pain, was put to test post 9/11, albeit in sub-conventional wars. The **ongoing Ukraine war has also upended such notions about conventional wars,** involving a great power. Moreover, **technology diffusion** has **unarguably changed** the character of warfare, **emboldening** middle and small powers, besides non-state entities, **to asymmetrically challenge** stronger adversaries in interstate and intrastate wars**,** by ***adopting and adapting new ideas and technologies***. Therefore, besides the Ukraine War, which has become the testbed for western technologies, a few recent conflicts like the Nagorno-Karabakh War (2020), Israeli-Hezbollah operations (2021) and Yemen-Saudi Arabia conflicts, have been analysed for relevant lessons on harnessing technological advancements and their innovative application. Growing prowess in dual use technologies, recent innovations and the ongoing drive for Make in India (Defence), present a unique opportunity for Indian Armed Forces, drawing from these lessons, with specific relevance for the Indian armed forces. A summary of these lessons is outlined below with a few **caveats**.

- **Firstly**, India's nuanced, *vast and varied, geographical environs* are different and would entail *exploitation of varied warfighting technologies and tactics*. application across domains.
- **Secondly**, India's adversaries are likely to *exploit their high-end capabilities*, unlike Russia, which apparently has primarily fielded legacy technologies, *reserving few modern assets* of air and land forces.
- **Thirdly**, India's adversaries are *unlikely to disregard canonical principles* of war, jointness, and combined arms doctrines with respect to manoeuvre warfare and SEAD/DEAD.
- **Fourthly**, India's adversaries are *unlikely to reflect inadequacies in training*.
- **Fifthly**, *nuclear deterrence* and thresholds will significantly *impact the objectives, scope, scale and duration* of conflict.

Salient Lessons for Technology Adoption and Adaptation

- **Combined Arms Manoeuvre Warfare.** Advanced tandem warhead man-portable, top attack anti-Tank missiles like Javelin and NLAWS, including improvisations like vehicle mounted Brimstone, have been game changers. Despite the anti-tank threat, *Tanks/AFVs will remain relevant in offensive and defensive combined arms manoeuvre in air-land warfare*. The following technology infusions must be prioritised:-
  - ***Indigenous NAG has both top attack and tandem warheads and must be fielded** at scale earliest*.
  - The *vulnerability to attacks from above, needs to be mitigated* through *active protection.*
  - *"See through armour" capability and integration with ISR/Combat drones*, for the existing and future platforms like the light tanks, FRCV and FICV.
  - *Laser and missile approach warning systems, indigenous night sights and multi-spectral aerosols* must be developed expeditiously and integrated with existing inventory of tanks and AFVs.
  - LAMV (Light Armoured Multipurpose Vehicle), wheeled AFVs, HELINA for WSI & LCH helicopters and Integrated Svl and Targeting System (ISAT-S) must be developed and fielded earliest.

- **<u>Artillery Fires</u>**. A ***judicious mix of precision and massed fires from guns, mortars and rockets will be needed***, together with integral and networked drone based ISR, to shorten the kill chain. Ukraine leveraged ***app GIS ARTA and its decentralised C2 system to shorten the artillery kill chain.*** The following lessons are germane:-

    - Doctrines/TTPs to fight dispersed with shoot-scoot capability, must be evolved expeditiously.

    - High rates of fire over extended periods necessitate *adequate ammunition and scales of barrels/spares/sub-systems*. Ammunition stocks need to be *dispersed, hardened and kept mobile*. Scales of Pinaka (ER) rockets need to be enhanced.

    - ***Since ISR and mobility are key to survivability and effectiveness***, Mounted Gun Systems (*MGS)* systems needs to be fielded at scale. Induction of additional tracked/self-propelled K9 Vajra-T guns, 155 mm/ 52 cal MGS (AoN stage) and 105 mm MGS (RFI stage) needs to be expedited.

    - Precision Guidance Kits (PGK) and Course Correcting Fuzes (CCF) for the 155mm family (Dhanush, ATAGS, Sharang, M-777), both part of the Positive Indigenisation List (PIL), need to be developed and inducted earliest (Make-1 route).

    - *Agile and robust C2 systems*, including resilient PNT and *secure SATCOM & SDR* Networks with integral drones and multi-domain C2 nodes are critical.

    - *Runway Independent RPAs and mini RPVs* need to be fast tracked.

- **<u>Urban Warfare</u>.** Given therapid growth of towns and villages in the border areas, Urban Warfare will be a reality. This calls for doctrinal and TTP evolution for offence, defence and logistics. *See-through wall systems, ROVs, Unmanned Ground Systems and thermobaric munitions will be needed on priority*.

- **<u>Capabilities in the Air Domain</u>**.

    - **<u>Standoff Weapons</u>**. Russia has leveraged standoff Air to Ground weapons extensively, mostly on fixed targets, staying within sovereign airspace. Missile accuracy has improved with better inertial and satellite-

guided systems. The ranges of cruise missiles will need to be enhanced to strike targets in depth. The technology of seekers plays a very important role. Range Extension Kits (REK) for various aerial dumb bombs must be developed expeditiously. Enabling Joint- ISTAR must be fielded on priority.

- **BVR Combat**. The Russia-Ukraine war has underscored that aerial warfare has changed from close kinetic action (dog fights) to BVR, where sensors, including advanced AESA radars and long-range missiles are decisive, besides EW capabilities that can jam enemy radars and spoof incoming missiles. Uttam AESA radar, Astra BVRAAM Mk-2 must be realised early.

- **Anti-Radiation Missiles**. Russian Su-30SM and Su-35S fighters have regularly fired Kh-31P and Kh-58 anti-radiation missiles to suppress and target Ukrainian SAM radars. Ukraine has recently integrated US supplied AGM-88HARM missiles onto their Mig-29, Su-27 and Su-30 aircraft. This has been a game changer, destroying Russian radars or forcing them to restrict their radiation, thereby providing more flexibility to Ukrainian ground and air operations. Ukrainians overcame the likely challenges in integrating American and Ukrainian weapon systems in terms of software coding, avionics and sensors. **Indigenous capabilities for Anti-Radiation Missiles must be leveraged post-haste**.

- **Helicopters.** Many Russian helicopters were lost to ground fire, especially SAMs as Russian failed to carry out proper SEAD/DEAD. In a combined arms battle, helicopters need to be used in synergy with other systems. Induction of HELINA, greater self-protection, EW suites along with coordinated operations with drones is inescapable for the LCH, WSI and LUH fleets. Panoramic night vision for pilots (as in AH-64) is an urgent necessity.

- **UCAV/ RPSA & Combat Air Teaming Systems**. While this capability was ***not demonstrated in the recent conflicts***, it is likely to revolutionise aerial combat. Indigenous versions CATS Warrior, CATS Hunter and CATS-Infinity (a High-Altitude Pseudo Satellite) must be test bedded and fielded early. The CATS Warrior's capability to launch *24 CATS-Air Launched Flexible Asset (ALFA-S) swarm drones*, as also their launch by

combat aircrafts, *would enhance their ranges and combat effectiveness*. *Ghatak (RPSA)*, a stealth Unmanned Combat Aerial Vehicle (UCAV) and its *downscaled technology demonstrator- Stealth Wing Flying Testbed (SWiFT) must be realised earliest*. It must have applications for the Navy on Aircraft Carriers and LPDs. Appropriate changes in operational and tactical doctrines, TTPs, organisations, *force design and structure (manned and unmanned mix)* must be evolved concurrently.

- **Force Enhancement**. Additional AWACS, AEW&C and AAR must be fielded early, so as to leverage the flexibility of multi-role aircrafts. Concurrently, *Joint-ISTAR capability should be developed expeditiously*. VTOL, Stealth and 360degree multi-domain awareness in Gen-5 and above platforms is a must.

- **<u>Maritime Unmanned Underwater Capabilities</u>**.

  - Though the recent conflicts witnessed limited naval engagements, operations in the maritime domain by Ukraine constrained the Russian Black Sea Fleet successfully, by merely targeting ships with missiles and unmanned surface vessels (USV). The success stories include sinking of Moskva, striking Saki Airbase, the oil refinery at Novorossiysk and striking naval assets at Sevastopol with few aerial drones, USVs fabricated with Jet Ski engines and a Starlink like receiver. Ukraine has used ***explosive USV rather than Unmanned Undersea Vehicles (UUVs)***, despite the latter being more stealthy and more damaging by striking below the waterline, **since UUVs have limitations** in communications, payloads, ranges and speeds. PLAN operates a large variety of USVs, UUVs and ROVs with capabilities to detect submarines, detect mines, carry towed acoustic decoys, conduct patrols and conduct strikes. *Even Greece, Portugal, Singapore, Turkey and South Korea* have *rolled out armed USVs*. *The Houthis and Hamas* have used explosive laden unmanned speed boats and submersibles respectively. Swarms of USVs are being developed by China and Turkey.

  - Leading Navies are experimenting with counter-measures like supersonic missiles; composite systems (guns, rigid hull inflatable boats, and helicopters); lasers, EW and even unmanned drones. Innovative ideas

like nets could be imagined against USVs, but stopping swarms would remain a challenge.

- Armed USVs, being developed collaboratively by DRDO with Start-ups and L&T (partnering with New Space Research & Technologies), the Extra-Large UUV being developed by MDL and Underwater launched Unmanned Aerial drones must be trial evaluated and fielded earliest.

- **Joint/Tri-Service Capabilities.**

  - **Joint Command and Control and Intelligence**. This was a glaring failing in the Russian operations. **Ukraine's *devolved command structure***, *which* enabled *more dispersed joint forces* to effect integrated and coordinated operations, presents a remarkable example. To actualise this capability, interoperability and joint digitisation strategies need to be infused in service/joint C4ISR and targeting systems. The Army Integrated Decision Support System (AIDSS), Army Mobile Cellular Communications and robust Tri-Service (Joint) SDR and MANET communications must be fielded early. Exploration of NFS and DCN with tri-Service apps must commence forthwith, besides integration of AFNET, NCN and ASCON. A joint imagery/intelligence data cloud, with shared protocols is a must. This capability needs to be harnessed through Joint doctrines, with the exploitation accelerated by *extensive joint wargaming, modelling & simulation, exercises in LVC environment*, on priority.

  - **Air Land Operations**. Synergised air and land operations, with inter-multi domain and intra-multi domain capabilities, are inescapable for prosecuting successful operations. A much greater degree of *Joint AD, Air Space management and Close Air Support* is necessary. Technologies to enhance and infuse *inter-operability in communications and fielding joint C4ISR& EW Systems* soonest, is a clarion call. Joint SDR and MANET networks, Joint Operational DATA Links (ODL) need to be fielded earliest.

  - **Long Range Precision Targeting**. Extensive employment of long-range precision weapons on military and critical energy/water infrastructure, together with massed fires, much like the 20th century attrition warfare, has been witnessed in Ukraine. Indian Armed Forces need to continue to

enhance accuracy and miniaturisation of sensors, enhance range and autonomy of targeting systems. Target *hardening and subterranean profiles* need to be factored while developing the warheads, together with the *ability to engage moving targets*. Precision targeting with conventional missiles has strategic effects and early induction of **Pralay missiles** is called for. The A2AD capability must be bolstered through space based sensors and HAPS.

- **Secure Communications, Seekers & Electronic Warfare**. **AI driven/ enabled spectrum management and ESM operations is inescapable**. *Several SDR and EW projects/ requirements of the Armed Forces need urgent attention*. Secondly, there is a need to evolve a **joint concept of CEMA**, where communication, cyber and electromagnetic spectrum are leveraged seamlessly. Survivable *drones need to be employed for EW and communications relay in contingencies*.

- **Hypersonic Weapons**. Though "Kinzhal" launched from Mig31K was used more as a coercive tool, it failed to have any spectacular impact, due to inappropriate target selection. DRDO and ISRO are progressing R&D in hypersonic technologies, having successfully demonstrated scramjet technologies since 2020. *Doctrines for their will employment will need deliberation*. Nevertheless, *R&D for Hypersonic weapons (cruise and boost-glide) and FOBS (Fractional Orbital Bombardment system) must continue apace*, to bolster deterrence as well as technological parity.

- **Drones/Loitering Munitions (LM) and Swarms**. Both Nagorno-Karabakh and Ukraine conflicts have witnessed successful employment of these cost-effective weapons, with unprecedented outcomes. While drones like TB-2 achieved high success rates in the initial phase of the Ukraine conflict, reported high *kill rates of upto 90% are indicative of low survivability of UAS in contested and denied AD environments*. Nonetheless, **drones will be used extensively by our adversaries**, since both have a wide range of combat drones in service. In addition to being *tank/guns/vehicles killing machines*, drones *constrain the freedom of movement of ground forces by day or night and impose costly counter-*

options. ***Doctrines and TTPs*** **for MUM-T must also evolve concurrently** and the following need to be expedited:-

- Small drones already fielded for a few infantry battalions must be scaled up and also be provided to SF.
- There is a need to ensure *resilient networking/communications and autonomous navigation for their effective employment*.
- Legacy systems be modified as decoys.
- Drones be used for EW and range extension for BVLOS weapons.
- Drones specific to varied domains and threats must be fielded earliest at scale. **Tapas or equivalent MALE system must be fielded** for all three Services by 2023-24.
- The Alpha Design-Elbit Systems jointly developed ***kamikaze*** drones must be fielded earliest.
- **Swarm drones,** developed by Indian start-ups, have already been inducted in limited numbers for mechanised formations by the Army. These must be scaled up after imbibing early lessons.
- Indigenous Anti-Radiation Missiles, under procurement from private companies, must be fielded early for the IAF and Navy.

- **<u>Air Defence and Counter Drone Capabilities</u>**. ***AD systems in the Ukraine conflict have changed the course*** *of the conflict.* The ***strategy of air denial vis a vis Air Superiority, especially in defensive scenarios, needs deliberation and doctrinal evaluation***. *Indigenous multi-layered AD systems (*Radars and Missiles), duly *augmented by S-400, provide a potent AD capability against enemy aircrafts*. However, as deep strikes by Ukraine demonstrate, *gaps and vulnerabilities can always be exploited*. The ***voids in mobility of GBAD systems and VSHORADS/MANPADS need to be filled*** on priority. Extensive use of cheap unmanned systems (large, medium, small, loiter, swarmed), to

effect ISR, combat and logistics, on land sea and air, is visualised. There is an ***urgent requirement to invest in building a multi-layered, cost effective, AD/Counter UAS (CUAS) capabilities*** *with both hard and soft kill options*. Ukraine has innovatively adapted 70mm Rocket APKWS-Vampire, indigenous anti-drone rifles and light vehicle mounted 12.7mm AD guns. *Each Service as well as the BSF have placed orders for limited numbers on different indigenous providers* (BEL, Zen Technologies, Gurutwaa Systems). The IAF initiated DISC-6 problem statement for **Hand held hard kill CUAS** must fructify earliest. The option to co-produce Israeli systems like SMASH 2000L are also being explored. The cheapest and best multi-layered and multi-mode (hard and soft kill) ***indigenous system must be identified and deployed at scale earliest***.

- **Camouflage and Concealment**. India's adversaries are likely to leverage intelligent digital sensors (satellites and ubiquitous drones) and networks, with proven real time situational awareness by day and night. iDEX initiatives have led to **successful demonstration of paints/ multispectral nets**, which should be **procured at scale** for all services and critical nodes/ installations.

- **Technologies in the Space Domain**.

  - **Space Based ISR**. Integration of AI enabled ISR through space based assets and UAVs needs to be harnessed expeditiously by enhancing the numbers and types of multi-domain sensors, expeditiously incentivising private industries. *Problem statements listed in DISC-8 challenge* need urgent solutions.

  - **ASAT**. Non-kinetic Anti-Satellite capabilities need to be developed. Measures to enhance Space Situational Awareness and counter-measures like satellite hardening and Rendezvous Proximity Operations be developed expeditiously to thwart such efforts by adversaries.

  - **Launch on Demand (LoD).** India needs to develop the ability to launch payloads at a short notice to augment capabilities during conflicts. Rockets being developed by private entities, such as the recently tested

Vikram-S, developed by Skyroot Aerospace or Agnibaan being pursued by Agnikul, could be leveraged.

- **Position, Navigation and Timing**. Jamming of space enabled PNT services would be the first action by adversaries. Our weapon and precision targeting systems must be *enabled for IRNSS/NAVIC and GAGAN and anti-jamming and spoof-proofing of their signals needs to be ensured*. *Quantum Technology based PNT alternatives need to be developed on priority*.

- **Communications**. Starlink-like LEO based constellations with resilient optical and secure terrestrial communications is inescapable. *GSAT-7 B, C & R must be launched by 2024*.

- **Cyberspace.** Even though the Ukraine war did *not witness disruptive effects in the cyber domain as anticipated*, the Russian cyber-attack on *Viasat, one hour before invading Ukraine and near 200% increase in cyber-attacks on Ukrainian military and government targets in the first three days*, are instructive. *Adversaries are likely to resort to Cyber fires as surprise attacks, together with kinetic strikes. Wave tactics ie short bursts of intense cyber fires* coordinated with kinetic effects, followed by regeneration periods, could be the likely pattern. *Resilience of C2 systems of the Armed Forces* must blunt their impact. Therefore, *Cyber organisations should be optimally sized for prolonged tasks*. Requisite *surge capacity* must be developed. *Cyber Defence, intelligence collection, selective signalling, offensive and responsive cyber fires* should remain a priority. The lesson for India is to *leverage vast resources of talent in academia, industry and start-ups* to provide solutions at *a pace of relevance*, before and during conflict.

- **Logistics**. Military operations in Ukraine and elsewhere will continue to be decided by logistical factors as much as by tactical successes. Forces will need to evolve doctrines to *operate dispersed with as little logistics footprints as possible*, since resupplies and staging forward/rearward of spares/sub-assemblies will be targeted. This will have a *bearing on initial stocks near airfields, ports and depots*. ***Technologies that deliver SWaPC and facilitate energy generation locally*** (not on a grid), will need urgent attention.

- **Harnessing Technologies Through CMF**. Russian dependence on Western components for critical platforms as has been exploited as a major vulnerability. There is a requirement to lay down priorities for *harnessing dual-use technology to build capability* and put in place *structures and infrastructure to develop capacities*. Miniaturisation is critical for developing next generation systems and weapons for military purposes. These include micro-electronics, Micro-Electro-Mechanical Systems **(MEMS)** and Micro-Opto-Electro-Mechanical Systems **(MOEMS)**, which are revolutionising system and sub-system designs through radical miniaturisation of optical, sensing, electronic and mechanical components. Indigenisation must include *investments in R&D in materials, foundational and emerging technologies*. While the Semiconductor Mission has been launched, it is urgent and important to roll out *indigenous chips (SHAKTI and VEGA) with DIR-V Programme (Digital India RISC-V) by 2023-24 as planned.*

- **OSINT/Citizen-Int**. Technological in Ukraine, including AI, allowed intelligence networks to process diverse data in time, enabling greater shared situational awareness**. Adaption of government apps like "Diia" and e-Voroh**" allowed any and every Ukrainian citizen to became a sensor. These were further ***decrypted and curated by AI enthusiasts***. In the Indo-China/Pak contexts, with *invasive digital BRI* a norm in China and Pakistan, the *ability to turn citizens into sensors will likely be leveraged*. Though OSINT carries the risks of veracity, ***regulation of information uploaded on apps/social networks can mitigate the risks***. Satellite based internet must be fielded in*critical border areas* to *enhance shared situation awareness and communications*.

- **Doctrines, TTPs and Technology**. Technology development by itself would prove inadequate in influencing the outcome of operations, unless *supported by appropriate changes in operational philosophies, doctrines, TTPs, organisations, human resources and logistics*. **Both Azerbaijan and Ukraine did not let doctrines become dogmas**. Special emphasis should be laid on training of combatants in handling these technologies through relevant TTPs, testing them for their efficacy and updating them through regular exercises. *LVC/ Synthetic training, modelling, simulation and wargaming should be imbibed across the three Services*.

- **Nuclear Deterrence**. The salience of nuclear coercion has been underscored by the Ukraine conflict. In the Indian context, likely nuclear coercion by Pakistan can shape responses. Development of advanced nuclear weapon technologies by China like

hypersonic, ballistic and cruise missiles, across the triad, calls for expeditious development and fielding of the *BMD Phase 2, HSTDV (Cruise) and space based real-time launch detection capabilities*.

Success in hybrid physical, virtual, information and cognitive battlefields calls for a ***shift from "traditional attritional" capabilities to smart denial and retaliation***. This presupposes a whole-nation approach to *close the gap between government and industry so that resource needs are met timely*, by ensuring that relevant technologies are harnessed concurrently, ***leveraging digital transformation***. The **"triple helix" model of innovation**, bringing together *government (including the Armed Forces), industry (including commercial technology communities) and academia, must be adopted* to respond to the demands of the hyper-digitised and connected battlefield. It is equally evident that modern ***lethal weapons also need highly trained warfighters and joint teams***.

Simply stated, it is evident that ***modern lethal weapons need highly trained warfighters and combined arms, cross-Service teams***, which will make the critical difference between success and failure. Stand-off/BVR capabilities, SEAD/DEAD, ground-based AD, counter-drones, massed & precision fires and sea-bed/ underwater warfighting capabilities will be decisive in the foreseeable future.

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